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The Tuning of the World in the 20th and 21st Century: Discourses on Sound and Ecology

Abstract: In this paper, I would like to systematize possible areas, disciplines, and practices that deal with sound and ecology. Also, I would like to research their potential in solving global environmental and sonic problems. I would explore this topic with the idea of following the genesis and continuity of the development of ecological thought and practice concerning sound and music: from the concept of *acoustic ecology*, as a key one, which since the 1970s has brought to the fore the question of the relationship between sound and the environment, i.e., sound in the environment, through other disciplines based on critical thinking about the relation between sound and current environmental problems.

Keywords: sound; ecology; environment; bioacoustics; biomusic; soundscape ecology; eco-acoustic; sound studies; ecomusicology/ecocritical musicology.

> "Sonic sensibility reveals the invisible mobility below the surface of a visual world and challenges its certain position, not to show a better place but to reveal what this world is made of..."[1]

I would start this paper with perhaps a seemingly banal but crucial thesis: the role of sound in any environment and ecosystem is vital for human and non-human species and other entities.[2] Although the appeal of visual culture in our daily lives never seems to be stronger than today,[3] auditory practices also play an essential role, placing sound and the listening of sound in the center of this paper. Here, I do not only mean that sound exists as a medium of artistic creation (in the case of music or

[1] Salomé Voegelin, *Sonic Possible Worlds: Hearing the Continuum of Sound* (New York: Bloomsbury Academic, 2014), 3.

[2] See, for example, the research and data provided by European Commission on the page *Science for Environment Policy*, https://ec.europa.eu/environment/integration/research/newsalert/about.htm, acc. on April 17, 2021.

[3] Historically, the 'enthronement' of the eye was established in ancient civilizations, with the introduction of the phonetic alphabet. Maršal Mekluan, *Elektronski mediji i kraj kulture pismenosti* (Loznica: Karpos, 2012), 22.

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sound art, for example) but as an indicator and transmitter of different messages and information about the environment.[4] Keeping in mind the thesis that listening is "[…] an act of engaging with the world"[5], we could say that the quality of sound defines the quality of life and, in the end, the quality of the actual (post)human biosphere. In other words, "daily practice of listening develops in each one of us a conscious physical, emotional, and mental relationship to the environment",[6] and this is where the power of listening activities and process lies. As a musicologist interested in sound[7] and ecological issues, I would like to introduce some crucial points in the evolution of discourse about sound and its role in our environment. Also, I would like to systematize possible theoretical approaches to this topic and research their potential in accentuating and solving global environmental acoustic problems.

The Tuning of the World in the 1970s: Acoustic ecology

As the title of my paper shows, inspiration for this topic comes from one of the most influential books dedicated to the relationship between sound and the environment: *The Tuning of the World*,[8] by Canadian composer Raymond Murray Schafer (1933–2021),[9] the pioneer in ecological discourse about sound.[10] This book was created after the launch of the *World Soundscape Project* (1972), the group for research and education about sound and environmental issues.[11] The history of this project began in the late 1960s and early 70s at Simon Fraser University in British Columbia (Canada).[12] Here Schafer, together with the group of young composers, students, and activist (Hildegard Westerkamp, Barry Truax, Howard Broomfield, Peter Huse, and Bruce Davis), established and institutionalized the idea to research the sonic environment,

[4] Joanna Teresa Demers, *Listening Through the Noise: The Aesthetics of Experimental Electronic Music* (Oxford: Oxford University Press, 2010), 115.

[5] Salomé Voegelin, *Listening to Noise and Silence: Towards a Philosophy of Sound Art* (New York, London: Continuum, 2010), 3.

[6] Hildegard Westerkamp, "Editorial," *Soundscape: The Journal of Acoustic Ecology* 1, 1 (Spring 2000): 3.

[7] I presented some of my research on this topic in a book, *Sound Art/Zvukovna umetnost – Muzikološka perspektiva (teorije)* published by the Faculty of Music, the University of Art in Belgrade, in 2019.

[8] This book was realized in 1977, after the essay "The Music of the Environment" (1973). In 1994 the book was reissued under the title *The Soundscape, Our Sonic Environment and the Tuning of the World*.

[9] Raymond Murray Schafer studied at the Faculty of Music at the University of Toronto and the Royal Conservatory of Music in London. He was teaching as an artist-in-residence at Memorial University (1963–65), and at Simon Fraser University (1965–75). Thanks to the support of the other mentioned institution, as well as UNSECO, and the Donner Canadian Foundation, he started the World Soundscape Project. See more: https://www.thecanadianencyclopedia.ca/en/article/r-murray-schafer-emc, ac. on April 21, 2021.

[10] Since Schafer passed away recently, I would like to dedicate this paper to the memory of his precious work.

[11] https://www.sfu.ca/~truax/wsp.html, acc. on April 17, 2021.

[12] The founding of this project took place in the context of the review of Western anthropocentrism since the 1960s. That was the period when the "era of ecology" began. One crucial moment was the publication of the book *Silent Spring* by Rachel Carson (1962) and other writings and publications influenced by Zen Buddhism by Aldo Leopold, Aldous Huxley, Henry David Thoreau, etc. See more: George Sessions, "The Deep Ecology Movement: A Review," *Environmental Review* 11, 2 (Summer, 1987): 105–25.

or the *soundscape* (first, in Vancouver), regarding the problem of noise pollution.[13] The term "soundscape" refers to all the sounds in one environment, and it is crucial for understanding the status and role of sound in one concrete natural or urban ambiance. According to Schafer, "the soundscape is any acoustic field of study. We may speak of musical composition as a soundscape, or a radio program as a soundscape or an acoustic environment as a soundscape [...] A soundscape consists of events *heard,* not objects *seen.*"[14] In that sense, the soundscape is a much broader concept than the sonic environment, including natural and artificial perceptual phenomena, and the musical basis of the idea is apparent.[15] Schafer used the term for the first time in the booklet *The New Soundscape: A Handbook for the Modern Music Teacher* (1969),[16] dedicated to his creative music education practice.[17] In this publication, Schafer discusses the idea of music as an open auditory concept, explaining that "all sounds belong to a continuous field of possibilities lying within the comprehensive dominion of music."[18] In other words, if the "sonic universe"[19] is the new orchestra of today, our entire environment could be explained as one extensive musical composition or a soundscape. Starting from music and the idea of expanding its borders (as a composer), Schafer raises the question of the relationship between sounds, music, environment, and sound pollution and raising awareness of this problem. His personal experience was of crucial importance for further development of his soundscape idea and future work:

> In September 1965, I began my duties in the Communication Center of Simon Fraser University. The bulldozers were still ploughing the cap off Burnaby Mountain, where the university was being built. The noise was, at times, unbearable. I think the 1960s must have been the noisiest decade of the twentieth century. Jet aircraft had just been introduced for commercial flights, expanding the noise profile around airports enormously since they were much noisier than turbo-prop planes. Cities

[13] See the page: https://www.sfu.ca/sonic-studio/worldsoundscaperoject.html, acc. on April 17, 2021.

[14] Raymond Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Rochester, Destiny Books, 1994), 7–8. His interest in art, music, and sound is probably due to his poor eyesight in one eye and glaucoma. Raymond Murray Schafer, *My Life on Earth & Elsewhere* (Erin, The Porcupine's Quill, 2012), 9.

[15] Due to ambiguous interpretations, this term was standardized at the international level in 2008 by the International Organization for Standardization (ISO). According to ISO 12913-1:2014 "soundscape will be understood as a perceptual construct, related to a physical phenomenon. The standard distinguishes the perceptual construct (soundscape) from the physical phenomenon (acoustic environment), and clarifies that soundscape exists through human perception of the acoustic environment." https://www.iso.org/obp/ui/#iso:std:iso:12913:-1:ed-1:v1:en, acc. on April 21, 2021.

[16] Before him, as far as I know, the term was used by Buckminster Fuller in the paper "The Music of the New Life" from 1966. See: https://www.sfu.ca/~truax/soundscape.html, acc. on April 21, 2021.

[17] Schafer's other publications from this period are *The New Soundscape* (1969) and *The Book of Noise* (1970). Barry Truax, "Acoustic Ecology and the World Soundscape Project," in *Sound, Media, Ecology* ed. by M. Droumeva, R. Jordan (Cham: Palgrave Macmillan, 2019), 21.

[18] Raymond Murray Schafer, *The New Soundscape: A Handbook for the Modern Music Teacher* (Ontario/New York, Berandol Music Limited/Associated Music Publishers, 1969), 2.

[19] Schafer, *The New Soundscape…*, 63.

> were growing rapidly to the unmuffled sounds of construction noise. Rock bands were pushing the amplified volume of music to levels well over a hundred decibels, louder than the music had ever been before.[20]

In the early 70s, Schafer began to study the soundscape more intensively,[21] realizing that the "sounds of the environment were changing rapidly, and it seemed that no one was documenting the changes"[22]. Besides caring about disappearing sounds, he was also concerned about new sounds and their effect on human health.[23] To research the changing soundscape and consequences of that transformation, Schafer founded, as have I already mentioned, the *World Soundscape Project* to organize some concrete endeavors. In the beginning, group members embarked on the research intuitively (since they had no experience in environmental sound analysis and study), trying to find an adequate methodology.[24] The primary practice was centered on critical listening to sounds and recording (collecting) them, which was not surprising because the researchers mostly came from the realm of music. Besides sound recorders, they also used a sound level meter to analyze and document the soundscape in detail.[25] The crucial activities of this group were focused on environmental issues, especially research on noise and its effects on the environment.[26] As a result of the analysis of the concrete sound reality, *The Vancouver Soundscape* (1972) project was created as a written (one book) and recorded (two LP records) document. The book considers "earwitness" accounts about the environment, as well as other essential and provocative questions, such as, for example, how the development of different materials or electricity transformed the soundscape.[27] The recognizable sounds of the city of Vancouver (Schafer calls them "soundmarks")[28] were recorded and presented on records to monitor the further development of the soundscape in the future and locate possible sound

[20] Schafer, *My Life on Earth & Elsewhere*, 92.

[21] It is symptomatic that environmental movements are becoming more frequent on Canada's West Coast. For example, there, more precisely, in Vancouver, the Greenpeace organization was founded in 1971. Truax, "Acoustic Ecology and the World Soundscape Project," 22.

[22] Schafer, *My Life on Earth & Elsewhere*, 120.

[23] Ibid.

[24] Truax, "Acoustic Ecology and the World Soundscape Project," 23.

[25] Ibid.

[26] One of the first activities was a conference about aircraft noise. This event was a kind of rebellion, as evidenced by the fact that the President of Canadian Pacific Aircraft's speech was interrupted by the playing of recordings of jets. The conference program also included the "anti-noise" workshops dedicated to topics including the public and noise, acoustical terminology, psychological response to noise. Schafer, *My Life on Earth & Elsewhere*, 121.

[27] Ibid., 122.

[28] This term Schafer explains in the following way: "soundmark is derived from landmark and refers to a community sound which is unique or possesses qualities which make it specially regarded or noticed by the people in that community". Schafer, *The Soundscape*, 10.

changes.[29] These recordings were followed by the *Soundscape of Canada* project, a ten-hour radio program (1974). Then, recordings of sound environments were collected in villages in Europe (Sweden, Italy, Germany, France, Britain) and published under the title *Five Village Soundscape* (1975, and in 1977 as a booklet with sound examples).[30] This project not only acted as a document but aimed to serve as a means of reaction, proved that reckless construction could endanger the natural balance (such as the case of a fishing village, Lesconil, which could have been disrupted by highway construction).[31] According to the above, Schafer characterizes this project as the beginning of the ***acoustic ecology movement***. From this point, various practices focused on developing awareness of environmental change began to branch out, such as *soundscape ecology*, *sound* or *sonic ecology*, and *soundscape studies*.[32]

I want to emphasize that studying sound in/of the environment has developed in non-musical disciplines also, such as architecture and urban design.[33] Here, we could find another line of development of soundscape studies, which, according to some researchers, was the inspiration for Schafer's and his associates' practice. In that sense, it is crucial to underline the work of Michael Southworth, Professor Emeritus of Urban Design and Planning at the University of California. In some literature, we can find information that he was the first to use the term "soundscape" in a scientific article titled "The Sonic Environment of the Cities"[34] (this paper was published in 1969 after his Master's Thesis, written in 1967).[35] So, it is possible to assume that he used the term "soundscape"[36] before Schafer (or simultaneously and independently of him) and that his article inspired the *World Soundscape Project*.[37] Southworth explains that his interest in the urban soundscape dates from 1966 to 1967.[38] He aimed to "go beyond the visual image of the city to work on some aspects of city sense that had not received attention ..." and "to understand how people perceive the full range of city sounds – not just noise – and how the sonic environment and visual environment interact."[39] Also, he presented a method of observing the environment during a walk

[29] In 1996 Schafer realized the second project dedicated to Vancouver, more precisely a continuation of the previous one: *Soundscape Vancouver*. See for example: https://www.sfu.ca/~truax/vanscape.html, acc. on April 17, 2021.

[30] Truax, "Acoustic Ecology and the World Soundscape Project," 23.

[31] Schafer, *My Life on Earth & Elsewhere*, 125. In 2009 this project was re-realized with the idea of comparing landscapes through time, under the title *Acoustic Environments in Change*.

[32] Garth Paine, "Acoustic Ecology 2.0," *Contemporary Music Review* (2017): 2.

[33] Östen Axelsson, "Soundscape revisited," *Journal of Urban Design* 25, 5 (2020): 551.

[34] In that period he was a PhD student in city planning at MIT in Boston. Axelsson, "Soundscape revisited," 551; see also: Michael Southworth, "The Sonic Environment of Cities," *Environment and Behavior* (1969): 50.

[35] See also the paper: Michael Soutworth, "Listening to the City," *Journal of Urban Design* 25, 5 (2020): 556–60.

[36] In that context, the term soundscape appeared as an original creation, a "natural evolution" of the term landscape. This term can be related to terms "townscape" and "cityscape", current in the 1960s. Soutworth, "Listening to the City," 559–60.

[37] Axelsson,"Soundscape revisited," 551.

[38] Soutworth, "Listening to the City," 556.

[39] Ibid.

and moving through a city (which Schafer would do a few years later through "sound walk"): "I designed the trip to expose participants to a variety of sonic and visual settings […] At the end of the trip, participants reported on the places and sounds they found most memorable, preferred, and disliked."[40] When he gathered all the information, he created a visual, graphic representation of noticed sounds,[41] and this is closely related to the Schaefer's similar practices called "sound mapping". It is symptomatic that in the papers whose authors come from Schafer's circle, we do not come across such claims. Regardless of the right of priority, it is clear that Southworth's work has opened the way for sound research in urban planning and design, as evidenced by the architects and planners interested in this topic.[42] Despite that, as a musicologist and someone who deals with sound from that point of view, I will focus more on Schafer's work and its repercussions.

Schafer's new revolutionary thinking about sound within soundscape studies and movement brought new disciplines – *acoustic ecology* and *acoustic design*.[43] He explains acoustic ecology in the following words: "[…] Acoustic ecology is, therefore, the study of sounds in relationship to life and society. This cannot be accomplished by remaining in the laboratory. It can only be accomplished by considering the effects of the acoustic environment on the creatures living in it."[44] On the other hand, acoustic design serves as a methodology for proper listening: "Acoustic design should never become design control from above. It is rather a matter of the retrieval of a significant aural culture, and that is a task for everyone."[45]

The concept and idea of acoustic ecology as an interdisciplinary field of studies were further systematized through the publication *Handbook for Acoustic Ecology* (edited by Barry Truax, 1978),[46] directed to different areas of research (acoustic, psychoacoustic, environmental studies, noise measurements, electroacoustic, audiology,

[40] Ibid, 557.

[41] Ibid.

[42] See issue No. 5 (Vol. 25) of the *Journal of Urban Design*, titled "Soundscape revisited." On the other hand, some studies and disciplines related to architecture were developed from Schafer's studies. One example is the field of *aural architecture,* which "refers to the properties of a space that can be experienced by listening. An aural architect, acting as both an artist and a social engineer, is, therefore, someone who selects specific aural attributes of a space based on what is desirable in a particular cultural framework." Barry Blesser, *Spaces Speak, Are You Listening? Experiencing Aural Architecture* (Cambridge/London: MIT Press, 2007), 5.

[43] Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 205.

[44] Ibid.

[45] Ibid., 206. He then suggests strategies for adequate listening and practicing listening skills, such as "ear cleaning" and "soundwalk": "The soundwalk is an exploration of the soundscape of a given area using a score as a guide. The score consists of a map, drawing the listener's attention to unusual sounds and ambiances to be heard along the way. A soundwalk might also contain ear training exercises." Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World*, 208, 212–13.

[46] The term "acoustic ecology" was used for the first time in this publication's title. Hildegard Westerkamp, "Editorial," 4.

music, linguistic, and communication).[47] In that context, some crucial explanations are dedicated to phenomena related to "noise pollution" and "noise measurements", but in an innovative way that denies noise as a necessarily negative concept.[48] So, in order to avoid pejorative meaning, the term "sound pollution" comes into use "as an imbalance of a soundscape, not simply as 'too much loud noise'"[49] The idea of soundscape (listening of a soundscape) remains central in Truax's book *Acoustic Communication* (1984), another publication dedicated to acoustic ecology and acoustic communication from a human perspective as a system of relationship between sound, listener, and the environment.[50] So Truax, as he explains, introduces novelty into the field of sound and soundscape studies, focusing on the communicational approach, as well as on technological and media developments and their impact on sound.[51] The importance of listening and sound for this praxis Truax explains in the following words:

> Listening is the key issue in communication via sound because it is the primary interface between the individual and the environment. It is a path of information exchange, not just the auditory reaction to stimuli. I used the term "soundscape" above, not just as a synonym for "acoustic environment," but as a basic term of acoustic communication. It refers to how the individual and society as a whole understand the acoustic environment through listening.[52]

The idea to research the acoustic environment as a complex relationship directed the future research of Schafer's followers, gathered around the *World Forum for Acoustic Ecology*. This organization was founded in 1993 (during The First International Conference on Acoustic Ecology in Banff, Alberta, Canada) as "an international association of affiliated organizations and individuals,[53] who share a common concern with the state of the world soundscape as an ecologically balanced entity. Our members represent an interdisciplinary spectrum of individuals engaged in studying the scientific, social, and cultural aspects of natural and human-made sound

[47] The second edition was realized in 1999 as a multimedia (CD-ROM) publication. See: Lauire Radford, "Barry Truax, editor: Handbook of Acoustic Ecology, 2nd edition (CD-ROM version)," *Computer Music Journal* 25, 1 (2001): 93–4.

[48] We find a similar idea in Southworth. For him, the noise represents the necessity of one city: "While noise blocks much valuable cultural and natural sonic information, a city without 'noise' or lively, complex sound would probably seem quite dead and boring." So, he proposes that noise should be part of every environment but that its effects should be regulated through sonic environmental design (Soutworth, "Listening to the City," 557).

[49] See more: https://www.sfu.ca/sonic-studio-webdav/handbook/Intro1.html, acc. on May 28 2021.

[50] Truax, *Acoustic Communication* (Norwood, New Jersey: Ablex Publishing Corporation, 1984), xi-ii.

[51] Ibid, xiv.

[52] Ibid, xii.

[53] WFAE has branches in Europe, Asia, Australia, South and Central America, and the USA. More on: https://www.wfae.net/membership.html, acc. on April 17, 2021.

environments."[54] Those activities continued with establishing *Soundscape: the Journal of Acoustic Ecology* (in 2000) dedicated to the research of acoustic-ecological issues.[55] All this led to the increasing internationalization of the movement and forging new directions and disciplines outside the traditionally determined musical-acoustical borders.

To Other Disciplines and Fields

Along with acoustic ecology, as a practice that is "complementary to traditional ecological concepts rather than situated within them",[56] other corresponding disciplines dedicated to the sound fund of the environment, such as ***bioacoustics***,[57] are also referential for this topic. Unlike the anthropocentric focus of acoustic ecology, bioacoustics deals with non-human sounds and the sound world of specific single species and living organisms. Due to its complexity, this practice is multidisciplinary-oriented (towards psychology, neuroscience, engineering, anthropology, zoology, music, etc.), although its methodology is based on recording and listening.[58] More precisely, the history and the development of the entire discipline are related to recording technology, including the distribution of light and portable tape records from the 1950s and 60s.[59] It is a comparative view (*comparative bioacoustic*) including "the study of sound propagation, dispersion, attenuation, absorption, reverberation, and signal degradation; as well as sound detection, recognition, and classification in both marine and terrestrial organisms (including humans)."[60] Also, the comparative bioacoustics analyses the effects of industrial noise on the environment and live organisms using the acoustic properties of the habitat (more correctly, its audio recordings) as reference points.[61] Starting from the fact that "every living organism produces an acoustic signature", even microscopic ones,[62] bioacoustics searches for those sound marks in aim to explain the complexity of the ecosystem. Also, in connection with the mentioned discipline, we could speak about ***biomusic***, a collaborative, transdisciplinary field in

[54] Ibid.

[55] Some of the sections of the journal are "research in acoustic ecology" (a section devoted to a summary of the current study), "sound bites" (an overview of acoustic ecology issues from the press), "soundwalks", etc. See more here: https://www.wfae.net/journal.html, acc. on April 17, 2021.

[56] Bryan C. Pijanowski et al., "Soundscape Ecology: The Science of Sound in the Landscape," *BioScience* 61, 3 (2011): 204.

[57] Bioacoustics emerged as a subdiscipline of ethology – the study of animal behavior. Charles Brown and Tobias Riede, eds., *Comparative Bioacoustic: An Overview* (Glendale: Department of Physiology, Midwestern University, 2017): i.

[58] Ibid, ii.

[59] According to: https://www2.ib.unicamp.br/profs/jacques/ibac2003/history.html, acc. on April 17, 2021.

[60] Ibid.

[61] Brown and Riede, eds., *Comparative Bioacoustics: An Overview*, ii.

[62] Krause points out that even viruses leave sound signatures, each according to the species to which it belongs. Bernie Krause, *Wild Soundscapes: Discovering the Voice of the Natural World* (New Haven, London: Yale University Press, 2016), 54.

which scientists and musicians study non-human sound worlds, relating them to human experience and musical preferences.[63]

Bernie Krause, recording engineer, producer, and musician, gives an example of connecting bioacoustic ideas and strategies with the concepts of acoustic ecology through the discipline of ***soundscape ecology*** (under this name, it has been developing for the last twenty years).[64] Yet, despite these terminological changes, this practice shares some essential principles with acoustic ecology, such as listening and interpreting natural (animal and environmental) and human sounds, making *field recordings,* and archiving soundscapes[65] as one of the powerful acoustic features and quality of a natural world environment. Soundscape ecology brings a holistic oriented model of approach dedicated to a soundscape as a whole in order to evaluate specific habitats. In that process, learning about natural soundscapes requires particular listening skills, paradoxically closely related to recording technology. Thanks to this technology, a new listening method is being developed: *heightened listening* or listening that is more active,[66] amplified, and critically formed (primarily due to microphones as technical equipment focusing on sound and its micro-acoustic nuances). According to Krause, using recording equipment also improves our visual experience and helps us to distinguish locations, landscapes through the listening of recorded sounds.[67] These words are mainly addressed to those who are afraid of technology, those technophobes like himself, with the idea of pointing out the benefits of using microphones, audio recorders, headphones, and other equipment,[68] in a posthumanistic manner (which implies coexistence with technology). This method is especially significant for listening to sounds that the human ear cannot usually register but which have a crucial acoustic signature (the sounds of singing ants, dunes, underwater organisms, ice, glaciers moving, etc.).[69]

[63] Aaron S. Allen, "Ecomusicology," Grove Music Online, Jul 25, 2013, https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-1002240765, acc. on June 3, 2021.

[64] Krause, *Wild Soundscapes: Discovering the Voice of the Natural World*, 15.

[65] According to Krause, a soundscape comes from three sources: non-biological natural sounds from natural habitat (geophny); the second one is related to the unique collective voices of the natural world, which is difficult to find (biophony); the third acoustic source is human-generated (antropophony) and it can have a detrimental effect on the previous two (Krause, *Wild Soundscapes*, 15). Like Schafer, he also describes soundscapes, especially wild soundscapes, as "divine music" (Ibid., 20).

[66] The idea to use listening to learn is at the core of "deep listening" by Pauline Oliveros (she conceived this practice in 1989). This kind of listening enables a listener to enhance its listening skills and learn about others, the environment, and the inner self. Deep listening should be practiced through different exercises designed "to calm the mind and bring awareness to the body and its energy circulation". Pauline Oliveros, *Deep Listening: A Composer's Sound Practice* (New York, Lincoln, Shangai: iUniverse, 2005), 1.

[67] Krause, *Wild Soundscapes: Discovering the Voice of the Natural World*, 78.

[68] Ibid, 107–110.

[69] Ibid. We also find these ideas in art projects. For example, artist Jana Winderen is interested in the immateriality of sound. Therefore, she searches for sounds from hidden sources, from inaccessible locations. She finds these sounds on the banks of rivers, next to glaciers, in the depths of the ocean in which there are invisible but audible sound landscapes, and then she records them with different types of specific microphones. The recorded sound then becomes the material for sound installation. An example is her work *Ultraworld* (2012),

Soundscape ecology deals with all sounds from all sources – biological, geological, or anthropogenic, and it is also concerned with noise.[70] Also, in the center of this discipline is the research of feedback information between humans and soundscapes (for example, human-generated noise and its affection on natural habitats in the case of motorized recreation in national parks).[71] The methodology for this kind of research is specific and exact, such as sound measuring (by automated digital recording systems) and visual representation of it (through spectrograms). Also, for the beginning of the research, different ecological hypotheses are essential: the morphological adaptation hypothesis (an organism's physical attributes influences sort of sound signals it produces); the acoustic adaptation hypothesis (the adaptability of certain organisms to adapt its sound); and the acoustic niche hypothesis (each species used different frequency ranges making their own acoustic "niches").[72] One example of soundscape ecology mechanisms and projects is Krause's soundscape archive[73] made of field recordings from natural habitats (containing over 4,500 hours of soundscape sounds),[74] dedicated to the research of mutual influences between landscape and soundscape.[75] Except in archival form, these materials could be used in sound sculptures, sound installations, other artificial states that mix (human) music and natural sounds, etc.[76]

Besides soundscape ecology, we should mention one more specific and related practice proclaimed in 2014 by the International Society of Ecoacoustics.[77] According to this society, **ecoacoustics** is an:

> interdisciplinary science that investigates natural and anthropogenic sounds and their relationship with the environment […] Ecoacoustics operates in all types of terrestrial and aquatic (freshwater and marine) ecosystems extending the scope of acoustics and bioacoustics.

from the series of installations *Silent Field*. The sound material is made up of ultrasound recordings made using microphones on the surface and underwater, in different locations (in Thailand, Russia, England, Norway, Denmark, Sweden). See: https://www.janawinderen.com/, acc. on April 17, 2021.

[70] Pijanowski et al., "Soundscape Ecology: The Science of Sound in the Landscape," 204.

[71] Ibid, 205.

[72] Pijanowski et al., "Soundscape Ecology: The Science of Sound in the Landscape,"207.

[73] Krause founded an organization dedicated to recording and preserving natural soundscapes called *Wild Sanctuary*. See more on: https://www.wildsanctuary.com/, acc. on April 17, 2021.

[74] One of Krause's interesting practices was listening and recording a *sound safari*. During the 1980s he led his clients on such trips to Alaska, Costa Rica, Australia, and Africa. His goal was to introduce people to pristine soundscapes. In this context, he also uses the term "field trip". (Krause, *Wild Soundscapes: Discovering the Voice of the Natural World*, 45).

[75] Pijanowski et al., "Soundscape Ecology: The Science of Sound in the Landscape," 209–10. His famous project is *The Great Animal Orchestra*, commissioned by Foundation Cartier in 2016. This project was realized as an electronic installation based on an audiovisual representation of soundscapes (from Canada, Central African Republic, Zimbabwe, Brazil, etc.). You can hear the audio version here: https://www.youtube.com/watch?v=b-trinTDDjnQ. See also an interactive web page of this project: https://www.legrandorchestredesanimaux.com/en, acc. on April 17, 2021.

[76] Krause, *Wild Soundscapes: Discovering the Voice of the Natural World*, 27.

[77] Ibid.

> Ecoacoustics recognizes that sounds can be both the subject and tools of ecological research. As the subject, sounds are investigated in order to understand their evolution, functions and properties under environmental pressures. As tools, sounds are used to study and monitor animal diversity, abundance, behaviour, dynamics and distribution, and their relationship with ecosystems and the environment.[78]

This discipline and society is dedicated to different ecoacoustical activities: from the promotion of a scientific approach (through seminars, meetings, publications), conservation and archiving, especially of disappearing acoustic ecosystems, to education within new formats[79] and artistic concepts (such as science-based sound art).[80]

Environmental themes are also recognized in the inter/transdisciplinary field of **sound studies**. These studies were defined in 2004 by Trevor Pinch, a professor of technological studies and sociology at Cornell University, and Karin Bijsterveld, a professor in the Department of Technology and Social Studies at the University of Maastricht. They defined it as "an emerging interdisciplinary area that studies the material production and consumption of music, sound, noise, and silence and how these have changed throughout history and within different societies."[81] Some of the disciplines that sound studies include are: acoustic ecology, sound design, and soundscape design, anthropology of the senses, history of everyday life, history of the environment, cultural geography, urban studies, listening culture, art studies, musicology, ethnomusicology, literature studies.[82]

These topics also influenced musicology and the expansion of its disciplinary framework. One result is the subdiscipline **ecomusicology,** or **ecocritical musicology**. The term ecomusicology is related to North American and Scandinavian academic circles since 2000, but the formation of this practice is a consequence of the spread of environmental awareness in the 1970s.[83] The basic idea of this discipline

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[78] https://sites.google.com/site/ecoacousticssociety, acc. on April 17, 2021.

[79] Krause notes that this discipline is still less represented within academic institutions: "While some European countries, like Italy and France, have advanced bioacoustic curricula, as of this writing in the United States the field is difficult to find in all but a minimal number of undergraduate and graduate environmental studies programs." (Krause, *Wild Soundscapes: Discovering the Voice of the Natural World*, 72).

[80] https://sites.google.com/site/ecoacousticssociety/goals, acc. on April 17, 2021.

[81] Pinch and Bijsterveld, eds., *The Oxford Handbook of Sound Studies* (Oxford: Oxford University Press, 2012), 7–8.

[82] Ibid, 6–7. Capital editions dedicated to this topic were published in 2012, *The Oxford Handbook of Sound Studies* (editors are Pinch and Beisterveld) and *The Sound Studies Reader* (edited by Jonathan Stern). In June 2014, a gathering dedicated to mapping the field of sound studies ("Sound Studies: Mapping the Field") was held in Copenhagen, organized by the European Association for Sound Studies (ESSA). Interestingly, the edition on sound studies in German was published as early as 2008, under the title *Sound studies: Traditionen – Methoden – Desiderate* (Holger Schulze, ed., Transcript Verlag, 2008).

[83] Aaron S. Allen, "Ecomusicology," *Grove Dictionary of American Music* (New York: Oxford University Press, 2013). Institutionalization of this discipline was achieved both in musicology and ethnomusicology, in the form of particular groups: *Ecocriticism Study Group* (2007) formed by American Musicological Society, and *Ecomusicology Special Interest Group* (2011) formed by Society for Ethnomusicology. See more: https://www.ethnomusicology.org/page/Groups_SIGsEco; https://ecomusicology.info/sem-ecomusicology-sig/, acc. on April 28, 2021.

is to, through communication with other different related and seemingly unrelated disciplines, look at and broadly establish the relationship between music/sound and nature/environment in a more comprehensive, cultural, and social framework.[84] In the context of ecological crisis, ecomusicology/ecocritical musicology also aims to critically "portray human-environment relationships"[85] and contextualize "the significance of sound and music studies to all life".[86] One example of the problematization of this relationship is the musical instrument and its material – responsible thinking about the materials from which instruments are made is also a vital prerequisite for sustainability. Even though the musical and musicological basis is apparent here, it is essential to say that this area is multi-perspectival or transdisciplinary, supporting the fusion (not just the collaboration) of disciplines and fields (arts, humanities, social sciences, and natural sciences).[87]

Conclusion

In this paper, I wanted to explain and systematize some disciplines essential for understanding the relationship between sound and environment in a period of environmental crisis. Starting from acoustic ecology, I presented this topic's complexity and accentuated the importance of a multi-disciplinary approach. The complexity of this method reveals the complexity of the environmental situation in which we live, perhaps unaware that *tuning of the world* is more demanding and delicate than ever (in ecological, but also, in any other sense). So, our task (as researchers, scholars, humans, posthumans) is to *listen*, always having in mind that listening is the crucial principle for engaging with the world. By developing rich listening strategies, our world will, I hope, become an ecologically healthier and safer place to live.

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[84] Also, the basics of the discipline and its features are presented in the book *Current Directions in Ecomusicology* (edited by Aaron S. Allen and Kevin Dawe in 2016), which bring numerous examples of ecomusicological research.

[85] Allen, "Ecomusicology".

[86] Aaron S. Allen and Kevin Dawe, "Ecomusicologies," *Current Directions in Ecomusicology*: *Music, Culture, Nature*, ed. by Aaron S. Allen, Kevin Dawe (New York, London: Routledge, 2016), 11, book chapter available online, https://libres.uncg.edu/ir/uncg/f/A_Allen_Ecomusicologies_2016.pdf, acc on April 17, 2021.

[87] Allen and Dawe, "Ecomusicologies," 2.

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