

Acoustic Ecology as tool for Environmental Awareness

The ocean soundscape

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Abstract

In a context in which the awareness of the impact of urban sound on our society is being raised, we are still facing the problem of increasing noise pollution. Moreover, according to studies in emerging fields such as soundscape ecology, animal sound communication has changed due to a soundscape transformation caused by increasing anthropogenic noise. This also applies to the underwater ecosystems: pile driving, shipping and renewable energies are some of the threats that we are facing today as they contribute strongly to underwater noise pollution. The recording of the underwater soundscapes can help us establishing a sound map to comprehend the development of this environment that is so important for the climatic conditions of this planet's health. Moreover, the study of oceanic sound dynamics can reveal useful information in terms of our planet's health. And not only that: by utilizing these underwater recordings in an artistic context, we can help raise awareness of acoustic problems marine life has to face today.

Keywords

Underwater noise
Acoustic ecology
Ocean soundscape

Introduction

Ocean is the pivotal factor determining the climatic conditions on the planet. The study of ocean sound dynamics can reveal useful information regarding our planet health. This research project intends to understand the ocean soundscapes and find out how the relationship between sound and nature can be a tool for designing immersive auditory spaces. The main goals of this investigation are to understand the ocean underwater soundscapes, how they are changing and evolving, to perceive how these changes are affected by the environment, to compare different areas, to study the anthropogenic impact on these soundscapes and to access what are the main contributions for sound pollution inside the ocean in our country.

1. Purpose of the research (and importance to the field)

According to studies in emerging fields such as soundscape ecology, we can observe how animal sound communication (bioacoustics) has been changing due to a soundscape transformation caused by increasing anthropogenic noise (Francis & Barber, 2013; Pijanowski et al., 2011). Bernie Krause describes the dilemma in his book: more than 50% of the material recorded over nearly five decades comes from sites so badly compromised by various forms of human intervention that the habitats are either altogether silent or the soundscapes can no longer be heard in any of their original forms (2015, 29).

The purpose of this research is to work directly with the ocean soundscapes in order to protect, understand and improve our knowledge on environmental topics, always on the lens for creating awareness to the society by sharing the results with the community through artistic approach and creative work. Soundscape recording, analysis and interpretation of data are also main parts of the project. The outcome will be not only establishing a library with the sound memory of the selected places or the development of a sound map of the Portuguese coast, but also

designing artistic interventions drawing on environmental field recordings and data sonification immersive sound projects. With an interdisciplinary approach, we may sensitize communities to be aware of our ocean underwater soundscapes environments, we can work in collaboration with other scientific fields of relevance to study the relationships between these soundscapes and the ocean health or ocean biology, bringing a wider access to the qualitative aspects of the ocean sound and how these soundscapes can influence our way to relate with the ocean itself.

2. Brief survey of background and related work

The Navy has long used sound to detect objects underwater (Hole et al, 2017). Sound is used by scientists, industries, navies, and others to communicate underwater, to monitor the ocean's moving water masses, to get images of the seafloor and structures beneath it, and to localize and track sources of sound in the ocean (Hole et al, 2017).

As Jennifer Miksis-Olds states, sounds from low-frequency sources like ships, seismic air-guns, and blue whales transmit 1000's of km in the deep ocean and can be combined to contribute to local soundscapes, making sound one of the most accessible tools for exploring the ocean (Miksis-Olds 2016). National Aeronautics and Space Administration (NASA) and The National Oceanic and Atmospheric Administration (NOAA) are both active researchers with cutting edge technologies for exploring and learning our environments. According to Tsang-Hin-Sun, investigating the variability of ambient sound in the oceans is the key for understanding many oceanic processes, such as surface wave interactions, wind, and climate change, as well as monitoring for seismic events and marine life (Tsang-Hin-Sun et al, 2015).

Miksis-Olds states that sound can be used to observe a variety of signals in marine ecosystems ranging from natural phenomena to anthropogenic activities indicative of global ocean use

and climate change. For a better understanding of global ocean noise, she examined changing acoustic conditions over the course of a year in the Pacific, Atlantic, and Indian Oceans. She got results that show differences between the soundscapes generated on opposite sides of an island that explain how the dominant ambient sound sources are influenced by regional physical, biological, and anthropogenic factors (2012).

Artists that develop experiences to challenge people's everyday awareness using technology and sound are my main inspiration works. Leah Barclay¹ explores the connection between art, the environment and the local communities. In her work *WIRA 2015*,² an interactive sound installation, she explores the cultural and biological diversity of river systems through an augmented reality sound walk. This installation is open for user's contribution with their own recorded soundscapes and was constantly evolving through the course of the exhibition. Matthew Burtner³ with his latest work *Music for Climate Science at Nasa 2017*⁴ pretends to discuss how music can contribute to climate science. Caitilin de Bérigny⁵ is an artist that creates awareness on environmental issues as theme in her work for the past decade. In her collaborative article "Tangible User Interface Design for Climate Change Education in Interactive Installation Art", she describes an interactive installation artwork, which incorporates tangible user interface objects and combines environmental science and multiple art forms to explore coral reef ecosystems that are threatened by the effects of climate change. She argues that the use of tangible user interface in an installation-art setting can help engage and inform the public about crucial environmental issues (de Bérigny, 2014). Also, in her work *Interantartica*⁶, she draws attention to the climate change and offers a three-screen video installation where the viewer hears Antarctic compositions, created by other viewers in real-time interaction and presents scientific data through a multi-sensory experience (sound, sight, touch).

1 <http://leahbarclay.com/>

2 http://leahbarclay.com/portfolio_page/wira/

3 <http://matthewburtner.com/ecosono/>

4 <http://matthewburtner.com/music-for-climate-science-at-nasa/>

3. Description of the proposed approach

Starting from the issues already addressed in the context of the master's degree on how to improve our aural awareness, I question how we can use sound and soundscape compositions to establish a deeper emotional connection with natural elements that are alien to the urban environment. Field research is a way to engage and explore our environment through emerging media technologies, and art made possible to show creatively the results with new audiences. The creative interpretation of data demonstrates the power of art when paired with other fields. The idea of exploring and investigate the ocean, the ocean soundscapes, the acoustics, the impact of noise rising on the fauna will give me not only important data on the scientific approach but also on artistic point of view. The central theme of this investigation project is to study sea soundscapes to better understand the ocean sound dynamics with the aim to create environmental awareness in our society through art. Another focus of this research is also soundscape studies, especially in environmental data analysis with purposes for presenting data visualization and sonification works. The first part of the investigation will be the assessment of existent implemented hydrophones, a survey of investigation centres that work with the ocean and understand our sound policies in the sea. Using existent hydrophones in different parts of the ocean and proposing new key sites for recording sound we will have conditions and the possibility of developing a general sound map of our coast.

There are number of investigation centres in our country for possible partnerships in this project like the Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), the Research Centre in Biodiversity and Genetic Resources (CIBIO), the Center for Environmental and Marine Studies (CESAM), MARINFO, STRONGMAR or Oceano Vivo Foundation just to name a few. The Pacific Marine Environmental Laboratory (PMEL) from NOAA, have an acous-

5 <http://www.caitilindeberigny.com/>

6 <http://www.caitilindeberigny.com/#/interantartica/>

tics program for accessing the noise in the EUA. Learning from their framework we can also start collecting our own data nationally. SUB-ECO, a program funded by the Ministry of Defense of Portugal started a project that aims at reinforcing the capabilities of national underwater surveillance. After the local/ national assessment my goal is to make connections with several international organizations for an interdisciplinary approach. I am interested in using existing data as well as new data as raw material for data sonification works. The collaboration with the Underwater systems and Technology Laboratory in FEUP, where I am able to work with their team on sea expeditions, allowed me to record and monitor the sound activity in specific locations in our coast. Other data like salinity, temperature, pressure, turbidity or chlorophylla can also be used for data visualization and sonification tests. The data and material collected will be raw material for artistic practices.

4. Expected contributions

Our planet offers a wide distribution of fragile and endangered territories and disappearing soundscapes. I think it is important to deepen our knowledge to protect these locals, so we can preserve them in the future or, at least understand through interdisciplinary research what are the threats and concerns related to these places. Our country has a big extension of coast offering a variety of interesting locations to collect meaningful information and data related to the ocean. From a long time now researchers, scientists and now artists are relying on sound and on soundscapes to study and understand environments. Art or new media art are becoming tools for different approaches on scientific interpretation. With the evolution of technology, we can connect different fields like arts and science and interpret or evaluate environmental data using innovative forms of creativity of visualization. Art practice promotes the creative use of media and technology for creating awareness in the society. These forms of creative artworks with strong environmental messages also awake the public for our present problems. I feel moved by this to create

art that can bring awareness to the communities, to keep our oceans health and activate citizens to connect with these goals. The ocean represents to Portugal one of its greatest's natural and economical resources, so I feel that it is important to document the outcome of this investigation for the future. The expected results of this investigation project will be based on these three main branches: **Artistic / educational:** Creating awareness in the society through artistic practice, artistic expression as tool to engage audiences, immersive auditory spaces (Artworks, Installations, Sound art), educational workshops; **Noise pollution / ecology:** Elaborating a sound map of the Portuguese coast, analysis tools, database for public consultation, possible application on public health issues, intangible heritage, preservation of the sound memory; **Scientific:** Reflection on value and results in thesis format, publications (both in scientific support in conferences and colloquiums and in more informal formats for discussion and reflection).

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