Suon Laulu (Song of the Swamp): Soil Data Sonification of Post-Human Landscapes

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Abstract

Suon Laulu (Song of the Swamp) is a graphic score, choral performance, and programmed video visualizing and sonifying 160 years of soil data from post-extraction peatland landscapes. This research is part of *Re:Peat*, a multifaceted eco-art project. In 2019-2020, Anne Yoncha worked with scientists at Natural Resources Institute Finland (Luke) to study restoration techniques for peatland extraction sites. Using a hyperspectral camera, she accessed data about soil health from soil core samples which we are unable to see with the naked eye.

The piece moves from past to present. Variations in water content, temperature, and level are mapped onto musical staves, the upper staff representing a restored study plot, and the lower, an unrestored plot. Composer Hannah Selin translated these into a choral composition for the Tuira Chamber Choir, inserting 50 human voices into the data translation process, evoking our enmeshment with soil and the non-human species living in it. Accompanying is a video programmed by Brian Givens with Processing visual coding language. In it, the false-color hyperspectral camera image is the hidden "seed image", rearranging pixels in the visible image from the stereo microscope. The data both obscures and reveals information about our non-human, soil-dwelling neighbors.

Keywords

Bio Art, Art-science, Bio-data Sonification, Graphic Notation, Sound Art, Expanded drawing, Hyperspectral Imaging, Post-extraction Landscapes, Ecological Restoration, Digital Ecologies, Place-making, Interactions, Sustainability, Human and Non-human Agents, Acoustic ecologies, Ecological Consciousness, Place-based storytelling

Introduction

Suon Laulu (Song of the Swamp) visualizes and sonifies 160 years of soil data from post-extraction peatland landscapes. The research aims to translate data about landscapes we have permanently altered into multisensory experiences, to build affinity with our non-human neighbors and question unintended consequences of ecosystem interventions in changing climates.

Artist Anne Yoncha collaborates with ecologists at the Natural Resources Institute Finland (Luke) to materialize data about peatland via an art-science approach, with a goal of building affinity with new publics.

Peatland is a rare type of ecosystem where *Sphagnum* moss slowly decomposes and creates an anaerobic, water-logged desert where only it can survive and thrive. In this way the plant is similar to us.

Growing on average just one millimeter a year, *Sphagnum's* slow labor sequesters carbon, preserves our climate and pollen record, and holds on to lost objects and bodies. While this work focuses mostly on *Sphagnum* as archivist underground in the near-Arctic environment of Northern Finland – and on what happens when we remove this archive – it is meant to bring awareness to our multitudes of non-human plant and microbial neighbors living in and creating our soil closer to home. A look underground at Finland's peatlands and extraction sites can help us understand fragile mires, swamps, and fens, and our complex relationship with extraction and the post-human landscapes left behind.

Figure 1. Handmade analog-process paper with plant fiber sourced from extraction site, embossed with image of hyaline cells, or "dead" space in sphagnum moss which creates the anaerobic peatland ecosystem, embossed using laser-cut microscope image as plate ©Anne Yoncha.

Anne Yoncha made paper surfaces from plants sourced at the extracted site, using a small-scale paper-making process as a nod to Finland's paper-making industry (Fig. 1), and has experimented with using other materials from site for mark-making (Fig. 2). Attaching transducers to these surfaces allows the handmade paper—made from novel ecosystem components—to become speaker surfaces, playing sounds of the site. Anne then used hyperspectral imaging of

core samples representing restoration treatments in post-extraction peatland study sites to generate a graphic score (Fig. 5). By sonifying this data antiphonally, listeners may be able to hear differences between untreated soil in the left ear and soil which has been de-acidified with a peat-ash treatment (the residue from burning peat for fuel) in the right.

Figure 2. Handmade dye altering traditional iron gall ink recipe using tannic plant matter from extraction site, and altered paint mixed with peat ash, a sandy substance created as an industrial by-product from peat burning, and later used as a restoration treatment to neutralize soil pH ©Anne Yoncha.

Hyperspectral cameras can see the invisible; they capture both the visible light range (about 380-740 nm for human eye) and wavelengths that human eye cannot see. Hyperspectral imaging is a technology combining imaging and spectroscopy. Each material, due to the difference in chemical composition and inherent physical structure, reflects, scatters, absorbs, and emits electromagnetic energy in distinctive patterns at specific wavelengths. This unique characteristic of an object, called spectral signature or spectral fingerprint, can be identified with hyperspectral imaging. Hyperspectral imaging enables simultaneous detection physical and geometrical features of the product including shape, size, appearance, and color (Fig. 4).

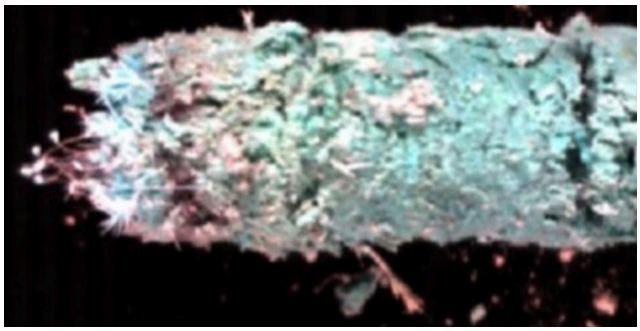
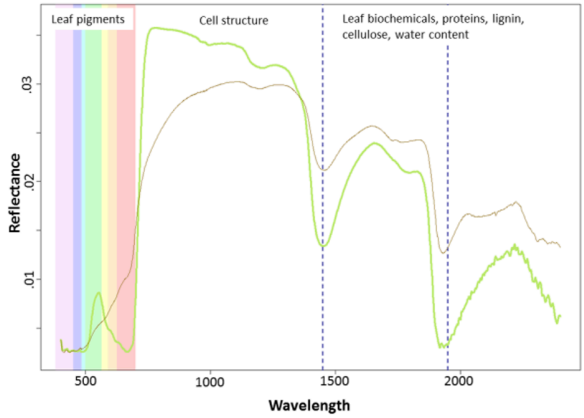


Figure 3: A false-color image of one of Anne Yoncha's soil cores samples made with a hyperspectral camera (Specim FX 17, Specim, Spectral Imaging Ltd) ©Anne Yoncha.

50 humans are voicing approximately 160 years of peatland soil development in 10 minutes and 30 seconds. We hear two sonified core samples (Fig. 3). The unrestored sample is panned left – nothing has been added to the soil. The restored sample is panned right – peat ash has been added to this soil. The sound moves from low to high, so we can hear differences over a dozen decades of peatland soil development, removal, and remediation. We are able to hear some choir members voice conserved peatland soil development, and some voice changes in soil development at a peatland extraction site. The insertion of the human voice into this data translation process is meant to highlight our entanglement with non-human, and specifically soil, species.

Figure 4: A graph showing reflectance by wavelength of a healthy



plant, including 1450nm water absorption band. The graph was generated using Spectrometer PSR+ © Gerard Sapés, University of Florida.

The restoration ecology researchers led by Anne Tolvanen at Luke have explored ways to reengage with degenerated peatlands such as peat extraction sites. The peat soil used for this project was taken from study sites which were reclaimed for reindeer herding, a traditional livelihood in the area. Ash, an industrial by-product from burning peat for power and heat at Toppila station in Oulu, has been the most effective soil treatment, de-acidifying it and leading to a viable novel ecosystem for reindeer forage.

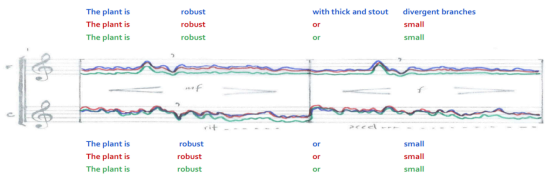


Figure 5: Part of a page of graphic score using reflectance data collected with Specim FX-17 camera, lyrics sourced from a taxonomy of Finnish *sphagna* species ©Anne Yoncha.

Using a graphic notation format in the tradition of artists like John Cage and Cathy Berberian (Fig 5), we collaborate with US composer Hannah Selin as well as Satu Korpi, the leader of Tuira Chamber Choir in Oulu Finland, to create an intertwining choral voicing of this data—literally inserting

the human voice into this data about ecosystems we have altered (Fig 7).

Collaborator Brian Givens wrote a Processing program to create a visualization of soil data to accompany the choral performance. The video component of this work uses a hyperspectral image made at Natural Resources Institute Finland as the "seed" image to scatter pixels of a stereo microscope image of a stem of Sphagnum moss. The images are then reversed so we see an image of the moss reconstructed. Soil data obscures and reveals information about the plants growing in it (Fig. 6).

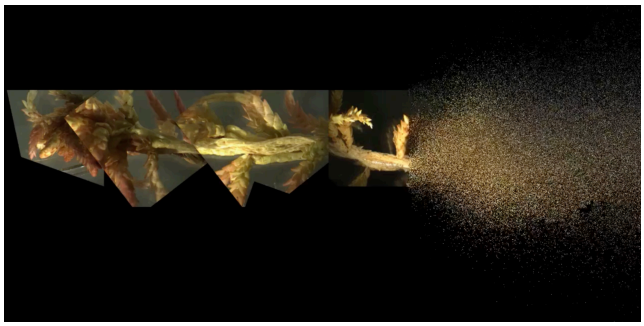


Figure 6: Video still from Processing visualization ©Brian Givens and Anne Yoncha.

The musical performance of this piece was premiered by the Tuira Chamber Choir, conducted by Satu Korpi At the Ostrobothnian Contemporary Music Festival (https://www.lokakuu.fi/) October 7th, 2023 in Oulu, Finland.

My work combines experimental art and ecological science to explore mechanics of plant physiology. By translating these processes into artworks, I aim to build affinity with unfamiliar ecologies apparently out of sight or possessing different temporalities than our own. My practice combines digital sensing technology, such as bio-data sonification, and analog processes including painting with ink I make from locally-sourced plant matter – so the materials used in the piece add another layer of data.

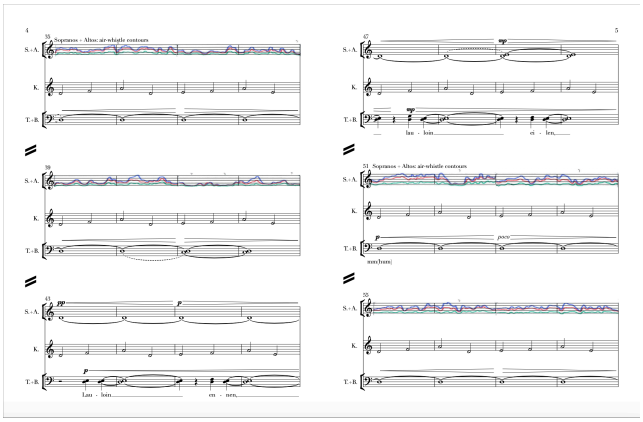


Figure 7: An excerpt from the Suon Laulu choral score, composed by Hannah Selin and drawing from the graphic score made by Anne Yoncha. ©Hannah Selin.

When public understanding of ecological problems is limited, creative artists have been historically successful in uncovering background narratives, thereby shaping how scientifically-declared emergencies are perceived and acted upon. How do we balance a sense of urgency in the time of climate change with potential unintended consequences of our interventions?

Acknowledgements

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Author Biographies

Anne Yoncha is Assistant Professor of Art at Metropolitan State University Denver. Born in Wilmington, Delaware, she earned an MFA at the University of Montana, and was awarded a Fulbright fellowship at Natural Resources Institute Finland working with restorationists to make collaborative art-science work about former peat extraction sites. Her practice combines digital sensing technology, such as bio-data sonification, and analog, traditional painting and drawing processes. Her HAB (High Altitude Bioprospecting) working group includes artists, biologists, and programmers working to contact high-altitude microbes using a heli-kite. Outside the studio she can be found doing other environmental “research” via bicycle.

Composer, violist and vocalist Hannah Selin juxtaposes acoustic instruments with electronics and field recordings to create striking and vibrant sound-spaces. Her music delves into the inner lives of sounds: shimmering sound-masses interact in unexpectedly moving ways, and instruments merge and separate to create sounds beyond their own.

Brian Givens is an artist and craftsman working in a variety of disciplines including woodworking, painting, drawing, electronics and computer graphics. He has collaborated with Anne Yoncha on several pieces that explore the intersection of the natural world and technology. Additionally, Brian is a mechanical engineer with 25 years of experience in advanced materials, manufacturing and R&D.

Satu is the current artistic director of the Tuira Chamber Choir, a mixed choir operating in Oulu. The choir was founded in 1969 and currently has approx. 40 active members. The choir has been led by Pekka Mäntymaa (1969-1989), Leena Hyvönen (1989-1997), Risto Laitinen (1998-2023) and since 2023 Satu Korpi. In addition to traditional chamber choral music, the choir has performed works with orchestral accompaniment in collaboration with e.g. With the Oulu Symphony, Oulu Opera and Kemi City Orchestra.

Anne Tolvanen is a programme director, professor in forest ecology, at Luke. She is a leading specialist in restoration.

Oili Tarvainen is a senior specialist at Luke involved with sample management, and who was responsible for practical work in the study sites. Her background is in restoration ecology.

Anna-Liisa Välimaa is a senior scientist at Luke involved with food and bioproducts. She uses modern technologies such as hyperspectral imaging in her research.