

The City Soundscape and the Brain

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Abstract

River Listening is a practice-led research collaboration between independent artist Dr. Leah Barclay and the Australian Rivers Institute to explore new methods for acoustically monitoring three Queensland river systems: the Brisbane River, the Mary River and the Noosa River. The project involves the establishment of site-specific listening labs to experiment with hydrophonic recording and sound diffusion to measure aquatic biodiversity including fresh-water fish populations – a key indicator of river health. This paper introduces the foundations for the project and preliminary experimentation through the initial listening labs in Australia. *River Listening* fundamentally explores the creative possibilities of aquatic bioacoustics and the potential for new approaches in the management and conservation of global river systems.

Keywords: acoustic ecology, aquatic bioacoustics, hydrophone, field recording, rivers

1. Introduction

In our current state of environmental crisis, biodiversity assessment is critical to understanding the rapid ecological changes taking place across the globe. In the last ten years, there has been a strong emergence of non-invasive monitoring involving auditory recordings of the environment. This emerging field is commonly referred to as soundscape ecology and shares many parallels with other fields, including bioacoustics. Soundscape ecology has an array of creative possibilities that have been deeply explored by practitioners including Bernie Krause (2012) and Leah Barclay (2013). The literature suggests it will continue expanding within scientific fields, with a particular focus on the importance of soundscape conservation, the impact of noise pollution, and the value of soundscapes to assist with biodiversity analysis. There are now a growing number of international projects and scientific institutions embracing methods of bioacoustics in biodiversity analysis of aquatic environments.

In 2014, The Australian Rivers Institute (ARI) and Dr. Leah Barclay were awarded a prestigious Synapse grant to support the development of *River Listening*, a new creative project exploring aquatic bioacoustics. Synapse is an initiative of the Australia Council for the Arts and the Australia Network for Art and Technology (ANAT) that supports collaborations between artists and scientists in Australia. This project extends Barclay's long-term engagement in acoustic ecology to explore the creative possibilities of aquatic bioacoustics in collaboration with an interdisciplinary research team.

2. River Listening

River Listening is a practice-led interdisciplinary collaboration of freshwater biodiversity, virtual technologies, soundscape ecology and environmental sound art to explore methods of hydrophonic recording, soundscape analysis and virtual dissemination. The project draws on the Australian River Institute's existing work in freshwater bioacoustic monitoring (Linke, Gifford & Kennard 2013) to conduct a series of case studies and experiments on three diverse Queensland river systems; the Brisbane River, the Mary River and the Noosa River.

Despite the rapidly growing interest in emerging auditory fields such as soundscape ecology, there is yet to be standardised approaches to field recording and interpreting the data. While scientists have developed advanced software tools for species recognition, there is a growing need to consolidate the available tools and explore the value of listening to the data in new ways. There are also exciting possibilities to make this data available for a wider audience through digital technology and creative collaborations.

The *River Listening Synapse* residency specifically involves field labs on the three identified rivers experimenting with various hydrophonic recording techniques and sound processing. The labs each involve a three-week immersive engagement process, which is based on a methodology developed during Barclay's doctoral research. The labs involve three daily recording sessions; sunrise, midday and dusk. Each recording session is approximately two hours, with a custom-made quadrophonic hydrophone rig attached to a moving kayak. These recordings are databased onsite, and made available online for analysis at the Australian Rivers Institute.

In addition to the kayak recordings, other field kits are distributed on location to capture sounds without human intervention. These include a stationary hydrophone that records from the same location during the entire field lab and a series of smaller field kits to capture the soundscapes above the water. The additional field kits are useful to analyse particularly sound sources in the hydrophone recordings that might be difficult to identify. The recording sessions are accompanied by community workshops and creative development experiments involving streaming and processing the hydrophone recordings.

The field labs are designed in an open format and encourage collaborations with the local community. The future outcomes will be made available through a virtual sound map and public listening sessions in Queensland, Australia. The database of recordings will form the foundation for a series of experiments at the Australian Rivers Institute to explore new methods in understanding and analysing the data from a scientific and creative perspective.

3. The River Listening Group

The River Listening labs in Queensland are part of a broader project in aesthetic and compositional perspectives on freshwater ecology. Whilst terms such as *ecosystem biodiversity*, *health*, *vulnerability* and *resilience* appear prominently in both scientific literature and policy debate, there is little consensus as to what these terms actually mean. Despite a widespread understanding of the importance of systems thinking in ecological ontology (Marshall, 2002), these concepts are often studied from a reductionist perspective, with simple operationalisations – such as equating biodiversity with species counts – uncritically adopted.

At issue here is that such terms are not fundamentally scientific, but rather socio-political, even theological: “irrespective of the concept label, characterisations and assessments of ecosystems and their attendant change are inescapably dependent on values.” (deChazal 2010:4). However, formal operationalisations of scientifically measurable quantities *can* adopt a holistic perspective, and indeed holistic acoustic indices of ecosystem ‘health’ are emerging as an exciting new technique in ecology (Servik 2014).

The River Listening Group is a new interdisciplinary collaboration formed by independent artist Dr. Leah Barclay, freshwater ecologist Dr. Simon Linke from the Australian Rivers Institute, and music technologist Dr. Toby Gifford from the Queensland Conservatorium of Music. The Australian Rivers Institute (ARI) is Australia’s largest university aquatic ecosystem research group with globally recognised expertise in river, catchment and coastal ecosystems. ARI is currently leading a range of innovative projects revolving around catchment and river ecosystem processes, aquatic biodiversity and conservation, and aquatic ecosystem monitoring and assessment.

The scientific grounding of the *River Listening* collaboration is directed by ARI Senior Research Fellow Dr Simon Linke, one of Australia’s leading freshwater conservation scientists, whose pioneering work in biomonitoring and river conservation planning has been used by agencies and NGOs from South East Queensland to the Congo. Barclay and Linke are joined by music technologist Dr Toby Gifford, a world-leader in real-time audio processing, machine listening and automated musical scene description who has worked with the ARI to establish frameworks for a real-time bioacoustic wildlife population monitoring network for Australian waterways.

4. Creative Foundations

Barclay's interest in rivers manifested in early environmentally engaged instrumental compositions such as *River of Mirrors* (2004), composed for chamber orchestra and inspired by elements of the Noosa Everglades. This work used an array of extended performance techniques to imitate the natural soundscapes, and employed repetitive textures to evoke the tannin-stained, mirrored waterways of Noosa River. The following year, in 2005, she composed *Confluence*, her first major multimedia environmental work commissioned for the opening of Earth Song Exhibition, during the launch of the Queensland Great Walks. Although not inspired by a specific river, *Confluence* drew inspiration from the characteristics of water and rivers. The piece was composed for cello, and used live electronics, digital projections and two dancers, which created a confluence of artistic media in a constant state of change that was controlled live. These two projects informed the development of Barclay's largest rivers project *Sound Mirrors*, and the beginning of a large-body of work inspired by rivers over the last ten years.

Sound Mirrors is an interactive sound installation that responds to specific rivers across the world. During 2009 and 2010 Barclay travelled through Australia, India, Korea, and China, capturing the sound of significant rivers and their surrounding communities. *Sound Mirrors* grew out of her lifelong connection with rivers and a deep personal affinity with water. She was inspired to explore a voice for the rivers through electroacoustic composition at a time when she felt it was becoming more important to listen to the environment.

Barclay's creative inspiration from rivers is shared by a wide spectrum of electroacoustic composers who have created works inspired by rivers across the world. Among the most pertinent is *Voicing the Murray*, an immersive sound installation by pioneering Australian composer RosBandt. The work was commissioned for the Mildura Arts Festival, and was designed to give the Murray River a voice: 'A voice derived from all the voices impinging on its banks and surfaces' (Bandt, 1996).

Bandt's composition process involved several on-site recording sessions, which focused on gathering stories from the local people. She was interested in the idea of capturing endangered sounds and exploring how the soundscape of the area had changed and evolved with the impact of technology. The project was underpinned by environmental intentions; Bandt wanted to draw attention to the environmental degradation of the area, by encouraging listeners to engage in the rich soundscapes:

I was excited at the prospect, as the Murray River is such a unique and critical habitat for the whole of Australia. It is a manmade oasis which has brought with it the by-products of man's overuse of the environment, erosion, salination, and cultural dislocation for indigenous peoples. (Bandt, 1986)

The electroacoustic repertoire inspired by rivers can be divided into three relatively distinct categories: works composed in the studio inspired by rivers; works drawing on environmental field recordings from rivers; and, finally, site-specific works that involve interactivity and community engagement. The first category includes iconic electroacoustic composers such as Richard Lainhart's *The Course of the River* (1975), Douglas Lilburn's *Soundscape with Lake and River* (1979), and Kaija Saariaho's *Trois Rivières* (1994).

Italian composer David Monacchi's electroacoustic composition *Statid'Acqua* (States of Water) composed in 2006 is a most effective sonic exploration of a river. Those fortunate to experience a live performance of the work are immersed in multichannel sound diffusion that draws the listener deep into a dense sound world that at times evokes the sensation of being underwater. The work was inspired by the multiple physical transformations of water (such as evaporation and condensation) through processed field-recordings. The composition draws on field-research in Rome on the Tiber River, ranging from its springs in the Monte Fumaiolo to its outlet in the Tyrrhenian Sea. Monacchi explored many recording techniques, including an array of microphones and movements along various sound sources, such as springs, streams, waterfalls and caves (Monacchi, 2006). The final composition is presented as a 30-minute performance on a multichannel sound array with 18 loudspeakers.

Garth Paine's composition *Present in the Landscape* (2011) is among the most pertinent of compositions that successfully explores contentious environmental issues through immersive river soundscapes. This work was composed during a residency at Bundanon in New South Wales, Australia, and is an exploration of the nearby Shoalhaven River.

Present in the Landscape specifically addresses the existence of a river, which runs across floodplains, and has had a dynamic and active life, changing direction, remapping its own presence in the landscape over centuries, as large weather events have occurred. However, a decade ago the large Tallowa dam was constructed upstream from the Bundanon property with the intention of providing drinking water to the communities on the south coast of New South Wales. (Paine, 2011)

The damming of Shoalhaven completely transformed the river and had a profoundly negative effective on the local environment, as is apparent in the damming of many rivers worldwide. Paine spent time interviewing the community surrounding the river to capture local perspectives. This included Aboriginal men who offered a critical understanding of the river from the perspective of traditional owners. His ambisonic field recordings captured the environmental soundscapes of the river, from the jumping fish to the temporal flow of the landscape itself (Paine, 2011). *Present in the Landscape* was presented as a six-channel composition and has also been published as a stereo recording.

The diverse literature inspired by rivers is impossible to capture in an introductory paper, but this collection of works would not be complete without mention of Annea Lockwood's trilogy of river sound maps. The trilogy begins with *A Sound Map of the Hudson River* (1982), and is followed by *A Sound Map of the Danube* (2005) and *A Sound Map of the Housatonic River* (2010). Lockwood has experimented with river soundscapes from the mid-60s, but the sound maps solidified her process of creating an 'aural tracing' (Lockwood, 2010) and of documenting the entire length of the river through sound. The sound maps are realised as multichannel installations with the recorded sites located on a wall map accompanied by a time-code so the listener can locate the current soundscape at any given time. Lockwood's sound maps are certainly rich creative responses to the rivers, and they are also functional and accessible insights into their respective acoustic ecologies.

As rivers across the world continue to be impacted by human activity, the *River Listening* project is designed to extend on the existing creative work in this area to explore a process that could bring attention to rivers as ecological entities that deserve respect and conservation. *River Listening* is deeply grounded in the scientific possibilities of field recording and the role of community engagement and multi-platform presentations. The process involves not just composing (in the traditional sense of the word) but collaborating with the community, listening to each river, and, at each site, responding and adapting to other processes that may emerge.

The Noosa River positioned in a UNESCO listed Biosphere of Australia, the historic Han River flowing through the city of Seoul, South Korea, and the Pamba River in the evocative backwaters of Kerala, South India, formed the foundation of Barclay's *Sound Mirrors* project. The process was mirrored at each river involving three distinctive stages: on-site research, field recording and composition. Each of the stages involved various elements specific to that environment, such as community interviews and intensive study and collaborative performances. The process of working with the three specific rivers in Australia, Korea, and India was completed over the duration of three months, working in cultural immersion in

each location. In addition to the three rivers, *Sound Mirrors* involved shorter duration projects on the Huangpu River in Shanghai, China, and the Pearl River Delta in Hong Kong. The realisation of *Sound Mirrors* was just as much about the cultural immersion in the rivers' communities as it was about the creative process.

The process in the field varied from sculpting and layering sounds recorded on location to directly responding to the environment. The source materials range from hydrophone recordings deep in the Noosa River, to pilgrims chanting at dusk on the banks of the Pamba in South India. Barclay worked intuitively with these materials in each location and attempted to capture a living aspect of culture through focusing on various sound marks of the environment. This project was produced on the road – in makeshift studios on boats, trains, riverbanks, and in hotel rooms – while drawing further inspiration from the environment. Working in the cultural context provided insight into the layers of tradition that were impossible to access without first-hand experience. Although these rich webs of history and heritage raised issues of possible cultural appropriation, every effort was made to approach this material in a culturally sensitive way. The most critical process was gathering permission from the appropriate custodians and building strong relationships with the rivers' communities. By producing these works on location, as opposed to returning to the studio, Barclay was able to gain feedback from the local community and collaborators, which was invaluable for her research process.

The *Sound Mirrors* installation has been exhibited a number of times, including the Noosa Regional Gallery in Australia, the Gallery of Modern Art in Bangalore, India, and at Stellenbosch University in South Africa. Eleven of the resulting compositions were released as an album, titled *Transient Landscapes*, and these works have also been programmed at various conferences and festivals. Barclay also began performing *Transient Landscapes* as a live work where she creates a multi-channel mix of the river soundscapes in real-time in response to the performance location. This project has no doubt brought attention to the soundscapes of rivers, yet it's unlikely to have made any significant contribution to the conservation of river systems. While it was a positive learning curve, Barclay recognised the potential for creative projects to have a wider impact when combined with ongoing community engagement, interdisciplinary collaborations and multi-platform outcomes. *Sound Mirrors* was a starting point for these ideas, and laid the foundation for *River Listening*.

5. Listening to the Thames

As a pilot project the River Listening Group will develop an audiovisual installation at the 25th Anniversary Electronic Visualisation and the Arts in London, July 2014. Based on a live hydrophone audio-stream from the Thames, the installation will deliberately inhabit a liminal space at the arts-science nexus, seeking to highlight the positive contributions each domain can have on the other, and document an emerging model of aesthetic-scientific exploration.

6. Future Implications

As the international interest in the emerging auditory fields of bioacoustics and soundscape ecology continues to expand, there are clear opportunities to harness virtual technologies to develop accessible community engagement around the creative and scientific possibilities of listening to the environment. *River Listening* provides a model to develop a truly interdisciplinary approach at the critical stage of creative development and it is anticipated the future results will be beneficial to national ecosystem monitoring programs. It is also hoped that *River Listening* could become a catalyst for community engagement and interdisciplinary thinking at a time when the conservation and management of aquatic ecosystems is a critical priority. At the conclusion of the *River Listening* labs in Queensland, the research team hope to expand this project across Australia and beyond.

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