

A watercolor illustration of a dark bird perched on a light-colored branch. The background is a soft, textured wash of light colors with some darker spots and splatters, suggesting a natural, perhaps slightly misty or rainy, environment. The style is delicate and artistic.

7th Conference on Acoustic Ecology
Soundscape, Biophony and Climate Crisis

Book of Abstracts

Department of Music Studies, NKUA Hellenic Society of Acoustic Ecology

Municipality of Epidaurus



SESSION I

Soundscapes in Virtual and Augmented Reality

Konstantina Stavropoulou (Ionian University)

Magdalini Chatzaki (Foundation of Research & Technology)

Integrating Soundscapes with Augmented Reality: Design and Implementation of a Geo-Located Audio AR App on the European Trail E4 on the Sitia Plateau

This presentation details the design and implementation of an audio augmented reality application for the European path E4, specifically the segment traversing the Sitia plateau. Developed in production of the Foundation of Research & Technology, this project aims to interpret the environmental and cultural heritage of the region, capturing also the essence of local life over time through the sounds. The motivation for creating this application arises from the need for a multisensory environmental perception and an enriched acoustic experience. The main purpose is to enhance hikers' experience by providing geolocated audio that conveys the historical and environmental narratives of the area, which are not immediately perceptible through direct sensory experience.

The content of the application was developed after long term study of the area, interactions with the local population and extensive multi-day field recordings.

To support educational engagement, an accompanying usage plan for primary school students was developed, proposing activities and suggestions based on acoustic ecology principles. Furthermore, the presentation will cover the outcomes of the demonstration of the

app in a group of educators from across Greece and two local student groups. These sessions highlighted the application's potential to enrich environmental perception and foster a deeper acoustic experience.

Philippos Theocharidis (Ionian University)

Interactive electroacoustic music – the concert space as an ecosystem: The Mon Repos Augmented Soundscape Project – A site specific sound installation in a dialectic with its environment

The main objective of this project is the design, development, and implementation of a platform for creating interactive electroacoustic music works and sound installations that reshape the relationship between organized sound, the environment, and the audience. A platform for creating technologically augmented sound ecosystems is proposed, with an emphasis on open space applications that will incorporate sounds from the biological and geological dimensions of the sonic environment as well as human activity within a holistic soundscape. The central idea is to consider the concert space as an ecosystemic unit, with integral elements being the human audience-participants and the natural environment, and where sound becomes the medium for communication between different lifeforms (human or not) and artificial agents simultaneously producing and (maybe even) coordinating sound in this space. The Mon Repos Augmented Soundscape Project, described here, is a first attempt at implementing such a system in the form of a site-specific sound installation. It took place on June 2022 within the area of the Mon Repos urban forest in Corfu, Greece.

Christina Georgiou, Areti Andreopoulou, and Anastasia Georgaki
(National and Kapodistrian University of Athens)

Διερεύνηση της επίπτωσης των Μαγνητικών Καταιγίδων στο γήινο οικοσύστημα μέσω της ηχητικής αποτύπωσης

Η Ηχητική Αποτύπωση δεδομένων αποτελεί σήμερα ένα δημοφιλές εργαλείο για τον διαμοιρασμό της γνώσης με ένα ευρύτερο κοινό και την ευαισθητοποίησή του απέναντι σε κρίσιμα ζητήματα. Η σχέση της με την ακουστική οικολογία αναδεικνύεται μέσα από έναν σημαντικό αριθμό έργων που έχουν σκοπό να προβληματίσουν σε σχέση με το ζήτημα της κλιματικής αλλαγής. Οι Μαγνητικές καταιγίδες μπορούν να αποτελέσουν ένα ακόμα σημείο τομής, καθώς η σύγχρονη έρευνα αναδεικνύει επιδράσεις πέρα από τα τεχνολογικά επιτεύγματα και στο γήινο οικοσύστημα. Ο ήχος μπορεί να μεταφέρει πληροφορίες σε σχέση με δεδομένα που έχουν να κάνουν με τον προσανατολισμό και τη μετανάστευση των ζώων, την ανάπτυξη των φυτών και την ανθρώπινη υγεία και συμπεριφορά αναδεικνύοντας τον διεπιστημονικό χαρακτήρα της γνώσης και ανιχνεύοντας τις συσχετίσεις και τους κινδύνους που κρύβει το διάστημα για τη Γη και τη ζωή σε αυτή.

Η παρούσα εργασία συνοψίζει τα αποτελέσματα της έρευνας των επιδράσεων των Μαγνητικών Καταιγίδων σε διάφορους τομείς και επιχειρεί μια πρώτη ηχητική μεταφορά των κινδύνων που κρύβει το φαινόμενο μέσα από τη αποτύπωση καταιγίδων διαφόρων εντάσεων.

Improvisation, body, voice and space and acoustic ecology

Mary Fogarty (York University)

The Horrors of 'Harmlessness': the 2024 'Cicadapocalypse' and Climate Change

This paper presents an analysis of the media representations of insects and climate change, using cicadas in North America as a case study. I argue that the framing of the 2024 'Cicadapocalypse,' and other representations of insects, reveals a great deal about ordinary human relationships to other species. The aim is to connect movement, from the perspective of post-humanist dance studies, with sound ecology in order to explore their relationships in ways that inform critical reflection on the circumstances of climate change.

Shortwave Collective

Collective Listening Across Distance

This performance-presentation shares the praxis and the thinking behind our methodology of listening across distance. We consider the electromagnetic spectrum as one of the many layers that compose the natural and human soundscape. We use radio-listening as a way to reflect together on the situatedness and the material and cultural ecologies at stake in every listening, as well as how we understand what listening is and can be, within a collective feminist practice that includes composing, performing, creating installations, living labs and workshops.

Nicolas Remy (University of Thessaly, Cresson)

Evangelia Paxinou (Cresson)

Petros Flampouris (University of Thessaly)

All That Is Solid Decays Into Air

The study is centered on the abandoned building of the Sanatorium in Pilio in Greece, where participants engage in sonic encounters to enhance their understanding of environmental sounds and their implications. Sound is used to uncover the connections between our surroundings and our sensory perceptions. Nature and the built environment have been coexisting for many years and the presence of an infinity of sounds constitutes an ideal terrain for rethinking our aesthetic relationships with our environment. By using tools like Sympathy radio and in-situ improvisation, participants create a dynamic sound “milieu” that fosters a deeper connection with their environment. This approach challenges traditional notions of soundscape (against soundscape) and emphasises experiential emerging (against immersion) in order to develop a new aesthetic (sympathy) leading to an engagement with the ambiance of the ruins.

SESSION II
Soundscape Analysis I

Petros Flampouris (University of Thessaly)

Nicola Remy (University of Thessaly, Cresson)

Non-standard acoustic measurements for architectural soundscape mapping

The presented paper is an ongoing PhD research that aims to investigate new tools and techniques to study the soundscape, the sound ambiance, and the sound events. The research anticipation is to investigate new tools and methods to supplement traditional acoustic measurements and develop new qualitative criteria specific to the site and to the sound phenomena that one can experiment. The methodologies are stretched among different architectural scales aiming from regional/ public to human scale/ private building sound analysis. Design-wise it is believed that the rendered sound phenomena and results derived from this research benefit the related architectural design strategies and the created sound environment.

Philippe Woloszyn (Laboratoire Passages UMR CNRS 5319)

Kahina Ikni (Laboratoire Passages UMR CNRS 5319)

Elsa Alfonsi (Bordeaux Métropole)

The sound territories of diversity, between humans and non-humans. An anthropological-biodiversity approach to the soundscapes territorialization in urban resourcing areas

This research is part of the LIFE Biodiver'Cit  et R silience (BCR) ecological restoration project for residents, whose acoustic dimension refers to the "quiet areas" component of Bordeaux Metropolis's Environmental Noise Prevention Plan (PPBE). It presents a hybrid multidimensional landscape indicator; the sound source's presence spectrum, designed to capture the spatial evolution of the bio- and anthropophonic qualities of the living environment within "resourcing" urban territories. This hybrid method, tested on the Burck wood in M rignac (France), is currently being extended to

other quiet areas (as defined by the European directive 2002/49/CE) - woods, forests, parks and gardens - in the Bordeaux metropolis. The results are sometimes unexpected, concerning the "resourcing" territorialisation of sound practices shared between humans and non-humans. Ultimately, this ambient analysis model will evolve into a tool for observing and spatially qualifying these "quiet areas", facing urban responses to climate change.

Mersida Ndrevataj (Luav University of Venice)

Petros Flampouris (University of Thessaly)

Echoes of Embodied Experiences: Walking Methodologies for Sensorial Research

Urban environments are characterized by their physical structures and the rich tapestry of sensory experiences they offer their inhabitants. However, conventional methods of assessing urban experiences often privilege the tangible and visible aspects and the nuances by which these influence social practices and the use of public space. A sensory approach to urban environments emphasizes the multifaceted nature of human perception, highlighting the importance of sensory experiences in understanding interactions with surroundings. This article presents the results of field research at Lisbon's Oriente Station. Using shadowing and sound recording as sensory methodologies, researchers observed the walk of a blind person within the different areas of the station, focusing on auditory stimuli and mapping his journey while arguing for the need of unconventional studying methodologies. The two proposed methodologies proved effective in uncovering hidden dimensions of urban experience.

Soundscape Analysis II

Maria Kantzaridou (Hellenic Institute of Speleological Research)

Ioannis Ekklesiarchos (University of Crete)

Panagiotis Georgiakakis (Natural History Museum of Crete, University of Crete)

Ioannis Nikoloudakis (Hellenic Institute of Speleological Research)

Kaloust Paragamian (Hellenic Institute of Speleological Research)

Soundscape of Agia Paraskevi Cave (Skoteino, Crete, Greece)

The representation of the sonic environment has received increased attention, concerning the capture of biological, geophysical and human sounds. As far as ecology is concerned, collection and analysis of sound recordings contribute to wildlife monitoring and conservation planning. Caves and karst are little studied, vulnerable ecosystems even though they host a variety of animal species with unique adaptations and they provide valuable ecosystem services. Cave soundscapes are not studied at all, as far as we know, a fact that led us to an original research concept: divide the Agia Paraskevi Cave (Skoteino village, Crete, Greece) to ecozones, divide a day to time-periods and look thoroughly for spatial or/and temporal soundscape variations. The results of the analysis of the sound recordings confirmed our presumptions that the presence/absence of specific taxa's sounds depends on their habits. Besides, breeze out of the cave, ventilation inside the cave etc. were quantified (number of files containing geophysical sounds) as well as human presence. Hopefully, by this contribution a new focal point may be created in cave studies.

Aggelos Tsaligopoulos (University of the Aegean)

Stella Sofia Kyvelou (Panteion University of Social and Political Sciences)

Nicos Bobolos (University of West Attica)

Aimilia Karapostoli (Democritus University of Thrace)

Yiannis Matsinos (University of the Aegean)

Measuring the noise footprint of tourism

The concept of "footprint" in environmental science refers to the resources needed to support a lifestyle, policy, or business strategy, with various methods developed for its calculation. Sound environments and soundscapes are important resources that should be sustainably managed. Environmental noise affects human well-being, health, and productivity, especially in tourist accommodation, which has a substantial noise impact. This research developed a noise footprint calculator for tourist accommodations on Lesbos Island, Greece, identifying main noise sources and using sound level meters for measurements. Noise maps were created using CadnaA software, and soundscapes were assessed following ISO 12913-1:2014 guidelines. Findings showed seasonal variations in noise footprints and an inverse relationship between complexity and noise, highlighting the need for policies that reduce noise and preserve soundscapes in tourism.

Petros Flampouris (University of Thessaly)

DIY sound practices for Architecture experiencing

A critical approach is needed to push the field-recording and soundscape experience scene in the opposite direction and highlight the matters related to the field in wider technological, socioeconomic and political contexts. The labour related to the tools used in the research that is produced is discussed. As an escape plan, a DIY approach is discussed, in order for the users to create and experience the sound environment with their own made tools. This paper aims to discuss sound-related DIY construction a sound enthusiast can create in order to experience the sound environment: what to hear - how to hear it.

Examples are presented on the process of making in several different set-ups. This research anticipation is to investigate new tools and methods to supplement traditional sound recording gear and tools, specific to the site and to the sound phenomena that one can experiment.

SESSION III

Soundscape analysis and Digital Preservation I

Natalia Lithadioti, Theofanis Maragkos (Ionian University)

The sounds of the last traditional tinsmith of Skopelos

Traditional tinsmithing, one of the most ancient professions, is now on the verge of disappearing. This research project focuses on capturing the sounds of the last traditional tinsmith workshop in Skopelos. The goal is to produce a sound documentary (podcast) that elucidates the craft and chronicles the historical trajectory of tinsmithing. The narrative framework is constructed through the detailed recounting of Giorgos Lithadiotis, the island's last practicing tinsmith. The storytelling delves into the socio-cultural fabric of Skopelos, presenting anecdotes and daily life events that span from the last years of 19th century to contemporary times.

For the completion of the sound documentary, it was deemed essential to create a sound library that included audio samples from the process of constructing four essential gears linked to the tinsmithing profession: the wedding crown case, the gutter, the serving tray, and the coffee pot. Mr. Lithadiotis' interview was recorded in the town of Skopelos, specifically in the courtyard of a traditional house.

For the sound design of the documentary, recordings were made of 12 different soundscapes of Skopelos, including the old port, the tinsmith workshop, the town's narrow streets, beaches, and more. These soundscapes were used as the audio background for the documentary.

Foivos Adamidis, Kalliopi Chatzimichail, Sofia Kapota, Panagiotis Karounias, Christos Paleologos, Theofanis Maragkos, and Charikleia Minotou (Ionian University)

Soundscapes and Soundwalks at Protected Areas, The case study of the National Marine Park of Zakynthos

Protected Areas (PA) are national parks and wildlife refuges where legislative framework is setting rules for protection and management. The coexistence of humans and nature is a critical goal for sustainable development. PA are field, for scientific study and instruction on the ecological processes and conservation. Acoustic Ecology (AE) is an interaction of sounds in the environment and develops the acoustic perception, so human can cultivate an understanding the acoustic environment and gain an integrated experience.

Students run this research under the frame of the lesson AE of the Department of Environment, Ionian University which aims to create communicative material for the PA its ecosystems and biodiversity. A map and two paths have been created, while descriptions and narratives were compiled. The recordings of the soundscapes were executed utilizing high-fidelity audio equipment, adhering to the principles and methodologies of AE. The research emphasizes towards the examination of spatial variations in sound within natural ecosystems. An inventory of biodiversity, landforms and ecosystems found at each point was conducted. Virtual touring is engaging way for people to remotely discover places. By adopting virtual tours, we can lessen the negative effects of traditional tourism while opening up global chances for cross-cultural contact.

**Emmanouil Lianis, Giorgos Dedousis, Konstantinos Bakogiannis,
and Areti Andreopoulou**

(National and Kapodistrian University of Athens)

Exploring the sonic tapestry of insular Greece: Spatial capture and systematic analysis of the Naxos' Island soundscape

This research investigates the influence of human activity on the acoustic environment of Naxos, through an extensive set of recordings captured at 84 locations across the island, using First order ambisonics. The recorded data is complemented by sound pressure level measurements and in situ sound source identification through active listening. The analysis includes sound source classification, comparison of the captured locations by region and a preliminary loudness analysis. Findings highlight the fact that although human activity may have an impact on the soundscape of Naxos, nature sounds still dominate the soundscape of the island. Sound recordings of all locations, accompanied by complementary information are presented through an interactive Max/MSP application that allows users to spatially experience the unique spatial features of each site and compare the auditory content of the recorded soundscapes by simply selecting locations on a map.

Soundscape analysis and Digital Preservation II

Katerina Tzedaki (Hellenic Mediterranean University)

Τα ηχοτοπία της παράκτιας τουριστικής περιοχής του Αδελιανού κάμπου στο Ρέθυμνο της Κρήτης

Η έρευνα αυτή παρουσιάζει το περιεχόμενο και τις διαφορές του ηχητικού περιβάλλοντος ανά τις εποχές του έτους στις εκβολές δύο ποταμών στην ανατολική ακτή της πόλης του Ρεθύμνου, χαρακτηρισμένες σαν παραλίες ωτοκίας της θαλάσσιας χελώνας caretta caretta χρησιμοποιώντας δύο διαφορετικές μεθόδους ανάλυσης του ηχοτοπίου και συγκρίνοντας τα αποτελέσματα τους.

Dimitra Agrafioti, Emmanouil Anastasiadis, Theofanis Maragkos
(Ionian University)

The Wetland of Vravra: Case Study of a Recording of a Threatened Soundscape

The wetland of Vravra, located between the urbanized Artemis and the rapidly developing Markopoulo, stands as a vital wildlife habitat in Attica. Remarkably, its landscape has remained almost unchanged since ancient times. However, contemporary environmental concerns loom large: the ongoing conversion of Erasinos River's natural banks into engineered structures threatens the rich biodiversity that defines this significant region.

The present study concerns the recording and analysis of the characteristics of the wetland of Vravra and was conducted in 2019, prior to the works and interventions in the wetland. The

primary objective of this research was the acquisition of different types of data (recordings, film, and photographs). Our focus centered on studying spatio-temporal variations of sound in this unique ecosystem. Moreover, in order to represent the wetland and its changes throughout an annual cycle (from May to December 2019) more accurately, we conducted four recordings (one for each season for three different time periods (morning, midday and afternoon-dusk)).

The soundscape of the Vravrona wetland is characterized as a high-fidelity (Hi-Fi) environment, distinguished by exceptional acoustic and aesthetic sound quality. There is a high density of sound data and sound diversity due to a high concentration of avifauna at the recording positions

Penelope Bekiari (National and Kapodistrian University of Athens)

George Edmondson (University of Birmingham)

Anastasia Georgaki (National and Kapodistrian University of Athens)

Resonant Echoes: Acoustic Heritage and Cultural Memory in the Mani Peninsula

This project investigates the acoustic memories of the Mani Peninsula, focusing on inhabitants' connection to water and nature. By gathering and analysing sounds and narratives from residents, we explore the changing soundscape; highlighting the profound relationship between community and the natural environment. This interdisciplinary exploration combines ethnographic methods with accessible technology, offering a novel approach to acoustic ecology and the documentation of Mani's heritage. Beyond scientific

findings, this research evidences the importance of participant-made sound recordings as a method for eliciting vivid "ways of knowing," capturing perspectives that text alone cannot convey

SESSION IV

Acoustic ecology and soundscape ecology I

Frank Pecquet (Univ-paris1 panthéon-sorbonne)

Sound anthropology and ecosound

Acoustic ontology" characterizes the relationship we have with the world of sound, our world of sound being in the forefront, and that of the human tribe, the human community, being in the background. The word "ecosound", a neologism composed of the contraction of two terms "ecology" and "sound", refers to this paradigm. Since Schafer and his insights on the question of ecology, sound embraces the acoustic environment, through its notion of "amenity" (tuning), as an entire dimension and within which rethinking structurally the society can/must be done in relation to such acoustic reality. This acoustic reality constitutes a form of socio-economic engagement, with respect to health, norms and standards, and the environment, three areas of focus in design research. The role of sound design and its actors is therefore to monitor this question of a new "sound order", which we have defined as "ecosonic" and within which, our daily life is organized in different living spaces, in accordance with existing norms and standards and structural frameworks, as well as others yet to be established.

Μέλισσα-Άννα Σελεβίστα (ΕΑΠ)

Καταγραφή και αξιολόγηση ηχητικού περιβάλλοντος: “Η προσέγγιση του ηχοτοπίου ως εργαλείο ενίσχυσης της ακουσματικής εμπειρίας σε άτομα με ή χωρίς απώλεια ακοής”

Η εργασία έχει ως θέμα την καταγραφή και αξιολόγηση ηχητικών περιβαλλόντων αλλά και επιπροσθέτως την προσέγγιση συγκεκριμένων ηχοτοπίων ως εργαλείο ενίσχυσης της ακουσματικής εμπειρίας ατόμων, είτε ακούντων ή με απώλεια ακοής. Σκοπός της εργασίας αποτελεί η διερεύνηση της προσέγγισης του ηχοτοπίου ως συμμετοχική διαδικασία/ακουσματική εμπειρία, με επίκεντρο την ίδια την ακρόαση και με παράλληλη δημιουργία μιας ψηφιακής βάσης ηχητικών δεδομένων. Τα σημεία σταθμοί των ηχητικών καταγραφών βρίσκονται σε φυσικό τοπίο περιιαστικά της πόλης του Αγρινίου και στη Λίμνη Τριχωνίδα που επιλέχθηκαν βάσει της ποικιλομορφίας του ηχοτοπίου. Ο εξοπλισμός που χρησιμοποιήθηκε είναι φορητός ψηφιακός καταγραφέας ήχου και ακουστικά over ear. Οι συμμετέχοντες στη διαδικασία επιλέχθηκαν με παραμέτρους την ακουστική ικανότητα, τις γνώσεις και την εμπειρία τους όσον αφορά τη βιοποικιλότητα αλλά και τη διαδικασία καταγραφής. Εργαλείο εξαγωγής συμπερασμάτων ήταν η συνέντευξη πριν και μετά τις καταγραφές. Η απεικόνιση των καταγραφών (με κυματομορφές και φασματογραφήματα) κατέδειξε μια μετρήσιμη περιγραφή και αξιολόγηση των ηχητικών περιβαλλόντων και οι συνεντεύξεις την υποκειμενικότητα και ευχαρίστηση της ακρόασης. Τα συμπεράσματα που προέκυψαν έδειξαν την ενίσχυση και την προσήλωση στα ηχητικά ερεθίσματα του περιβάλλοντος, μέσω της καταγραφής τους, ως παραμέτρους

που συνεισφέρουν στην προσέγγιση του ηχοτοπίου ως ακουσματική εμπειρία από άτομα χωρίς αλλά και με μερική απώλεια ακοής.

Charikleia Minotou (Ionian University)

Theofanis Maragkos (Ionian University)

Aristotelis Martinis (Ionian University)

Aristotelis Filippos Skiadaresis (Ionian University)

Spyros Kotomatas (WWF Greece)

Acoustic ecology and Protected areas, the challenge to raise awareness and promote their unique cultural and environmental value through soundscapes. The case study of Gyaros Marine Protected Area

The protection of natural and cultural heritage constitutes a challenge for the preservation of memory. Gyaros, a place of imprisonment and exile and a National Marine Protected Area is the case study area. Environmental interpretation facilitates the visitor to become informed, to receive information and data of an area, enabling them to understand its cultural and natural significance within the context of an in-person visit or virtually through digital means. This research constitutes part of a ""CLLD-LEADERProgram"" and focuses to the creation of awareness material for general and special groups. The compiled material includes: a sound path, soundscapes, photos, 32 different narratives as audio tours, videos with soundscapes as audio backgrounds at different seasons. Additionally, a photographic library and a sound library were created. To capture both the visual and audio material, equipment was used that reliably and realistically recorded the relief of Gyaros and its soundscapes.

The virtual visit to a place and the creation of an (audio) route with the option to select points of interest according to the visitor's preferences creates interaction and a personal, immersive experience. Recording and capturing an entire island with audiovisual material and soundscapes represents a holistic approach to environmental interpretation.

Acoustic ecology and soundscape ecology II

Peter Nelson (University of Edinburgh)

Some Notes on an Ecology of Time

Acoustic ecology is typically concerned with sound and listening located at specific sites where the focus of attention is the auditory phenomena themselves. The ecological perspective thus seeks to explore the consequences of the presence, absence and co-existence of auditory phenomena as evidence of the evolution of a specific stratum of lived existence. This presentation will focus on the temporal aspect of sound phenomena, exploring the ways in which sound embodies time, and proposing the time phenomenon of rhythm as a specific set of relational properties with meaning. Taking a cue from Henri Lefebvre's work 'Rhythmanalysis', the presentation will assert that sound makes time, and that the ecology of sound thus creates a parallel ecology of time, with consequences for the perception and experience of living beings. The presentation will explore the ecological niche inhabited by humans, and discuss the evolutionary pressures evident in shifting experiences of time through sound.

Wiktor Mastela, Areti Andreopoulou, and Thanos Polymeneas-Liontiris (National and Kapodistrian University of Athens)

Environmental Sound as a Form of Ecological Activism. Case Study: The Soundscape of "Pedion Areos"

It could be argued that there is a sound environmental crisis that is not so 'audible' to the general public. It is important to understand the problem of environmental degradation in a multi-level way and in this context to recognize the effects of this degradation at the level of sound. Therefore, in this particular study the sound is presented as a basic means of environmental awareness and a medium for environmental activism. The disciplines of ecology, sociology and musicology are used to search for and study sources related to sound activism and political action through sound. Hence, this paper explores these properties by relating sound to political action through a collection of fragmentary thoughts and suggestions from various studies that combine activism with sound. Reference is also made to the personal study of the city park in order to discuss in more detail the importance of sound in green spaces in urban areas.

Gabriel Farilekas, Anastasia Georgaki, Thanos Polymeneas, and Penelope Bekiari (National and Kapodistrian University of Athens)

Ground Vibrations and Geophonic Sounds Impact on Human Brain Activity

The influence of ground vibrations and geophonic sounds on human brain activity represents a compelling intersection of acoustic ecology, neuroscience, and psychology. This research aims to delve

into how low-frequency vibrations and natural ground sounds, typically recorded and analysed within the field of acoustic ecology, impact human physiological and psychological states. By examining mechanisms such as resonance, entrainment, and auditory perception, this study will explore how these natural stimuli can alter brainwave patterns, regulate neurotransmitter levels, and induce various emotional and behavioural changes. The therapeutic potential of these findings is significant, offering novel approaches for stress reduction, enhanced cognitive focus, and improved mental well-being. Furthermore, our methodology includes recording brain data while participants listen to these sounds and sonifying this data to communicate our findings to a broader audience. This approach underscores the innovative ways in which acoustic ecology can be integrated into urban planning and therapeutic practices to enhance human quality of life.

SESSION V

Soundscapes as a compositional framework I

Θωμάς Αποστολόπουλος (Εθνικό και Καποδιστριακό Πανεπιστήμιο Αθηνών)

Ηχητικό περιβάλλον και παραδοσιακή Μουσική στα ορεινά Πιέρια πριν την ηλεκτροδότηση

Στην παρούσα εισήγηση μελετάται το ηχητικό περιβάλλον των χωριών των ορεινών Πιερικών με χρονικό όριο την προ του εξηλεκτισμού της δεκαετίας του 1960. Πρόκειται για ένα περιβάλλον ελληνικής αγροτικής υπαίθρου. Το ερώτημα που

απασχολεί την εισήγηση είναι: τί άκουγε ο κάτοικος μιας τέτοιας περιοχής μέχρι και εκείνη την εποχή και πώς αυτό το ηχητικό τοπίο επηρέαζε τη μουσική του έκφραση κυρίως στην εκτέλεση της κοσμικής παραδοσιακής μουσικής και λιγότερο της εκκλησιαστικής ψαλτικής. Αυτό το ηχοτοπίο συντίθεται από ήχους της φύσης (αέρας, φυσικά φαινόμενα, ζώα, πουλιά κ.λπ.) και ανθρωπογενείς ήχους από τη χρήση απλών εργαλείων και βέβαια ηχητικών αντικειμένων και μουσικών οργάνων, όπως αυτά είχαν μακραίωνη παρουσία στις προβιομηχανικές κοινωνίες. Κατόπιν επιχειρείται η ανίχνευση επιρροών και αντανάκλασεων αυτού του περιβάλλοντος σε μοτίβα, φόρμες και τεχνικές της τοπικής παραδοσιακής μουσικής, καθώς η αποτύπωση αυτή αναμένεται να είναι παρούσα στη διαμόρφωση αλλά και την επιτέλεση της παραδοσιακής μουσικής μέχρι και την εν λόγω εποχή, δηλαδή προ της εισαγωγής του ηλεκτρισμού και των αλλαγών που η τελευταία επέφερε.

Luc Messinezis (University of Peloponnese)

Acoustic Futures: Eavesdropping on Dystopian and Utopian Possibilities

With this article I discuss how acoustic ecology, sound art and studies can contribute to raising awareness by discovering hints of a dystopic or a utopic future within the past as well as the current acoustic reality. The arrow of time lets us remember the past but never the future. I argue that we can utilise interdisciplinary research methodologies in order to investigate in depth and communicate to a wider audience the aural elements of a dystopian or utopian possibility. Imagined future possibilities are based on collective experience that has accumulated over the years, therefore, the

aesthetic materialisation that I seek, is a process based reverse-engineering of an imagined future. By utilising a variety of practices such as the study of historical artworks of different disciplines and by proposing innovative ways to approaching the current soundscape, the article illuminates how sound studies and acoustic ecology may acquire a role that is crucial in envisioning and crafting the future, offering a sensory-rich lens through which we can better understand but also influence the trajectories of our world.

Maria Kolia and Areti Andreopoulou (National and Kapodistrian University of Athens)

"Oceanic ClimateScapes": A real – time sonification of aquatic physicochemical climate change data, set on marine soundscapes

In "Oceanic ClimateScapes" the authors argue that creative sonification can be used as a means of better understanding and empathizing with the ecological changes that happen in aquatic ecosystems. "Oceanic ClimateScapes" examines in theory and practice the relationship between culture, nature and performance and how they correlate with sonification and algorithmic composition with the help of new technologies such as electronics and programming. The performance that was conducted involved mapping physicochemical parameters to corresponding sound transformations over actual recorded samples of marine soundscapes (sonification), derived from hydrophone recordings in the Hellenic Trench in correlation with "Pelagos" Institute. Ultimately, an algorithmic composition/sonification unfolds with the climate data being the "conductor" of the piece. Arduino sensors collect the data and map them to sound parameters for real-time

interaction. Climate change is primarily anthropogenic in the Capitalocene Epoch, and in an analogy to sound, all these natural soundscapes become distorted and alienated from their original form. By immersing listeners in the sounds of the seas and oceans and how they are distorted through sonification of changing physicochemical data, the authors aim to inspire a sense of responsibility and action for the preservation of these vital ecosystems.

Soundscapes as a compositional framework II

Theofanis Maragkos (Ionian University)

Georgios Konstantakis (TEI of Crete)

Athanasios Epitideios (Ionian University)

Apostolos Loufopoulos (Ionian University)

Renata Dalianoudi (Ionian University)

The soundscapes of Kea as an auditory background for recording traditional instrumentalists

This research project, funded by the Cycladic Identity program of the Museum of Cycladic Art, documents the traditional music of Kea through ten independent documentaries featuring the island's last surviving old musicians. The study employs an innovative methodology that combines musical performances with in-situ recordings of local soundscapes, aiming to capture both the cultural heritage and the environmental context of Kea's music tradition. Recordings took place at various locations across the island, including historical sites and natural settings, during two sessions in June and July 2023. The project's uniqueness lies in its approach to

simultaneously record traditional musicians' performances and the surrounding soundscape, providing a multifaceted portrayal of Kea's natural and cultural heritage.

The research applies acoustic ecology principles to produce high-quality audio and audiovisual recordings, integrating soundscapes and ambient sounds into the documentaries' narrative. It also includes ethnomusicological documentation of the performed songs, exploring interpretation differences based on musicians' origins and the impact of spatial-temporal conditions on their creative expression.

This pioneering methodology in the Cycladic Islands offers a comprehensive framework for documenting, preserving, and promoting Kea's musical tradition while highlighting the intricate relationships between living beings and their auditory surroundings.

Nikolaos Kokolakis (Hellenic Mediterranean University)

Utilizing soundscape analysis for site-related fixed media composition inspired by the acoustic environment and history of the Decauville route at Alona, Florina

This study investigates the potential of mixed media music composition in creating site-specific/site-related music that integrates soundscapes, instrumental music, and electronic sounds. The proposed approach explores how mixed media music composition can enhance our awareness of the environment and its social context. The research methodology primarily employs qualitative soundscape analysis methods through a case study, resulting to the creation of an original soundscape composition. The focus is on how compositions can reflect the unique qualities of a

particular environment and on the compositional techniques that can be developed to systematically and methodically integrate these media.

It centers on two designated sites: the wind-energy park located at Golina Hill and the Decauville route in Alona, which inspired the fixed media work ""Trails"". It outlines the on-site methodology of soundscape analysis, encompassing assorted recordings, two sound maps, imagery capturing specific recording sessions' locations, and a comprehensive sound diary. Additionally, the report delves into the processing of those recordings and provides an analytical presentation of the compositional process.

Dimitris Bakas (Hellenic Society for Acoustic Ecology)

Eleni Gerofoka (Ministry of Culture)

Air and Sound: Historical sound and Archeological data transformed into Sound Art

In 2017, the communication action entitled Environment and Culture, organised by the Department of Archaeological Museums, Exhibitions and Educational Programs of the Ministry of Culture, was exhaled by the theme of ""air"", with the general title ""Wind Breaths"". As part of this action at the Archaeological Museum of Dion, as an archaeologist at the Ephorate of Antiquities of Pieria, in collaboration with the composer, Dimitris Bakas, we made an innovative educational program for primary and secondary school students focused on the instrument Hydraylis, a keyboard instrument found in ancient Dion, exhibited at the Museum of Dion. Dimitris Baka's work Aeses (meaning 'breath'), in the form of a Soundscape exhibited in the Museum, revolves around air, the

element that the Hydraulis manipulates, using hydraulic mechanism, to create sounds. From this perspective, instead of examining the field of historical musical data, it focuses on a more ambiguous area of interpretation: historical sound data. Specifically, it deals with sound, not melody or the system that created a melody. Ultimately, sound – rather than melody – constitutes an ontological characteristic of the instrument, derived from its functionality (its λόγος) and the nature of its construction.

SESSION VI

Acoustic ecology in education I

Aimilia Karapostoli (Democritus University of Thrace)

Dimitris Giouzepas (Democritus University of Thrace)

Aggelos Tsaligopoulos (University of the Aegean)

The notion of soundscape in Architectural education; The case of two short design assessments in the studio

This research concerns the presentation and comparison of two short design assessments in the architectural studio, concerning sound and acoustic ecology, that took place in two different academic years, March 2021 and March 2023, involving a non-specialist audience in sound issues, such as 6th semester students of architecture. The evaluation of the assessments highlighted the need to simplify standardized theory to communicate key concepts of soundscape theory and acoustics. But, the intense interest of the participants, mainly due to the use of equipment and software for processing and reproducing soundscapes, was great. The use of Soundscape maps

and graphic scores as an alternative way of architectural representation was decisive, so as to expand the constraints of traditional architectural visualization.

Olympia Agalianou (National and Kapodistrian University of Athens)

Approaching urban parks through movement and listening: An educational intervention for environmental awareness

Antonis Tritsis Park is an ecosystem of great importance, is dedicated to environmental awareness, and is located near the center of Athens. The current action research assesses the effectiveness of a five-hour training session organized for working teachers. The goal is to promote visits to urban parks and enhance students' environmental awareness through an embodied understanding of nature acquired through a creative process. It is about an indicative four-part scaffolding combining both ideas of acoustic ecology and elemental music and dance pedagogy. 20 teachers of various specialties took part. The research data was gathered through participant observation, reports from critical friends, participants' reflective diaries, videos of brief group performances, and two group interviews with the focus group method. This was followed by a thematic analysis, using an inductive process, and constant comparison. It seems that the embodied connection with nature and the artistic expression derived from it can enhance environmental consciousness and deepen understanding. In addition, the exchange of experiences enhances the development of relationships with nature and people. Additionally, the teachers were motivated and felt capable of organizing their interventions to utilize the park and the open space creatively using the body and senses.

Renata Dalianoudi (Ionian University)
Sotiriou Christina (University of West Attica)
Theofanis Maragkos (Ionian University)

Radio ecological documentary: from the field recordings in the natural environment to the educational audio-stories

This paper examines the creative transformation of field recordings into educational audio-stories and radio ecological documentaries. Drawing on Bill Nichols' (1991) definition of audio documentaries as sonic narratives based on field recordings for scientific, environmental, and educational purposes, we explore the multifaceted process of capturing, curating, and repurposing environmental soundscapes.

The study emphasizes the ethnographic value of field recordings in capturing geophonic, biophonic, and anthropogenic sounds, which constitute natural soundscapes and reflect cultural environments.

Our methodology for field recording utilizes a diverse corpus of high-fidelity field recordings from various Greek territories, encompassing isolated natural environments, anthropogenically altered landscapes, and urban soundscapes. These recordings, featuring anthropogenic, biophonic, and geophonic sound sources, were creatively integrated to construct narrative frameworks for audio-stories.

The research also explores the educational potential of these audio-stories, or "echo icons," in introducing children to music and environmental awareness. Through listening and imitation exercises, children engage with natural sounds, developing rhythmic skills, environmental understanding, and creativity.

This study contributes to the fields of acoustic ecology, ethnomusicology, and environmental education, offering insights into innovative approaches to sonic storytelling and ecological awareness.

Andreas Mniestris and Ioanna Etmektsoglou (Ionian University)

Acoustic Ecology and Transdisciplinarity in University Music Studies: A context for cultivating sound aesthetics, ethics and ecological activism

The purpose of this presentation is to introduce an educational action - in the form of a semester-long course entitled "Sound-Environment-Communication", a course which complements the curriculum of the Music Department of the Ionian University, by introducing theoretical concepts, contemporary research trends and artistic practices that have been developed in the field of acoustic ecology. Since 2015, when this course was introduced, students from all music specializations have enrolled in it, although it has been mostly attended by music education majors.

The final student projects are characterized by considerable variety in the subjects addressed, and demonstrate understanding and a creative approach to key issues of acoustic ecology in the form of an artistic or pedagogical work.

In the presentation we will share the main objectives of the course along with elements of its content and curriculum organization. Given the interdisciplinary and potentially transdisciplinary nature of the course subject, the different academic areas of the two instructors, but also the different majors of the students, we will discuss in particular the teaching approaches and roles of the

participants. Following the theoretical discussion, we will present and evaluate critically, excerpts from two particularly insightful student projects.

Δημήτριος Σαρρής (Ιόνιο Πανεπιστήμιο)

Πρόγραμμα «Ηχοτοπία του Ταϋγέτου» Από τον ηχητικό γραμματισμό στον οικολογικό γραμματισμό

Η εργασία παρουσιάζει την μεθοδολογία ανάπτυξης και τα μέχρι στιγμής αποτελέσματα του προγράμματος «Ηχοτοπία του Ταϋγέτου». Το πρόγραμμα αναπτύσσεται από φορείς εκπαίδευσης και τοπικής αυτοδιοίκησης από το 2022 στην Μεσσηνία προκειμένου να υποστηρίξει ερευνητικά, επιμορφωτικά και εκπαιδευτικά μαθητικές και παιδαγωγικές ομάδες που επισκέπτονται προγραμματικά τον βορειοδυτικό Ταϋγετο, και προέρχονται από όλη την Ευρώπη.

Η μεθοδολογία του προγράμματος περιλαμβάνει δύο σκέλη: Ένα όπου για ένα έτος μελετήθηκαν στοχευμένα τα ηχοτοπία του Ταϋγέτου, δίνοντας σημαντικό εκπαιδευτικό/επιμορφωτικό υλικό ένα δεύτερο όπου το υλικό αυτό αξιοποιήθηκε σε μαθητικές και παιδαγωγικές ομάδες ενώ παράλληλα βελτιωνόταν διαρκώς.

Πέραν των αποτελεσμάτων αυτών, ωστόσο, η έρευνα κατέδειξε τον τρόπο που οι επιδράσεις της κλιματικής κατάρρευσης στο βουνό απηχούν και στα ηχοτοπία του. Με κύρια ηχογόνο και ηχοποιητική πηγή το νερό και τις διαδικασίες παρουσίας του στο βουνό, ο Ταϋγετος υφίσταται τις επιπτώσεις της κλιματικής κατάρρευσης ως μια «ηχοτοπιακή κατάρρευση», όπως θα την κατανοούσε ο άνθρωπος που διαβιεί στο βουνό.

Έτσι, τα κύρια θεωρητικά εργαλεία στα οποία βασίστηκε η διαμόρφωση του υλικού, δηλαδή ο «ηχητικός γραμματισμός» και ο «οικολογικός γραμματισμός», συμπληρώθηκαν από την κατάλληλη «πολιτική γραμματισμών», που προσανατόλισε το πρόγραμμα σε μια συμβολή στην κατανόηση και αποτροπή της κλιματικής κατάρρευσης που ζούμε.

SESSION VII

Acoustic ecology in education II

Yannis Mygdanis (Pierce - The American College of Greece)

Design and implementation of STEAM scenarios reflecting ubiquitous acoustic ecologies in primary music education: an initial overview and perspectives

Integrating acoustic ecology strategies into music education presents a transformative approach to comprehending and engaging with sound in our daily lives. This concept is aligned with technological advancements, fostering fresh opportunities for creativity and learning. This study investigates the development and integration of STEAM educational scenarios that reflect ubiquitous acoustic ecologies to enhance primary music education. The research conducted at Pierce – The American College of Greece involved fifth and sixth-grade students over 15 weeks. The program was structured around the STEAM model, incorporating hands-on activities to promote collaboration, project-based learning, and inquiry-based learning. Elements from existing practices, such as soundwalks, were utilized and expanded based on contemporary digital and

multimodal literacies. Students engaged with technological tools and practical activities that connected music with environmental sounds. The findings demonstrated numerous advantages for students, including increased participation and interest in music and the development of self-regulation, creativity, innovation, and ecological awareness. Implementing new technologies like 3D printing and artificial intelligence further enhanced the educational experience. This research underscores the potential for integrating ubiquitous acoustic ecologies into primary music education to provide enriching and meaningful learning experiences, opening new pathways for music education and student development.

Dana Papachristou and Yorgos Samantas (University of Thessaly)

Aural Inclusion: Bridging Sound Art and Technology for/with the d/Deaf and hard of hearing

This paper explores sound, technology, and the experience of Deaf and hard of hearing individuals, so as to demonstrate and reflect upon educational practices from secondary education to adult learning that facilitate inclusive, multisensory experiences in sound modules. This approach emphasizes on the relation between individuals or cultural groups with their sonic environments. Particularly, working in Deaf and hard of hearing educational settings, emphasis is placed on vibrotactility and kinetic methodologies among other, taking into account the gravity of these modalities in Sign Languages, as well as the available technology.

Andromachi Vrakatseli (National and Kapodistrian University of Athens)

Acoustic Oiko-topia: Educational aspects of collectivity and sustainability through sound

The soundscape has the capacity to connect living and non-living entities through sound, adding a dimension to Acoustic Ecology that is connected to the collective consciousness by means of sonic materiality. This research presents educational activities of environmental sound art and sound studies related to the formation of this sonic collectivity. How it is crucial for developing sustainability and for promoting *acoustic justice*, which is associated with the political connotation of listening. Acoustic Oiko-topia is a workshop for primary school children that took place at the Museum of the Environment, Greece. The aim of the project was the presentation of nature as a common space of dwelling through sound. It focused on the following categories: a) The importance of vocal communication -through experiential exercises. b) The role of the acoustic communication of biofauna- trough specific examples c) How humans interfere with biophony resulting in its extinction and in changing the acoustic character of the seasons d) How field recording practices enable students to understand in situ the role of human interference and to cultivate acoustic co-presence.

Acoustic Oiko-topia educational programme is a sonic exploration of connections and interferences that fosters community engagement and cultivates a collective acoustic consciousness. The proposed methodology results in an understanding of how human noise affects seasonal and climatic conditions and how humans can take action to promote sustainability through active listening.

Theodoros Lotis (Ionian University)

Latent Learning and the Salami Sound Effect

My hypothesis is that the obstruction of the latent learning processes by the salami sound effect interferes with our ability to create auditory cognitive maps of the environment. As a consequence, the capacity to develop an accurate sense of location, direction and distance within our environment, as well as the motivation to enjoy and explore the full range of a soundscape are also diminished.

SESSION VIII

Bioacoustics, biodiversity, and climate crisis

Ricardo Climent (NOVARS Research Centre, University of Manchester)

Camille Rivera (Oceanus Conservation)

Bioacoustics and videogames as transformative media to engage the public in sustainability. Restoring blue carbon habitats in the Philippines

This paper examines how bioacoustic data and environmental recordings can become a new transformative pathway to engage people in sustainability research, when constructed as an integral part of a climate-action video game.

Mangrove World is a collaboration project between KeepItHuman, a videogame in sustainability and spin-out company at the University of Manchester, Imago Software and Oceanus Conservation, a blue carbon conservation and restoration NGO in the Philippines.

Environmental audio-logs and audio recordings were used to capture three contrasting aural fingerprints in mangrove habitats in the Philippines, such as, La Union, Manila Bay and Bais reserve in Negros Oriental. The aim of the collected acoustic data analysis served two key purposes: First, to be combined with other monitoring systems used by the NGO such as, remote sensors and orthomosaic map observations (satellite and drones). Second, to become an integral part of the sound design of the videogame Mangrove World, alongside its composed music themes and citizen science interviews, to raise awareness about mangrove reforestation and conservation.

Panagiotis Syrios, Angeliki Kontopoulou, and Anastasia Georgaki (National and Kapodistrian University of Athens)

“The Song of Blackbird”: a bioacoustic and musicological approach

The spring soundscape in the city is a rich mosaic of sounds in which blackbirds play a key role. The blackbird (*Turdus merula*) is known for its melodic song. Song learning is extremely similar in songbirds and humans and relies on a specialized set of brain regions. The song of adult blackbirds includes imitation of other bird species and even environmental sounds and is highly repetitive, with males developing a distinctive sequence of notes that occur frequently. The European blackbird in particular is known for its improvisational abilities, adding variations and new sequences to its songs. The degree of polysyllabicity in blackbird's song is another characteristic of the species. According to the approach of French composer Olivier Messiaen, the integration of song of songbirds involves not only direct transcription but also adaptation and harmonization to fit its unique musical language. In pop music there are many references

that highlight the symbolic importance of the blackbird. The aim of this study is to analyse and compare the songs of blackbirds coming from three different regions of the Mediterranean, in order to gain a comprehensive understanding of their songs that include both their biological functions and their artistic skills.

Dimitris Batsis (University of Ioannina)

EcoMuseum Zagori soundscapes: Raising awareness through acoustic community interventions

Ecological concerns are addressed through artistic endeavours, placing acoustic ecology at the forefront of environmentalism. EcoMuseum Zagori, founded in 2014, uses sound art to protect and sustain Zagori's natural and cultural heritage, a UNESCO World Heritage site since 2023. EcoMuseum participates in European projects using the EchoLoci application: PONT (2023-2025) for vulture protection and ACCTING for preserving pastoral routes. These projects address wildlife conflicts and reduce poison bait use through soundscapes, interactive apps, workshops, and citizen science.

EchoLoci, is a project that records biodiversity with citizen participation. It is a project that highlights transhumance's role in conservation, engaging the community. EchoLoci uses soundscapes for ecosystem conservation, improving transhumant farmers' social standing, and illustrating sound art's significance. It creates a biodiversity soundmap, with stakeholders contributing data on livestock trails.

EchoMuseum enhances collaborative learning for managing environments. Five spatial points in East Zagori Liapi were selected

to record seasonal sound diversity, highlighting biodiversity. Inspired by Leah Barclay's projects, EchoLoci's immersive experiences emphasise sound and environment interplay, promoting environmental awareness and sustainable practices through innovative artistic expression. This process proposes natural soundscapes for a future database of fauna and cultural landscapes in a Virtual and Augmented Reality framework.

Katerina Talianni (University of Thessaly)

Ecocritical sonorous narratives: soundscapes for listening in the Anthropocene

In the Anthropocene era, the acoustic environment echoes the profound impacts of climate change, with biodiversity and ecosystems undergoing significant transformations. This paper explores the concept of "ecocritical sonorous narratives", emphasizing how soundscapes, created by both human and more-than-human agents, reflect such environmental shifts. Through the lens of cultural ecocriticism, I delve into the materiality of acoustic spaces, considering not just their auditory presence but their broader ecological and cultural implications. I argue that the act of listening can become a mode for ecocritical engagement, fostering deeper connections between imagination and ecology. By examining the intersections of sound art, environmental data sonification, and soundscape composition, this paper highlights the potential of auditory experiences to convey the complexities of ecological crises. Drawing on Donna Haraway's notion of making (odd)kin as aud(ible)kin, I propose that listening can rearticulate our relationships with the environment, offering a sensuous and

embodied understanding of climate change that can potentially inspire climate action.

Dimitra Remidianaki, Orestis Karamanlis and Anastasia Georgaki
(National and Kapodistrian University of Athens)

Vln_temp project: Music creation for violin and live electronics using sound transfer techniques to reflect global temperature changes

Το VI_temp project αποτελεί ένα μουσικό έργο για βιολί και live electronics. Ο σκοπός της σύνθεσης είναι η ανάδειξη σοβαρών οικολογικών ζητημάτων, συγκεκριμένα το ζήτημα της κλιματικής αλλαγής, μέσω της δημιουργικής χρήσης δεδομένων παγκόσμιας θερμοκρασίας εδάφους. Η διάδραση υπολογιστή και εκτελεστή οδηγεί σε μία πιο έντονη και διακριτή ερμηνεία με απώτερο σκοπό την κατανόηση της κρίσιμης στιγμής που βρίσκεται ο πλανήτης σήμερα. Η φόρμα του έργου καθορίζεται με βάση τα αποτελέσματα από την ηχητική αποτύπωση και τον προγραμματισμό για την αντιστοίχιση τεχνικών του οργάνου με συγκεκριμένες ηχητικές παραμέτρους.

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