Augmenting Urban Space with Environmental Soundscapes and Mobile Technologies

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Abstract

As locative media and augmented reality swell into mainstream culture, this article traces my creative explorations with locative sound, stretching across a decade of practice. The featured projects are all embedded into larger research initiatives, which are designed to explore the value of acoustic ecology as a socially engaged, accessible and interdisciplinary field that can inspire communities across the world to listen to their environment. These interconnected projects draw on sound walking, mobile technologies and locative media to investigate the role of sound in achieving presence and connection to place. The creative works are accompanied by the introduction of new projects that are informed by this research, and reflections on the future possibilities of locative media in exploring layers of our social, cultural and ecological environments through sound.

Introduction

Sound has a profound ability to make us feel present and connected to our surrounding environment. In recent years, there has been a proliferation of site-specific audio works exploring the possibilities of mobile technologies and locative media in place. This means at any given moment in an urban environment, we could be moving through a sound field of voices, music, memories and sonic art, dispersed invisibly throughout the places we inhabit. While this material is available only to those with mobile devices and knowledge of the locative experiences, the advancement of new technologies and the accessibility of mobile devices means new opportunities for exploring our social, cultural and ecological environments through sound. In the 2007 CreateWorld keynote presentation in Australia, pioneering media artist Nora Farrell, remarked that the future of computing is in the mobile phone. She proposed it to be the most valuable platform for creative artists to focus our energies, and predicted an incredible future for interactive spatial audio on mobile platforms. The body of work that has evolved internationally over the last decade suggests Farrell's premonition was certainly correct and she has been an endless source of inspiration for my ongoing research.

New technologies are providing a rapid increase in accessibility and engagement, however these practices stem from a significant body of creative work dating back to the 1960s. Transient experiences in which the core focus is sound and listening, are well established in practices such as Soundwalking, which has been active since the 1970s when it was pioneered by practitioners including Westerkamp (1974), McCartney (2014) and Corringham (2016). Locative sound art practices have been active for almost four decades, with artists including Max Neuhaus in the 1960s, Janet Cardiff and George Bures Miller's audio walks in the 1990s and a wide diversity of artists over the last two decades. Significant works include Graeme Miller's *'Linked'* (2003), a piece that broadcast voices and memories along the M11 Link Road in London after 400 houses were demolished, and Christina Kubisch's *'Electric Walks'* which launched in Cologne in 2004 and involved listeners wearing sensitive wireless headphones that amplify inaudible electromagnetic fields in one's surrounding environment (Kubisch, 2016).

Many of the works in the field have an underpinning ecological focus. In *'Listen Toward the Ground'* by Jeremiah Moore (exhibited at ISEA2012 in New Mexico), the soundscape of downtown Albuquerque was superimposed with oilfield infrastructure to highlight the realities of energy extraction. ISEA2012 also featured the work of Teri Rueb, who is widely considered a leader in the field particularly through her work *'Core Sample'* (2007) which uses GPS across Spectacle Island in Boston Harbor to evoke sound material and cultural histories of the landscape. At ISEA2012, Rueb collaborated with Larry Phan on the work *'No Places With Names'*, which explored the concept of wilderness and its shifting meanings across cultural contexts through geolocated sounds surrounding the Institute for American Indian Art in Santa Fe. The sounds and personal stories emerged from the landscape and facilitated a profound connection to the immediate environment that would have been impossible to achieve inside a gallery.

Listening and walking are both temporal activities that have the capacity to connect us to the physical landscape (Behrendt, 2013). Despite the emerging body of work, it has been widely considered that mobile technologies disconnect us from the environment. During a session at the 2013 IUCN World Parks Congress in Sydney, there were numerous presentations that suggested spending time in the wilderness free from mobile devices. These were the most effective means to inspire ecological engagement and climate action amongst younger generations. However, having witnessed young people engage with ecological locative media experiences, I hold the position that a headphone-based sonic experience can motivate communities to connect to their environment through sound. Thus my presentations during the congress revolved around thinking of mobile technologies as tools for reconnection as opposed to disconnection, which was met by a mixture of curiosity and disagreement.

This notion has been championed by others including Behrendt (2013) who suggests that locative media experiences such as Rueb's *'Core Sample'* (2007) have the potential to reconnect people with natural ecosystems rather than alienate them. Speed (2010) believes locative media has the capacity to construct a sense of place through its potential to bind geographical, social and cultural dimensions. Droumeva (2016) examines the multimodal possibilities of the smartphone and highlights how it is increasingly integrated into the fabric of everyday life particularly through sensorial encounters with physical spaces. In

the context of oral history, Bradley (2012) suggests locative audio experiences can have important implications in the ways oral history can be presented and connected to places, and moreso, play a vital role on how it is collected, achieved and curated. As locative media and augmented reality shifts into mainstream culture, this article traces my creative explorations with locative sound stretching across a decade of practice. While the highlighted projects differ in terms of content, they all share the same intention in experimenting with the possibilities of mobile technologies as tools for ecological connection and exploring the value of acoustic ecology as a socially engaged, accessible and interdisciplinary field that can inspire communities across the world to listen to the environment.

Creative Explorations in Locative Audio and Site-Specific Sound Art

My initial encounters with sound in locative media experiences happened in Europe and Australia, through museum tours and audio walks that had a tourism or historical focus. While I was intrigued by the possibilities, it was not until a performance in 2007 that I became engaged in exploring locative media experiences in my own creative practice. *'iOrpheus'*, otherwise known as the *'iPod Opera'*, was a large-scale transient performance which used sound to activate the South Bank Parklands in Brisbane, Australia, on August 31, 2007. *'iOrpheus'* was conceived and created by American composer William Duckworth and media artist Nora Farrell, who are widely regarded as internet pioneers through their creation of virtual music and interactive web based experiences (Duckworth, 2005). The project was produced by the Queensland Conservatorium Research Centre with the support of a Fulbright Senior Specialist Grant.

The performance interpreted the story of the mythical musician Orpheus in five acts stretching the entire length of South Bank parklands with live music, immersive sound installations, dance and dynamic fire displays. '*iOrpheus*' was a ground breaking work that pioneered the possibilities of iPods in live performance. Multiple devices were dispersed throughout the event streaming ribbons of sound that moved throughout the parklands sonically connecting each node of the performance. The sounds were streamed via podcasts, with Farrell and Duckworth truly exploring the creative potential of emerging technologies. This was the first largescale performance to use podcasting in such an innovative way and exposed the audience to the future possibilities of mobile technologies in music composition. I was deeply inspired by the entire experience—from the transient nature of the performance to the incredible way mobile technologies were seamlessly used to heighten our connection to place and sense of sonic immersion.

I was privileged to meet and work with Nora Farrell and William Duckworth during their time in Australia and my pathway into locative media was solidified in 2008 when they invited me to collaborate on '*Sonic Babylon*', an interactive sound garden riding local Wi-Fi networks. The '*Sonic Babylon*' sound gardens were designed to grow with music, sounds, and stories, accessible on mobile devices in selected spaces within a community. As visitors move through the garden, the *'Sonic Babylon'* application tracks their position in the space and the 3D audio engine generates a real-time sound mix relative to the location of the planted sounds. The Sound Garden toolkit and *'Sonic Babylon'* application, developed by Nora Farrell, was modified from Tactical Sound Garden [TSG], an open source software platform for cultivating public sound gardens developed by artist and architect Mark Shepard. The Tactical Sound Garden tool kit draws on the culture of urban community gardening to posit a participatory environment for new spatial practices and social interactions (Shepard, 2005).

The positional audio environment of *'Sonic Babylon'* and TSG allows users to not only listen to the soundscapes but also participate by planting and pruning sounds. Mark Shepard describes the TSG Toolkit as a parasitic technology, as it feeds on the propagation of WiFi access points in dense urban environments (Shepard, 2005). In locations where there are minimal WiFi access points, the gardens may consist of a single street, but when there is a density of nodes the gardens have the capacity to grow across the entire city and beyond (Farrell, 2009). While both *'Sonic Babylon'* and the Tactical Sound Garden toolkit had a clear intention for densely populated urban spaces, I was interested in exploring the potential in regional areas during the first phase of Sound Gardens in Australia. In addition to *'Sonic Babylon'* installations at the National Film and Sound Archive in Canberra and the Queensland Conservatorium Research Centre in Brisbane, I worked with Duckworth and Farrell to install sound gardens in regional communities on the Sunshine Coast, which required the installation of WiFi nodes specifically for this experience.

The first *'Sonic Babylon'* installation on the Sunshine Coast launched at the Noosa Regional Gallery on September 12, 2009. The sound garden grew with historic recordings, local stories, indigenous voices and excepts from my sound installation *'Eco Sonus'*, commissioned for Floating Land 2009. *'Eco Sonus'* was a multi-platform project designed to connect communities to the environment through sound and acoustic ecology. The collaboration with *'Sonic Babylon'* was a perfect extension to *'Eco Sonus'* in allowing communities to experience the acoustic ecology of Floating Land, augmented through the art gallery and along the Noosa River. The *'Sonic Babylon'* sound gardens have a diversity of positive outcomes for a community, including the ability to repurpose existing digital content (such as oral history) and also the ability to observe a system, a virtual ecology, and hear what kind of voices and themes may arise. I was fascinated by the versatility of the project and its ability to grow within a community over time. I was also in awe of the creative process of both Duckworth and Farrell and inspired to delve deeper into the potential of mobile technologies and locative media in my own creative practice. The *'Sonic Babylon'* mobile application and overarching creative project was clearly ahead of its time, highlighting the incredible creative and technical genius of Nora Farrell. The mobile app had the capacity to host dynamic and interactive spatial audio experiences, it provided incredible agency to the community in sculpting personal sonic experiences. As some of the world's leading artists, Nora Farrell and William Duckworth were incredibly generous collaborators and designed the experience to meet the needs of the community. It was evident their work was truly about the value of deep listening and sound as a tool for connecting, inspiring and revealing possibilities for the future.

'Sonic Babylon' became an integral element of various acoustic ecology projects I produced across regional Queensland from 2010–2015. The project was a core layer for *'Cypress Trilogy'*, a work commissioned for the Sunshine Coast Council TreeLine initiative—one of Australia's most ambitious green art projects in 2010. *'Cypress Trilogy'* combined immersive environmental soundscapes, live performers, interactive

lighting and live projection art and was my first major commission inspired by the Noosa Biosphere Reserve. The piece opened with a collaboration between Indigenous artist Lyndon Davis and the Gubbi Gubbi Dance troupe on the banks of the Noosa River and was followed by 'Dusk, Darkness and Dawn', three contrasting movements that formed the body of this multi-sensory performance. The work provided a rich tapestry of local history abstracted through the soundscape and featured pioneering Korean taegum artist Hyelim Kim, virtuoso guitarist Anthony Garcia, video artist James Muller and dancers Jeremy Neideck and Mary Eggleston.

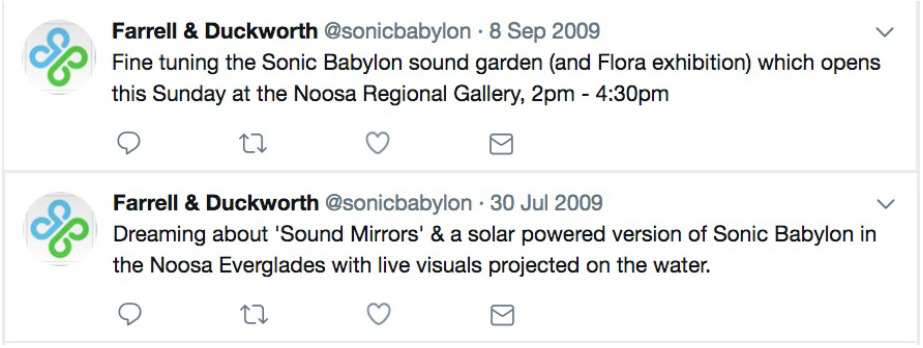
Cypress Trilology

'Cypress Trilogy' concluded by returning outdoors to the same location as the prelude, with the soundscapes blending into the '*Sonic Babylon*' sound garden, together with interactive lighting set among the trees along the Noosa River. While the performance had been a passive experience, this final experience was deliberately designed to directly engage the community in the interactivity of the work. The *'Sonic Babylon'* sound garden enabled interaction, engagement and immersion with the environmental soundscapes. The idea was to empower the community to become collaborators in the work and also to emphasise the importance of acoustic ecology and participatory engagement in the overall project. I was inspired to integrate *'Sonic Babylon'* to offer the community agency. By the community adding their own sonic responses and becoming part of the project, the sound garden was dynamic, alive and constantly evolving, resulting in a sustained process of community engagement beyond the performance, and encouraging engagement with place in new ways.

Amongst the first layers of sound planted in *'Sonic Babylon'*, were conversations with Lyndon Davis, who spoke about the Indigenous history of the Noosa Biosphere Reserve and introduced Gubbi Gubbi words (the Indigenous language of the region). As this cultural knowledge is not easily accessible for the local community, it was rewarding to observe this project facilitating knowledge sharing through new technologies. Young children were learning the Gubbi Gubbi words for their surrounding environment as they walked throughout the gallery—their parents were equally curious in discovering layers of local history though sound. *'Cypress Trilogy'* also used twitter to host a conversation with the community about the project and explore new ideas for the future. The idea of mobile technologies reconnecting communities to the environment was seen as a contradiction by some, but the local community was clearly engaged and actively listening to environments that were not traditionally audible.

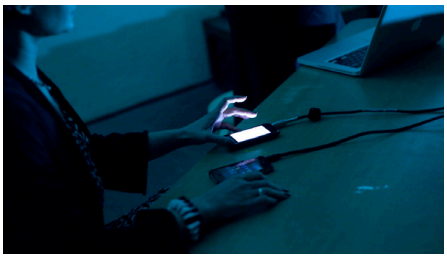
While *'Sonic Babylon'* was undeniably a ground breaking milestone for locative sound art and ahead of its time in terms of concept, technology and innovation—maintaining the engagement of the community was always a challenge. The project came at a time when smart phones were not in everyone's pocket, and the notion of using a mobile phone to plant and prune locative soundscapes was beyond comprehension for some members of the community. This inspired the development of community workshops and initiatives such as '*NeoSonic*' (2010), which provided accessible pathways for regional communities to explore and experiment with the creative potential of mobile technologies in public space. '*NeoSonic*' was developed and funded under the banner of NeoGeoGraphy, a creative place-making program initiated by Queensland local government to assist communities in navigating new technology. In addition to *'Sonic Babylon'* installations at the Cooroy Library and Mill Place Precinct, I launched a suite of other projects through *'NeoSonic'* including a virtual orchestra (using mobile devices), networked performances with children, sound walks and extensive interactive workshops which were supported by funding from Arts Queensland and Sunshine Coast Regional Council.

At the NeoGeoGraphy showcase in November 2010, we created a multi-sensory performance mixing community interviews and environmental recordings with live



Tweets from 'Sonic Babylon' in 2009

digital drawings, projection art, live musicians and Gubbi Gubbi Dancers. I improvised with soundscapes streaming on two iPads, while Nora Farrell composed a live mix from *'Sonic Babylon'* with iPhones in each hand. As we were using the first iPads distributed in Australia—we believe this was the first-time iPads and iPhones were combined for an immersive performance that integrated live streaming audio and spatial diffusion. The concert was a prelude to ongoing community engagement with *'Sonic Babylon'*, where local audiences recorded and composed their own soundscapes. Despite these periods of intensive community engagement, it was a continual challenge encouraging the local community to engage with these locative media experiences independently. This was largely due to the accessibility of mobile devices and the technical aptitude of the communities engaged in these projects in regional areas.



Nora Farrell and Leah Barclay performing at the NeoSonic showcase in 2010

Throughout 2010–2013, I created various stand-alone sound walk experiences which simply used fixed media compositions streamed on mobile phones, and physical sound maps including walking directions. These had varied successes in terms of engagement but lacked the sophisticated complexity and interactive possibilities of *'Sonic Babylon'*. I began to explore the multi-platform potential of locative media in extending the experience of live performances. The first public outcome of this research was during the 2013 season of *'Zameen'* at Sydney's Riverside Theatre for Paramasala Festival.

'Zameen' is the first major performance from *'The DAM(N) Project'*, a large-scale interdisciplinary art venture that connects Australian and Indian communities around the common concern of global water security. It presents the lives of remote communities in the Narmada Valley of North India, displaced by large-scale dam development which is securing hydropower for Indian cities. 'Zameen' is a Hindi word meaning 'land'. It is a word that has become synonymous with the Narmada movement and with the submergence of the valley. As a performance piece *'Zameen'* is a holistic project. It integrates innovative technology, diverse community perspectives and true stories of resilience, to create an immersive performance through projections, choreography and multi-channel soundscapes. Described as mysterious, beautiful and utterly captivating (Paramasala, 2013) *'Zameen'* pulls audiences into the heart of a remote Indian community fighting for their way of life. Within this world, two dancers perform an intense, controlled and intricate dance score inspired by the stories and movement of the community. An immersive audiovisual environment, composed entirely out of recordings from the Namada Valley, positions the audience in the midst of their song and struggle to secure land in the face of large scale dam development.

'Zameen' was developed collaboratively with Sydney-based producer Jehan Kanga and S. Shakthidharan, the director of CuriousWorks, who created triptych visuals for the show in response to my immersive soundscapes. My material for this project was sourced during a journey we made into India's Narmada Valley in 2011. We lived and worked alongside families whose lands and livelihoods are slowly being submerged due to large scale dam development in the area. The movement to halt the submergence and question India's development processes—called the Narmada Bachao Andola or "NBA"—has become one of the most successful activist movements in contemporary social history.

The season of *'Zameen'* at Parramasala Festival 2013, was designed as a multi-platform experience. Our documentary screened on a loop prior to the show and the foyer featured a photography installation that visually explored the communities we encountered during our creative development in North India. The festival also invited us to create a locative sound installation to accompany the show. Unlike the participatory *'Sonic Babylon'*, this was to be a singular experience with a specific thematic focus. The source sound material is predominately from the regional area of Jobat, where we collected stories and solidarity songs from over 20 displaced groups who had gathered at a satyagraha (non-violent protest). Each soundscape draws from our experiences in situ, ranging from abstract explorations of hydrophone recordings in the Narmada River, to songs of hope from the children. Ultimately, the soundscapes of *'Zameen'* were designed to connect global communities around the common concern of global water security and to reveal the ramifications of damming rivers that hold cultural and spiritual significance for indigenous communities world-wide. The locative media experience needed to be culturally sensitive to these voices as well as adapt to how audiences shifted through the work. My response was to compose a series of three minute experiences that worked together as a multi-layered composition and were designed to draw the audience outside towards the Parramatta River.

I explored the possibilities available—developing a custom mobile application or various exisiting platforms that would be appropriate. We settled on using an application called *Sonic Maps*, a locative audio application that will be discussed in detail in the next section of this article. I was attracted to *Sonic Maps* as it allowed me to use GPS to position the soundscapes, thus allowing the audience to journey through a non-linear exploration of the soundscapes throughout the Riverside foyer and along the Parramatta River. However, I encountered some immediate technical problems as the theatre and its surrounding area was in a GPS blackspot, which meant the app was unable to recognise the locations and the audio playback did not function correctly. Due to time and budget constraints we were unable to develop a customised app, so we resorted to recreating the sonic environment as a series of fixed media experiences streaming from our website (**www.thedamnproject.com**). Audiences could use their own smartphone or the players and headphones provided at the box office, to immerse themselves in the soundscapes before or after the show. Despite the technical issues, this provided a rich layer to the work and gave audiences the opportuity to engage with the soundscapes in a more embodied way, particularly as they walked along the river bank. The juxtaposition of listening to the heart-breaking stories of the Narmada River while walking along an altogether different and healthy river system, opened up possibilities to deeply reflect on the water thematic that rippled throughout this project.

The audio tours model was also explored during the launch of the Biosphere Soundscapes project in 2012 (**www.biospheresoundscapes.org**), with binaural recordings and electroacoustic compositions designed for augmented reality sound walks

through particular locations in the Noosa Biosphere Reserve. These were not location triggers, but simply just visual sound maps and streaming audio files. This process highlighted for me, the limitations and simplistic nature of these experiences. While they are very effective in some instances, they were too restrictive for the style of experiences I envisaged that were truly responsive to place and only activated with location and movement. I was much more interested in the idea of the sounds only triggering once a listener was present in the specific locations, which is the feature of the WiFi technology pioneered through *'Sonic Babylon'* and TSG, as well as the plethora of GPS triggered locative media tools becoming readily available. As McCartney (2014) outlines there are many limitations of audio tours, particularly in relations to pacing, rhythm and timing, but she also emphasises that "decisions about the location, style, content, and montage of sound in a soundwalk have political, social and ecological consequences" McCartney (2014).

At this point in time when locative media applications were gradually proliferating public spaces, I was intrigued by platforms that presented opportunities for collaboration, where community voices, memories and local history were intertwined with locative artworks and soundscapes. This was the underpinning of the creative projects that will now be discussed. They explore the idea of adapting and appropriating existing tools that work towards the development of a custom application for acoustic ecology and augmented reality audio. Prior to introducing these projects, I will briefly reflect on the available tools to contextualise my decisions with using specific platforms.

Augmented Reality Sound and GPS Audio Tools

The following section does not seek to review all existing augmented reality or locative media applications for audio, but rather chronicle the applications that have influenced this research and highlight the platforms that are collaborative in nature and focus on specific tools relevant to the creative projects I was engaged with throughout these projects. It should be noted, that while aspects of these mobile applications influence and inform how audiences interact in public space, the focus of this research remains on deep listening, engaging with our soundscape, and exploring the possibilities of mobile technologies in interrogating and understanding our relationship with place.

NoTours **NoTours.org**, is a locative media project by the collective **Escoitar.org**, designed by Horacio Gonzalez and Enrique Tomas. This application encourages community participation and allows users to attach sounds to a location using GPS. While this app has many positive features, it runs on android only, so was not suitable to meet the accessibly guidelines of this research. The *NoTours* application has inspired a wide spectrum of similar projects and has been particularly influential at the NOVARS Research Centre, currently directed by Professor Ricardo Climent at the University of Manchester. The NOVARS Research Centre has developed a large portfolio of augmented reality projects and its alumni include some of the current leaders in the field, including Dr Ignacio Pecino, who developed *Sonic Maps* when he was a PhD student at NOVARS. In addition to providing a sophisticated GPS audio platform, *Sonic Maps* includes a 3D audio engine option using Unity3D for immersive soundscapes and rendering sounds in realtime. It also allows flexibility when experiencing sounds in situ and includes tools such as panning through device rotation and responsive sound levels based on your location in relation to the sound file. *Sonic Maps* is also available for iOS and Android and builds on the original tools developed by *NoTours*. *Sonic Maps* was the platform used for the initial sound experiences for '*Zameen*' and it allowed us to explore the challenges and opportunities when using GPS to trigger audio experiences in urban and regional locations.

Josh Kopeck, a London based entrepreneur and artist working with sound and geolocation, was also a PhD student at NOVARS where he was inspired by *Sonic Maps* after experiencing one of the sound walks produced using the app. This resulted in the creation of *Echoes* (Echoes.xyz), an augmented reality application that uses GPS to determine the users' location and orientation, in order to trigger content while moving through an environment. *Echoes* was developed in collaboration with Mathias Rossignol and has produced a wide spectrum of dynamic experiences in addition to supporting an expanding database of user generated content. While *Echoes* was not used in the initial creative projects outlined in this article, the potential of this platform sparked a range of new projects and influenced the development of my latest body of work that will be discussed at the end of this paper.

There are a wide spectrum of other applications that facilitate the creation of GPS audio tours such as *Shoudio* (**www.shoudio.com**) and *U-GRUVE* (**www.u-gruve.com**), an application that has commissioned composers to create music in response to place and use GPS to trigger the compositions for listeners. *U-GRUVE* was designed and created by Richard Rodkin, a New York-based composer and creative coder who launched the app for Creative Tech Week 2016 in New York City. The accessibility of location-based technology and the popularity of podcasts means GPS audio experiences are gradually becoming part of consumer media, particularly with ventures such as *DeTour* (**www.detour.com**) producing GPS audio walks that take you beneath the surface of the city "infused with cinematic scoring and storytelling by some of the best writers and sound designers in the world" (**www.detour.com**).

Amongst these applications, I discovered *Recho* (**www.recho.org**), an app that was attempting to establish a social network for sound and had perfected an interface for GPS audio. The platform hosts an incredible diversity of content across the world ranging from geo-located sonic art and museum tours, to community stories and challenging treasure hunts. *Recho* also allows users to record directly into the app, responding in realtime to their experience and allowing the soundscapes to grow in a similar way to *'Sonic Babylon'*. The platform was created by Copenhagen based designer Åsmund Sollihøgda and transmedia-producer Mads Damsbo, who were inspired to create *Recho* by their love for podcasts. The pair were interested in the idea of users leaving digital sounds in physical places and the notion that stories and interactions inherently belong to place. The user experience of *Recho* is also designed to explore the possibilities of audio in location-based social media, with the ability to connect, share and collaborate, or even leave sounds at a specific location for a single user. My initial attraction to the app was the accessible sonic experience and the interface. While many GPS audio apps are reliant on map based visual interfaces, *Recho* transforms the users' device into a dynamic sonic compass with sound appearing in colour coded shapes and sizes in relation to the featured content. The interface for interact-

ing with the soundscapes was intuitive and accessible and allowed users to experience the soundscapes in a non-linear way.

Åsmund Sollihøgda and the *Recho* team were enthusiastic about the possibilities for their tools being used in the context of acoustic ecology, environmental engagement and awareness. While not the initial intention of the platform, they were highly supportive in exploring a range of ideas related to sound, place and locative media. In December 2014, we formed a partnership to explore the creative potential of *Recho* through a series of sound installations augmenting public spaces with environmental soundscapes. The following creative projects outline the results from our partnership from 2014–2016.

Wira River Listening

WIRA means moving water in Gubbi Gubbi language, the first nation people of the Noosa Biosphere Reserve in Queensland, Australia. In late 2004, I composed my first piece inspired by the Noosa River. This was the beginning of a decade of creative work that explores the value of sound, digital technology and community engagement in environmental awareness. '*WIRA River Listening*' is an interactive sound installation that reimagined the world beneath the surface of the Noosa River for Floating Land 2015 at the Noosa Regional Gallery in Queensland, Australia. Floating Land began as a biennial outdoor sculpture event in 2001 and has since grown to become one of the most significant contemporary 'green art' events in Australia. The theme of Floating Land 2015 was Reflect & Re-imagine which provided an opportunity to pause and reconnect with the grassroots beginnings of this event, exploring the connection between art, the environment and the local community.

'*WIRA*' explores rivers as the lifeblood of communities and reimagines the Noosa River in sound by layering the environmental sounds of the river system with sonic art, stories and soundscapes from Floating Land that I have recorded and composed over the last decade. The installation is underpinned by hydrophone (underwater) recordings layered with a diversity of cultural and biological soundscapes. Many of these soundscapes include the voice of Gubbi Gubbi artist Lyndon Davis speaking in Gubbi Gubbi language and introducing the Indigenous history of the Noosa River. When experiencing '*WIRA*' on location, these geo-located soundscapes are layered with binaural and hydrophone recordings and live streams of the Noosa River. These recordings and hydrophone streams evolve and adapt based on the conditions of the Noosa River, meaning every walk is a unique experience. The installation was designed inside the application *Recho* and was the first public outcome from our partnership. '*WIRA*' was also the first major creative outcome from *'River Listening'*, an interdisciplinary project exploring the creative possibilities of aquatic bioacoustics in global river systems. *'River Listening'* launched in 2014 through my Synapse Residency supported by the Australian Network for Art and Technology and Australia Council for the Arts and was developed in collaboration with the Australian Rivers Institute.

'*WIRA River Listening*' opened on August 27, 2015, and has remained a permanent installation for the community. The entire installation takes roughly one hour to experience, but the compositions were created in a non-linear layout meaning listeners could experience the installation in sections or return to different locations over the duration of the exhibition. The distance of each sound varied, with some placed very close together and others further apart, to encourage reflections and active listening to the natural sounds of the Noosa River and surrounding environment. In these instances, the listener was encouraged to walk for up to five minutes before they reached the next soundscape. It was essential '*WIRA*' was accessible for the local community, so those without access to a smart phone could also listen inside Noosa Regional Gallery at the '*WIRA*' listening station. I also created an accessible version online (www.leahbarclay.com/wira) with selected compositions, to allow community members who were unable to walk the distance the opportunity to listen from any location. The gallery provided headphones and listening devices during open hours, although the installation remained live consistently, thus listeners could come at dawn or dusk to experience the installation and many opted for listening at times when the gallery was closed and the surrounding environment was much quieter.

The soundscapes of '*WIRA*' explore the value of sound and technology in contributing towards environmental awareness and engagement. Each sound was located in direct relation to a relevant part of the river bank. Snapping shrimp became louder as you walked towards the jetty, community voices arose at landmarks, and the sounds of deep hydrophones drew listeners closer to the water. While much of my previous research had suggested that a multi-channel immersive acousmatic concert with high-quality speakers is the most effective method to inspire environmental engagement through electroacoustic music, '*WIRA*' suggested otherwise. Community members who would never attend an electroacoustic concert were enthralled by the experience and children stayed engaged and listening for a remarkable amount of time. Naturally some compromises had to be made in order to stream via the mobile application. Initially I had composed the soundscapes as approximately three minutes each and had attempted to maintain the quality by using limited compression on the resulting sound files. This was not realistic as the sound files were taking up to 30 seconds to load. The second iteration during my creative development involved two-minute sound files with minimal compression. This reduced the load time to 10–15 seconds, however my preliminary tests with community members recommended that the sounds needed to load in 3 seconds, or ideally play instantly. This resulted in a compromise in the sound quality which was ultimately worth it as listeners tended to stay engaged for longer periods of time.

'*WIRA*' was accompanied by performances, community workshops and regular group sound walks which all contributed towards the accessibility and engagement of this installation. Comments including "*I have never thought about rivers making sound, or how sound affects the environment*", "*Listening to the soundscapes and voices as I walk along the river made me lose all sense of time and notice things I didn't even know were there*" and "*WIRA opened up a different way of listening and a new way of understanding sound in the environment*", were amongst the positive responses to the installation. Some members of the community struggled with the technology on their phone, but fortunately the gallery listening station and the other listening methods meant there were multiple ways to access the sounds.

As '*WIRA*' stretches towards the river mouth, looking out towards the ocean, the voices from Indigenous communities in Vanuatu could be heard across the surface of the water. These included the rich soundscapes from the Leweton Cultural Group and Vanuatu Women's Water Music who were visiting artists at Floating Land 2015 and who are exploring new ways to

preserve their cultural knowledge as their islands continue to experience the true ramifications of climate change.

Sandy Sur, the leader of the Leweton Cultural Group, visited Noosa and listened to the sounds of his communities for the first time along Noosa River before the installation formally opened at Floating Land. Although he had granted permission to use the sounds, it was important to me that he experienced the work and found value in the project before we proceeded. He stood in silence at the river mouth and looked out towards Vanuatu listening intently. He thought this technology could be powerful in sharing his culture and bringing awareness to rising sea levels in the Pacific Islands. These Island communities are at risk of not just loosing their homes, but their cultural knowledge systems which are deeply connected to the environment. While this was the first time Sandy had experienced a locative media installation, he could immediately understand that this technology had the potential to contribute to his mission in brining wider awareness to the state of the Pacific Islands and the knowledge and culture that will be lost if we do not take action.

At a time when communities urgently require new ways to connect with the environment, locative sonic art offers the possibilities to reconnect listeners through the social, cultural and ecological dimensions of place, memory and sound. Members of the local community also experienced the preview of *'WIRA'* with Sandy and made comments such as; *"This is how sound should be kept and preserved, outdoors in the environment, not on a hard drive in the library"* and "*It is like discovering another world floating in the air, that we can all access"*.

Through ongoing conversations with Sandy Sur and my long-term collaborations with local Gubbi Gubbi artists and Indigenous communities in India, Brazil and across Australia, I was privileged to learn about traditional knowledge systems and how cultural soundscapes are intrinsically connected to place. Through this initial collaboration with Sandy for the *'WIRA'* installation, it became apparent that soundscapes located in environments using GPS, resonated strongly with Indigenous perspectives on place and sound. Sandy believed it made perfect sense for a sound to be attached to an environment with GPS and he felt it to be much more natural than the way we currently consume music and podcasts through mobile devices.

Sandy Sur's personal research aims to develop a deeper understanding of the role sound plays in ecology and how the music of Vanuatu is deeply inspired by place. The Vanuatu *Water Music* is now evolving in response to rapidly changing climates and Sur advocates for this tradition as a call to action. He describes the *Water Music* as a message passing through space that connects with every aspect of the surrounding environment; the sound travels and transforms, remaining part of an interconnected mesh that allows people to understand land, water, nature and culture. This resonates strongly with what Timothy Morton (Morton, 2007) describes as the vast intertangling 'mesh' flowing through all dimensions of life, as well as Steven Feld's concept of acoustemology, which explores sound as a distinctive medium for knowing the world (Feld, 1996).

Sandy Sur and his community perceive sound and water in similar ways—a substance that is essential for survival with cultural and spiritual significance. It holds knowledge and is deeply connected to place. Sandy recognised the possibilities of locative sonic art as a dynamic and accessible call to action that mirrored his cultural perspectives and offered an intimate window for communities to connect to place through traditional knowledge, memories and soundscapes. We spoke for many hours

River Listening Image from Brisbane River, Queensland, Australia

about the synchronicity between Sandy's perspectives on listening, the Australian Indigenous tradition of Dadirri (deep listening to the land) and Pauline Oliveros' incredible deep listening practice which has been profoundly influential on my personal artistic practice. Oliveros' perspectives on sound, embodiment, listening and tuning to our environment continue to inspire and influence how I think about sonic relationships and connections in these installations. Her work provided a wonderful connection point for us to share ideas for the preliminary work with '*WIRA*' and ongoing collaboration between Australia and Vanuatu.

The '*WIRA*' collaboration with Sandy Sur also sparked a wide spectrum of other new ideas such as coastal sound walks that live streamed the sounds of humpback whales songs and stories of Island communities in the distance, composed into a rich and immersive sonic experience. Accessible mobile technologies could become valuable tools in not just reconnecting us to the environment, but also in helping us to explore the acoustic ecologies of changing environments across the globe. While many continue to consider mobile technologies as key factors in our disconnection to the environment, particularly amongst the younger generations, '*WIRA*' explored ways for repurposing these technologies as accessible creative technology that can reconnect us to the environment and facilitate collaborations that reveal ecological systems. It opened up the potential synchronicities between location based augmented reality and Indigenous knowledge systems. '*WIRA*' allowed communities of listeners to hear sounds beneath the surface of a river they would not usually think about, and to explore the importance of sound in our surrounding environment, particularly at a time when it is increasingly important to listen to the rapid ecological changes taking place across the world.

Rainforest Listening: Climate Week New York City 2015

'*Rainforest Listening*' is an augmented reality project that layers a canopy of rainforest soundscapes in urban environments to inspire ecological engagement. Listeners access the sounds via mobile devices and sculpt their own experience by triggering geolocated soundscapes as they walk through iconic locations across the world. The soundscapes are all drawn from a database of my field recordings from tropical rainforests in South America and the Asia Pacific region gathered across a decade. I had created numerous installations and performances drawing on these recordings that were designed to educate audiences in the complexity of rainforest soundscapes, but now I was interested in designing experiences to translate this awareness into action. '*Rainforest Listening*' was created specifically as an engagement tool for Rainforest Partnership (**www.rainforestpartnership.org**), an international NGO founded with a mission to protect tropical rainforests by partnering with people at global and local levels to create lasting solutions to deforestation. By connecting this installation to a conservation organisation, the audience has a direct pathway to take action, either by educating themselves further about rainforest conservation or donating directly to Amazon communities during the experience.

There are numerous conservation organisations who would have been appropriate for this collaboration. I was attracted to Rainforest Partnership as they work directly with rainforest communities to find opportunities and collaborations for ecological and economic sustainability. This involves developing projects that protect the forest by solidifying its local value through eco-tourism, research, traditional knowledge, medicine and arts and cultural ventures. While local communities see inherent value to the forest, the economic benefit of logging, mining and agriculture often influences their decisions, especially when they may have limited opportunities and their livelihoods are under threat. Rainforest Partnership employs a collaborative, results-driven model and works in collaboration with local governments, conservation organisations and established contacts that have already gained community trust. Most importantly, the communities play an active leadership role in the design and implementation of projects and the income generated goes directly to the communities.

Rainforest Partnership have had an incredible impact in a short period of time in supporting 14,744 people, preserving 31,249,556 trees, storing 741,683 tons of C02 and protecting 197,782 acres (Spelman, 2016). Nonetheless, like many conservation organisations they struggle to engage the general public in their cause and are constantly seeking new tools that allow people to experience the Amazon Rainforest. The Amazon Rainforest is widely considered as the lungs of our planet, the Amazon Basin alone stores 400 million metric tons of CO2 per year—about 25% of all carbon stored on land, and it produces 20% of the world's oxygen. Nearly 4,500 acres of rainforests are lost every hour from illegal logging, mining, agriculture, forest fires, and oil drilling (Spelman, 2016). There is a global imperative to protect tropical rainforests and an urgent need for new tools for engagement and awareness.

I worked collaboratively with Rainforest Partnership in developing a series of creative projects that could bring attention and awareness to their work. Our specific interest was finding ways that people could experience the Amazon Rainforest during international events, and we decided on the idea of connecting people to the rainforest during international climate conferences (hosted in urban environments) through experiencing the soundscapes of the Amazon. In many instances, the decision makers at these significant events have never had the opportunity to experience the Amazon, yet they are making critical decisions about the future of this ecosystem. Niyanta Spelman, Executive Director of Rainforest Partnership, often spoke about the value of film and story telling in connecting policy makers to the rainforest. Having experienced the rich and dynamic soundscapes of the Amazon she was immediately enthusiastic about the potential of sound to connect people with the rainforest.

'*Rainforest Listening*' launched in September, 2015, in the centre of Times Square with an augmented reality sound walk programmed as part of Climate Week NYC. The sounds of the rainforest grew across New York City where hundreds of people engaged with this experience in iconic locations such as Central Park and Dag Hammarskjold Plaza, the gateway to the United Nations. During the major events and our scheduled sound walks, listeners downloaded the app *Recho* and were encouraged to sculpt their own experience by triggering geolocated soundscapes as they walked throughout New York City. The experience was composed as twenty minute non-linear soundscapes pivoting on the major venues for Climate Week NYC. Each twenty-minute experience included a collection of two-minute excerpts that tracked various ecosystems throughout a twenty-four-hour period in the centre of the Amazon Rainforest. The featured ecosystems

were lowland tropical rainforest with abundant wildlife. Listeners could hear the rich biodiversity of insects and birdlife and those who ventured deeper into the sound map discovered the endangered Amazon River dolphins or elusive howler monkeys hidden throughout Manhattan.

The placement of each sound was planned meticulously to encourage listeners into spaces where the urban soundscapes were less intrusive and provided room for reflection and immersion in the soundscapes. The sounds expanded and evolved each day, particularly for specific events throughout Climate Week NYC. This included the Social Good Summit on September 27–28 at the 92Y building in Manhattan, where I added voices of activists and communities speaking about the ramifications of climate change and the importance of conservation. Additional recordings were also incorporated over the duration of the installation including Jay Needham's Panama recordings that were created in partnership with the Asociación Panamericana para la Conservación and the Institute for Neotropical Conservation.

The key activities for *'Rainforest Listening'* in New York City were also supported by organisations such as Ear to the Earth and the Streaming Museum and this project extended our partnership with *Recho*, who assisted in adapting aspects of their audio tools to deliver this installation. The support and partnerships enabled a streamlined process for user generated content throughout Climate Week NYC and encouraged people to respond to the installation. We provided headphones and listening devices at major events and also fixed streaming options via **rainforestlistening.com** for those unable to run the app on their smart phone. The daily engagement was positive and far exceeded previous installations, with an average of 80–100 streams per day across the various listening options. 70% of users listened to between five and ten minutes of audio, with 15% listening to more than twenty minutes. This retention rate exceeded my previous installations of a similar nature, which was possibly due to the subject matter and many of the listeners already having a personal affinity with rainforest conservation.

I had some initial concerns about launching the project in Times Square, while it is undeniably an iconic location, the sensory overload of sound, screens and the constant flow of people does not make it an ideal listening environment. However, this juxtaposition proved valuable in observing how the rainforest soundscapes affected the participants in the installation. Many people arrived in Times Square flustered and in a rush to experience *'Rainforest Listening'* between sessions or other Climate Week commitments and it was fascinating to observe this initial tension dissolve as listeners put on the headphones and started to walk through Times Square exploring the rainforest. They were visibly moving slower and immediately engaging with the environment in a much calmer state, which was in direct contrast to the large crowds flowing through Times Square around them. This observation was made by the Rainforest Partnership team, but also by a series of university students who could identify who was participating in the installation and who was just wearing headphones based on how they were acting. This sparked some further explorations with a team of neurologists at New York University in exploring the neurological value of listening to the Amazon Rainforest in urban environments.

The overall feedback was extremely positive and while we had accurate data for engagement, it was complicated to measure impact. How could this experience influence listeners to make conscious decisions and take action to support the Amazon Rainforest? It was possible to gauge the initial layer of impact based on how people engaged with Rainforest Partnership, particularly via social media platforms, online content and making donations to rainforest communities. However, measuring the long-term impact required further research.

While there were still many questions in terms of impact and the requirement of further technical development, the installation during Climate Week NYC solidified the future potential of this project and quickly resulted in numerous invitations to other international events. It was clear that listening to the rainforest connected people in an immediate and embodied way that is not possible with any other sensory experience. *'Rainforest Listening'* is not just an artwork, but a long-term research project that will see recording devices and live streaming networks installed in rainforest communities over the next decade. This project is equally grounded in the scientific possibilities of listening to the environment, drawing on bioacoustics, ecoacoustics and emerging fields of biology concerned with the study of environment pattern and changes through sound. In the coming years, we hope you will be able to walk through international landmarks, from London Bridge to the Sydney Opera House, and listen to the changing soundscapes of the Amazon Rainforest.

Two Rivers, One World, Austin, Texas

Following Climate Week 2015 in New York City, the *'Rainforest Listening'* installation toured to SXSW Eco 2015, a global environmental conference in Austin, Texas. During the three-day event we hosted sound walks and activities based at the Social Good Hub, a venue produced by the United Nations Foundation. As part of the official SXSW program we also produced an event called *'Rainforest Recharge'* for attendants of the conference to listen to a live performance of immersive rainforest soundscapes that I created in collaboration with Garth Paine. An unexpected outcome of *'Rainforest Listening'* in Austin was SXSW Eco delegates using the installation to navigate between different venues. The geotagged sounds connected the venues for the purposes of our scheduled sound walks, but delegates using the app for navigation outside of these scheduled times, sparked a series of creative ideas for hosting conservation events where the audience would have to discover the venue by following the soundscapes. *'Rainforest Listening'* also featured at Austin City Limits music festival, October 2–11, 2015 as part of ACL Cares with Rainforest Partnership. While this generated a lot of curiosity amongst attendees, it also highlighted the difficulties of hosting the project during a music festival where network coverage was unpredictable and attendees were conscious of preserving their phone battery to last the duration of the festival.

Inspired by '*WIRA River Listening*' and my ongoing work with global river systems, we conceived a new project in Austin titled '*Two Rivers, One World*'. This project was designed to connect the sounds of the Amazon River with the Colorado River that flows through Austin. The project was produced in collaboration with Rainforest Partnership as a public event for the City of Austin. The creative process initially involved hydrophone recordings in the Colorado River and creating a sound walk that mapped the sounds beneath the surface of the Colorado River with a series of my existing recordings and compositions from the Amazon River in central Brazil. The audience could navigate

Austin Mayor Steve Adler and Rainforest Partnership Executive Director Niyanta Spellman

their way along the river bank, weaving between the soundscapes of the two distinctive river systems in addition to listening to live hydrophones during the scheduled sound walks.

The evocative idea of Amazon River dolphins intertwining with the sounds of the waterways of Austin ignited the curiosity of a diversity of demographics, particularly those engaged with water management. The Austin City Council were highly supportive of this endeavour and hosted a proclamation and official opening in the Austin City Hall Plaza where Steve Adler, the Mayor of the City of Austin declared October 8, 2015 as *Two Rivers, One World Day.* This was certainly an unexpected level of support and engagement, and revealed another positive layer to these installations in connecting like-minded organisations and facilitating ongoing partnerships. As a result of this installation, Rainforest Partnership established a stronger relationship with Austin City Council and positioned themselves as innovators in the conservation space. This installation also opened up the possibilities for new ways of connecting and comparing the soundscapes of river systems, both through live streams and merging fixed media.

COP21, Paris, 2015

At the 2015 United Nations Conference on Climate Change (COP21), we brought the rainforests and rivers of the world to Paris and encouraged global leaders to listen to nature and take climate action. It was a venture that further extended my collaborations with Rainforest Partnership and Recho. Together we connected the banks of the Seine River with river systems across the world and transformed iconic locations throughout Paris into the Amazon Rainforest. The Eiffel Tower and surrounding parklands were reimagined as immersive sonic experience layering rainforest soundscapes over the city. Each observatory platform of the Eiffel Tower was interpreted as the four distinct layers of tropical rainforest vegetation through immersive soundscapes and original sonic art I composed exclusively for COP21. Over 200 rainforest sounds were planted across Paris during COP21 at major side events including Petit Palais for Earth To Paris—Le Hub, The Global Landscapes Forum, The Hub Culture Paris Pavilion and throughout Le Bourget, the main location of COP21.

Conscious of previous issues with large-scale events (including ACL in Austin), I created other ways for listeners to access the sounds which included streaming from social media platforms and presenting experiences in Podwalk, a new app developed by the Recho team specifically for site-specific podcasts. Our Podwalk experiencers followed a similar path to the Recho sound maps but allowed listeners to trigger continuous audio files (using GPS) as opposed to navigating through shorter sound files. Podwalks were created as twenty minute compositions, providing a more immersive and narrative driven experience in situ. The benefit of the Podwalk app was that listeners could download the entire audio file (while on WiFi) then experience the installation on location just by triggering GPS without using cellular data. I produced six compositions for Podwalk, three revolving around rivers and three focused on tropical rainforests. While we viewed Podwalk as an additional layer to the Recho experience for those without local data, the Podwalk proved more popular in some locations where listeners opted for extended listening experiences as they moved between venues.

Our augmented reality sound walks were a featured part of ArtCOP21, a cultural program designed to position art as playing an integral role in ecological transition and sustainable development. This resulted in significant engagement around the installation, particularly during key activism events in Paris. We encouraged listeners to add their voices by recording directly into the app. This additional layer of the experience proved highly valuable as we were able to weave the voices of policy makers alongside Indigenous elders speaking about the true ramifications of climate change. I was joined in Paris by Dr Toby Gifford, another collaborator from Australia who assisted in adapting the installations onsite. During the UN meetings and side events we interviewed delegates and activists to incorporate their voices into the installation each day. The layers of voices also stretched across the globe to those that were unable to attend COP21 but had messages they wanted to share with delegates. While the focus of this installation remained on connecting listeners to the rainforests and rivers of the world, the layers of voices offering hope, inspiration and calls to action, became central to the success of this project. With permission from Sandy Sur and his family in Vanuatu, we included the Leweton voices and songs alongside political leaders speaking about the unfathomably future for Pacific Island communities.

The augmented reality sound walks showcased at COP21 demonstrated that locative sound can offer a profound and embodied way for communities to engage with complex information about climate change and ecological crisis. While the ephemeral nature of this installation meant it was not accessible to all, those who experienced the work commented on the value of listening and the importance for moments of reflection in the context of largescale conferences. While there was certainly a wide spectrum of ways we could improve the technology and dissemination, it was clear these experiences provide ongoing value in the context of climate change events.

Yarra River Listening

'*Yarra River Listening*' was commissioned for Pause Fest 2016, in Melbourne, Australia. It was designed as an augmented reality

installation to explore the soundscapes of the Yarra River which flows through the city of Melbourne. This experience extended on previous *'River Listening'* installations by stretching throughout Melbourne's iconic Federation Square with a sound map connecting to river systems across the world. Listeners could hear snapping shrimp in the centre of Federation Square, Amazon river dolphins as they walk down the steps, and pilgrims chanting on the banks of India's Pamba River as they look towards the sky. These sonic discoveries were composed to connect listeners to the soundscapes of global river systems and explore the value of sound in contributing towards environmental awareness and engagement. The soundscapes were all based on my field recordings from rivers across the world that I have collected over the last decade. The piece was composed in the form of an extended electroacoustic piece, yet the non-linear layout of the sound map (literally reflecting a scaled down map of the world) meant listeners could mix the layers of sound in real-time and explore constantly changing soundscapes.

As listeners walked closer to the Yarra River, local sounds become more prevalent until the installation is filled primarily with hydrophone recordings and responses to the Yarra River. In this particular instance, I experimented with the notion of mobile devices connecting listeners to the sound of their surrounding environment. As the listener walked along the river bank, the installation sounds gradually reduced in volume until the final two sounds were mostly silence with very sparse sounds almost inaudible. While some listeners tended to disperse when they reached the subtle material, many stayed till the end, walking slower and in some case standing still and continuing to listen to their surrounding environment. During interviews with listeners after the experience, they reflected on simple observations such as *"I really never noticed how loud the trams are*" or "*It's very relaxing to just stand and listen*" to more profound observations such as "*Towards the end, I thought I was still listening to the app but then I realised I was actually hearing the sounds that were all around me, I was listening to a boat drifting below the bridge as if it was music and I realised that everything around me sounded louder and more interesting*". This comment and others similar, suggested that this experience certainly has the capacity to encourage people to actively listen to their surrounding environment and engage with place through sound.

In '*Yarra River Listening*', through the app Recho, users had the option to record a response to the installation that was geo-located and included in the work in real-time. While I monitor this very closely, allowing and encouraging user generated content in these installations is both an asset and a risk if listeners choose to record inappropriate content. Community engagement remains to be an integral part of my art practice and the majority of my projects are multi-platform and participatory, always encouraging communities to be an active part of the process and welcoming them to collaborate and contribute. This interactivity allows listeners to have agency in the experience, which has been particularly powerful when working with indigenous communities as evident in previous installations. In *'Yarra River Listening*', as with all the projects highlighted in this paper, sounds are placed meticulously in locations, responding to the sonic environments of each place and constructed in ways that they flow together with the pacing, timing and structure of my immersive compositions, regardless of the directions listeners navigate through the space. I am naturally open to the community adapting these experiences, but *'Yarra River Listening* 'was the first installation where I questioned the ongoing inclusion of these tools after the need to censor multiple recordings added by users. One example was a user who planted recordings behind multiple trees along the river bank whispering "*I'm behind the tree, watching you*".

While some listeners found these creative interventions highly amusing others were offended by this material which created an unsettling layer that was certainly not relevant to the content of the project. In these instances, I remove the user generated content as soon as possible, but as these installations continued to expand at various locations across the world (and in multiple time zones) it became imperative to explore other avenues for managing user generated content. The reality was that increased engagement, nationally and internationally, was resulting in an increase of inappropriate content. When sensitive cultural material, partner organisations and funding bodies are involved, the risk was too high to continue with the open format in Recho.

The partnership with Recho and the resulting creative projects presented an incredible platform to explore and experiment with the possibilities of augmenting urban environments with mobile technologies. Recho launched with a mission to become a global interconnected social network for sound. While the platform has been successful in global engagement, the developers shift in focus to the Podwalk platform means Recho development has halted for the time being. In addition to the complexities with user generated content, I also reached a limit with Recho in terms of adapting existing tools as we placed more focus on live streaming audio, 3D soundscapes, head tracking, interactivity, and triggering with other data. The preliminary research suggested that developing these installations through one central mobile application would be most effective to maximise accessibility and engagement.

'*Sonic Babylon*' undeniably paved the way for location audio and interactivity and remains to be one of the most effective platforms for user generated content and engagement. While both *'Sonic Babylon*' and Recho offered a diversity of opportunities for location audio, it was clear the curated experiences I was composing required different options for presenting complex soundscapes and sensitive material involving Indigenous voices. Despite this, I am excited and inspired about the future possibilities of blurring the lines between artists and audiences, particularly in the context of connecting these projects across multiple continents in real-time.

CANOPY (Rainforest Listening)

In early 2016, we began development on CANOPY, a custom application for *'Rainforest Listening'* augmented reality audio experiences. The CANOPY application placed more focus on immersive sound environments and shifting through vertical and horizontal ecosystems. The CANOPY pilot was responsive to the conditions of the surrounding environment and triggered soundscapes based on weather patterns and time of day. It was designed so these features would allow listeners to explore soundscapes that will change and adapt in real-time. The application features tools that will allow listeners to connect and donate to rainforest conservation in a much more accessible way and provides more scientific context for the soundscapes. The final feature that will be added in the future is live streams from the central Amazon Rainforest that can be accessed through the application. In collaboration with Dr Toby Gifford, we are also adapting a head tracking interface he has deigned to allow listeners to shift through 3D sound fields in urban environments. The CANOPY app is still in development phase and will be released publically in 2018.

South Bank Augmented Reality Sound Walks—World Science Festival 2017

In March 2017, the Queensland Conservatorium Research Centre launched '*100 Ways to Listen*'—a new project exploring the art and science of sound and documenting a decade of innovative music-making in Queensland. '*100 Ways to Listen*' launched at the 2017 World Science Festival Brisbane, with performances, interactive installations and immersive sonic environments presented by over 150 staff and students at the Queensland Conservatorium. '*100 Ways to Listen*' was conceived as a reflection on the innovation and impact of iOrpheus, the project mentioned at the beginning of this article that was presented across South Bank Parklands.

I planned to develop a series of new augmented reality sound walks, inspired by the innovation of iOrpheus and *'Sonic Babylon*' and connecting the outcomes of the recent projects I had the privilege of presenting across the USA and Europe. After much research, I decided to return to my collaboration with Josh Kopecek at Echoes.xyz to develop a new portfolio of accessible experiences. We established a partnership and began working on a new customised platform for acoustic ecology and augmented reality.

On July 22, World Water Day 2017, I launched the South Bank Augmented Reality Sound Walks as part of the '*100 Ways to Listen*' program at World Science Festival Brisbane. The sound walks all revolved around aquatic recordings and compositions, highlighting marine and freshwater environments across the world. The sound walks were created within the Echoes.xyz platform and used GPS points along the Brisbane River to trigger audio based on location and movement. These experiences explored the artistic and scientific possibilities of listening to the environment and the potential for new approaches in the conservation of global waterways.

The project featured three augmented reality sound walks responding to bodies of water. The first, *Hydrology*, explored the diverse sonic properties of aquatic ecosystems that cover over 70% of the Earth's surface. The sounds were recorded using hydrophones in freshwater and marine ecosystems across the planet. The featured soundscapes included snapping shrimp on coastal reefs in the Sian Ka'an Biosphere Reserve of Mexico, melting ice in Norway's Kvina River and Humpback Whales along the Queensland coastline. The second experience was an adapted *River Listening* sound walk that reimagined the world beneath the surface of the Brisbane River. The sounds of the river system were layered with creative responses that connected to river systems across the world. This sound walk contributed to our ongoing '*River Listening*' interdisciplinary project exploring the art and science of listening to rivers and the creative possibilities of aquatic ecoacoustics. This sound walk also showcased the ongoing interdisciplinary collaborations at Griffith University between the Australian Rivers Institute and the Queensland Conservatorium Research Centre. The final featured sound walk, *Sonic Reef*, was a call to action to protect the Great Barrier Reef, one of the greatest natural wonders of the world. This installation draws on scientific recordings from the reef that showcase the value of sound in understanding ecosystem health. *Sonic Reef* was a pilot project developed in collaboration with the Queensland Conservatorium Research Centre, the Australian Marine Conservation Society, JASCO Applied Sciences and a team of passionate artists, scientists and conservationists.

World Science Festival Brisbane provided the perfect platform to launch these new augmented reality sound walks. Based on my previous experiences, we provided a variety of ways to make sure the listening experiences were accessible including pop up listening stations with student guides, headphones, additional devices and online streaming for listeners without smart phones. Audiences downloaded the free app Echoes.xyz (for iOS and Android) and selected a personalised sound walk to explore over 100 aquatic soundscapes throughout South Bank. Their phone acted as a sonic compass as the soundscapes triggered automatically as listeners walked into active locations.

It was exciting to witness the general public engaging with the changing soundscapes of the Great Barrier Reef and I was impressed by the level of engagement with the experiences throughout the festival. One of the most exciting elements of these mobile experiences is the ability to take them directly to places of congregation and locations with politicians and decision makers. During the launch of the World Science Festival on World Water Day, we hosted a listening station and were able to demonstrate the sound walks to media, politicians and even the Queensland Science Minister, who was shocked to learn that fish make sounds that can be used for assessing freshwater biodiversity.

It is unlikely I would have been able to convince the Queensland Science Minister to attend an immersive electroacoustic concert, yet the accessibility of mobile technologies means I could literally put this installation in the hands of decision makers at a major event. The sound walks received multiple invitations following the World Science Festival Brisbane, including the Smithsonian Earth Optimism Summit in Washington, DC, where the soundscapes of waterways across the world were installed throughout the Smithsonian in April 2017. The future possibilities were evident and I continued working with Nora Farrell and Josh Kopecek on our new customised platform for acoustic ecology and augmented reality audio.

Aurality

On July 18, World Listening Day 2017, we launched *Aurality*—a new mobile application for acoustic ecology and augmented reality audio powered by Echoes.xyz and developed in collaboration with Josh Kopecek. The long-term ideas for *Aurality* were developed in collaboration with Nora Farrell and inspired by her pioneering work in locative audio from 2005. *Aurality* was presented as a major work at the 2017 Queensland Music Festival by Brisbane City Council, The Queensland Conservatorium Research Centre, Noosa Alive and Noosa Regional Gallery.

Aurality launched as a site-specific augmented reality audio project exploring and connecting Queensland's rainforests, rivers and reefs through music, sound and acoustic ecology. The app used GPS points along the entire coastline of Queensland to trigger audio based on location and movement. The experience was activated in eight communities and designed as a tool to connect listeners to conservation efforts around protecting the Queensland's rivers, reefs and rainforests. The soundscapes also stretched to Pacific Island communities based on my long-term collaborations with Sandy Sur in Vanuatu. I developed and composed the initial layer of sonic material, based on my database of Queensland field recordings stretching across a decade. We plan to facilitate community collaborations and curated user generated content in the future iterations across Queensland. The project has extensions planned throughout Australia and the Asia-Pacific region.

Aurality: South Bank, Queensland, Australia

The next phase of *Aurality* is currently in development and in 2018 the platform will open up as a community acoustic ecology platform, focused around augmented reality and location-aware audio experiences for conservation and climate action. *Aurality* combines acoustic ecology, environmental field recordings and sonic art with live streaming audio. We are developing a network of permanent open microphones and hydrophones in collaboration with a network of international sound art organisations that will facilitate real-time listening within the app, building on the initial success of live hydrophones in the WIRA River Listening installation.

Conclusions

The installations outlined in this paper are not stand alone experiences, but all connected to larger research initiatives exploring the value of acoustic ecology as a socially engaged, accessible, interdisciplinary field that can inspire communities across the world to listen to the environment. The notion of augmenting urban spaces with environmental soundscapes is something that has been explored through many of my projects over the last decade. These ideas continue to play a vital role in my research into the role of mobile technologies and locative media in inspiring ecological awareness and engagement.

These sonic experiences provide opportunities for the general public to explore sound worlds they would not necessarily have access to, ranging from the centre of the Amazon Rainforest to remote river systems throughout South India. While the installations traditionally involve headphones, they encourage deep listening and are created in response to the acoustic ecologies of each place. By positioning sounds in very specific locations, these experiences are designed to use mobile technologies to connect to our surroundings and draw listeners into their sonic environment. This research acknowledges the inherent contradictions in suggesting locative media and mobile technologies can be tools for responding to climate change. As Behrendt (2013) and others have highlighted, mobile technologies are fossil-fuelled and carry a heavy carbon footprint through their production and the satellite networks and infrastructures that support them. However, emerging mobile technologies are increasingly accessible and offer possibilities that deserve further exploration particularly as more people relocate to cities and do not have access to wilderness areas. As the field of acoustic ecology continues to expand and become more interdisciplinary, these technologies allow us to explore other layers of our social, cultural and ecological environments through sound.

Considering the rapid developments in this field in recent years, it is almost impossible to predict what the future holds, but it is likely we will see a shift away from screen based augmented reality with more focus on wearable technology and sound. We have already seen a rapid increase of reimagined headphone experiences that support personal auditory profiles, ambisonic decoding and interactive head tracking (Ossic, Nura and Audeara to name a few). This shift will naturally allow for more opportunities in sound for locative media and will hopefully facilitate a balance between visual and auditory engagement. While the technology is an integral layer to this research, the core focus remains on sound and its ability to influence our perception and awareness of the environment around us. Recent research (Boulton, 2016) suggests that engagement with our ecological crisis and ultimately behavioural change towards our environment, needs to happen at a deeply philosophical and sensory level. These projects investigate the role of sound in facilitating connection to place and the value of mobile technologies in exploring

and exposing changing acoustic ecologies across the globe.

This article is dedicated to Nora Farrell (1966–2017) who opened my mind to the possibilities of mobile technologies in understanding and interrogating our relationship with places and communities through sound. While this edition of *Soundscape* reflects on the life and work of Pauline Oliveros, who has also been a profound influence on my work, it seemed appropriate to reflect on the impact and influence of Nora Farrell, a friend and collaborator of Pauline who I found equally innovative and inspiring in her perspectives on sound. While Nora remained out of the limelight for much of her career, her technical genius and pioneering ideas will undoubtedly continue to influence and inspire for generations to come.

About the Author

Dr. Leah Barclay is an Australian sound artist, composer and researcher working at the intersection of art, science and technology. She specialises in acoustic ecology, environmental field recording and emerging fields of biology exploring environmental patterns and changes through sound. Over the last decade her work has focused on the conservation of rivers, reefs and rainforests through interdisciplinary creative projects that inspire communities to listen.

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