Cymatic patterns of the Black Cockatoo: Visualising the calls of wildlife in Australia

Leah Barclay
University of the Sunshine Coast
Sippy Downs, QLD, Australia
lbarclay@usc.edu.au

Tricia King
University of the Sunshine Coast
Sippy Downs, QLD, Australia
fking2@usc.edu.au

Lyndon Davis
Gubbi Gubbi Dance
Sunshine Coast, QLD, Australia
gubbimob@hotmail.com

1. INTRODUCTION

The Sunshine Coast region in Queensland, Australia is home to a diversity of wildlife including iconic Black Cockatoos that are currently facing a range of threats and challenges. The impacts of climate change and habitat loss from bushfires, droughts and urban development have resulted in select species of Black Cockatoos classified as vulnerable for extinction. Acoustic methods are now being engaged to monitor Black Cockatoos and inform conservation efforts, this includes large-scale spatial and temporal mapping and specialised projects such as exploring how nestling vocalisations change through time (Teixeira et al. 2021). Community engagement is essential in wildlife conservation and acoustics offer various interdisciplinary pathways to understand vulnerable species in new ways.

Black Cockatoos feature heavily in First Nations song, dance and visual arts in the Sunshine Coast region and have been an inspiration for internationally recognised Indigenous artist Lyndon Davis for over a decade. Davis paints traditional patterns referencing flora and fauna from the Sunshine Coast and was particularly interested in exploring how the visual representation of wildlife calls correlated with geometric patterns associated with Indigenous designs, to demonstrate ecological interconnection.

Beeyali is a research project exploring new methods for visualising the calls of wildlife on Kabi Kabi Country, the traditional lands, and waters of the Sunshine Coast in Queensland, Australia. The project brings together Indigenous knowledge, environmental research, emerging technology, photography and sound to visualise wildlife calls using cymatics, the science of visualising acoustic energy or sound. The first phase of the project focuses on the calls of Black Cockatoos through a series of experiments to reveal cymatics with organic materials and digital technology.

Cymatics. Photography. Acoustic ecology. Sound. Projection art. Indigenous knowledge.

Figure 1: Lyndon Davis with Cockatoos

Working in collaboration with sound artist Dr Leah Barclay and photographer Dr Tricia King, Davis conceived Beeyali – a research project exploring new methods for visualising the calls of wildlife on Kabi Kabi Country in Australia.

Beeyali is a Kabi Kabi word meaning 'to call' and the project brings together Indigenous knowledge, environmental research, emerging technology, photography and sound to visualise the calls of wildlife using cymatics, the science of visualising acoustic energy or sound. The pilot phase of the project was commissioned as a large-scale projection work for NEW LIGHT 2021 – a competitive national award from the Australian Network for Art and Technology (ANAT) supporting experimental and diverse moving image works by contemporary First Nations artists.
The first phases of the project focused on the calls of cockatoos and involved a series of experiments to reveal cymatics with native flora, ochre, water, Kabi Kabi designs and digital photography. The research team explored ways to create digital cymatics using photography of the Black Cockatoos as the source material in pattern generators activated through sound.

Figure 2: Beeyali cymatic experiments with cockatoo calls vibrating with water and ochre

This resulted in the development of new techniques for sonic visualisation that have informed a body of audio-visual creative works featuring large-scale projections that are introduced throughout this paper. The dynamic geometric patterns respond to audio and have developed new knowledge in cymatics with original processes that combine acoustic ecology, photography and Indigenous knowledge. This technique is applied to wildlife calls to inspire the conservation of biological and cultural diversity through creative practice. The Beeyali project will expand in 2022 and is designed to explore connections between cultural and environmental knowledge to inspire climate action, environmental empathy and interdisciplinary processes that intersect Indigenous knowledge, science, creative practice, and new technology.

Figure 3: Beeyali – live projection performance for Floating Land 2021, Noosa Biosphere Reserve

2. CYMATICS

Cymatics is an interdisciplinary field studying the visualisation of acoustic energy (Jenny 1967). It is a technique emerging from Hans Jenny’s experiments in the 1960s using powdered materials scattered across a surface that generated distinctive and complex patterns when activated with sound waves.

Figure 4: Cymatic patterns – sound visualisations

He discovered that particular frequencies pulsated and shifted the materials into rich and dynamic patterns. When sound activates these liquids and materials the vibrations create kaleidoscopic movement and geometric patterns.

Figure 5: This cymatic image shows a marine trilobite fossil, from an early Cambrian period, circa 526 million years old on the left and the right shows a trilobite pattern appearing through cymatics (created with a CymaScope by John Stuart Reid).

Jenny (1967) was the first to suggest links between cymatics and the environment, with striking similarities between the geometric patterns emerging and naturally occurring principles and patterns in ecosystems. This resonates strongly with Indigenous notions of environmental interconnection and was the fundamental inspiration for the Beeyali project. Connections to cymatics and environmental geometry are evident in the complex patterns of many Indigenous art traditions in Australia. Lyndon Davis believes that everything is connected in our local ecosystems.
and these patterns can help to tell a story about what is happening in our environment. Lyndon’s interest in cymatics were initially through watching sand vibrate on resonant brass plates played with a bow creating different geometric patterns known as the Chladni figures which were documented in Ernst Chladni’s book Discoveries in the Theory of Sound. Davis was inspired by the ways the geometric patterns connected to his painting style and wanted to explore the relationships between sound and geometry in his work.

Cymatics has inspired various creative projects and collaborations including mainstream projects such as live visuals for Björk’s Biophilia tour created by visual artist Meara O’Reilly. Richard Grillotti (2021) led the project ‘Resonant Waves’ – an interactive installation that incorporates cymatic patterns to reveal the complex symmetrical shapes of sound. This multisensory artwork generates and processes wave interference patterns that are translated into dynamic geometries across different modalities. Participants simultaneously hear, feel and see the patterns created when a carefully selected range of sound frequencies generate motion in water. Photographer Linden Gledhill has also drawn inspiration from cymatics with a background in science which has led him to use advanced microscopy and high-speed equipment that reveals cymatic patterns and perspectives that are usually invisible to the human eye.

3. RESEARCH TEAM: LISTENING IN THE WILD

The creative team behind this project bring unique skills to the collaboration that contribute in various ways. The trio first worked together on Listening in the Wild – a series of immersive soundscapes and site-specific photography exploring environments across the Sunshine Coast commissioned for Horizon Festival 2020 and produced as remote experiences in response to the Covid-19 pandemic. Through virtual sound walks along Eudlo Creek, Maroochy River and Old Woman Island interwoven with Kabi Kabi stories, this project investigated how remote embodied experiences of natural environments can facilitate ecological empathy, cultural knowledge and connection to place. Listening in the Wild builds on a large body of research in immersive media art responding to ecological crisis and climate action (Gilmurray et al. 2017).

Under the cultural guidance of Kabi Kabi artist Lyndon Davis, Listening in the Wild explored new ways of using virtual technologies with live soundscapes and site-specific photography to connect audiences to locations and cultural knowledge across the Sunshine Coast. The project developed new tools for streaming audio in a high-quality format and asked how we can appropriately and effectively use audio-visual experiences to connect communities to place and develop a deeper understanding of cultural and environmental knowledge. The project was part of a portfolio of research exploring the possibilities of live streaming technologies to facilitate environmental connection during global Covid-19 lockdowns. Listening in the Wild was awarded the 2021 APRA Art Music Awards for Excellence in Experimental Music with comments including ‘This project is spearheading the way forward for future Australian sound art and is a quality model for all to follow’. This research project was the starting point for the Beeyali collaborative team and revealed how our unique skillsets can work together.

Dr Leah Barclay is a sound artist, composer, designer and researcher who works at the intersection of art, science and technology. Barclay’s research and creative work over the last decade has investigated innovative approaches to recording and disseminating the soundscapes of terrestrial and aquatic ecosystems to inform conservation, scientific research and public engagement. Her work explores ways we can use creativity, new technologies and emerging science to reconnect communities to the environment and inspire climate action. Barclay’s research is designed to advance the field of acoustic ecology and ecoacoustics to demonstrate the value of sound in the environment (Barclay 2020).

Dr Tricia King is an active documentary photographer. Her research focuses on photography, its role in personal and cultural memory, and the construction of identity. Utilising techniques like photo-elicitation, documentary and collaborative photography, Tricia develops collaborative participant driven projects working predominantly with people experiencing social isolation. Most recently she has worked with older people living in aged care to explore their lived experience and help develop programs to assist with greater socialisation (King 2021).

Lyndon Davis is a direct descendant of the local Kabi Kabi people, traditional custodians of the Sunshine Coast region. In 1995, Lyndon founded the Gubbi Gubbi Dance troupe, bringing together a group of young Indigenous artists and musicians from the Sunshine Coast, presenting local Traditional Aboriginal Song and Dance. The dance troupe are now one of the most in demand Aboriginal performance groups in Queensland and are regular performers at major events. In addition to his performance work, Lyndon is an active visual artist, painting the stories of his homelands and the connection between people, the land, the animals and spirituality. Over the past years, he has worked with anthropologist Dr Ray Kerkove researching the
local traditional designs of Southeast Queensland and incorporating a contemporary form into his artwork, acknowledging the Aboriginal art styles from this region. His visual art is held in national and international collections, and he has been commissioned by various high-profile organisations, museums and art collectors. Davis’ experimental art practice has been featured at major festivals with immersive installations and large-scale projections commissioned for Horizon Festival, Floating Land, ANAT and Illuminate Adelaide.

Figure 6: Beeyali creative team working in the studio

4. LISTENING TO ECOSYSTEMS

The impacts of climate change are becoming increasingly visible and audible in ecosystems across the planet. Scientists continue to sound the alarm and we urgently need more effective ways to engage communities in conservation and climate action. There is still much to learn about the interconnected nature of the planet’s ecosystems and many remote locations still lack basic species inventories. Conventional environmental monitoring that requires scientists to travel for field work is highly invasive and has not been practical or possible during the COVID-19 global pandemic. This style of environmental monitoring is also constrained to restricted areas and manual processing of observations which can often generate bias results (Linke et al. 2018). Listening to changing ecosystems with remote audio recorders offers a transformational opportunity to monitor remote environments and engage communities in the process. Acoustics can help inform environmental management decisions and accelerate conservation efforts (Teixeira et al. 2021).

Rapid advancements in acoustic technology mean we can now monitor changing environments through accessible, affordable, and non-invasive acoustic sensors. Innovations in hardware and software mean that acoustic monitoring can be conducted by local communities and offers a viable method for measuring ecological changes and monitoring biodiversity (Deichmann et al. 2018). Ecoacoustics draws on acoustic ecology, a well-established interdisciplinary field that emerged in Canada in the late 1960s.

Ecological sound artists emerging from the acoustic ecology movement have propelled many of the most significant discoveries that have informed the development of ecoacoustics. Their nuanced understanding of our sonic environment and knowledge that sound can engage communities and listeners at a deeper, more attuned level strongly aligns with the interdisciplinary intentions of ecoacoustics and the foundations of acoustic ecology. Immersive sound installations and performances drawing on recordings from ecosystems have been successful in evoking empathetic and philosophical responses to climate change that can inspire ecological action in communities (Monacchi 2013; Burtner 2011). Ecological sound art performances are regularly presented with visualisations, most often in the form of spectrograms providing a direct representation of the sound.

Ecological sound art presented in a collective listening experience can create metaphors to help communities connect with environmental issues on a deeper and more personal level. These creative works can immerse communities in a remote ecosystem and inspire awareness and respect for invisible or inaccessible areas of the environment that they would not traditionally be able to access (Gilmurray 2017). Visualisations of sonic environments provide another sensory connection to this process.

Figure 7: The Great Animal Orchestra – Bernie Krause (spectrograms of environmental soundscapes)

Salomé Voegelin (2014) believes that when communities engage in these collective listening experiences it is possible to become submerged in a 'sonic possible world' where personal listening experience can inspire communities to think
differently about the environment. The intersection and relationship between sound and visuals in this context warrants further exploration and has inspired various creative approaches in the initial phase of Beeyali research.

5. BEEYALI CREATIVE PROCESS

Beeyali brings together Indigenous knowledge, environmental research, emerging technology, photography and sound to visualise to calls of wildlife using cymatics. The project was developed throughout 2021 with the pilot phase commissioned as a large-scale projection work for NEW LIGHT 2021 – a competitive national award from the Australian Network for Art and Technology (ANAT) supporting experimental and diverse moving image works by contemporary First Nations artists. The initial phase of the project involved field work to generate audio recordings and photographs of the Black Cockatoos and observe the cockatoos in different contexts, including direct interactions with cockatoos in captivity and field observations in the wild.

Observing and recording the Black Cockatoos both in captivity and in the wild allowed the team to study the natural movements and rhythm of the birds over both close and distant proximities. These varying spatial observations highlighted the diversity of movement, colour and sound of the birds, allowing the examination of the intimacy of small, detailed movements such as the ruffling of feathers or unique vocalisations, as well as the majestic gliding motion of the birds in full flight.

In the wild, the birds were observed on the Sunshine Coast and recorded in Noosa Biosphere Reserve with remote audio sensors installed for long durational field recording. Working within the large-scale aviaries of a Sunshine Coast bird rescue sanctuary, juvenile and adult black cockatoos living in captivity were photographed and recorded. Many of the birds were socialised to fly to humans which allowed the team to connect, touch and converse with the birds intimately. Black Cockatoos have complex social behaviours, and so the ability to observe at close proximity allowed greater insight into nuances around their communication and behaviour with both humans and each other.

The approach to photographic work was to both record the patterns of the birds and their locomotion. Images such as Figure 9 shows the feet and tail feathers of a black cockatoo in flight just after leaving a branch. Using a slow shutter speed on the camera to allow small but significant movement of the bird, the patterning becomes blurred to show the blending of the colours as the bird moves through the air. The natural eye cannot perceive the blending of the colours in such a way, so the photograph allows the recording of this colour shift and provides a visual image which directly informs our knowledge of how the patterning of the bird changes with the movement of flight. This image evokes the patterns of an audio spectrogram and references the movement and vibrations of cymatics. The socialised birds of the rescue sanctuary displayed strong characteristics which we have come to understand of Black Cockatoos and indeed many parrots in general. They climbed over the equipment and inspected (and pecked at) any object or person introduced to their environment – swarking and flying from person to person. The intimacy of the encounter into their environment allowed connections to be made between the birds and the individual team members. This connection is evident in Figure 10, where the Black Cockatoo has made direct connection and eye contact with the photographer. In this way, the image more closely resembles portraiture than wildlife photography as we get a clear connection between the photographer and the sitter. The detail in this image, particularly in the chest feathers and eye, inspired the research team to explore digital cymatic experiments, using the photograph as source material in generative audio visualisations.
Cymatic Patterns of the Black Cockatoo: Visualising the calls of wildlife in Australia
Leah Barclay, Tricia King & Lyndon Davis

Figure 10: Photograph of a Black Cockatoo during field work that was used as source material during the following digital cymatic experiments.

Through a series of experiments using digital photographs (including Figure 10), the research team developed experimental techniques for digital cymatics using the audio recordings of cockatoo calls to filter images in real-time using generative geometric patterns.

Figure 11: Beeyali digital cymatic experiments

This was an intuitive process that was instigated by the clarity and detail in the photography and the field work observations by the team. Short audio recordings of vocalisations were edited and used to filter the image in real-time to create the geometric patterns which we coined as a form of digital cymatics.

Figure 12: Beeyali digital cymatics – Bunya Trees

This most fascinating result of these experiments were cultural symbols emerging in the patterns. In Figure 12, the feathers and eye of the cockatoo become a rippling cymatic pattern where landscapes and trees emerged in the imagery. Lyndon Davis immediately referenced the four small trees as Bunyas – culturally significantly trees on Kabi Kabi Country in the Sunshine Coast region.

Figure 13: Beeyali digital cymatics – cultural patterns

In Figure 13, the pulsating geometric patterns are responding to the cockatoo calls and referencing cultural shields and other significant imagery. This process revealed a natural intuitive interconnection between the computational processes and the environmental locations of the work.

The digital cymatics were accompanied by traditional cymatic experiments in the studio that were documented in various ways. Photography is a 2D object which does not record movement but rather implies it, allowing the photographer to control how movement is perceived. This is primarily achieved through the use of long or slow shutter speeds. In contrast to the way in which the birds themselves were photographed using a long shutter speed to blur and signify movement, during the cymatic experiments the movement projected through their calls was recorded quite differently but to the same effect of visualising the movement. A fast shutter speed was used to “freeze” the
droplets of water and ochre as they were propelled into the air from the sound of the cockatoos and this action of freezing allows the movement to be implied.

Figure 14: Beeyali cymatics with water

Figure 14 shows the photographing of cymatics using water and Figure 15 shows cymatics using ochre mixed with water in the speaker cone. These photographs are integrated with the digital cymatics to inform large-scale projection artworks.

Figure 15: Beeyali cymatics with ochre

6. CONCLUSIONS

Beeyali has resulted in the development of new techniques for sonic visualisation that have informed a body of audio-visual creative works featuring large scale projections that were produced through these experimental processes. The dynamic geometric patterns respond to audio and have developed new knowledge in cymatics with original processes that combine acoustic ecology, photography and Indigenous knowledge.

These new techniques are applied to wildlife calls to assist in new methods for the conservation of biological and cultural diversity and inspire climate action, environmental empathy and interdisciplinary processes that intersect Indigenous knowledge, science, creative practice, and new technology. This work is intended to be presented at public events to actively engage communities in the process and outcomes. The pilot research is now moving to the next phase and the research team intend to expand the project from the focus on cockatoos to exploring the calls of a diversity of wildlife on Kabi Kabi Country on the Sunshine Coast in Australia. The next phase of the project is proposed to focus on aquatic life with the calls of marine mammals and the team are currently exploring Beeyali visualisations with the soundscapes inside trees for Lyndon Davis’ first solo exhibition at the USC Art Gallery in Australia.

Figure 16: Beeyali – large-scale projections, NEW LIGHT 2021, Presented by Illuminate Adelaide and ANAT

7. REFERENCES

Barclay, L., Gifford, T., and Linke, S. (2020). Interdisciplinary approaches to freshwater ecoacoustics. Freshwater Science, 39(2), 356–361. https://doi.org/10.1086/709130

Burtner, M. (2011). EcoSono: Adventures in interactive ecoacoustics in the world. Organised Sound, 16(3), 234–244. https://doi.org/10.1017/s1355771811000240

Deichmann, J., O. Acevedo-Charry, L. Barclay, Z. Burivalova, M. Campos-Cerqueira, F. d'Horta, E. Game, B. Gottesman, P. Hart, A. Kalan, S. Linke, L. Nascimento, E. Staaterman and T. Aide. (2018). It’s time to listen: There is much to be learned from the sounds of tropical ecosystems. Biotropica 50:719–178.

Désirée Waller, M. and Chladni, E. (1961). Chladni Figures: A Study in Symmetry. George Bell & Sons.
Cymatic Patterns of the Black Cockatoo: Visualising the calls of wildlife in Australia
Leah Barclay, Tricia King & Lyndon Davis

Gilmurray, J. (2017). Ecological sound art: Steps towards a new field. Organised Sound, 22(1), 32-41. doi:10.1017/S1355771816000315

Grillotti, R., DiLallo, A. and Forbes, A. G. (2020). Resonant Waves: Immersed in Geometry. Leonardo, 53(4), 401–407. https://doi.org/10.1162/leon_a_01926

Jenny, H. (1967). Cymatics: The Structure and Dynamics of Waves and Vibrations. Basilius Presse.

King, T. (2021). Remembering and forgetting: Using photographs as social artefacts in an aged care setting, Visual Studies, DOI: 10.1080/1472586X.2021.1963828

Linke S., Gifford T., Desjounquères C., Tonolla D., Aubin T., Barclay L., Karaconstantis C., Kennard M., Rybak F., and Sueur J. (2018). Continuous monitoring of freshwater environments using underwater passive acoustics. Frontiers in Ecology and the Environment.

Monacchi, D. (2016). A Philosophy of Ecoacoustics in the Interdisciplinary Project Fragments of Extinction. In F. Bianchi, V.J. Manzo (Eds), Environmental Sound Artists, Oxford University Press, New York.

Schafer, R. Murray. (1977). The Tuning of the World. USA: Random House.

Teixeira, D., Hill, R., Barth, M., Maron, M. and van Rensburg, B. J. (2021) Vocal signals of ontogeny and fledging in nestling black-cockatoos: Implications for monitoring. Bioacoustics. https://doi.org/10.1080/09524622.2021.1941257

Voegelin, S. (2014). Sonic Possible Worlds: Hearing the Continuum of Sound. Bloomsbury Academic.