

Soundscapes

Methodological contribution for its use in Landscape Architecture studies

Kaisa Masso

Dissertação para a obtenção do Grau de Mestre em
Arquitectura Paisagista

Orientador: Professor Doutor Pedro Arsénio

Jury:

PRESIDENTE

Doutora Ana Luísa Brito dos Santos de Sousa Soares, Professora auxiliar do(a)
Instituto Superior de Agronomia da Universidade de Lisboa.

VOGAIS

Doutor Luís Paulo Almeida Faria Ribeiro, Professor auxiliar do(a) Instituto Superior
de Agronomia da Universidade de Lisboa;

Doutor Pedro Miguel Ramos Arsénio, Professor auxiliar do(a) Instituto Superior de
Agronomia da Universidade de Lisboa, orientador

2024

ACKNOWLEDGEMENTS

I would like to thank my advisor Professor Pedro Arsénio for his guidance and patience during the process of completing my thesis. His advice, suggestions and comments were very valuable.

I am also thankful to the Professors of Instituto Superior de Agronomia, who have guided me through the way of becoming a Landscape Architect.

I am very thankful to my colleagues in KINO Landscape Architecture atelier who have believed in me since the beginning, and given me the opportunity to grow and learn through the participation in their marvellous and paradigma-changing projects.

I would like to thank all the participants in the survey who took the time from their busy lives to contribute to this research.

Last but not least, I would like to thank my loving partner and friends for all their support and patience during the last two years.

ABSTRACT EM PORTUGUÊS

Vivemos em um mundo altamente visual - fortalecido também pelo constante crescimento das redes sociais. Por essa razão, é fácil esquecer que o som é uma das formas essenciais de percebermos e nos comunicarmos com o mundo.

As pesquisas acústicas no contexto do planejamento de espaços abertos e design urbano têm se concentrado há muito tempo em questões problemáticas - como reduzir o ruído indesejado. Não há tantos estudos sobre como criar ou manter um ambiente acústico agradável em espaços públicos. Além disso, as possibilidades de usar paisagens sonoras como uma ferramenta para restauração ecológica começaram a ser pesquisadas apenas recentemente.

Enquanto os estudos atuais de Arquitetura Paisagística ou Avaliação de Impacto Ambiental consideram principalmente o impacto do ruído, o estudo dos sons naturais que são percebidos positivamente pelas pessoas, como uma motivação essencial para visitar áreas naturais, não está incluído nas abordagens atuais de avaliação. As universidades que oferecem cursos de Arquitetura Paisagística também carecem de disciplinas sobre som no contexto do design de paisagens.

Esta tese chama a atenção para o aspecto do som nas paisagens. Ela apresenta os métodos que foram testados nos últimos anos no campo da análise de paisagens sonoras no contexto da arquitetura paisagística, planejamento paisagístico, restauração paisagística e gerenciamento paisagístico.

As principais questões de pesquisa são:

- Como a análise de paisagens sonoras pode fornecer contribuições relevantes para estudos em planejamento, design, restauração e gerenciamento de paisagens?
- Como os seres humanos percebem as paisagens sonoras ao seu redor?
- Quais são os métodos que nos permitem analisar as paisagens sonoras ao nosso redor?
- Quais são as paisagens sonoras em que as pessoas gostam de estar?
- Como poderiam as paisagens sonoras que as pessoas gostam ser alcançadas com a ajuda da arquitetura paisagística, planejamento paisagístico e gerenciamento paisagístico?

Palavras-chave: Paisagens sonoras; Percepção auditiva; Ecologia sonora; Conservação de paisagens sonoras; Arquitetura Paisagística.

ABSTRACT IN ENGLISH

We are living in a highly visual world - that is also fortified by the constant rise of social media. For that reason, it is easy to forget that sound is one of the essential ways for us to perceive and communicate with the world.

Acoustic research in the context of planning of open spaces and urban design have long been concentrated rather on problematic issues, such as traffic noise, vibrations, etc, and how to decrease the unwanted noise. There are not so many studies about how to create or maintain a pleasant acoustic environment in public spaces. Also, the possibilities of using soundscapes as a tool for ecological restoration have been starting to be researched only recently.

Whereas current Landscape Architecture (LA) or Environmental Impact Assessment (EIA) studies mainly consider the impact of noise, the study of natural sounds that are positively perceived by people, as an essential motivation to visit natural areas, are not included in current assessment approaches. Universities teaching the degrees of Landscape Architecture are also lacking courses about sound in the context of landscape design and management. Thus, LA schools are overlooking the opportunity to strengthen the arguments for protecting valuable ecosystems and landscapes, and they are also neglecting a quality of the natural environment that may importantly contribute to human nature-based healthy and pleasant experiences.

This thesis draws attention to the aspect of sound in landscapes. It presents the methods that have been tried out in recent years in the field of soundscape analysis in the context of landscape architecture, landscape planning, landscape restoration and landscape management.

The main research questions are:

- 1) How can soundscape analysis provide relevant contributions to studies in landscape planning, design, restoration and management?
- 2) How do humans perceive soundscapes around them?
- 3) Which are the methods that let us analyse the soundscapes around us?

- 4) Which are the soundscapes that people like to be in?
- 5) How could the soundscapes that people like be achieved with the help of landscape architecture, landscape planning and landscape management?

Keywords: Soundscapes; Aural Perception; Soundscape ecology; Soundscape conservation; Landscape Architecture

RESUMO ALARGADO EM PORTUGUÊS

O som faz parte do nosso ambiente e é parcialmente responsável pelo nosso bem-estar. Por essa razão, é importante estudar os sons como parte inerente das paisagens. As ferramentas para fazê-lo começaram a surgir na segunda metade do século passado e começaram a se desenvolver no contexto da Arquitetura Paisagística apenas nas últimas décadas.

Como música treinada e uma pessoa com extrema sensibilidade ao som, sempre me interessei pelas formas como o sentido da audição contribui para nossa experiência e avaliação do espaço ao nosso redor. Além disso, conviver com um membro da família com deficiência visual me fez questionar qual é a importância das paisagens sonoras na percepção ambiental.

Vivemos em um mundo altamente visual - que também é fortalecido pelo constante aumento das redes sociais. Por essa razão, é fácil esquecer que o som é uma das maneiras essenciais para percebermos e nos comunicarmos com o mundo.

A pesquisa acústica no contexto do planejamento de espaços abertos e design urbano tem se concentrado há muito tempo em questões problemáticas, como ruído do tráfego, vibrações, etc., e em como reduzir o ruído indesejado. Não existem muitos estudos sobre como criar ou manter um ambiente acústico agradável em espaços públicos. Além disso, as possibilidades de usar paisagens sonoras como uma ferramenta para a restauração ecológica começaram a ser pesquisadas apenas recentemente.

Enquanto os estudos atuais de Arquitetura Paisagística (AP) ou Avaliação de Impacto Ambiental (AIA) consideram principalmente o impacto do ruído, o estudo de sons naturais percebidos de forma positiva pelas pessoas, como uma motivação essencial para visitar áreas naturais, não está incluído nas abordagens de avaliação atuais. As universidades que

oferecem cursos de Arquitetura Paisagística também carecem de disciplinas sobre som no contexto do design e gerenciamento de paisagens. Assim, as escolas de AP estão negligenciando a oportunidade de fortalecer os argumentos para a proteção de ecossistemas e paisagens valiosas, e também estão ignorando uma qualidade do ambiente natural que pode contribuir de maneira significativa para experiências saudáveis e agradáveis relacionadas à natureza humana.

Esta tese chama a atenção para o aspecto do som nas paisagens. Ela apresenta os métodos que têm sido experimentados nos últimos anos no campo da análise de paisagens sonoras no contexto da arquitetura paisagística, planejamento de paisagens, restauração de paisagens e gerenciamento de paisagens.

Nesta tese, vou apresentar uma visão geral da história e desenvolvimento da pesquisa no campo das paisagens sonoras em geral e, mais especificamente, no contexto da Arquitetura Paisagística. Também darei exemplos de metodologias que podem ser usadas na pesquisa de paisagens sonoras. Na parte prática, darei um exemplo de abordagem metodológica, investigando a percepção de três paisagens sonoras no Alentejo, Portugal.

No primeiro capítulo, darei uma visão geral da história e evolução do estudo das paisagens sonoras e sobre alguns projetos pioneiros nesse campo.

No segundo capítulo, focarei na percepção humana das paisagens sonoras: explicarei a importância da percepção auditiva e descreverei como ela difere da percepção visual; esclarecerei como as paisagens sonoras diferem do ruído; e abordarei o tópico de como os seres humanos percebem as paisagens sonoras e como isso pode afetar seu humor e bem-estar.

No terceiro capítulo, estabelecerei uma conexão entre o estudo das paisagens sonoras e a Arquitetura Paisagística: argumentarei que a Arquitetura Paisagística sempre foi tratada como uma disciplina visual e enfatizarei como as paisagens sonoras podem ser integradas na Arquitetura Paisagística.

No quarto capítulo, explorarei como as paisagens sonoras podem ser tratadas como patrimônio cultural.

No quinto capítulo, apresentarei algumas maneiras como as paisagens sonoras têm sido usadas na restauração de paisagens: como as mudanças nas paisagens sonoras afetam a

biodiversidade e vice-versa; como as paisagens sonoras são usadas para medir os resultados da restauração de paisagens; e como podem ser usadas para restaurar a biodiversidade.

No sexto capítulo, explicarei por que é tão importante conservar as paisagens sonoras.

No sétimo capítulo, apresentarei algumas metodologias para a pesquisa de paisagens sonoras, como passeios sonoros, entrevistas, gravações e visualizações de som.

O oitavo capítulo contém a parte prática desta pesquisa, apresentando uma metodologia possível para a avaliação de paisagens sonoras e aplicando-a a três paisagens sonoras do Alentejo. O objetivo desta parte é mostrar o caminho para possíveis pesquisas práticas de paisagens sonoras do que obter respostas e resultados finais e fundamentais.

O nono capítulo conclui a parte prática, estabelece conexões entre paisagens sonoras saudáveis e biodiversidade, e apresenta alguns exemplos de design do meu país de origem, criados em conjunto com meus colegas no ateliê de Arquitetura Paisagística KINO.

O décimo capítulo apresenta as respostas às perguntas de pesquisa e conclusões. Também apresenta as limitações deste estudo e propõe algumas perspectivas futuras para o estudo da paisagem sonora no contexto da arquitetura paisagística.

Como resultado, pode-se afirmar que as paisagens sonoras desempenham um papel crucial na formação das experiências das pessoas em paisagens, influenciando suas percepções gerais, bem-estar e interações dentro de um determinado ambiente. O que as pessoas estão observando em seu ambiente externo circundante é uma experiência ambiental holística e multisensorial. A pesquisa mostrou que a maioria dos sentimentos positivos é provocada pelas paisagens que possuem a maior variedade de sons naturais (biônicos e gefônicos). O aspecto auditivo contribui muito para a criação de um senso de lugar - uma paisagem que, de outra forma, seria considerada bonita devido à sua aparência visual, pode ser desagradável de passar tempo devido às suas características auditivas. Por esse motivo, o estudo das paisagens sonoras antes e durante o processo de planejamento é de grande importância.

Tanto a pesquisa teórica quanto a prática comprovaram que as pessoas preferem paisagens com uma ampla variedade de sons naturais. Isso pode ser traduzido em outras palavras como biodiversidade, que pode ser encontrada tanto em ambientes urbanos quanto rurais.

Mais do que apenas criar composições esteticamente atraentes ao nosso redor, os arquitetos paisagistas podem sempre concentrar-se em trazer a biodiversidade para mais perto das pessoas.

Glossário de Termos

Ecologia de Paisagens Sonoras - o estudo das relações acústicas entre organismos vivos, humanos e outros, e seu ambiente, quer os organismos sejam marinhos ou terrestres.

Bioacústica - área de pesquisa que se concentra no estudo do som e da comunicação acústica no reino animal. Envolve a análise dos sons produzidos por animais, como aves, insetos, mamíferos marinhos e outras criaturas, para obter insights sobre seu comportamento, ecologia e padrões de comunicação.

Conservação de Paisagens Sonoras - esforços voltados para preservar e proteger o ambiente acústico de uma área específica, com ênfase na manutenção ou aprimoramento de seus sons naturais e culturais.

Ecologia Acústica - o estudo da relação entre som, o ambiente e seres humanos. Concentra-se na compreensão dos sons dos ambientes naturais e construídos e como eles afetam os sistemas e o bem-estar ecológico das pessoas.

Biofonia - coleção de sons produzidos por todos os organismos em um local durante um período de tempo específico.

Geofonia - os sons originários do ambiente geofísico, que incluem vento, água, trovão, movimento da terra, etc.

Antrofonía - sons produzidos por objetos humanos estacionários (por exemplo, unidades de ar condicionado) e em movimento (por exemplo, veículos).

Interações Fônicas - possíveis interações entre biofonia, geofonia e antrofonía.

Soundwalk - qualquer excursão cujo principal objetivo seja ouvir o ambiente.

Sons Fundamentais - tons de fundo de um ambiente diretamente influenciados pela geografia e clima, incluindo vento, água, animais, vegetação e características geológicas.

Esses sons não são ouvidos conscientemente, mas podem deixar uma marca profunda na percepção de um local por uma pessoa.

Sinais Sonoros - em contraste com os tons de fundo, são sons ouvidos conscientemente, uma vez que normalmente transmitem informações ou avisos (por exemplo, apitos de trem, buzinas de carros ou sirenes de ambulâncias).

Fontes Sonoras - termos que se referem a entidades físicas que estão produzindo sons - essas entidades podem ser objetos múltiplos complexos (por exemplo, tráfego) ou componentes (por exemplo, freios).

Marcas Sonoras - sons ou coleções de sons que são únicos para uma área ou local. Marcas sonoras tornam a vida acústica de uma comunidade única.

Descritores Sonoros - descrições de sons - podem ser substantivos (chocalho), adjetivos (zumbido) ou frases (sons delicados). Descritores de paisagens sonoras lidam com a totalidade do que é ouvido.

Paisagens Sonoras Hi-fi - paisagens sonoras onde os sons discretos podem ser ouvidos claramente devido a um baixo nível de som ambiente.

Paisagens Sonoras Lo-fi - paisagens sonoras, frequentemente urbanas, compostas por sons gerados pelo ser humano que ocultam outros sons.

GLOSSARY OF TERMS

Soundscape ecology - the study of the acoustic relationships between living organisms, human and other, and their environment, whether the organisms are marine or terrestrial.

Bioacoustics - research area that focuses on the study of sound and acoustic communication in the animal kingdom. It involves the analysis of the sounds produced by animals, such as birds, insects, marine mammals, and other creatures, to gain insights into their behaviour, ecology, and communication patterns.

Soundscape conservation - efforts aimed at preserving and protecting the acoustic environment of a particular area, with a focus on maintaining or enhancing its natural and cultural sounds.

Acoustic ecology - the study of the relationship between sound, the environment, and human beings. It focuses on understanding the sounds of natural and built environments and how they impact ecological systems and human well-being.

Biophony - collection of sounds produced by all organisms at a location over a specified time.

Geophony - those sounds originating from the geophysical environment, which includes wind, water, thunder, movement of earth, etc

Anthrophony - sounds produced by stationary (e.g., air conditioning units) and moving (e.g., vehicles) human-made objects.

Phonic interactions - possible interactions between biophony, geophony and anthrophony

Soundwalk - any excursion whose main purpose is listening to the environment

Keynote sounds - background tones of an environment that are directly influenced by geography and climate including wind, water, animals, vegetation, and geological features. These sounds are not listened to consciously, but may deeply imprint on a person's sense of place.

Sound signals - in contrast to keynotes, sounds that are listened to consciously, since typically they convey information or warnings (e.g. train whistles, car horns, or ambulance sirens)

Sound sources - terms referring to physical entities that are producing sounds - these might be complex multiple objects (e.g. traffic) or components (e.g. brakes).

Soundmarks - sounds or collections of sounds that are unique to an area or location. Soundmarks make the acoustic life of a community unique.

Sound descriptors - descriptions of sounds - these might be nouns (*rattle*), adjectives (*whirring*) or phrases (delicate sounds). Soundscape descriptors deal with the totality of what is heard.

Hi-fi soundscapes - soundscapes where discrete sounds can be heard clearly due to low ambient sound level.

Lo-fi soundscapes - soundscapes, often urban, that are composed of human-generated sounds that are hiding other sound

INDICE

INTRODUCTION	1
1 WHAT IS SOUNDSCAPE	1
1.1 The history and evolution of the term and pioneers	1
1.2 Pioneering projects	5
2 PERCEPTION OF SOUNDSCAPES	7
2.1 Importance and specifics of aural perception and how it differs from vision	9
2.2 Sound and image coherence and compatibility	10
2.3 How soundscapes differ from noise	11
2.4 Human perception of soundscapes	12
2.5 Attempts to classify and divide the sounds in the context of soundscape	13
2.6 How can soundscapes affect human behaviour	15
3 SOUNDSCAPES AND LANDSCAPE ARCHITECTURE	18
3.1 Landscape Architecture as a visual discipline	18
3.2 Soundscapes and sense of place	20
3.3 How to integrate soundscapes into landscape planning	21
4 SOUNDSCAPES AS CULTURAL HERITAGE	23
4.1 Japanese Sound Gardens	23
5 SOUNDSCAPES AND LANDSCAPE RESTORATION	24
5.1 How changes in soundscapes affect the biodiversity and vice versa	24
5.2 How to use soundscapes in landscape restoration	26
5.3 How soundscapes are used for measuring landscape restoration outcomes	28
5.4 How soundscapes are used for recovering biodiversity	30
6 SOUNDSCAPE CONSERVATION	31
7 METHODS	33
7.1 Soundwalking	33
7.2 Interviews	35
7.3 Recording the sound	35
7.4 Visualising the sound	35
8 PRACTICAL PART	39
8.1 Soundscapes of Alentejo	39
8.1.1 Methodology	39
8.1.2 Qualitative approach	39
8.1.3 Criteria of choosing the recording locations	40
8.1.4 Criteria of choosing the survey participants	40
8.2 Landscape of Alentejo: Montado	41
8.3 Recording locations	43
8.3.1 Herdade do Freixo do Meio	44
8.3.2 Parque Fluvial de Cinco Reis	47
8.3.3 Intensive olive grove	49
8.4 Recording day - climatic data	51

8.5 QR Codes and links for recordings	52
8.6 Survey	53
8.7 Participants	55
8.8 Answers to the survey and analysis	56
9 DEDUCTIONS FROM THE PRACTICAL PART AND CALL TO THE BIODIVERSITY	63
9.1 Examples of design for biodiversity	65
10 CONCLUSIONS	70
10.1 Answers to the research questions and deductions	70
10.2 Limitations of this study	71
10.3 Future prospects for soundscape study in landscape architecture context	72

INDICE OF FIGURES

Figure 1. WSP Team (1973): R.Murray Schafer, Bruce Davis, Peter Huse, Barry Truax, Howard Broomfield

Figure 2. Language map of descriptors used to describe sounds and soundscapes according to Davies and his colleagues.

Figure 3. Conceptual model of variations in soundscape elements across a human disturbance intensity gradient.

Figure 4: Recently burnt area on French Island, Australia (top two images) and wetland recently filled by environmental flows at Barmah National Park, Australia (bottom pair of images)

Figure 5. Acoustic profiles of the church bell and pipe band, Dollar; (right) profiles and incoming sounds on the acoustic horizon, Dollar

Figure 6. Isobel map by Barry Truax. The World Soundscape Project's Handbook for Acoustic Ecology

Figure 7. Spectrogram from Soundscape 1 - cow mewing

Figure 8. Spectrogram from Soundscape 1 - water dripping

Figure 9. Spectrogram from Soundscape 2 - bird splashing onto water

Figure 10. Recording locations

Figure 11. Location of Soundscape 1

Figure 12. Herdade do Freixo do Meio. Photo: André Felipe Vieira

Figure 13. Herdade do Freixo do Meio. Recording location of Soundscape 1. Photo: André Felipe Vieira

Figure 14. Location of Soundscape 2

Figure 15: Parque Fluvial dos Cinco Reis. Recording location of Soundscape 2. Photo: André Felipe Vieira

Figure 16: Location of Soundscape 3

Figure 17: Recording location of Soundscape 1 in the middle of the intensive olive grove. Photo: André Felipe Vieira

Figure 18. QR codes to the recordings of Soundscapes

Figure 19. Sound sources heard and feelings evoked by the Soundscape 1

Figure 20: Sound sources heard and feelings and memories evoked by the Soundscape 2

Figure 21: Sound sources heard and feelings and memories evoked by the Soundscape 3

Figure 22. Veerenni park, Tallinn, Estonia, KINO Landscape Architects. Photo: KINO Landscape Architects

Figure 23. Principles of a healthy street. Roosi street in Tartu, Estonia, KINO Landscape Architects. Photo: KINO Landscape Architects

Figure 24. City meadow in the city centre of Tartu, Estonia, created under the Curated Biodiversity team leadership. Photo: KINO Landscape Architects

Figure 25. European Goldfinch while eating dandelion seeds in Tartu. Photo: KINO Landscape Architects

Figure 26. A slatted flowerbed that allows temporary walking in tight spaces, while protecting plant roots from trampling. The small animals can pass underneath. Photo: Internet

Figure 27. Fahle outdoor space, KINO Landscape Architects. The narrow strips of soil between the tiles also give plants enough growth opportunities, and the overall impression of the rocky surface is green. Photo: Terje Ugandi

LIST OF ABBREVIATIONS

ANH - Acoustic Niche Hypothesis

EIA - Environmental Impact Assessment

Hi-fi - High fidelity

LA - Landscape Architecture

Lo-fi - Low fidelity

WSP - World Soundscape Project

WFAE - World Forum of Acoustic Ecology

INTRODUCTION

Sound is part of our environment, and is partially responsible for our well-being. For this reason, it is important to study sounds as an inherent part of landscapes. The tools for doing it started to emerge in the second half of the past century, and have started to develop in the context of Landscape Architecture only in the past few decades.

As a formally trained musician with a heightened sensitivity to sound, I've long held a deep fascination with the role of sound in shaping our perception of the environment. Moreover, living alongside a visually impaired family member has prompted me to contemplate the significance of soundscapes in our overall environmental awareness.

In this thesis I am going to give an overview of the history and development of the research on the field of soundscapes in general, and more specifically in the context of Landscape Architecture. I also give examples of methodologies that could be used in soundscape research. In the practical part, I give an example of one methodological approach, investigating the perception of three soundscapes in Alentejo, Portugal.

In the first chapter I am going to give an overview of the history and evolution of the soundscape study, and about some pioneering projects in that field.

In the second chapter I focus on the human perception of soundscape: I explain the importance of aural perception and describe how it differs from visual perception; I clarify how soundscapes differ from noise; and I open the topic how do humans perceive the soundscapes and how it can affect their mood and well-being.

In the third chapter I make a connection between the soundscape study and Landscape Architecture: I make a point that Landscape Architecture has always been treated as rather visual discipline, and I discuss how soundscapes could be integrated into Landscape Architecture.

In the fourth chapter I see how soundscapes could be treated also as a cultural heritage.

In the fifth chapter I present some ways how soundscapes have been used in landscape restoration: how changes in soundscapes affect biodiversity and vice versa; how

soundscapes are used for measuring the landscape restoration outcomes; and how they can be used for restoring biodiversity.

In the sixth chapter I explain why it is so important to conserve the soundscapes.

In the seventh chapter I present some methodologies for the soundscape research, such as soundwalks, interviews, recordings and sound visualisation.

The eighth chapter contains the practical part of this research, presenting one possible methodology for soundscape evaluation, and applying it to three soundscapes of Alentejo. The aim of this part is rather to show the way to the possible practical soundscape research, than to gain final and fundamental answers and results.

The ninth chapter draws conclusions from the practical part, makes connections between healthy soundscapes and biodiversity, and brings some design examples from my home country, created together with my colleagues in KINO Landscape Architecture atelier.

The tenth chapter presents the answers to the research questions and conclusions. It also presents the limitations of this study, and proposes some future prospects for soundscape study in landscape architecture context.

1 WHAT IS SOUNDSCAPE

1.1 The history and evolution of the term and pioneers

There have been several attempts to define the term *soundscape*, and the definition has developed through time. Over history it has been used by various disciplines, ranging from urban design to wildlife ecology, and from music to computer science.

The term was originally created by **Michael Southworth** in 1969, an architect and urban planner known for his work in urban design and environmental psychology. He first used the term in his book "The Sonic Environment of Cities" that explored how cities have evolved in terms of their acoustic environments, looking at how various factors such as technology, transportation, and culture have contributed to creation of the sounds in urban areas¹. This book is significant for many reasons: first, it explored the often-overlooked aspect of urban planning and design: the auditory experience, highlighting the importance of considering not only the visual aspects of cities but also the sounds that contribute to the overall urban atmosphere. Southworth used an interdisciplinary approach, drawing on different fields such as architecture, urban planning, sociology, and psychology to analyse and understand the acoustic character of city environments.

Later the term was developed and popularised by Canadian composer, writer, music educator, and environmentalist **Raymond Murray Schafer**. Schafer is perhaps best known as one of the founders of the field of acoustic ecology, the study of the relationship between sound, the environment, and human beings. He implemented the term *soundscape* to describe the sonic environment that surrounds us, and promoted awareness of the importance of preserving natural soundscapes and reducing noise pollution in urban environments. Besides that, he was also a prolific composer known for his innovative and experimental musical compositions that often-incorporated elements of environmental sounds, creating unique and immersive sonic experiences. His most influential book is "The Soundscape: Our Sonic Environment and the Tuning of the World"² where he discusses his

¹ "The Sonic Environment of Cities." *Environment and Behavior* 1, no. 1 (June 1969): 49–70.
<https://doi.org/10.1177/001391656900100104>.

² Schafer, R. Murray. *The Soundscape: Our Sonic Environment and the Tuning of the World*. Destiny Books, 1993.

ideas and research in the field of acoustic ecology. His work has had a profound impact on how we understand and appreciate the role of sound in our lives and the importance of preserving natural soundscapes. Like Southworth, he also used a multidisciplinary approach that has bridged the gap between music, science, and environmental awareness.

Another Canadian that has made early contributions to the development of the research field of soundscapes is **Barry Truax**, composer, acoustic ecologist, and researcher. Besides being known as an author of innovative compositions in the genre of electroacoustic music that explored the interplay between natural and synthetic sounds, he has been a leading figure in the field of soundscape studies and acoustic ecology, following in the footsteps of Schafer and the World Soundscape Project. He has conducted research on the acoustic environments of various locations, examining how soundscapes are shaped by human activity and environmental factors. His work brings together music composition, sound art, and acoustic ecology. In his most well-known book "Acoustic Communication" he reflects on the ways in which sound functions as a mode of communication in both human and non-human contexts.³ He explores how sound is used to convey information, emotions, and meaning, not only in language but also in natural environments and cultures. The concept of *soundscape* is a central theme in the book. Truax discusses the idea of the *soundscape* as the auditory environment that surrounds us and how it shapes our experiences. The book also addresses environmental concerns related to noise pollution and the degradation of natural soundscapes due to human activities, and emphasises the importance of preserving acoustic environments and the need for responsible sound design in urban planning. For this reason, it has served as a foundational text in courses related to sound studies, communication, and environmental studies.

Another member of the World Soundscape Project was Canadian composer **Hildegard Westerkamp** (b. 1946) who is renowned for her soundscape compositions, which involve the artistic manipulation and recontextualization of environmental sounds. She has created numerous pieces that draw attention to the sonic qualities of specific locations and their ecological significance. She has worked on radio documentaries that explore acoustic environments and the cultural significance of sound. Her radio pieces often incorporate interviews, field recordings, and experimental soundscapes. She also developed the empirical technique of *soundwalks* as a method of acquiring information about people's

³ Barry Truax, *Acoustic Communication* (Praeger, 2001).

interpretations and perceptions of the auditory environment, which is further discussed under the chapter Methods.⁴

A musician, bioacoustician, and sound ecologist **Bernie Krause** has extensively recorded natural soundscapes around the world. His work has been instrumental in understanding the complex acoustic interactions within ecosystems. He has also emphasised the impacts of human-generated noise on wildlife habitats. In 2012 Bernie Krause wrote “The Great Animal Orchestra: Finding the Origins of Music in the World's Wild Places”, where he explores how animals rely on aural environments to survive and also considers how the aural expression of the natural environment drives our own musical composition and expression.⁵

Professor of Landscape and Soundscape Ecology, **Bryan C. Pijanowski** and his colleagues have defined a soundscape as a combination of all sounds created in a landscape, whether from organisms, non-biological ambient sources, or those created by humans. Soundscape is dynamic, and is created by climate, land transformations, biodiversity patterns, timing of life history events and human activities. Forests, grasslands and wetlands support a diverse array of sounds produced by mammals, birds, amphibians, and insects; urban landscape is filled with sounds generated by vehicles, sirens, machines and other human-produced sounds; geophysical motion of the atmosphere and water create natural sounds, such as those of gushing rivers flowing over the terrain, or rain falling through a canopy.⁶

Pijanowski and his colleagues further elaborated on the connection between sounds and landscapes by defining soundscape ecology as all biological, geophysical, and anthropogenic sounds that emanate from a landscape and which vary over space and time reflecting important ecosystem processes and human activities. This definition identifies soundscapes as an audible reflection of the landscape and indicates the social and ecological significance of this resource. The authors build on the importance of this resource within the context of associated values.⁷

⁴ Hildegard Westerkamp, “Linking Soundscape Composition and Acoustic Ecology,” *Organised Sound* 7, no. 1 (April 2002): 51–56, <https://doi.org/10.1017/s1355771802001085>.

⁵ Bernie Krause, *The Great Animal Orchestra: Finding the Origins of Music in the World's Wild Places* (Hachette UK, 2012).

⁶ 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>.

⁷ Sarah L. Dumyahn and Bryan C. Pijanowski, “Soundscape Conservation,” *Landscape Ecology* 26, no. 9 (July 19, 2011): 1327–44, <https://doi.org/10.1007/s10980-011-9635-x>.

These pioneers, along with many others, have laid the foundation for the interdisciplinary field of acoustic ecology and research about soundscapes. Their work has contributed to our understanding of the intricate relationships between sound, environment, culture, and perception, and has inspired further research, artistic exploration, and environmental awareness.

1.2 Pioneering projects

In the late 1960s Schafer started the **World Soundscape Project (WSP)**, a pioneering interdisciplinary research initiative that aimed to study and document the acoustic environments, or soundscapes, of various regions and cultures around the world, ranging from natural settings, such as those found in forests, rivers and deserts, to urban areas, such as traffic, industrial noise, and human activities. WSP team members can be seen on Figure 1. Extensive field recordings were conducted to capture the sounds of various locations. The project emphasised the idea that soundscapes are an integral part of our sensory experience and can significantly impact our well-being. The researchers believed that by understanding the significance of sound, people could make more informed decisions about their sonic surroundings. One of the most well-known outcomes of the World Soundscape Project was the publication of the book titled "The Tuning of the World", also known as "Acoustic Ecology", that presented the project's findings and discussed the concept of acoustic ecology.⁸ The book played a crucial role in that pioneering field, and influenced subsequent research in the areas of soundscape studies and sound design. It also contributed to the wider environmental movement starting in the 1960s.



Figure 1. WSP Team (1973): R.Murray Schafer, Bruce Davis, Peter Huse, Barry Truax, Howard Broomfield

⁸ R. Murray Schafer, *The Tuning of the World* (New York : Knopf, 1977).

The World Soundscape Project accomplished a lot during the 1960s and early 1970s. By collecting qualitative data through soundwalks and focus groups, the project produced an archive of 300 audio tapes of sound environments throughout British Columbia and Europe, as well as written documents. After Schafer left the group in 1975, the project lost its speed.

Barry Truax and Hildegard Westerkamp continued to distribute the WSP's publications as well as taking care of maintenance and expansion of its archives. The World Soundscape Project led to the contemporary international movement, the **World Forum for Acoustic Ecology** (WFAE), initiating a new wave of public awareness in soundscapes.⁹ This international association consists of people from several different disciplines who are engaged in the study of social, cultural, and ecological elements of soundscapes across the world. The WFAE collaborates with an international network of related organisations to produce and promote research, education, events, conferences and publications involving acoustic ecology.

⁹ "World Forum for Acoustic Ecology - Welcome!," World Forum for Acoustic Ecology, accessed September 15, 2023, <https://www.wfae.net>.

2 PERCEPTION OF SOUNDSCAPES

In our century, where more than half of the world's population is living in urban areas, the art of listening has been gradually disappearing.

The prevalence of smartphones, social media, and other digital devices has made it easier for people to be constantly connected to information and entertainment. We are living with constant information overload - this can lead to distractions and a shorter attention span, making it more challenging for individuals to engage in deep, focused listening. The growth of online communication and remote work has reduced face-to-face interactions for many people. When communicating through screens, there may be a tendency to multitask or not fully engage in active listening.

The lack of listening is also affecting our relationships, as effective listening is closely tied to empathy and understanding. Sometimes a fast-paced, individualistic society may place less emphasis on empathetic communication, which is a fundamental aspect of active listening. Schools and educational systems may not always prioritise teaching effective listening skills, leaving individuals without the necessary tools to engage in active listening.

Due to all those reasons, we are not anymore used to paying attention to the sounds that surround us in our daily environment.

John Hull, an academic and theologian who was registered blind around the same time as the birth of his second child, has written the following lines:

Sometimes when I greet people by saying, 'nice day!' they remain unresponsive or even appear surprised. The idea of a nice day is largely visual. A nice day occurs when there is a clear, blue sky. The sun will be shining and it may be reasonably warm, although even a bright clear day in the middle of winter will be called a 'nice day although a bit nippy'. A sighted person would not call it a nice day, let alone a lovely day if it were overcast.

For me, the wind has taken the place of the sun, and a nice day is a day when there is a mild breeze. This brings into life all the sounds in my environment. The leaves are rustling, bits of paper are blowing along the pavement, the walls and corners of the large buildings stand out under the impact of the wind, which I feel in my hair and on

my face, in my clothes. A day on which it was merely warm would, I suppose, be quite a nice day but thunder makes it more exciting, because it suddenly gives a sense of space and distance. Thunder puts a roof over my head, a very high, vaulted ceiling of rumbling sound. I realise that I am in a big place, whereas before, there was nothing there at all. The sighted person always has a roof overhead, in the form of the blue sky or the clouds, or the stars at night. The same is true for the blind person of the sound of the wind in the trees. It creates trees; one is surrounded by trees whereas before there was nothing¹⁰.

And elsewhere:

I opened the front door, and the rain was falling. I stood for a few minutes, lost in the beauty of it. Rain has a way of bringing out the contours in everything; it throws a coloured blanket over previously invisible things; instead of an intermittent and thus fragmented world, the steadily falling rain creates continuity of acoustic experience.

I hear the rain pattering on the roof above me, dripping down the walls to my left and right, splashing from the drainpipe at ground level on my left, while further over to the left there is a lighter patch as the rain falls almost inaudibly upon a large leafy shrub. On the right, it is drumming, with a deeper, steadier sound upon the lawn. I can even make out the contours of the lawn, which rises to the right in a little hill. The sound of the rain is different and shapes out the curvature for me. Still further to the right, I hear the rain sounding upon the fence which divides our property from that next door. In front, the contours of the path and the steps are marked out, right down to the garden gate. Here the rain is striking the concrete, here it is splashing into the shallow pools which have already formed. Here and there is a light cascade as it drips from step to step. The sound on the path is quite different from the sound of the rain drumming into the lawn on the right, and this is different again from the blanketed, heavy, sodden feel of large bush on the left. Further out, the sounds are less detailed. I can hear the rain falling on the road, and the swish of the cars that pass up and down. I can hear the rush of the water in the flooded gutter on the edge of the road. The whole scene is much more differentiated than I have been able to describe, because everywhere are little breaks in the patterns, obstructions, projections, where some slight interruption or difference of texture or of echo gives an additional detail or

¹⁰ John Hull, *Notes on Blindness: A Journey through the Dark* (Profile Books, 2017).

dimension to the scene. Over the whole thing, like light falling upon a landscape is the gentle background pattern gathered up into one continuous murmur of rain.

I think that this experience of opening the door on a rainy garden must be similar to that which a sighted person feels when opening the curtains and seeing the world outside¹¹...

These quotations illustrate how sounds actually transmit information about the surroundings - if we would only listen.

2.1 Importance and specifics of aural perception and how it differs from vision

To explain how the soundscapes affect human behaviour, the importance of aural perception has to be first explained.

Walter Ong has demonstrated how the human consciousness was originally based on oral communication and listening.¹² He says that the human consciousness was changed in conjunction with the introduction of the written language. All humans undergo a similar process of development as children when they learn to read. Humans train themselves to use concepts as written words in the world of the written language, but expressions for sounds are created via the auditory sense.

One has to also understand how visual space differs from acoustic space. Visual space is sectorial and limited, whereas acoustic space is non-locational and rather all-surrounding. Acoustic space has no obvious boundaries. It focuses rather on a space itself than on objects in the space. Aural harmonisation is temporal, whereas visual harmonisation is spatial. Sounds are more transitory, more fluid, more unfocused, more lacking in context, less precise in terms of orientation and localization, and less capturable. For this reason, listening is not a passive sense. It is active and depends very much on the individuality of the listener.

¹¹ John M. Hull, *Touching the Rock: An Experience of Blindness* (SPCK, 2013).

¹² "Orality, Literacy, and Modern Media, Walter Ong," in *Communication in History* (Routledge, 2015), 63–69, <http://dx.doi.org/10.4324/9781315664538-14>.

For those reasons, compared to vision, sound perception *evokes emotions* rather than *provides information*.

Ernest G. Schachtel developed the theory of autocentric (subject-centred) and allocentric (object-centred) senses. Autocentric senses combine sensory quality and pleasure. The main point here is how people *feel*. In contrast, allocentric senses are concerned with objectification and knowledge. Vision is allocentric, sound autocentric.¹³

Apparently sounds provide a specific kind of information over and above the visual which helps enhance and emphasise the different components of the environment.

2.2 Sound and image coherence and compatibility

José Luis Carles and his colleagues analysed the sound and image coherence in greater depth, identifying the specific contribution of each stimulus to the total landscape value.¹⁴ They undertook an environmental perception survey to understand people's responses to different landscape sounds when combined with different landscape images. They show how the acoustic impact on landscapes and, in particular, on those most highly regarded by the population, can signify a loss of environmental quality which until now has been barely considered.

They begin with the idea that the suspicion of activities deleterious to the landscape awoken by the presence of unexpected sounds gives rise to high levels of rejection among subjects. When people are startled by unexpected sounds in their environment, they tend to strongly disapprove of activities that they suspect might harm the landscape.

They state that the evaluation of a sound greatly relies on how well it fits into the environment where it is heard, such as natural sounds in a natural setting. When sounds seem out of place in their context and do not convey relevant information (like traffic noise in a natural landscape), they are seen as "noise" and receive negative judgments.

¹³ Ernest G. Schachtel, *Metamorphosis: On the Development of Affect, Perception, Attention, and Memory*, 1984.

¹⁴ José Luis Carles, Isabel López Barrio, and José Vicente de Lucio, "Sound Influence on Landscape Values," *Landscape and Urban Planning* 43, no. 4 (January 1999): 191–200, [https://doi.org/10.1016/s0169-2046\(98\)00112-1](https://doi.org/10.1016/s0169-2046(98)00112-1).

Coherent combinations of sound and image are more highly rated than the mean of each component stimulus.

Specific sounds consistently raised the ratings for both urban and rural or natural scenes. This pattern was observed in their study, where the sounds of a flowing stream and a thunderstorm had a positive impact. Natural sounds, especially those related to water, tend to evoke positive emotions when viewing landscapes. The appeal of having water in a landscape has been interpreted as representing the qualities of survival and fertility associated with this element.

The most highly rated combination was the sound and image of a stream, while the lowest score was accorded the combination of the stream image and the sound of the busy park. These evaluations would seem to arise from the specific effect of the sound of water and the importance of sound and image congruence. The sound of the stream, in the meantime, usually increased the value assigned to images.

The images of city parks were more appreciated when subjects did not hear their real sound content, evidencing how such landscapes lose quality as the sound environment deteriorates. Many people would prefer to hear more silence in a park, considering its real function, or, even better, the sounds of nature.

An alarm sound in an environment where it doesn't belong conveys a different meaning than the same sound associated with a specific visual element of the landscape. In certain places with a distinct environmental identity, any acoustic disturbance can lead to a rapid deterioration in quality. This highlights the importance of preserving unique soundscapes.

As we can see from their research, sounds offer a unique form of information that complements and highlights various aspects of the environment, beyond what can be perceived visually. Being so, it makes it an important aspect to consider in landscape architecture, planning and management.

2.3 How soundscapes differ from noise

The soundscape concept is appealing because it seems to be a better fit than noise level to the many factors influencing human experience in the outdoor environment. However, a

drawback of this approach is the challenge of defining and understanding the various elements that constitute the soundscape, their interplay with one another, and their impact on human experiences and behaviours.

The essential difference between the noise study and the soundscape study as summarised by J. Douglas Porteous and Jane F. Mastin is that the soundscape is considered to be a phenomenon with *perceptual content*. It is not wholly reducible to a series of physically measured parameters. The aim of the soundscape study is to reintroduce the primacy of the *human element*. This goal may be realised through an understanding of the physical presence of the soundscape, the perceptual processing of the sound input, and the relationship between the two.¹⁵

2.4 Human perception of soundscapes

Sound artist Robert Worby has told the following regarding the sound:

Sound is very strange stuff. In fact, it's not 'stuff' at all because it has no discernible substance or mass. It's actually a process, a complicated process – of particles moving, of objects moving, of air moving and, sometimes, liquids moving. You cannot get hold of it, you cannot touch it, you cannot feel it in your hand. It's not a 'thing'. Things make sounds, and things have to move to produce sound, but sounds are definitely not things. When a sound has gone there's nothing left but a memory. It's like the complex gestures made by a calligrapher's hand, wrist and arm; there are movements, time passes, something happens. But where a calligrapher's gestures leave a mark on paper, a physical residue that can be seen, sound moves the air and leaves nothing behind. A sound unfolds in its own time and then it's gone forever. Only a memory survives. And memory fades quickly¹⁶.

Most people lack the linguistic tools necessary to articulate their experiences with sound. This deficiency in language may be connected to the absence of a well-defined aesthetic for sound and could reflect the predominant emphasis on visual elements in the design and

¹⁵ Porteous, J. Douglas, and Jane F. Mastin. "SOUNDSCAPE." *Journal of Architectural and Planning Research* 2, no. 3 (1985): 169–86. <https://doi.org/10.2307/43028767>.

¹⁶ "An Introduction To Sound Art – Robert Worby," accessed September 15, 2023, <http://www.robertworby.com/writing/an-introduction-to-sound-art/>.

conception of our surroundings. According to Worby, there isn't a dedicated vocabulary for describing the sounds produced by objects like guitars or telephones; people typically refer to the object itself when naming the sound. Consequently, the significance of a sound is frequently linked to the object responsible for its creation. Enhancing the awareness and lexicon for describing sounds would be beneficial for the work of landscape architects.

2.5 Attempts to classify and divide the sounds in the context of soundscape

Recently there have been developed some theoretical models to aid understanding of soundscape perception.¹⁷ They generally break down the problem into a number of elements that are considered important and are a way of starting to think about a perception problem with a large number of potential factors.

Schafer categorised three soundscape features and the way we perceive them: **keynote sounds, sound signals, and soundmarks**. Keynote sounds are the background tones of an environment that are directly influenced by geography and climate including wind, water, animals, vegetation, and geological features. These sounds are not listened to consciously, but may deeply imprint on a person's sense of place. Sound signals, in contrast to keynotes, are listened to consciously, since typically they convey information or warnings (e.g., train whistles, car horns, or ambulance sirens). Soundmarks, like landmarks, are sounds unique to specific locations. Unique soundscapes can then be defined as soundscape patterns that allow places to be differentiated.

Schafer recommends that designers should strive to preserve soundmarks, as unique soundmarks reflect community character. One way of doing this is to draw attention to soundmarks of distinction, which could be achieved through design interventions. An artistic task for landscape designers is to design a suitable level of vibrancy by attempting to manipulate the mixture of sound sources and how they change over time.¹⁸

¹⁷ William J. Davies et al., "Perception of Soundscapes: An Interdisciplinary Approach," *Applied Acoustics* 74, no. 2 (February 2013): 224–31, <https://doi.org/10.1016/j.apacoust.2012.05.010>.

¹⁸ R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Destiny Books, 1993).

Krause grouped sounds into three categories, to describe the sources of sounds in the environment: **biophony** (sounds from non-human organisms), **geophony** (geophysical sounds) and **anthrophony** (human-generated sounds).¹⁹

The model proposed by R. F. S. Job and his colleagues is based on the top-level components of *soundscape* (**all sounds**), *enviroscape* (**other environmental factors**) and *psychscape* (**listener variables**).

M. Zhang and J. Kang's model has four top-level elements: **source, space, people and environment**. Each element has several variables attached, both physical/quantitative and perceptual/qualitative.

B. Schulte-Fortkamp and A. Fiebig attempted to model the process of a person perceiving and responding to a soundscape. They described five elements or processes which can all occur in parallel: **the acoustics of the sound(scape), the initial perception, a negotiation process internal to the listener, psychological reactions and behavioural response**.

William J. Davies and his colleagues conducted a research where they found that the terms used for analysing the soundscapes could be grouped into three concepts: **sound sources, sound descriptors and soundscape descriptors**.²⁰ Sound sources are terms referring to physical entities – these might be complex multiple objects (e.g. traffic) or components (e.g. brakes). Sound descriptors are descriptions of sounds – these might be nouns (*rattle*), adjectives (*whirring*) or phrases (delicate sounds). Soundscape descriptors deal with the totality of what is heard.

Soundscape descriptors clustered under four categories which Davies and his colleagues named **cacophony, hubbub, constant and temporal**. In the category cacophony are terms used such as cacophony, symphony of racket, jumble of sound, kind of mud, morass and mishmash of sound. The category refers to a soundscape that is perceived as a negative mix of sounds and is associated with a negative listening experience. The category hubbub includes terms like hubbub, symphony of sound, sound soup and tapestry of sound. It refers to a soundscape that is perceived as a positive mix of sounds and is associated with a positive listening experience. In the category constant, listeners are referring to the constant

¹⁹ Bernie Krause, *Wild Soundscapes: Discovering the Voice of the Natural World, Revised Edition* (Yale University Press, 2016).

²⁰ William J. Davies et al., "Perception of Soundscapes: An Interdisciplinary Approach," *Applied Acoustics* 74, no. 2 (February 2013): 224–31, <https://doi.org/10.1016/j.apacoust.2012.05.010>.

Sounds within a soundscape can elicit both positive and negative physiological and psychological reactions in humans. Anthropogenic noise represents a fast increasing and often dominant sound in diverse landscapes, with transportation networks often the prevalent source of sound. Researchers have found increased levels of stress, sleep disturbance, hypertension, and risk of heart attack in people exposed to high levels of anthropogenic noise.

Conversely, natural sounds can aid in reducing stress, enhancing cognitive abilities, and providing a sense of restoration. The psychological, cognitive, and emotional advantages resulting from engagements with the natural environment are a component of a developing area of study known as psychological ecosystem services. Experiencing nature can lead to favourable impacts on memory, focus, concentration, self-control, and emotional well-being.

Soundscapes are influencing our stress level and overall health. Loud and constant noise, such as traffic or construction sounds, can contribute to stress, annoyance, and even negative health outcomes. Prolonged exposure to noise pollution has been linked to increased levels of stress hormones, cardiovascular issues, sleep disturbances, and impaired cognitive performance. In contrast, natural and tranquil soundscapes, such as those found in natural environments, can contribute to psychological restoration and well-being. These soundscapes provide a sense of escape from urban stressors and can help reduce mental fatigue.

Soundscapes can also influence our cognitive abilities. Exposure to natural sounds, like flowing water or bird songs, has been associated with improved concentration, creative thinking, and problem-solving. On the other hand, excessive noise or unpredictable sounds can disrupt cognitive tasks and reduce overall performance.

Soundscapes also play a role in shaping social interactions. For example, noisy environments can make communication more challenging, leading to misunderstandings and reduced social cohesion. Quieter and more comfortable soundscapes can encourage better communication and social engagement.

Appropriate soundscapes are important also in work and study environments. Some people may find that a certain level of background noise or specific types of sounds (e.g., ambient music) can enhance focus and productivity, while others may need quiet surroundings for optimal performance.

Soundscapes can influence our mood and emotions. Pleasant sounds, such as nature sounds or soothing music, can promote relaxation and positive emotions. Conversely, jarring or unpleasant sounds can lead to irritability, anxiety, and negative emotions.

Soundscapes contribute also to our sense of place and attachment to specific environments. People often form emotional connections to places through their sensory experiences, including the sounds they associate with those places. Soundscapes can also affect how people behave in different settings. For instance, people might choose to spend more time in locations with pleasant soundscapes, such as parks or natural areas, and avoid places with disruptive or distressing noises.

One more interesting way the soundscapes can influence human behaviour is consumer perceptions and behaviours in commercial spaces. We all have experienced how businesses often use background music and other sound elements to create specific atmospheres and influence shopping behaviours.

Cultural backgrounds and personal preferences can shape how individuals respond to soundscapes. What is considered soothing or acceptable in one culture might be different in another.

Being that said, the effect of soundscapes to human behaviour should not be underestimated nor neglected.

3 SOUNDSCAPES AND LANDSCAPE ARCHITECTURE

3.1 Landscape Architecture as a visual discipline

Humans are highly adept at understanding the world primarily through their sense of sight. Vision tends to take precedence over other forms of sensory perception, particularly among individuals without sensory impairments. The reasons for this preference are a subject of debate among neuroscientists and psychologists. However, this visual dominance, combined with a widespread Western cultural inclination to create visual depictions of landscapes (not just in the arts, including fields like landscape design and architecture, but also in landscape research), has significantly influenced how landscape scholars approach the perception and aesthetic appreciation of landscapes.

It may be fruitful, then, for landscape scholars to look to other forms of landscape writing to enlarge and enliven their own descriptive work. Jonathan Prior argues in his article that nature poems, for instance, frequently contain descriptions of sounds and contemporary nature writing offers imaginative ways of writing about landscape aesthetics beyond vision.²¹

Sound is studied in several traditional disciplines such as acoustics, music and oral communication. These disciplines, however, possess no significant connection to landscape architecture. Environmental psychology, on the other hand, has such a connection; it deals with the treatment of humans' sensory experiences in landscapes and outdoor environments. However, this has resulted in only a little interest in acoustic experiences in which sounds are considered to be resources. Environmental psychology in the context of landscape architecture has been rather visual discipline.

The classical noise research considers the risks of damages and disturbances, but lacks developed terminology for the creation of desirable acoustic environments in the context of landscape architecture.

As a result, the landscape design suggestions are thus limited to what the visual sense is able to transmit. That leads to a risk that the proposals do not consider the multi-dimensional reality which is absorbed and created by merging all the senses. How else could an idea based on the impressions of one of the senses - sight - be used to formulate an idea based

²¹ Jonathan Prior, "Sonic Environmental Aesthetics and Landscape Research," *Landscape Research* 42, no. 1 (November 8, 2016): 6–17, <https://doi.org/10.1080/01426397.2016.1243235>.

on the impressions from another sense, or even complex impressions, a combination of senses?

Landscape architecture projects are by norm presented, in all of its phases, on paper, or on computer screen, i.e. visually. Visual sketches as the only method of representing an outdoor environment can be likened to a certain extent to a musical score. An individual with little knowledge of the musical equipment will hardly hear the music by looking at the sheet.

The formulation of an auditory expression differs from that of a visual expression, since the latter is based on the fact that the expressions are always in possession of a visual reality.

3.2 Soundscapes and sense of place

Sense of place is defined as a collection of symbols, values, feelings and meanings ascribed to a specific place. A strong sense of place fosters an emotional connection between people and the environment. When outdoor spaces are designed to evoke feelings of comfort, belonging, and attachment, individuals are more likely to engage with and care for those spaces. This emotional bond is essential for creating sustainable and well-loved landscapes.

A sense of place also acknowledges and respects the cultural and historical context of a location. Landscape architects could use the opportunity to draw inspiration from the heritage and traditions of a region to create designs that reflect and celebrate its unique identity. This connection to the past can enhance a community's identity and pride.

A strong sense of place can also foster environmental stewardship. When people have a deep appreciation for the natural and cultural aspects of a place, they are more inclined to protect and preserve it.

Schafer referred also to soundscapes as an element of sense of place.²² Some researchers have proposed that the construction of a sense of place is developed from place specific attributes emphasising the physical landscape features. Considering that the visual environment is not the only thing influencing the sense of a place, others have claimed that soundscapes are an acoustic manifestation of place. Many sounds of nature, e.g. the sounds of oceans, rivers, the forest canopy or weather events vary significantly from place to place, from time to time, and with each instance. Schafer recognized the relationship between soundscapes and sense of place stating that every natural soundscape has its own unique tones, and often these are so original as to constitute soundmarks. Westerkamp has brought out that even our home environment has sounds that we perceive to create an acoustic sense of place.²³

Though, as Schafer indicated, humans are increasingly disconnected with their soundscapes. Low-fidelity (lo-fi) soundscapes, often urban, are composed of human-generated sounds that are hiding other sounds. Frequently the urban listener is

²² R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Destiny Books, 1993).

²³ Hildegard Westerkamp, "Linking Soundscape Composition and Acoustic Ecology," *Organised Sound* 7, no. 1 (April 2002): 51–56, <https://doi.org/10.1017/s1355771802001085>.

unable to hear low level sounds or distant sounds, and is surrounded by so many sounds that acoustic information is lost or ignored.²⁴

3.3 How to integrate soundscapes into landscape planning

The quotations from John Hull in one of the previous chapters illustrate how sounds transmit information about our surroundings. The descriptions are defined in such a manner that the landscape's character is brought forth by the sounds which are heard. The description by the blind man indicates a multitude of sounds amongst which most people can distinguish. Hull has been forced to develop his sense of hearing over a long period of time; nevertheless, his hearing does not differ biologically from that of other people.

Design decisions always have consequences in the soundscape of the place. The distance between walls, the height of the walls, the texture of the pavements, the location of different uses of land, the location of functional surfaces, the amount of vegetation, the height of the trees, water flows, etc. are all a part of landscape architecture and land use planning that affect the acoustic environment of any location. The sounds which accompany the design influence humans and also other creatures who have the sense of hearing. These may be experienced as comfortable or uncomfortable, but they are always able to relate some amount of information.

Integrating soundscapes into landscape planning involves considering the auditory environment alongside visual and spatial elements to create harmonious and functional outdoor spaces. Here are some examples of key considerations and strategies for incorporating soundscapes into landscape planning.

Soundscapes can be created for example with topography: the pasture landscape is a wide, open expanse of land with sections of woodlands around it. Smaller groves are close at hand. The wind often increases in speed in the open landscape and symbolises the openness of the location.

Important factor in the creation of the soundscapes is also the vegetation. The composition of the location's vegetation is revealed by the specific noise frequency of the wind as it passes through each species of tree. The shrubs and trees also constitute locations for songbirds.

²⁴ Sarah L. Dumyah and Bryan C. Pijanowski, "Soundscape Conservation," *Landscape Ecology* 26, no. 9 (July 19, 2011): 1327–44, <https://doi.org/10.1007/s10980-011-9635-x>.

The first step for incorporating the sound in the landscape planning could be the thorough analysis of the existing sound environment. Sources of noise pollution, such as roads, industrial areas, or construction sites, could be identified, and the potential impact of these noise sources on the desired use of the space and the well-being of users should be assessed.

Through soundscape zoning it is possible to divide landscapes into different zones based on their intended functions and noise tolerance levels. For example, quiet zones for relaxation and reflection can be designated, and active zones for recreational activities could be determined. This zoning can help manage and control soundscapes to suit different user preferences and needs.

Integration of natural elements such as vegetation, water features, and topographic changes help to create physical barriers that can help mitigate unwanted noise. Vegetation acts as a sound buffer and can absorb, deflect, or scatter sound waves.

Design guidelines could be developed that take into account both visual and auditory aspects of the landscape. Those guidelines could explain how sound-producing elements, such as fountains, wind chimes, or public art installations, can be strategically placed to enhance the acoustic environment.

Appropriate materials for hardscapes and surfaces can be chosen that can help manage sound reflections and absorption. Porous materials like gravel, wood, or vegetation can help reduce sound reflections, minimising the impact of noise.

Deliberate acoustic features could be introduced that contribute positively to the soundscape. These could include water features like fountains or streams, birdhouses to attract songbirds, or even sound sculptures that produce soothing or harmonious tones.

The needs and preferences of different user groups should be considered when designing soundscapes. The aim should be creation of spaces that cater to various activities and user experiences, ensuring that sound elements enhance the intended use of the area.

The soundscape elements should be regularly assessed and managed to maintain their intended effects. This could involve trimming vegetation, tuning musical installations, or ensuring that water features are properly functioning.

The best suitable soundscapes can be achieved, when involving local residents and stakeholders in the landscape planning process. Their sound preferences and any specific concerns related to the auditory environment could be found out during preliminary study of the planning process, and should be considered as an important input. This participatory approach can lead to more inclusive and effective soundscape design.

Soundscape's effectiveness could be constantly monitored and the design adapted as needed. Feedback from users can be solicited to ensure that the designed soundscapes align with their expectations and enhance their overall experience.

By considering soundscapes as an integral component of landscape planning, designers and planners can create outdoor spaces that are not only visually appealing but also contribute to a positive and harmonious auditory experience for all users.

4 SOUNDSCAPES AS CULTURAL HERITAGE

Aesthetic values in Landscape Architecture are increasingly pressured and threatened by accelerated social and physical change. So too are unique soundscapes. Sounds and sound patterns define and distinguish places from one another. In Japan the soundscapes are viewed as a part of the country's cultural heritage. Japanese Environmental Protection Agency developed a guidebook titled: 100 Soundscape of Japan: Preserving Our Heritage.²⁵

4.1 Japanese Sound Gardens

Japanese sound gardens are unique outdoor spaces designed with a focus on enhancing the auditory experience. These gardens are created to harmonise with natural sounds, such as flowing water, rustling leaves, and bird songs, as well as human-made sounds, like traditional Japanese instruments, e.g. bamboo flutes (*shakuhachi*), wind chimes (*furin*), and temple bells (*suzu*). These instruments are positioned in the garden to interact with the natural elements and create melodic sounds when the wind blows.

²⁵ Contributors to Wikimedia projects, "100 Soundscapes of Japan," Wikipedia, May 14, 2023, https://en.wikipedia.org/wiki/100_Soundscapes_of_Japan.

One fundamental element in Japanese sound gardens is water. The sound of flowing water, whether from streams, waterfalls, or fountains, is a central component in creating a soothing and meditative soundscape. Water features are often strategically placed to enhance the auditory experience.

Sound gardens consider the seasonal variations in the auditory landscape. Different plants, animals, and natural sounds come to life in each season, contributing to the overall experience.

While traditional Japanese sound gardens are well-established, contemporary landscape architects and designers continue to explore innovative ways to incorporate sound into garden design. Some modern sound gardens may feature digital or interactive elements to engage visitors in new ways.²⁶

5 SOUNDSCAPES AND LANDSCAPE RESTORATION

5.1 How changes in soundscapes affect the biodiversity and vice versa

Land use change is a significant stressor on ecosystems, especially as these changes alter biodiversity. Land transformations are significant. Globally, over 40% of the land surface is now used for agriculture or urban development. There is considerable evidence to suggest that vegetation structure influences species richness which is expected also to be manifested in its influence on biophony.

Bird songs differ according to the habitat where the signaller lives.

How humans produce sounds influences biophony, too. For example, some birds adjust the timing of their calls and sing more often at night in urban environments. Some birds sing at higher frequencies in urban environments. Studies about population levels of several species of birds in high traffic and low-traffic noise conditions show that 15% of the species were affected by traffic noise. The increased levels of noise in urban environments selects for songbirds that have more behavioural plasticity, demonstrated by the ability to adjust their calls.

²⁶ Richard Chenhall, Tamara Kohn, and Carolyn S. Stevens, *Sounding Out Japan: A Sensory Ethnographic Tour* (Routledge, 2020).

The increasing loss of natural sounds could be an indication of humans' weakening connection with nature. We need to improve our relationship with sound and actively listen to soundscapes to truly appreciate them. Doing so will reunite humans with sounds, and also inspire the appreciation, management, and conservation of the organisms and resources that create them.

Human domination of natural habitats has resulted in the loss of biodiversity. With the loss of habitat and biodiversity, areas lose their natural sounds. Natural sounds have been referred to as an endangered resource as the ability to experience them becomes increasingly rare. Human-generated sounds continue to spread to even remote, natural areas.

As the planet continues to warm, one may predict that the dynamics of soundscapes may also change. Thus soundscapes, too, may be altered by climate change.

Soundscapes and land use

Anthrophony is likely to vary across land uses (Figure 3). In human dominated environments, such as urban areas, anthropogenic sounds are probably dominating the soundscape. When human activities increase, so will anthrophony. Overall, anthrophony in urban environments will be composed of sound from vehicles (motors and road noise), and other machines associated with structures (e.g. air conditioners). Areas with many land uses (e.g. forests, agriculture) are likely to contain a mixture of sound sources.

Geophony is also likely to vary across different land use classes (Figure 3). For example, wind rustling through vegetation will be different in forests compared to that in wetlands or farmland with crops or pasture. Rain sounds different in areas that have a canopy (i.e. forests) compared to areas lacking vegetation, such as urban areas where rain sound is amplified by hitting concrete and other human made structures.

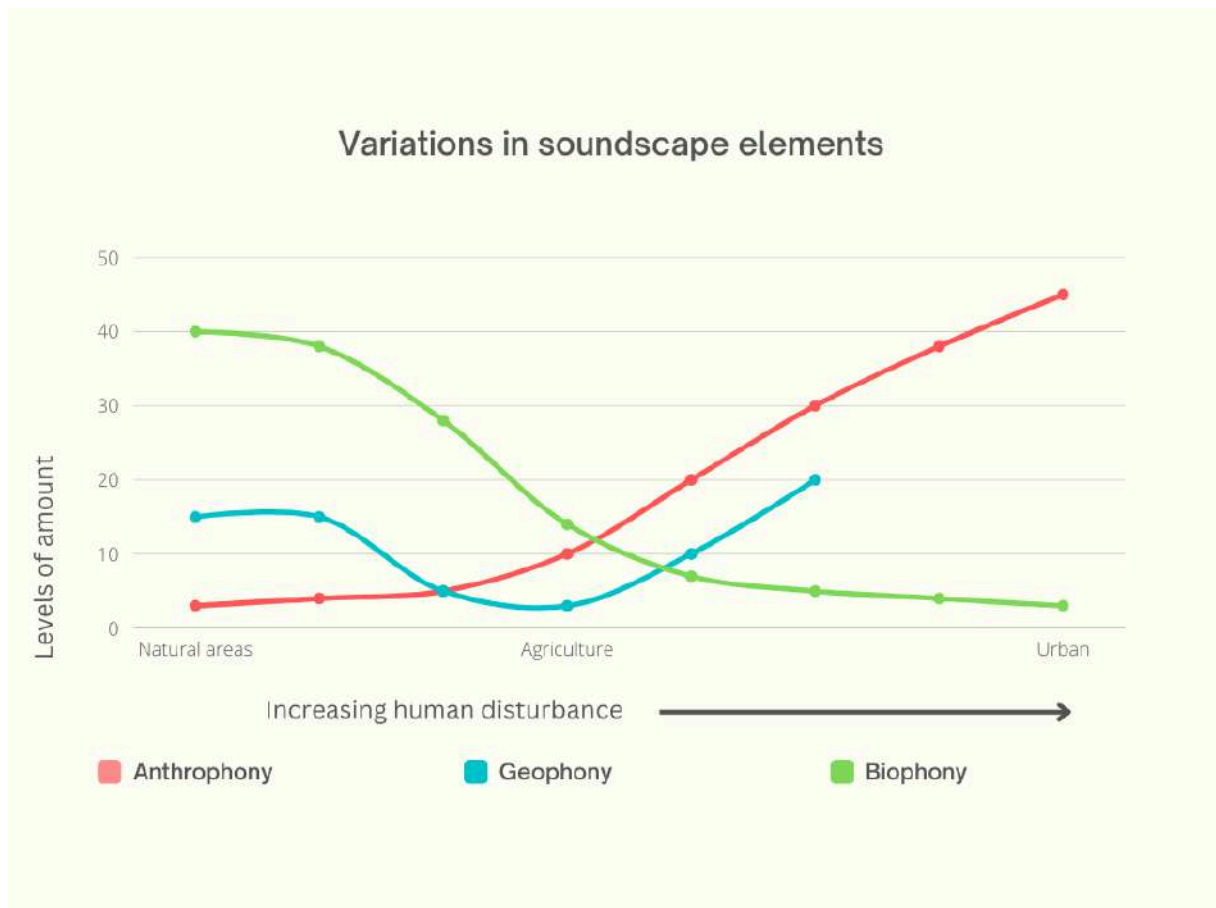


Figure 3. Conceptual model of variations in soundscape elements across a human disturbance intensity gradient.

5.2 How to use soundscapes in landscape restoration

Soundscapes can play a significant role in landscape restoration by enhancing the overall sensory experience and contributing to the ecological and psychological health of a rehabilitated environment. Integrating thoughtful soundscapes into restoration projects can help create more holistic and immersive spaces that promote well-being, biodiversity, and a sense of connection to nature.

Choosing native plant species that provide rustling leaves, wind whispering through branches, and other natural sound elements can enhance the soundscape. These sounds contribute to a more authentic and immersive experience, resembling the acoustic environment of a healthy native ecosystem.

Incorporating water features such as ponds, streams, or wetlands can introduce the calming and restorative sounds of flowing water. These features not only enhance the soundscape but also provide valuable habitats for aquatic and semi-aquatic species.

Selecting wind-resistant plant species can create the gentle rustling sounds of leaves moving in the wind. This adds a dynamic and soothing element to the soundscape while contributing to the visual aesthetics of the landscape.

Soundscapes can be designed to attract and support local wildlife species, including birds, insects, and amphibians. The presence of specific sound elements such as bird calls, water features, and insect sounds can help restore natural habitats and encourage the return of native fauna to the area.²⁷

Using playback systems or natural attractants, you can encourage the presence of birds and other wildlife known for their vocalisations. The addition of bird songs, frog croaks, and other natural sounds enhances the auditory diversity and ecological richness of the restored landscape. This topic is further elaborated under the chapter “How soundscapes are used for recovering biodiversity”.

Soundscapes can be integrated into interpretive signage and educational materials to engage visitors' senses and deepen their understanding of the restored environment. Guided audio tours or smartphone apps can provide real-time information about the natural and cultural significance of different soundscapes within the site.

Engaging local communities in the restoration process and allowing them to contribute to the soundscape design could foster a sense of ownership and pride. Access to restorative soundscapes could enhance the well-being of visitors and provide a space for relaxation, stress reduction, and reflection.

Implementing monitoring programs to track changes in the soundscape over time can provide valuable insights into the success of restoration efforts. Adjustments can be made

²⁷ Elizabeth Znidersic and David Watson, “Acoustic Restoration: Using Soundscapes to Benchmark and Fast-Track Rehabilitation of Ecological Communities” (Authorea, Inc., November 25, 2021), <http://dx.doi.org/10.22541/au.163783675.52249304/v1>.

based on how soundscapes evolve and how they impact both the ecosystem and visitors' experiences.²⁸

Integrating soundscapes with other sensory elements, such as fragrant plants, textured surfaces, and visual aesthetics, could create a more immersive and holistic experience, appealing to a wide range of senses.

Collaboration between landscape architects, acoustic experts, ecologists, and community members could help to design soundscapes that align with restoration goals and take into consideration the needs and preferences of all stakeholders.

Incorporating soundscapes into landscape restoration not only contributes to the ecological health of the site but also enhances the overall sensory experience, promoting a deeper connection between people and the restored environment.

5.3 How soundscapes are used for measuring landscape restoration outcomes

Abraham L. Borker and his colleagues have researched if the soundscape indices can predict landscape-scale restoration outcomes.²⁹ They depart from the statement that effective environmental restoration relies on rigorous measurement of intervention outcomes, but this can be logistically challenging and costly. Even at fine geographic scales, outcome metrics can often be inconsistent, damaging the ability to evaluate restoration success. As restoration interventions are applied at increasingly large scales, there is a need for scalable, cost-effective tools to be able to monitor patterns of recovery at appropriate landscape scales. Advances in passive acoustic recording technologies offer scalable sampling to measure ecological conditions at high spatiotemporal resolution. However, this has not been widely applied as a monitoring tool largely due to the enormous amount of resulting data and subsequent time consuming and expensive process of data analysis. This can though improve in the near future, with the quick developments in the area of AI and data science. Borker and his colleagues see that passive acoustic recording could be a complement to

²⁸ Abraham L. Borker et al., "Do Soundscape Indices Predict Landscape-scale Restoration Outcomes? A Comparative Study of Restored Seabird Island Soundscapes," *Restoration Ecology* 28, no. 1 (October 31, 2019): 252–60, <https://doi.org/10.1111/rec.13038>.

²⁹ Abraham L. Borker et al., "Do Soundscape Indices Predict Landscape-scale Restoration Outcomes? A Comparative Study of Restored Seabird Island Soundscapes," *Restoration Ecology* 28, no. 1 (October 31, 2019): 252–60, <https://doi.org/10.1111/rec.13038>.

remote sensing of landscape variables when comparing restoration outcomes to reference sites.

Elizabeth Znidersic and David Watson also demonstrate how acoustic recordings can quantify ecosystem attributes (restoration required or intact and functional), species diversity (groups of taxa calling) akin to the corresponding photograph. By measuring whole-of-system biological activity, acoustic data offer high resolution samples of biological activity to benchmark ecological comparisons and a trove of archivable site-specific sounds to engage stakeholders.³⁰

Good examples are the two cases below:

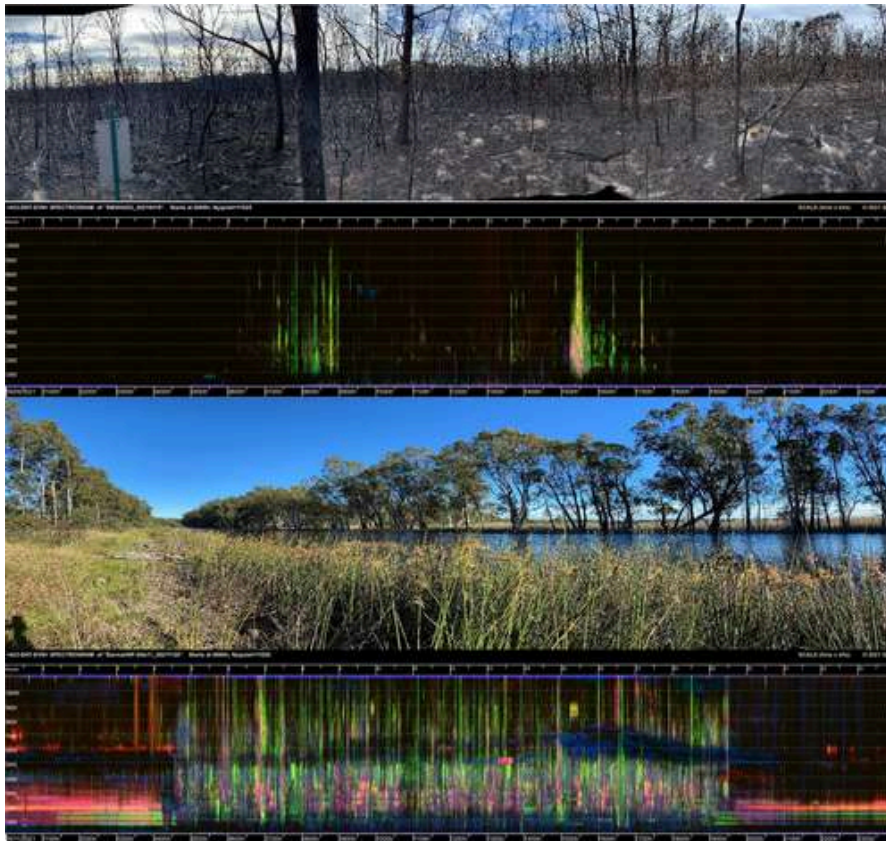


Figure 4: Recently burnt area on French Island, Australia (top two images) and wetland recently filled by environmental flows at Barmah National Park, Australia (bottom pair of images)

The top two images (Fig. 4) depict a recently burnt area on French Island, Australia. Beneath the photograph is a 24-h sound recording from the same site, processed into a visual

³⁰ Elizabeth Znidersic and David Watson, “Acoustic Restoration: Using Soundscapes to Benchmark and Fast-Track Rehabilitation of Ecological Communities” (Authorea, Inc., November 25, 2021), <http://dx.doi.org/10.22541/au.163783675.52249304/v1>.

interpretation of the soundscape. The x-axis is 24 h (midnight to midnight), y-axis 0–11,000 Hz.

The bottom pair of images (Fig 4) depict a wetland recently filled by environmental flows at Barmah National Park, Australia. The spectrogram shows an acoustically full site of species (insects, frogs, birds) vocalising during the 24-h period across most frequency bands, unlike the silent soundscape of the burnt site punctuated by passing songbirds.

Both examples demonstrate how acoustic recordings can quantify ecosystem attributes (restoration required or intact and functional) and species diversity. By measuring whole-of-system biological activity, acoustic data offer high resolution samples of biological activity to benchmark ecological comparisons.

5.4 How soundscapes are used for recovering biodiversity

Elizabeth Znidersic and David Watson introduce a new approach - acoustic restoration - focusing on the applied utility of soundscapes for restoration, recognising the rich ecological and social values they encapsulate. They state that broadcasting soundscapes in disturbed areas can accelerate recolonization of animals and the microbes and propagules they carry; and that long duration recordings are also ideal sources of data for benchmarking restoration initiatives and evocative engagement tools.³¹

³¹ Elizabeth Znidersic and David Watson, "Acoustic Restoration: Using Soundscapes to Benchmark and Fast-Track Rehabilitation of Ecological Communities" (Authorea, Inc., November 25, 2021), <http://dx.doi.org/10.22541/au.163783675.52249304/v1>.

6 SOUNDSCAPE CONSERVATION

Sarah L. Dumyahn and Brian C. Pijanowski have presented an argument that soundscapes are natural resources worthy of conservation.³² They say that soundscapes possess certain values, socially and ecologically, and therefore need to be conserved. They provide a framework for soundscape conservation derived from principles of landscape ecology and conservation biology.

They say that by treating soundscapes as resources, a new approach for conservation and management can be developed; one that is fundamentally different from incrementally regulating noise sources. In order to create a rationale for soundscape conservation, the associated values of this resource need to be clearly identified and linked in meaningful ways within the larger social-ecological system.

They bring out that a large body of literature documents the effects of noise exposure on human physical and mental health. Auditory health research has established clear relationships between decibel level exposure and associated hearing loss. Other health effects from chronic noise exposure have been found to include stress, annoyance, cardiovascular effects in adults, sleep disturbance, and decreased task performance. Children exposed to chronic noise have a higher likelihood of reading deficits and declines in other academic tasks. Quality of life impacts for people in noisy areas has been assessed by researchers, as well. Noise detracts from human wellbeing and other values, such as peace and tranquillity. There is strong evidence that human health and wellbeing are impaired when exposed to degraded soundscapes raising issues of rights to access a healthy acoustic environment.

Degraded soundscapes have been found to negatively affect some species of wildlife, as well. Motorised transportation noise has been found to mask, or limit the perception, of acoustic signals. Acoustic masking has many important implications for wildlife, such as prey location, predator avoidance and interspecies communication. Species have responded in various ways to urban noise, such as abandoning the area and making vocal adjustments by shifting amplitude or frequency of their songs. One study found that robins changed their singing time to evenings when the city was quieter. Additionally, noisier areas irrespective of habitat quality have been found to have reduced bird density and diversity. Anthrophony in

³² Sarah L. Dumyahn and Bryan C. Pijanowski, "Soundscape Conservation," *Landscape Ecology* 26, no. 9 (July 19, 2011): 1327–44, <https://doi.org/10.1007/s10980-011-9635-x>.

the soundscape can also decrease the listening area for species interfering with communication and predator detection.

Organisms produce a broad spectrum of sounds, and their composition has several suspected ecological causes. Bernie Krause proposed the Acoustic Niche Hypothesis (ANH) which predicts that competitive exclusion will cause species to adjust their signals to minimise interference from sounds produced by other species.³³ Similar arguments have been made by other bioacousticians. For example, it is emphasized reproductive importance in acoustic signalling and argued that sounds should evolve to maximise effectiveness of intraspecific communication; the timing, frequency and spatial location of sound production should be adapted to reduce acoustic interference from other species.³⁴

³³ Bernie Krause, *The Great Animal Orchestra: Finding the Origins of Music in the World's Wild Places* (Hachette UK, 2012).

³⁴ 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>.

7 METHODS

7.1 Soundwalking

Westerkamp's seminal text on soundwalking defines soundwalks as "any excursion whose main purpose is listening to the environment"³⁵. In a later article, she reflects on soundwalking in the context of our media-saturated lives:

This simple activity of walking, listening and soundmaking, invariably has the effect of not only re-grounding people in their community but also inspiring them about it, about creating a more balanced life between the global attraction of the computer and the local contact and touch with live human beings and reality³⁶.

Soundwalks combine a specific form of human mobility – walking – with a specific way of sensory attention – listening, and do so in a variety of ways and with a range of purposes, while often featuring elements of talking, silence, and media. This definition proposed here is wide, including mobile listening practices where walkers wear headphones to listen to or engage with sound from media devices in addition to listening to their soundscape. Soundwalking can be understood as research and practice that is not about sound but in sound, as well as not about walking but in walking. Soundwalking is a spatio-temporal, embodied, situated, multi-sensory and mobile practice. Soundwalks are used across a wide range of academic disciplines as well as artistic/creative practices, including as method, tool, and methodology. The concept and history of soundwalks is closely related to the soundscape concept, the history of acoustic ecology and considerations of listening. Over time, soundwalks have been considered and used by an increasing range of research and practice fields, including sound art, media studies, sound studies, urban planning, social science.

There is a distinction between soundwalking as an expert practice – for example as a research method or as artistic practice – and a more democratic understanding of soundwalking as something everyone can do, a more participatory, non-expert approach. Soundwalks can be understood as individual practice or as group experience. Audio recording can be a key aspect of soundwalks or not feature at all. A soundwalk can be an

³⁵ "Hildegard Westerkamp," Hildegard Westerkamp, accessed October 14, 2023, https://www.hildegardwesterkamp.ca/writings/writingsby/?post_id=13&title=soundwalking.

³⁶ Hildegard Westerkamp, "Exploring Balance & Focus in Acoustic Ecology," *The Journal of Acoustic Ecology* 11 (2011): 7–13.

end in itself or a means for something else. It can be artistic and creative or used as a research method to measure experience. Soundwalks can take place in busy urban environments or in remote landscapes. Those on a soundwalk could wear headphones (listening to their own audio recordings or to other audio) or not. They could add sounds to the soundscape in real-time through talking or with instruments, or aim to minimise their own sounds. Soundwalks can have a pre-described route or an improvised one. They can be one-off events or repeated activities, at the same time of the day/week/year or with variation.

Soundwalking is an important aspect of demonstrating the importance of individual experience in assessing the soundscapes of urban environments to move beyond noise abatement and towards a more complex understanding of urban soundscapes and associated design and policies. Building on this, the research team on the Positive Soundscapes Project developed soundwalking as a sociological method and as a tool that could be used in urban planning and associated disciplines.

Today, soundwalks are recognized as an important method and methodology for qualitative research across disciplines to create flowing, multi-sensory and embodied ways for social and cultural geographers to research the outside environment. They are useful for presenting site-specific cultural geography to the public in an accessible and inclusive way.

7.2 Interviews

Semi-structured interviews are used to discuss questions about the locations and their sounds. This is used in conjunction with pre- and post-soundwalk questions. The researchers argue this method makes it possible for the researchers and the participants to have a shared sensory experience of the environments under investigation, thus enabling a deeper and more meaningful semi-structured interview to take place.³⁷

7.3 Recording the sound

Bernie Krause summarised in detail many different ways to record natural soundscapes.³⁸ The paper by Luis J. Villanueva-Rivera and his colleagues serves as an introduction to sound for ecologists. Details about the physical properties of sound, the ways that sound is recorded, stored and analysed can be found there.³⁹

7.4 Visualising the sound

Hand to hand with the World Soundscape Project, the first visualisations of soundscapes were created by Schafer in his book “Five Village Soundscapes” (Figure 5).

³⁷ Behrendt Frauke, “Soundwalking,” in *The Routledge Companion to Sound Studies* (Routledge, 2018), 249–57, <http://dx.doi.org/10.4324/9781315722191-28>.

³⁸ Bernie Krause, *Wild Soundscapes: Discovering the Voice of the Natural World, Revised Edition* (Yale University Press, 2016).

³⁹ Luis J. Villanueva-Rivera et al., “A Primer of Acoustic Analysis for Landscape Ecologists,” *Landscape Ecology* 26, no. 9 (July 21, 2011): 1233–46, <https://doi.org/10.1007/s10980-011-9636-9>.

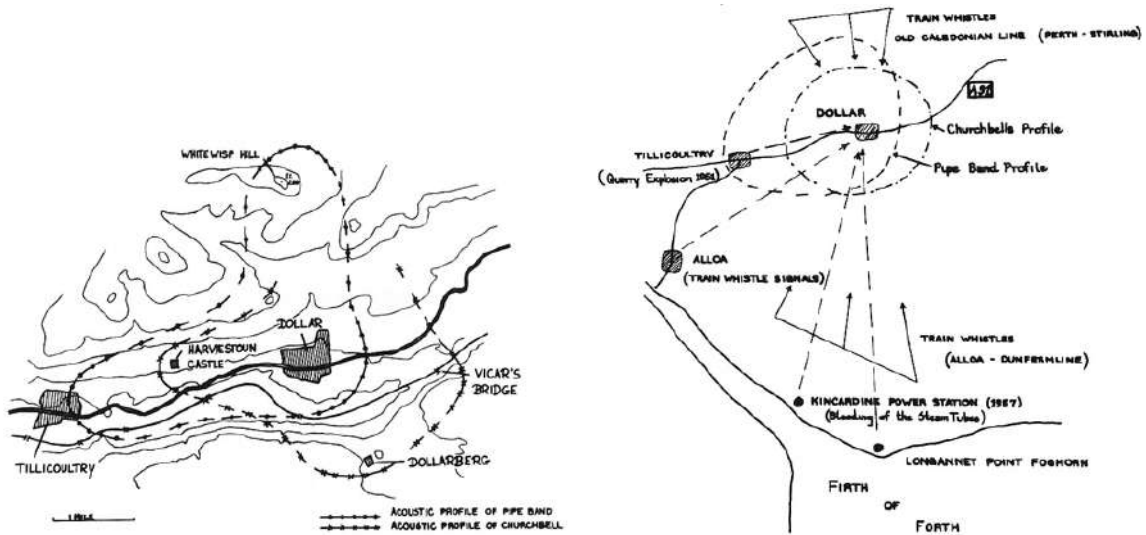


Figure 5. Acoustic profiles of the church bell and pipe band, Dollar; profiles and incoming sounds on the acoustic horizon, Dollar

In his book *The World Soundscape Project's Handbook for Acoustic Ecology*, Barry Truax presented the isobel map (Figure 6).⁴⁰

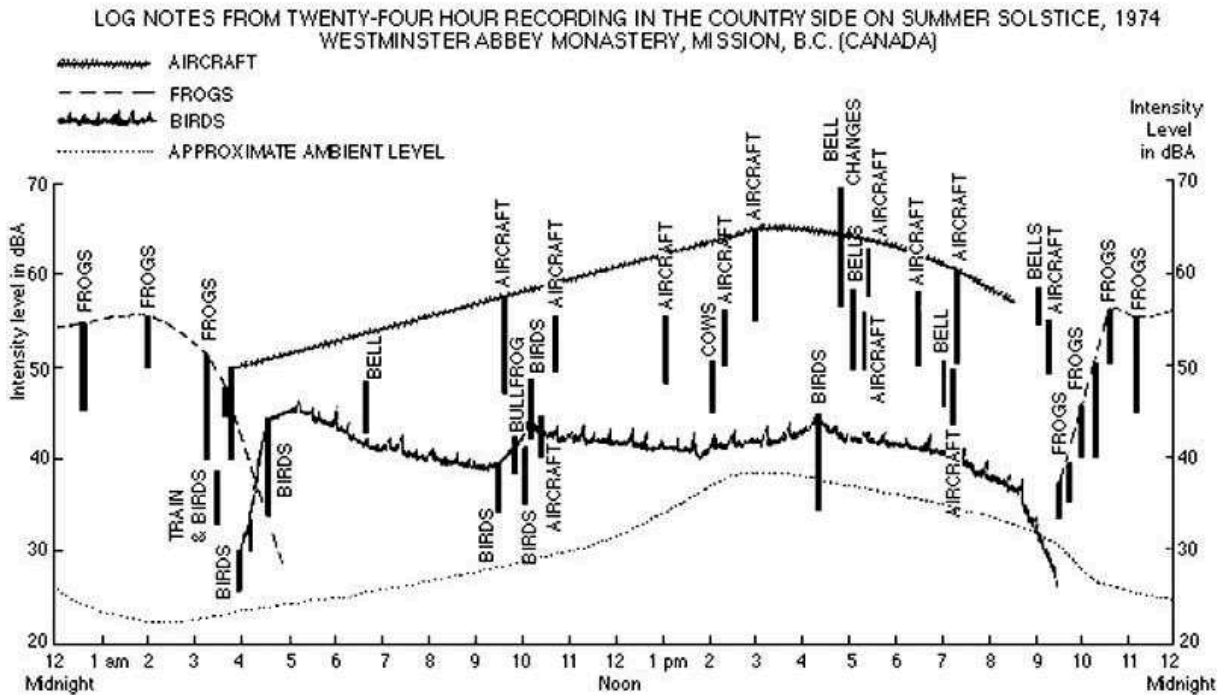


Figure 6. Isobel map by Barry Truax. *The World Soundscape Project's Handbook for Acoustic Ecology*

⁴⁰ Barry Truax, *The World Soundscape Project's Handbook for Acoustic Ecology* (A.R.C. Publications : Aesthetic Research Centre : World Soundscape Project, 1978).

Today, there are a variety of tools and techniques for processing and analysing digital sound files. One familiar visual acoustic tool used by ornithologists is the spectrogram. Spectrograms display acoustic frequencies along the y-axis, time on the x-axis and colours are used to denote intensity. There are studies where it was possible to discretize a spectrogram into small parts and then input these data into a GIS and calculate sound patch statistics (size, shape).⁴¹

The spectrograms depicting the moments from the soundscapes recorded and analysed in the practical part of this thesis, can be seen here below as examples (Figure 7, 8 and 9):

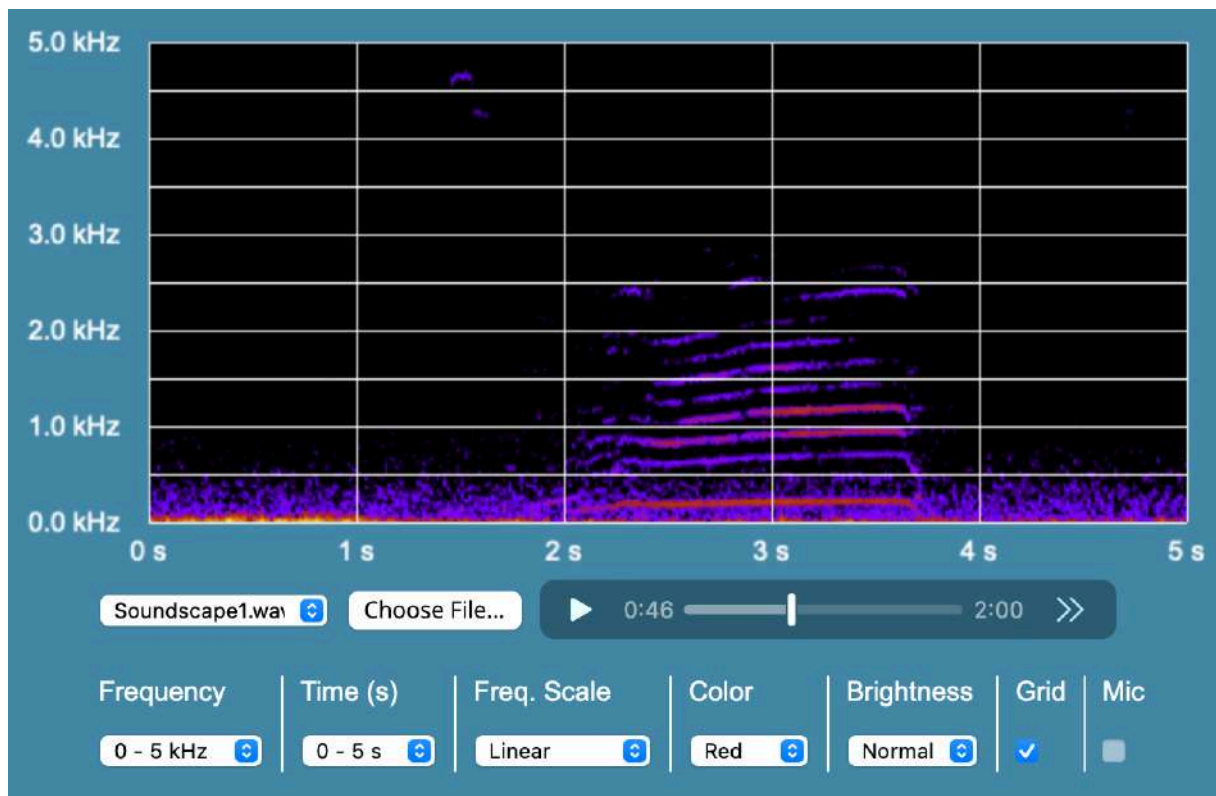


Figure 7. Spectrogram from Soundscape 1 - cow mewing

⁴¹ 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>.

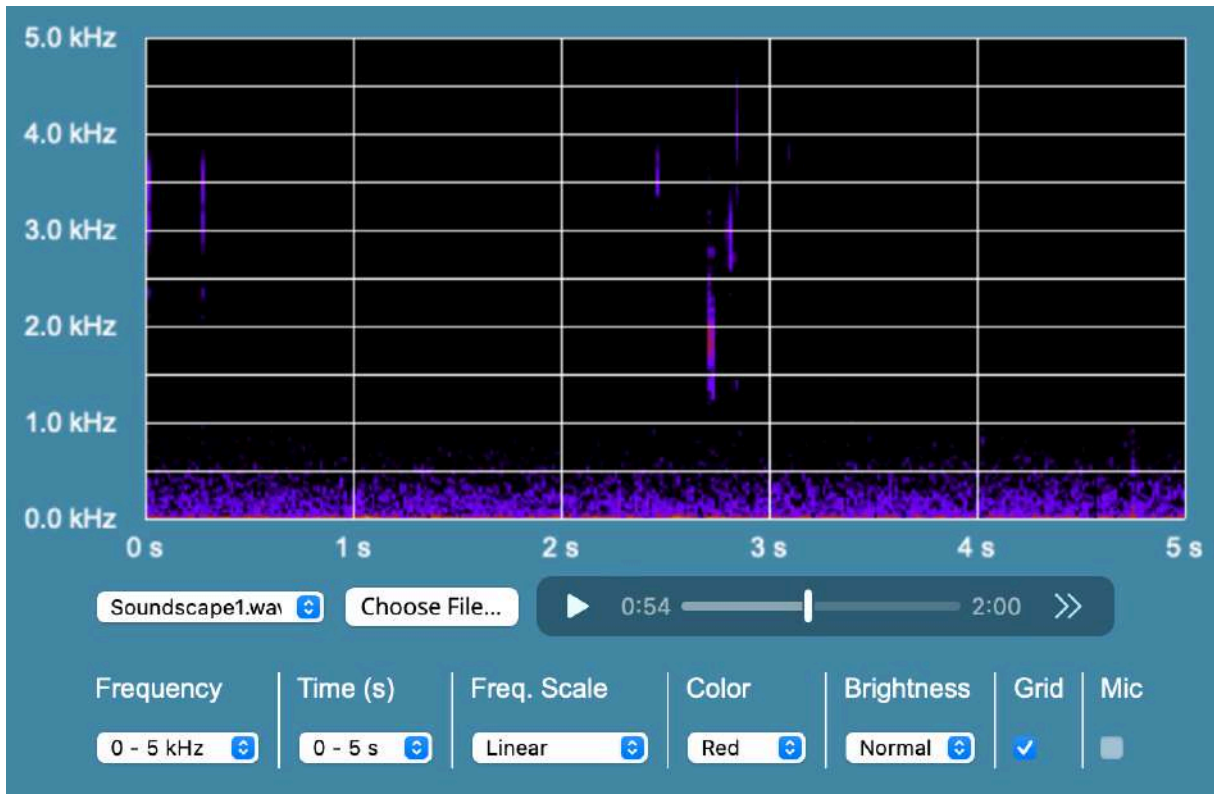


Figure 8. Spectrogram from Soundscape 1 - water dripping

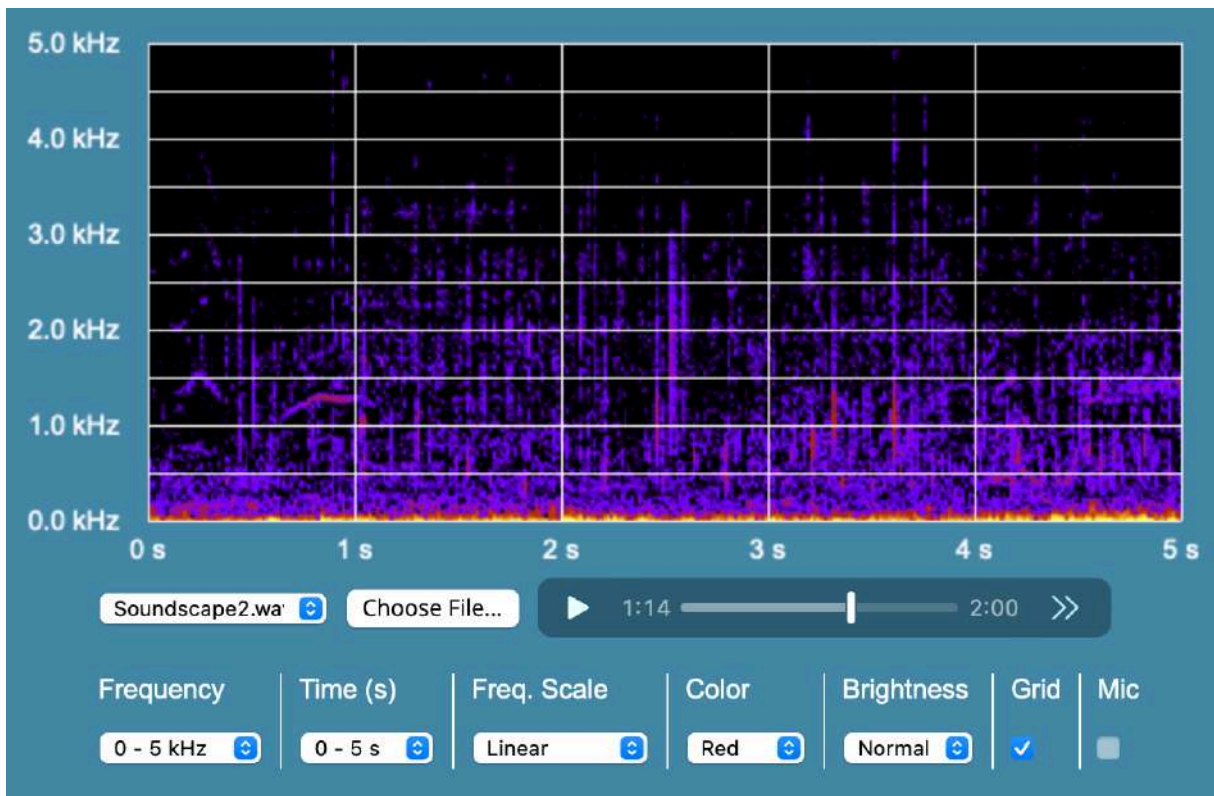


Figure 9. Spectrogram from Soundscape 2 - bird splashing onto water

8 PRACTICAL PART

8.1 Soundscapes of Alentejo

8.1.1 Methodology

The methodology for the practical part of this thesis was following:

Three rural **recording locations** were picked in Alentejo, Portugal, with distant soundscapes. Recordings were conducted in each of those locations and also photographs taken.

After that a **focus group** was formed. Unfortunately, the far-away location and limited time-span and financial means of the current thesis did not allow me to take the focus group to soundwalk to the recording areas.

Instead of that, a **survey** was elaborated that contained the recordings and several questions about them. Participants were asked to listen to the recordings and fill in the survey. At the end of the survey, photographs from the recording were shown, and participants were asked to match the photos with the heard recordings.

Then, conclusions were drawn.

8.1.2 Qualitative approach

Qualitative research encompasses any research method that doesn't rely on statistical techniques or quantifiable measurements to generate its findings. In this approach, data collection has explorative nature, which offers the opportunity to gain deeper and more comprehensive insights into people's emotional responses to environmental sounds. Qualitative research is particularly advantageous for gathering data in this thesis because it allows direct conversations with individuals, enabling a more thorough understanding of the environment.

8.1.3 Criteria of choosing the recording locations

Three locations were chosen in the Alentejo landscape that vary according to their type of land management. The idea was to choose three different locations:

- One where the traditional cultural landscape has been restored, with rich biodiversity and healthy ecosystem
- One where the traditional landscape has been completely ruined and biodiversity destroyed
- One where there has been attempt to restore biodiversity at least partially, but the artificiality of the landscape still dominates the wilderness and healthy ecosystem

8.1.4 Criteria of choosing the survey participants

The survey participants were chosen from as different characteristics as possible:

- people from different nationalities - Portuguese and foreigners;
- people from Alentejo and from other regions;
- people who live in countryside and people who live in the city;
- people of different ages;
- people of different gender.

8.2 Landscape of Alentejo: Montado

The Montado is a cultural landscape shaped by human activity. Over the ages mankind has been able to mould and sustain a multifunctional agro-silvo-pastoral ecosystem located in the south of the Tagus Valley. These areas were originally occupied by Mediterranean woodlands and are now populated by cork oaks and holm oaks - legally protected species since the 7th century - which grow in extreme edaphic-climatic conditions and very poor soils.

The enormous biodiversity of the Montado system turns this area into a buffer zone against the advance of the ongoing global process of desertification. This has been possible through a sustainable management of the balance between its arboreal, shrubby and herbaceous elements, based on the traditional knowledge and in the preservation of traditional forms of settlement.

The Montado Cultural Landscape is characterised by the distinctive traits of specific knowledge and the practise of a multifunctional agro-silvo-pastoral system, defined by low density tree population, consisting mainly of the *Quercus* species (*Quercus suber* and *Quercus rotundifolia*), as well as agricultural crops and pasture. With variations in the territory, this landscape is suitable for several uses, depending on the density of trees – cork oak and holm oak – that seek to adapt to the specific edaphoclimatic conditions, frequently dominated by skeletal soils with sparse organic matter and Mediterranean, Continental or Atlantic climate influences. By definition the Montado is a constructed landscape, shaped exclusively by human activity, that mankind has generated and managed in a unique manner, in order to guarantee its sustainability.

The Montado system currently occupies, in the South of Portugal, an area of over 1 million hectares, covering a significant part of the Alentejo region, large areas of the Tagus Valley and of Beira Baixa interior, as well as and the mountain ranges of the Algarve (Serra Algarvia).

The Montado is an expression of a system where human intervention has been present over many historical periods, whose ancient roots are documented. It is also an archaic landscape, where traditional systems are still present, in which modernisation processes associated with intensification of production or heavily mechanised processes tend to create disturbances and ruptures.

The Montado's environmental relevance is recognised due to the associated and interdependent fauna and flora, with a high diversity of species, including species of undeniable interest for conservation, such as the imperial eagle and Iberian lynx. The Montado system is also one of the mechanisms best adapted and adjusted to combat and control desertification in the Portuguese rural world. The existence of tree cover in pasture land (the so-called anthropogenic savannah) is of great importance for the production of fruits (acorns from the cork oak and holm oak trees) and foliage. The woody and herbaceous components produce significant effects in terms of the thermal system and soil water regulation and guarantee a high carbon capture capacity, making it possible to mitigate greenhouse gas emissions. The existence of scrub layer favours other complementary activities such as the production of honey, medicinal and aromatic herbs, mushrooms, vegetable coal and hunting.

The Montado landscape is made up of different types of cork oak and holm oak plantations, in a progressive succession, without sharp boundaries, but always varied and never monotonous.⁴²

⁴² UNESCO World Heritage Centre, "Montado, Cultural Landscape," UNESCO World Heritage Centre, accessed September 23, 2023, <https://whc.unesco.org/en/tentativelists/6210/>.

8.3 Recording locations

Recordings were made in three locations in the Alentejo landscape (Figure 10) that represent three different approaches to landscape management:

Soundscape 1 - Herdade do Freixo do Meio

An example of a multifunctional farm based on an agroforestry system in Portugal, and oldest and biggest organic farm in the country, as an example of healthy landscape, biodiversity and cultural heritage

Soundscape 2 - Parque Fluvial dos Cinco Reis

Situated 7 km from the city of Beja in Albufeira de Cinco Reis, which is intended to be a popular bathing recreation area, which would also allow for the creation of a set of parallel activities that promote the place.

Soundscape 3 - Intensive olive cultivation near Parque Fluvial dos Cinco Reis

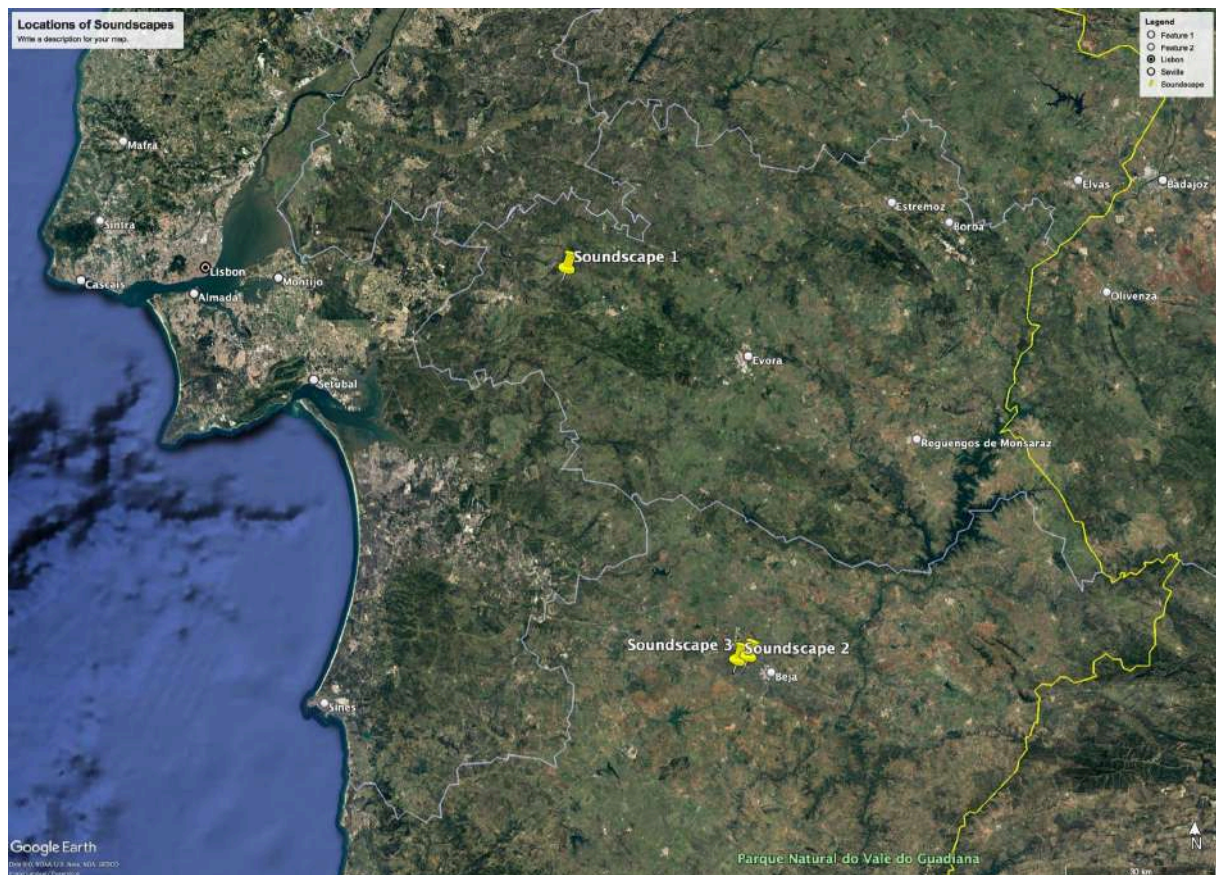


Figure 10. Recording locations

8.3.1 Herdade do Freixo do Meio

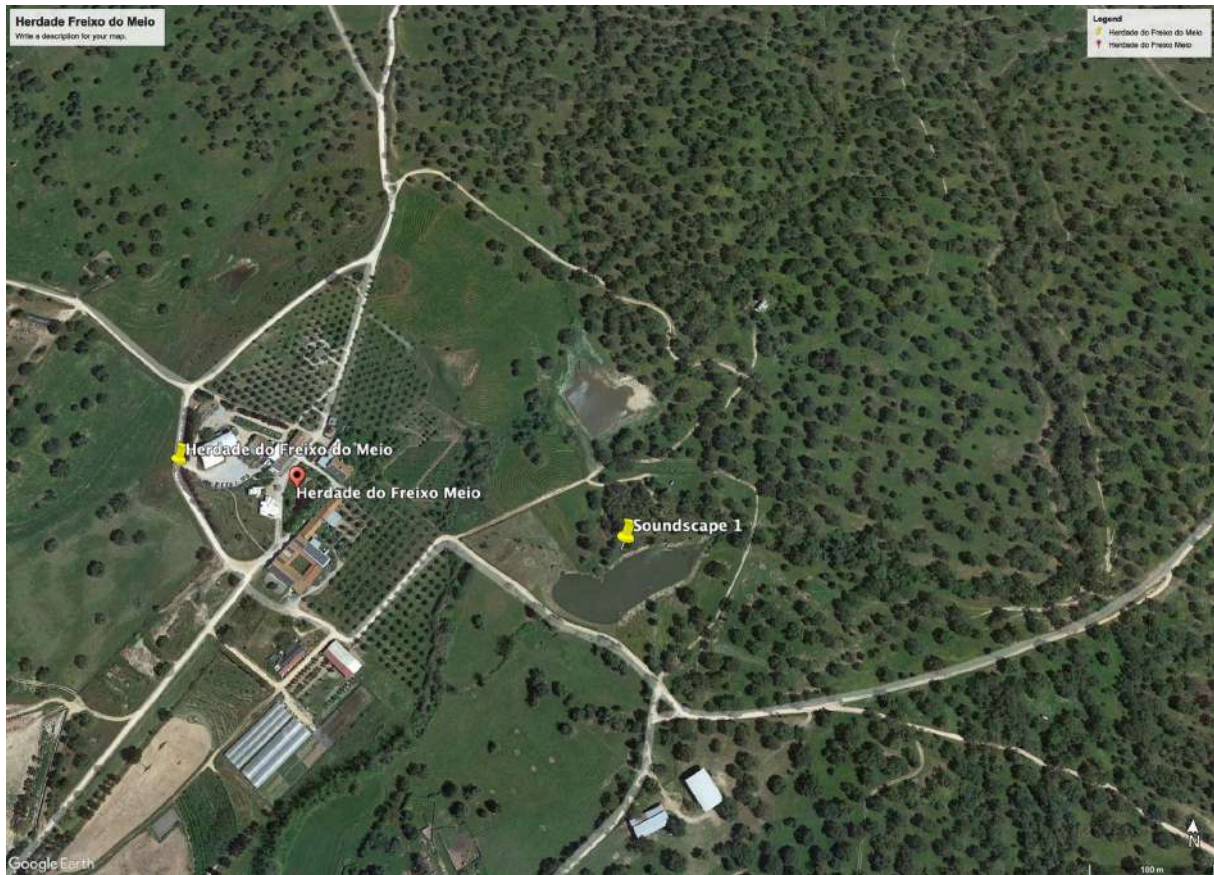


Figure 11. Location of Soundscape 1

The Herdade do Freixo do Meio (Figure 11 and 12) is a farm located in Montemor-o-Novo in Portugal that manages 440 ha of cork oak and holm oak Montado agroforestry systems. The farm also includes portions of irrigated land, vineyards, olive groves and biodiverse pastures and enables it to produce nearly all the ingredients of the Mediterranean diet with the exceptions of milk and fish. The Herdade Freixo do Meio is considered an example of a multifunctional farm based on an agroforestry system in Portugal, and remains one of the few economically viable projects in the area.

After being confiscated in 1974 during the Carnation Revolution, HFM was returned to the former owners in 1990 and since then tried to bring a new way of managing this heritage guided by the ethics of respect for the people and for the environment. The challenge of the new project was to efficiently manage a very ancient agroforestry system in Portugal by combining ancestral knowledge and sustainable practices and adapt it to the idiosyncrasy of the XXI century.

When the new project began in 1990, Alfredo Cunhal Sendim, the representative of the owners and new manager, found the farm in weak conditions with poor soil, erosion problems and a Montado with low levels of productivity. His first action was to ensure the recovery and maintenance of the quality of the soil as the base for increasing productivity. The next step was the implementation of a new strategy with the unique goal of finding a sustained maximisation of the management efficiency, considering the social-environmental-energy issues in order to achieve economic stability.

The new strategy was based in 4 basic pillars:

Diversification: taking advantage of the structure of the Montado offering a multifunctional environment to increase the possible uses of the land and activities and therefore the sources of revenue. Example: tourist activities and environmental education.

Differentiation: using local breeds, regional varieties and traditional treatments adding value to the final product. By using innovative and more sustainable techniques such as organic agriculture.

Efficiency: improving the efficiency of the processes by adopting professional management and qualified workers, increasing the knowledge and welcoming the use of new sustainable technologies and sources of energy.

Verticalization: considering the inclusion of all the steps of the product processing from field to final consumer including the opening of an own shop.

Since 2008, Herdade do Freixo do Meio has also acted as an economic active agent by embracing autonomous but complementary projects that strengthen the system as a whole and increase the number of products available from the farm. The independent projects include a 4.5 ha aromatic and medicinal garden, home-made bags and complements, 2 ha of a horticulture garden and 5 ha of orchards, free-range chicken production with a movable chicken house and a centre for artistic animations, storytelling and pedagogical workshops.

Herdade do Freixo do Meio also implemented several projects concerning alternative sources of energy: solar, wind and recycled diesel. It acts as an eco-tourism centre hosting an eco-camping and organising several pedagogical activities related to agriculture per year. It also supports scientific research project innovations and PhD experimental plans.

The exact recording location in HFM is depicted on Figure 13.



Figure 12: Herdade do Freixo do Meio. Photo: André Felipe Vieira



Figure 13. Herdade do Freixo do Meio. Recording location of Soundscape 1. Photo: André Felipe Vieira

8.3.2 Parque Fluvial de Cinco Reis

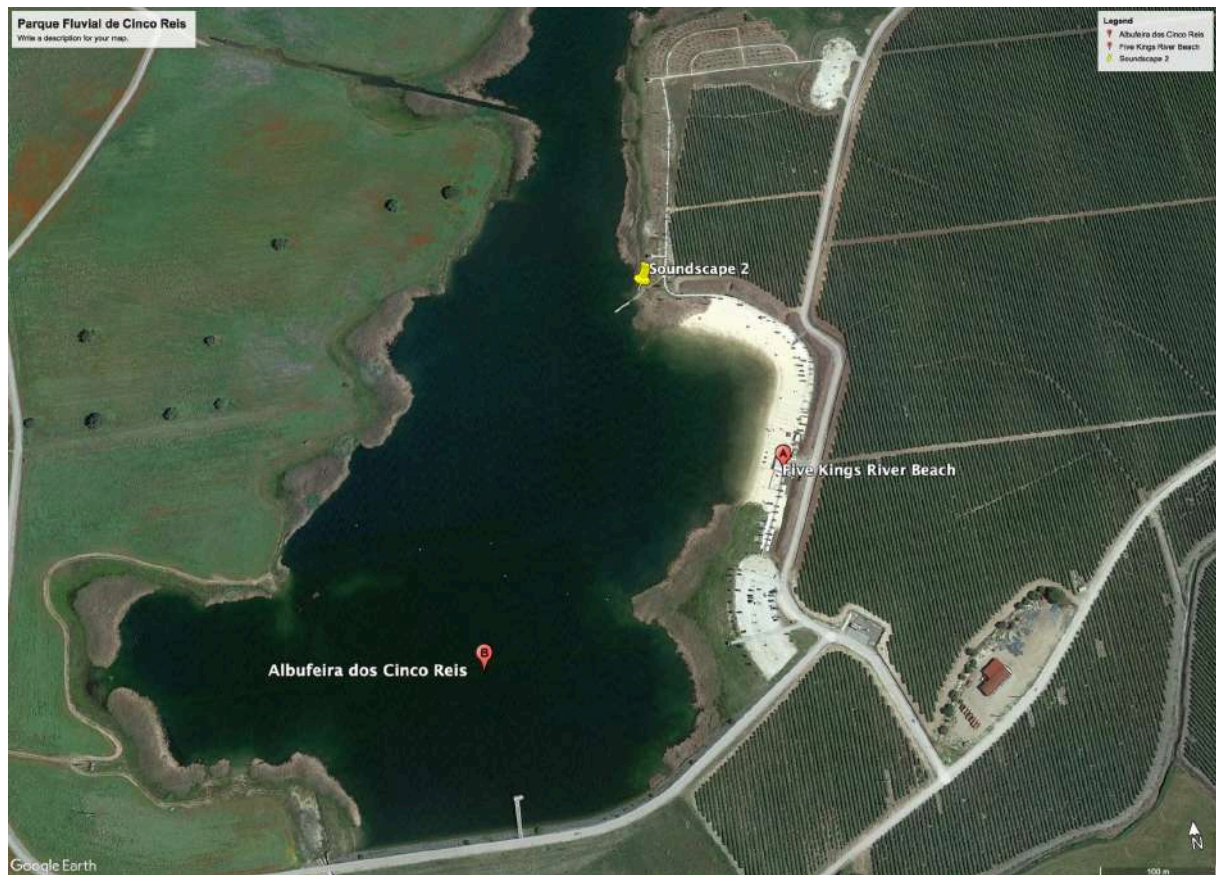


Figure 14: Location of Soundscape 2

Parque Fluvial de Cinco Reis (Figure 14 and 15) was inaugurated in 2020, with great expectation and curiosity from the people of Beja. The bathing recreation area is located 7 kilometres from the city, and it quickly gained the status of the region's favourite tourist attraction during the summer months. The Parque Fluvial de Sete Reis is considered a “small oasis at the gates of Beja”, which invites people to dive into the warm waters or “simply enjoy the tranquillity of the Alentejo landscape from the fine white sand”.⁴³ With a Blue Flag, the bathing area received “some rehabilitation interventions on the sand, inside and outside the water plane, walkway, signage and others”, announces the Beja Municipal Council.⁴⁴

The creation of Parque Fluvial de Cinco Reis had a cost of around 800 thousand euros, with Beja Municipal Council paying 50% of this amount. The remaining amount was financed by the Programa Valorizar of Turismo de Portugal (more than 300 thousand euros) and by the

⁴³ “Cinco Reis, o Parque Fluvial Que é Um Oásis de Verão Em Beja,” *Expresso*, July 27, 2023.

⁴⁴ Autarquia 360, “Município de Beja,” Parque Fluvial Cinco Reis, accessed September 16, 2023, <https://cm-beja.pt/cincoreis>.

enterprise EDIA (50 thousand euros). Cinco Reis dam is part of the infrastructure of the Alqueva Multi-Purpose Enterprise (EFMA) and receives water from the Alqueva reservoir through a system of canals and pipelines approximately 90 km long, after crossing 4 reservoirs, 2 intermediate reservoirs and being pumped in 2 large pumping stations.⁴⁵

Parque Fluvial de Cinco Reis can be characterised as a try to give something back for the nature and local community by the same company that's activity has brought deterioration to the traditional Montado landscape and damage to the ecosystems, by creating the vast areas of irrigation-based monocultures. It could be also compared with greenwashing, being the greenwashing defined as “the act of making false or misleading statements about the environmental benefits of a product or practice”.



Figure 15: Parque Fluvial dos Cinco Reis. Recording location of Soundscape 2. Photo: André Felipe Vieira

⁴⁵ “Praia Fluvial de Beja Significa Sinergia Da Atividade Primária Com a Turística,” *Rádio Voz Da Planície*, July 27, 2020.

8.3.3 Intensive olive grove



Figure 16: Location of soundscape 3

Characterised by dryness and immensity, the Alentejo Region, in Southern Portugal, has historically had the predominance of non-irrigated agricultural areas and cultures, such as the before mentioned agroforestry system of *Quercus suber* and *Quercus ilex* woodlands, called Montado. With the objective of improving agricultural productivity, a dam was constructed which offered a large volume of water for irrigation. As a result, a vast area of landscape, extending 83 kilometres and submerging 25000 hectares, with a total capacity of 4150 cubic metres, was created.⁴⁶

New water availability and the visual dimension of a large lake have triggered rapid changes in the landscape by means of irrigation and tourism development. The vast area that had traditionally been covered with Montado, experienced changes that destroyed the natural landscape and cultural heritage, substituting it with vegetables, intensive olive groves and

⁴⁶ André Samora Arvela and Thomas Panagopoulos, "Landscape Change Following the Alqueva Dam Construction," *LANDSCAPE & IMAGINATION Towards a New Baseline for Education in a Changing World*, n.d., 539–44.

vineyards, both using irrigation, along with golf courses and tourist resorts. The consequences were rapid soil erosion and loss of biodiversity.

The Soundscape 3 (Figure 16 and 17) was recorded in an extensive olive grove just few kilometres away from the Parque Fluvial dos 5 Reis.



Figure 17: Recording location of Soundscape 1 in the middle of the intensive olive grove. Photo: André Felipe Vieira

8.4 Recording day - climatic data

The recordings were carried out on the 11th and 12th of August. The weather on those days was extremely hot, reaching up to 37C. Wind speed stayed around 9-13 knots. The cloud cover was low.

8.5 QR Codes and links for recordings

QR Codes (Figure 18) to the recordings are added, to facilitate the reading of the present thesis on paper and hearing the recordings from the mobile device.

Soundscape 1	Soundscape 2	Soundscape 3
https://on.soundcloud.com/kC8dg	https://on.soundcloud.com/LQFn7	https://on.soundcloud.com/mLuYy
		

Figure 18. QR codes to the recordings of Soundscapes

8.6 Survey

The aims of the survey were following:

- To sensitize the focus group regarding the soundscape around them
- To make the focus group think about the soundscape in general
- To find out, which kind of imaginative landscape the recordings evoke in participants' mind
- Which kind of feelings the listened soundscapes provoke
- Are the soundscape preferences in correlation with the preferences of the visual representations of the same places

First, the participants were asked to close their eyes and to focus during a half a minute to the sounds they hear in their environment. In music education the ear training, or aural skills development, is the practice of learning to identify pitches, rhythms, chords, and other music theory concepts by ear - in other words, to sharpen one's ear. That kind of approach is also useful when trying to analyse the sounds of our everyday environment.

Then, the participants were asked to identify themselves by their gender, age, and nationality. To better understand their connection with nature, it was also asked if they live in the city or in the countryside, and if they grew up in the city or countryside.

Then, general questions about the sounds in the environment were asked from the participants of the survey:

Urban environments:

- Which kind of sounds do you find pleasant?
- What kind of sounds do you dislike?

Rural environments:

- Which kind of sounds do you find pleasant?
- What kind of sounds do you dislike?

Participants were asked to feel free to consider the sounds produced by:

- biophony - sounds produced by all living organisms
- geophony - sounds originating from the geophysical environment, which includes wind, water, thunder, movement of earth, etc
- anthrophony - sounds produced by human-made objects, that can be both stationary (e.g. air conditioning units) and moving (e.g. vehicles).

After that, the participants listened to the three soundscape recordings, and following was asked:

To describe each recording:

- What sounds do they hear?
- What sounds were dominant?
- From which sources they think the sounds were coming from?
- What kind of (visual) landscape the recordings evoked?
- What kind of feelings and emotions do the sounds evoke?
- Do the sounds bring up any memories?

After that the photos were shown of the recording locations, and the following was asked:

- Could you put the photographs in order, starting with the most pleasant and finishing with the least pleasant?
- Could you please justify your choice?
- Could you please try to match the recordings with the images?

Those questions explored how people understood the sounds in the environment and the way it might influence their feelings of the space, and also, how sound could add some added value to the landscape analysis.

These results help to dictate the usefulness of a new sound-based interpretive design for both the urban or rural environments.

8.7 Participants

Participants were chosen as different as possible in terms of age group, professions, nationality, their background of growing up in the city or countryside, and their current residence in the city or countryside.

The ten people whose consent was managed to get for replying the questions in the current half-an-hour survey can be characterised by the following:

Gender:

Female	7
Male	3

Age group:

21-30 yo	2
31-40 yo	3
41-50 yo	2
51-60 yo	3

Professions:

Mathematician; Cook; Landscape Architect; Photographer; Communication Specialist; Journalist (2); Tourist Guide; Designer, Diplomat

Nationality:

Portuguese	2
Estonian	4
Brazilian	2
South African	1
German	1

Country of residence:

Portugal	7
Estonia	3

Growing up in city or countryside

City	7
Small town	3
Countryside	0

Current residence in city or countryside

City	4
Small town	3
Countryside	3

8.8 Answers to the survey and analysis

The answers to the survey questions bring up several interesting aspects regarding the utility of soundscape analysis and its use in landscape architecture.

The recordings evoked similar impressions in many participants of the focus group.

The Soundscape 1 was generally perceived as the one containing the most natural sounds. All the participants identified bird calls, bees and other insects flying, water dropping, wind, some continuous rushing, cow mewing (Figure 19).

In the Soundscape 2 participants witnessed sounds produced by humans, together with a small amount of nature sounds - they mainly heard people chatting and shouting and kids playing and having fun, laughter, some water sounds, a duck landing on the water. (Figure 20)

Soundscape 3 (Figure 21) was considered pretty quiet, with some rushing and rumbling in the background, and a sharp and dominant sound of the car passing.

The dominant sounds in the first recording were the sounds produced by biophony, mostly insects, birds and animals, and by geophony; in the second recording the sounds produced by humans; and in the third recording anthrophonic sounds, namely the vehicles. It is important to focus that also the lack of sound: the silence was brought out in the case of the third recording.

To the question about which visual landscapes the recordings evoked, the answers included in the case of Soundscape 1 the nature, green pasture, green landscape with animals, forest, woods, warm summer day, happy rural surroundings, rural landscape with water (like a small river), trees with birds, insects flying around, high grass moving with wind. The feelings that this soundscape evoked were always positive: all the participants felt safe, relaxed, calm, happy, peaceful, serene and/or tranquil, and also words like beauty were used.

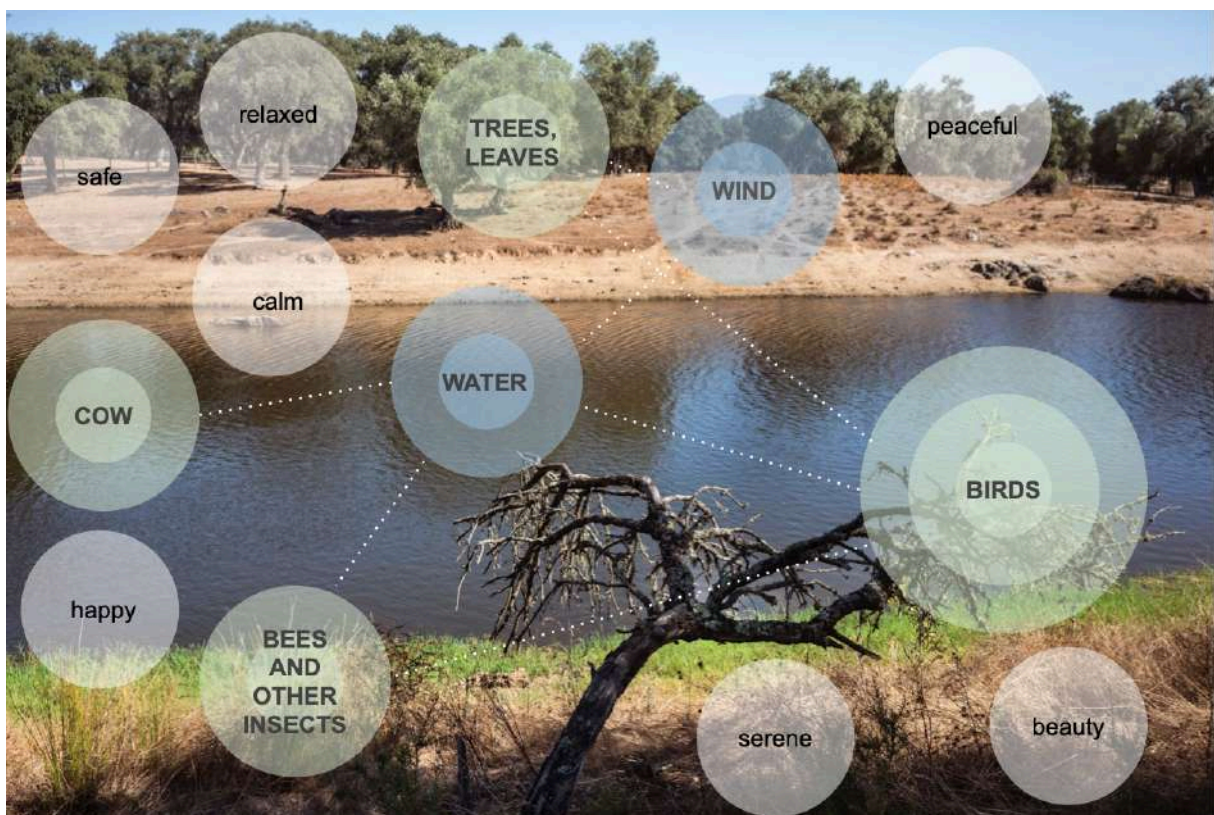


Figure 20. Sound sources heard and feelings evoked by the Soundscape 1

In the case of Soundscape 2 people imagined a place with water, a river or a lake, maybe a park or playground, with benches for people and ducks in the water; some kind of sports ground; warm weather that allows people to stay longer outside; a place in nature with many humans playing, drinking and having fun. The feelings that this soundscape evoke were more mixed and rather not so positive: one participant said “she felt light annoyances, and that when they want to rest they would not listen to this intentionally in their background”; the other stated that “her feelings were combined: mostly she feels still happy, as the soundscape brings her good memories of travelling; as people are outside, it must be warm; then again she feels a bit of agitation in the voice of the man, and that she wouldn’t stay in this place a long time”; the third said “I don’t like so much when they scream, makes me want to listen just to the nature and the sound of water” (Figure 20).

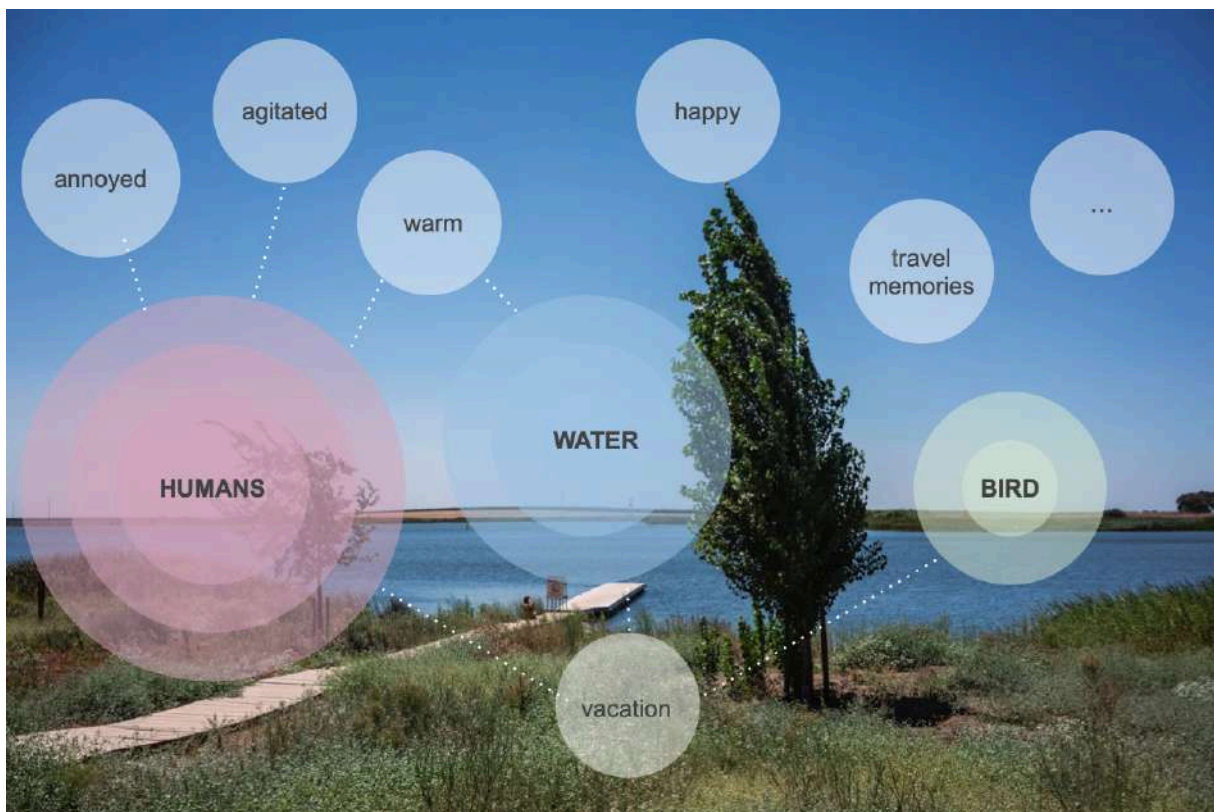


Figure 20: Sound sources heard and feelings and memories evoked by the Soundscape 2

In the case of Soundscape 3, one participant imagined an empty street with one or two cars passing by. The other one imagined either a rural setting, or a very sleepy part of a town where only one car passes in two minutes. A third one imagined a road close to nature. It is interesting that this soundscape made people imagine a scenario from the city setting - probably due to the complete lack of natural sounds. The feelings that this soundscape evoke were rather negative, or just numb: one participant said that “car sounds produce

stress for her, but the car that passed was the only and a quite quiet one, she has no big feelings”. The other also stated that she felt “nothing really”. A third one said that “she feels a strange emptiness, mainly because of the small noises she cannot identify very well” and that the soundscape provokes anxiety in her. She also said she dislikes the car noise. A fourth one said she felt “confusion, emptiness and apathy” (Figure 21).

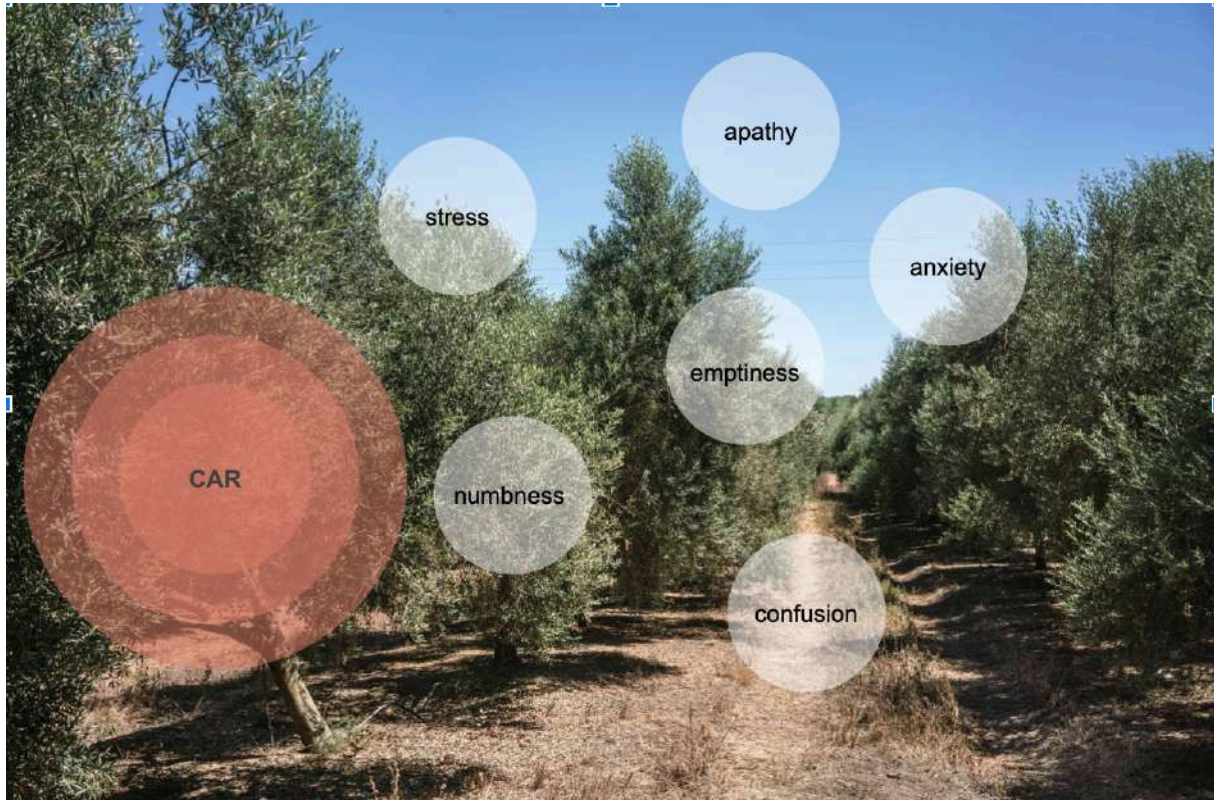


Figure 21: Sound sources heard and feelings and memories evoked by the Soundscape 3

It is interesting when after hearing the recordings, the participants were shown the photographs taken in the recording locations. Many participants considered for example the photographs depicting the intensive olive growth “beautiful” and gave high scores to those photos. The photographs depicting the Parque de Cinco Reis were considered rather pleasant, contrary to the soundscape recorded from the same place from where the photos were taken. In general the photos containing water had higher scores.

Participants had a hard time matching the photographs with recordings. On the photo, all the landscapes look beautiful and inviting; the massive lack of biodiversity and missing nature-produced sounds are not seen or perceived on the photos in a way it is perceived listening to the soundscapes. In one case, the Photo 1 (depicting the most biodiverse

landscape) was linked to the Soundscape 1 (recorded in the least biodiverse landscape) - just because it contained a gravel road that the mind connected to the car noise.

The answers about the recordings and photographs reflected also the replies to the general questions about soundscapes:

Question	Answers
2.1 Which kind of sounds do you find pleasant in an urban environment?	<ul style="list-style-type: none"> ● Birds ● Rain ● Ocean ● Music ● Low volume human sounds like: <ul style="list-style-type: none"> ➤ People chatting on terraces and gathering in their gardens; ➤ Kids playing ● Thunderstorm
2.2 What kind of sounds do you dislike in an urban environment?	<ul style="list-style-type: none"> ● Cars, motorcycles, car horns, traffic ● Human crowds and angry humans ● Construction works ● Sirens ● Metro ● Airplanes
3.1 Which kind of sounds do you find pleasant in a rural environment?	<ul style="list-style-type: none"> ● Sounds of nature ● Birds ● Wind in the tree canopies ● Rustling of leaves ● Rain ● Water ● Thunder

	<ul style="list-style-type: none"> ● Animal sounds ● Crickets at night ● Bees ● Fire burning in the fireplace in the campsite ● Snow crunching under the feet
3.2 What kind of sounds do you dislike in a rural environment?	<ul style="list-style-type: none"> ● When the animals go too crazy like cicadas, frogs, crickets. ● Tractors ● Mosquitos ● Dogs barking ● Artificial sounds ● Thunderstorms ● Neighbour cutting grass with a gas fuelled cutter

As can be seen, both in urban and rural environments people prefer sounds of nature, mostly geophonic and biophonic sounds. The least tolerated in both environments are anthroponic sounds, especially the ones produced by transportation networks and moving vehicles.

That is very similar to the results that Carter and his colleagues arrived at in their study about people's preferences.

Two important factors come out as a result of this survey. First, sound adds a very important factor to the perception of the landscapes. It carries the information about landscapes that visual observation alone would not be able to carry. It also very much contributes to how people feel themselves in landscapes - negative soundscape in a visually positively perceived landscape can ruin all the experience.

Secondly, while experiencing outdoor spaces, people are expecting from landscape design much more than a simple cancellation of negative noise (i.e. several anthroponic sounds such as traffic, for example). If landscape architecture would concentrate consciously also on

creating the positive soundscapes, it could turn people's experience of outdoor spaces even better. People are very much enjoying, both in rural and urban environments, the sounds of nature - birds singing, insects flying, leaves rustling in the wind, water murmuring. First two could be achieved by creating conditions for more species coming to designed environments - i.e. by increasing the biodiversity. The careful selection of vegetation species and ground cover types, and considerations on how those play together with the geological and climatic elements - wind, rain, soil - is capable of creating a whole symphony of sounds, experiences, feelings and memories. For example, rain drops make different sounds on different pavement types or on plants; the wind whistles in several different ways according to the canopy type and foliage of the trees and bushes. Also, creating conditions for the water to collect and murmur in the urban environment, we are at the same time creating positive soundscape, and also ecologically sustainable cities through stormwater management. Careful consideration of all those elements and their interplay makes the landscape architects real composers of the natural symphony, and at the same time avid militants for bringing biodiversity to the cities and fighting against climate change.

9 DEDUCTIONS FROM THE PRACTICAL PART AND CALL TO THE BIODIVERSITY

In 1962 saw the light of an important book regarding the loss of biodiversity that touches also the topic of soundscapes - Rachel Carson's "Silent Spring".⁴⁷ Carson's writing initiated a transformation in the relationship between humans and the natural world and stirred an awakening of public environmental consciousness.

The historical context and specific situation that pushed her to write that book were different - the cold war was at its peak; the chemical industry was one of the chief authors of the nation's prosperity. Though, and sadly, more than half a century later we face the similar problems: rapid climate change due to the unsustainable economic model, short-sightedness, and worldwide race for quick profit. Big energy companies' lobbies are still stronger than the voices of the ones who wish to save the planet; fossil fuel consuming vehicles tend to be still the dominant transportation means in the Western cities; big agriculture enterprises keep polluting the environment with harmful pesticides; and big monoculture plantations destroy the natural habitats.

Fifty years after passing the act of clean air, pollution around the world is worse than ever before. Forty years after passing the act of clean water, the amount of plastic in the ocean outweighs the fish that live there. Forty years after passing the act on endangered species, biodiversity on Earth is on sharp decline. And after decades of climate agreements, climate deterioration is only escalating.⁴⁸

The flying insect biomass index measured in German ecological reserves has fallen by 75% in the span of 26 years. The lack of bumblebees and butterflies busy around garden flowers is more than just a visual setback - more than 75% of global food crop types, including fruits and vegetables and some of the most important cash crops such as coffee, cocoa and almonds, rely on animal pollination - being so, much of our diet, health and lives depend on insects.⁴⁹

Most people in the world are living in the cities where they cast the natural and agricultural landscapes around them and expect impeccable ecosystem services: photosynthesis, soil generation, nutrient cycles, food, drinking water, wood, biodiversity, recreation in nature, etc. City dwellers assume that any resources their city needs to function must come from the

⁴⁷ Rachel Carson, *Silent Spring* (Houghton Mifflin Harcourt, 2002).

⁴⁸ Charles Eisenstein, *Climate--A New Story* (North Atlantic Books, 2018).

⁴⁹ KINO Landscape Architects, *Indispensable Outdoor Space* (Tartu: KINO, 2023).

outside, i.e. that the city must be able to thrive at the expense of the surrounding environment.⁵⁰ At the same time, city dwellers are unable to cope without biodiversity in the immediate vicinity.

This aspect was also evident in the survey responses for this thesis. Participants, whether in rural or urban settings, consistently expressed a strong preference for natural sounds, including birdsong, the gentle murmur of water (rain, rivers, the sea, and the ocean), and the whispering of the wind through leaves and trees. Notably, the absence of natural sounds, such as the complete lack of insect activity in the case of Soundscape 3, was found to induce feelings of unease and restlessness among the listeners.

For all the aforementioned reasons, both the urban environments and recreational areas in more rural settings should work in harmony with natural processes.

In the modern world, the "nature" that individuals have created within their immediate surroundings often lacks the authenticity of true nature. This manufactured version has been stripped of any unwanted elements commonly found in the natural world, such as fallen leaves, bothersome insects, signs of decay and illness, and is entirely subjected to human dominance. This type of nature can be described as sterile greenery, devoid of any intrinsic value or purpose beyond its utility to humans - like in the case of the landscapes of Soundscape 3, or even Soundscape 2.

Creating conditions for biodiversity, i.e. designing with the ultimate aim of ecological balance, biodiversity and healthy habitats, brings in the long perspective gain both to humans as to the planet in its whole.

Of the three soundscapes that are situated very close to each other, the participants clearly preferred the one that belonged to the most biodiverse landscape. Though visually the participants found all the landscapes quite pleasing, the soundscapes gave the clear notice that actually they would not feel themselves so well in the second and third landscape, compared to the first one.

⁵⁰ KINO Landscape Architects, *Indispensable Outdoor Space* (Tartu: KINO, 2023).

9.1 Examples of design for biodiversity

On Figures 22-27 there are some examples of the landscape design that sets biodiversity as one of its main design goals, from the two biggest cities of Estonia: Tallinn (the capital) and Tartu. By focusing on biodiversity, the design solutions also help to contribute to positive soundscapes, bringing to the city environment the birdsong, sound of bumblebees, and murmuring water.



Figure 22. Veerenni park, Tallinn, Estonia. KINO Landscape Architects. Photo: KINO Landscape Architects

In Veerenni Park (Figure 22), created on the site of the former plywood factory, the overarching landscaping approach prioritises biodiversity, aiming to provide habitats and food sources for both insects and birds while requiring minimal maintenance compared to regularly maintained areas. Trees and shrubs in the pocket gardens support biodiversity: as well as being decorative, they bear fruit, offering apples and cherries to people and food to pollinators. Semi-natural habitats, rich in species, are kept in less frequently used places offering suitable conditions for various wildlife while also enhancing the overall ecological balance. More frequently used areas are covered with utility lawn.

Carefully selected shrubs and trees are chosen for their suitability and resilience in urban environments, contributing to a cosy and inviting atmosphere. These plantings complement and extend the existing greenery, sometimes incorporating the same species or different varieties found in the surrounding vegetation.

Shrub planting areas are strategically categorised based on species' natural height, creating a dynamic and visually appealing landscape that frames park pathways and scenic views. Along preserved asphalt edges, planting zones for sun-loving and drought-tolerant perennials are incorporated, adding vibrant colours and textures to the urban environment.

Excess rainwater temporarily collects in ditches, where it provides a play area for children and drinking water for other species, as well as different and exciting flora.

Furthermore, landscaped areas may include broken or piled preserved asphalt surfaces, evolving over time with the help of natural processes, adding a unique touch to the overall design.



Figure 23. Principles of a healthy street. Rooski street in Tartu, Estonia, KINO Landscape Architects. Photo: KINO Landscape Architects

In Roosi street (Figure 23), principles of the healthy street were tried out. Landscaping has a significant impact on both the well-being of individuals in urban spaces and on the provision of habitats, food, and other resources for various species. Moreover, even small-scale landscaping efforts can play a crucial role in addressing issues such as increased rainfall runoff. It provides shelter from rain and sun for pedestrians, reduces ground and pavement temperatures, thus mitigating the urban heat island effect, among other benefits. However, the current trend in street landscaping often lacks diversity, with a notable absence of shrubbery and grassy areas. At best, streets feature tree-lined alleys (sometimes with bare trees) and neatly maintained lawns.

To achieve the principles of creating healthy streets, several measures were taken in the project of Roosi street. These included limiting the maximum distance between street tree canopies to 15 meters, incorporating shrubbery into the design, selecting plant species based on their capacity to provide habitat and food for insects, birds, and animals, ensuring that no more than one third of the total green areas were covered with turfgrass, and implementing Sustainable Urban Drainage (SUD) systems to irrigate the street vegetation.



Figure 24. City meadow in the city centre of Tartu, Estonia, created under the Curated Biodiversity team leadership. Photo: KINO Landscape Architects

Increasing biodiversity in cities is crucial in order to mitigate the effects of climate change, reduce the loss of species and their habitats, and create a better habitat for people both mentally and physically.

The parks of the city centre of Estonian second biggest town Tartu were lacking diversity in every sense. Fortunately, there is a lot of space with great potential for people and urban nature to coexist in a mutually enhancing way.

Within the framework of the project “Curated Biodiversity”, a meadow was established in the City Centre of Tartu (Figure 24) and bulbous flowers planted together with the help of the local inhabitants. Biodiversity was brought to the city centre’s parks during the summer, both by not mowing the park areas and by transplanting a patch of meadow. In order for the seeds to be sown in the soil, the grass cover was peeled from the meadow area, and then the seeds of the plants collected from the local meadows were sown.

Downtown parks turned into a landscape laboratory where changes will be systematically documented, and the conclusions drawn from the results that serve as a model and guide for improving any similar spatial situation.



Figure 25. European Goldfinch while eating dandelion seeds in Tartu. Photo: KINO Landscape Architects



Figure 26. A slatted flowerbed that allows temporary walking in tight spaces, while protecting plant roots from trampling. The small animals can pass underneath. Photo: Internet



Figure 27. Fahle outdoor space, KINO Landscape Architects. The narrow strips of soil between the tiles also give plants enough growth opportunities, and the overall impression of the rocky surface is green. Photo: Terje Ugandi

All of these projects prioritise the enhancement of biodiversity as the foundation of their design. In doing so, they also cultivate a captivating soundscape within the project areas. Carefully selected and various local tree and plant species, along with Sustainable Urban Drainage Systems (SUDS), contribute to the flourishing biodiversity and a plethora of natural sounds. These encompass the buzzing of insects, the melodious chirping of birds, the gentle rustling of wind through the leaves, and the tranquil murmuring of water in swales and detention basins.

10 CONCLUSIONS

10.1 Answers to the research questions and deductions

One of the research questions presented in this thesis was, **why could soundscape analysis provide an interesting resource for landscape planning, design, restoration and management**, both in Portugal and abroad.

In a highly visual world, people are not used to paying attention to the soundscapes around them. Nevertheless, the sounds that surround us have a profound influence on our physical and mental well-being. A greater awareness of sounds and other sensory impressions creates a more harmonious understanding of the individuals' aesthetic encounter with the surrounding landscape. Such an understanding should be taken into consideration during the processes of planning and design.

As a result of this study, it can be stated that soundscapes play a crucial role in shaping people's experiences of landscapes, influencing their overall perceptions, well-being, and interactions within a given environment. What people are looking at in their surrounding outdoor environment, is a holistic multi-sensory environmental experience. The survey showed that most positive feelings are provoked by the landscapes that have the greatest variety of natural (biophonic and geophonic) sounds. The auditory aspect contributes a lot to the creation of a sense of place - a landscape that is otherwise considered beautiful due to its visual look, can be unpleasant to spend time at due to its auditory characteristics. For this reason, the study of soundscapes before and during the planning process is of great importance.

The other question was, **which are the soundscapes that people like, and how could those be achieved with the help of landscape architecture, landscape planning and landscape management?**

Both theoretical and practical research proved that people like the most landscapes with a great variety of natural sounds. That could be translated into other words like biodiversity, that could be found more both in urban and rural environments. More than just bringing visually appealing aesthetical compositions around us, landscape architects could always focus on bringing biodiversity close to the people.

Third question was, **what practical tools and methods could be used during the soundscape planning process?**

The methods tried out since now are the surveys and interviews with the focus groups, that can be carried out as presented in the practical part of current thesis; soundwalks; and sound recordings, that can be later analysed in the way like was shown in the practical part.

10.2 Limitations of this study

The primary constraints of this study revolved around limited financial resources and time availability. Insufficient funds led to a shorter trip duration and a reduced amount of time spent in the recording locations. Time and financial constraints imposed limitations on the number of recordings made and on-site observations conducted at the recording locations. Future researchers should also consider the following factors:

Only ten individuals participated in the research. Consequently, the results are more general and less specific due to the small sample size, offering a limited representation of beach users' perceptions and behaviours.

Listener demographics, including age, gender, and visual or hearing impairments, can also influence soundscape perception. The participants had an uneven representation of age demographics: they were all in the range of 27 to 44 years old. An ideal composition for each group would include people from 20 to 80 years of age.

Ideally, sounds in different places could be recorded always at the same time of the day, and three times per day: in the morning, mid-day and in the evening, to capture the changes in the soundscapes.

10.3 Future prospects for soundscape study in landscape architecture context

The purpose of this research was to contribute to the development of the field of landscape architecture, with the aim to help to create better outdoor environments. This thesis concentrated on one of the senses, often neglected in landscape planning: the audition. The idea was to go further than noise-cancellation methods, and focus on how the landscape architecture could benefit from adding positive sounds to landscapes and their users. However, a long-term goal could be the development of **design practices that take into consideration all the intersensory aspects**.

Further exploring both urban and rural soundscapes through additional research would be valuable for the creation of innovative public spaces. The starting points for acoustic design research, principles and guidelines presented in this thesis can provide landscape architects with a broader range of strategies for creating meaningful places that are harmoniously integrated with their surroundings. To further enhance our understanding of acoustic design, it is essential to conduct additional research to identify areas of knowledge that were not covered in this thesis. Some of those potential knowledge gaps may encompass the following.

Land use patterns are frequently used to help comprehend the landscape during various activities. Nevertheless, it's crucial to conduct a **more thorough examination of the expectations and mental states of the people involved** in these activities at specific locations. One of the focus points while designing the future landscapes could be also defining the desirable acoustic qualities which promote different forms of land use.

One important research branch would be also to identify different techniques for recording sound, and to develop new technologies and softwares for analysing the soundscapes. With the rapid development of data processing and artificial intelligence, this area will probably offer many fruitful solutions in the near future.

It would be also interesting to investigate how different site interventions change existing soundscapes and assess the impact of design interventions on perception of space.

Bibliography

- 360, Autarquia. "Município de Beja." Parque Fluvial Cinco Reis. Accessed September 16, 2023. https://cm-beja.pt/cincoreis#submenu_3953.
- "An Introduction To Sound Art – Robert Worby." Accessed September 15, 2023. <http://www.robertworby.com/writing/an-introduction-to-sound-art/>.
- Borker, Abraham L., Rachel T. Buxton, Ian L. Jones, Heather L. Major, Jeffrey C. Williams, Bernie R. Tershy, and Donald A. Croll. "Do Soundscape Indices Predict Landscape-scale Restoration Outcomes? A Comparative Study of Restored Seabird Island Soundscapes." *Restoration Ecology* 28, no. 1 (October 31, 2019): 252–60. <https://doi.org/10.1111/rec.13038>.
- Carles, José Luis, Isabel López Barrio, and José Vicente de Lucio. "Sound Influence on Landscape Values." *Landscape and Urban Planning* 43, no. 4 (January 1999): 191–200. [https://doi.org/10.1016/s0169-2046\(98\)00112-1](https://doi.org/10.1016/s0169-2046(98)00112-1).
- Carson, Rachel. *Silent Spring*. Houghton Mifflin Harcourt, 2002.
- Centre, UNESCO World Heritage. "Montado, Cultural Landscape." UNESCO World Heritage Centre. Accessed September 23, 2023. <https://whc.unesco.org/en/tentativelists/6210/>.
- Chenhall, Richard, Tamara Kohn, and Carolyn S. Stevens. *Sounding Out Japan: A Sensory Ethnographic Tour*. Routledge, 2020.
- "Cinco Reis, o Parque Fluvial Que é Um Oásis de Verão Em Beja." *Expresso*, July 27, 2023.
- Contributors to Wikimedia projects. "100 Soundscapes of Japan." Wikipedia, May 14, 2023. https://en.wikipedia.org/wiki/100_Soundscapes_of_Japan.
- Davies, William J., Mags D. Adams, Neil S. Bruce, Rebecca Cain, Angus Carlyle, Peter Cusack, Deborah A. Hall, et al. "Perception of Soundscapes: An Interdisciplinary Approach." *Applied Acoustics* 74, no. 2 (February 2013): 224–31. <https://doi.org/10.1016/j.apacoust.2012.05.010>.
- Davis, Bruce. *Five Village Soundscapes*, 1977.
- Dumyahn, Sarah L., and Bryan C. Pijanowski. "Soundscape Conservation." *Landscape Ecology* 26, no. 9 (July 19, 2011): 1327–44. <https://doi.org/10.1007/s10980-011-9635-x>.
- Eisenstein, Charles. *Climate--A New Story*. North Atlantic Books, 2018.
- Ferreira, Vera, Thomas Panagopoulos, Anda Cakula, Rita Andrade, and Andre Arvela. "Predicting Soil Erosion After Land Use Changes for Irrigating Agriculture in a Large Reservoir of Southern Portugal." *Agriculture and Agricultural Science Procedia* 4

- (2015): 40–49. <https://doi.org/10.1016/j.aaspro.2015.03.006>.
- Frauke, Behrendt. “Soundwalking.” In *The Routledge Companion to Sound Studies*, 249–57. Routledge, 2018. <http://dx.doi.org/10.4324/9781315722191-28>.
- Hildegard Westerkamp. “Hildegard Westerkamp.” Accessed October 14, 2023. https://www.hildegardwesterkamp.ca/writings/writingsby/?post_id=13&title=soundwalking.
- Hull, John. *Notes on Blindness: A Journey through the Dark*. Profile Books, 2017.
- Hull, John M. *Touching the Rock: An Experience of Blindness*. SPCK, 2013.
- KINO . *Indispensable Outdoor Space*. Tartu: KINO, 2023.
- Krause, Bernie. *The Great Animal Orchestra: Finding the Origins of Music in the World’s Wild Places*. Hachette UK, 2012.
- . *Wild Soundscapes: Discovering the Voice of the Natural World, Revised Edition*. Yale University Press, 2016.
- “Orality, Literacy, and Modern Media, Walter Ong.” In *Communication in History*, 63–69. Routledge, 2015. <http://dx.doi.org/10.4324/9781315664538-14>.
- 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>.
- . “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>.
- Porteous, J. Douglas, and Jane F. Mastin. “SOUNDSCAPE.” *Journal of Architectural and Planning Research* 2, no. 3 (1985): 169–86. <https://doi.org/10.2307/43028767>.
- “Praia Fluvial de Beja Significa Sinergia Da Atividade Primária Com a Turística.” *Rádio Voz Da Planície*, July 27, 2020.
- Prior, Jonathan. “Sonic Environmental Aesthetics and Landscape Research.” *Landscape Research* 42, no. 1 (November 8, 2016): 6–17. <https://doi.org/10.1080/01426397.2016.1243235>.
- Samora Arvela, André, and Thomas Panagopoulos. “Landscape Change Following The Alqueva Dam Construction.” *LANDSCAPE & IMAGINATION Towards a New Baseline for Education in a Changing World*, n.d., 539–44.
- Schachtel, Ernest G. *Metamorphosis: On the Development of Affect, Perception, Attention, and Memory*, 1984.
- Schafer, R. Murray. *The Soundscape: Our Sonic Environment and the Tuning of the World*. Destiny Books, 1993.
- . *The Tuning of the World*. New York : Knopf, 1977.

- “The Sonic Environment of Cities.” *Environment and Behavior* 1, no. 1 (June 1969): 49–70.
<https://doi.org/10.1177/001391656900100104>.
- Truax, Barry. *Acoustic Communication*. Praeger, 2001.
- . *The World Soundscape Project's Handbook for Acoustic Ecology*. A.R.C. Publications : Aesthetic Research Centre : World Soundscape Project, 1978.
- Villanueva-Rivera, Luis J., Bryan C. Pijanowski, Jarrod Doucette, and Burak Pekin. “A Primer of Acoustic Analysis for Landscape Ecologists.” *Landscape Ecology* 26, no. 9 (July 21, 2011): 1233–46. <https://doi.org/10.1007/s10980-011-9636-9>.
- Westerkamp, Hildegard. “Exploring Balance & Focus in Acoustic Ecology.” *The Journal of Acoustic Ecology* 11 (2011): 7–13.
- . “Linking Soundscape Composition and Acoustic Ecology.” *Organised Sound* 7, no. 1 (April 2002): 51–56. <https://doi.org/10.1017/s1355771802001085>.
- World Forum for Acoustic Ecology. “World Forum for Acoustic Ecology - Welcome!” Accessed September 15, 2023. <https://www.wfae.net>.
- Znidarsic, Elizabeth, and David Watson. “Acoustic Restoration: Using Soundscapes to Benchmark and Fast-Track Rehabilitation of Ecological Communities.” Authorea, Inc., November 25, 2021. <http://dx.doi.org/10.22541/au.163783675.52249304/v1>.