Australasian Ecoacoustics Workshop 2017

Organised by the Australasian Chapter of Ecoacoustics

The Australasian Chapter of Ecoacoustics (ACEs) is a branch of the International Society of Ecoacoustics. The ACEs was formed in June 2016 at the International Society of Ecoacoustics Congress in Michigan when a group of like-minded individuals discussed the importance of Ecoacoustics in Australia.

ACEs is comprised of members from all across Australia and New Zealand who use Ecoacoustics for research, natural resource management or as a general interest. The group has been developed to share knowledge, network and collaborate on all things Ecoacoustics.

The Australasian Ecoacoustics Workshop has been organised and sponsored by:

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QUT VENUE

All workshop sessions at QUT on Thursday 2 Feb will take place in S Block (indicated in red below). Registration will open at 8am on the 2 Feb. Please come to level 6, room S620. Talks and posters will be held in S636/637. Lunch will be provided in the O Block Gardens Lounge/Level 1, O123 (indicated in yellow below). Networking Drinks will take place on the P Block Terrace on Level 6 (indicated in green below).

PROGRAM – THURSDAY 2 February 2017

QUT, Gardens Point Campus

8.00 to 8.45am Registration and Coffee (S620)

8.45 to 9.00am Welcome by the President of the Australasian Chapter for EcoAcoustics (S636)

9.00 to 9.20am Opening Keynote Presentation (20 min) Dr Matthew McKown (S636)

Acoustic sensor networks and artificial intelligence: Advancing evidence-based conservation.

Session 1 – Ecoacoustics: individual species (S636)

Scope: research that uses sounds (audible and ultrasonic) to investigate the ecology of individual species or populations

9.20 to 9.40am Keynote Presentation (20 min) Prof Lin Schwarzkopf

9.40 to 10.30am Poster session

- Acoustic surveys for Western Ground Parrots. Sarah Comer, Abby Berryman, Saul Cowen, Jeff Pinder, Cam Tiller, Chris Powell and Allan Burbidge
- Bioacoustics for conservation: New technology for endangered black-cockatoo monitoring. Daniella Teixeira, Richard Hill, Guy Castley, Martine Maron and Berndt Van Rensburg
- Assessing the Status of Koalas in Forests using Acoustics and an Occupancy Modelling Framework. Brad Law, Traecey Brassil, Leroy Gonsalves, Anthony Truskinger and Anna McConville.
- Using BARs to monitor the Zoothera Thrushes of the Tweed Range in northern New South Wales. Elliot Leach
- Finding the elusive Eastern bristlebird by engaging citizen scientists with bioacoustics. Jessie L Cappadonna, Margot Brereton, David M Watson, Paul Roe

10.30 to 11.00am Morning Tea (S620)

Session 2 – Ecoacoustics: communities and landscapes (S636)

Scope: research that uses sounds (audible and ultrasonic) in the environment to investigate community and landscape ecology

11.00 to 11.20am Keynote Presentation (20 min) Prof Paul Roe & Dr Susan Fuller

11.20 to 12.00pm Poster session

- Does artificial light at night affect acoustic communication? Michelle L Hall, Ashton L Dickerson and Therésa M Jones
- Using acoustic techniques to monitor wetland faunal responses to environmental water deliveries in the Goulburn Broken Catchment. Jo Wood and Simon Casanelia
- Citizen scientists are 'Communities Listening for Nature' in Victoria, Australia. Christine Connelly & Karen Rowe
- How analysis of underwater sound is affected by intra- and inter-site acoustic variation in a freshwater stream. Chris Karaconstantis, Simon Linke and Toby Gifford

12.00pm to 1.00pm Lunch (O Block Garden Lounge/Level 1, O123)

Session 3 – Big Data and Acoustic Indices (S636)

Scope: research that examines 'big' acoustic data analysis and indices

1.00 to 1.20pm Keynote Presentation (20 min) Dr Michael Towsey

1.20 to 2.10pm Poster session

- A pipeline and app for massive filtering and assisted inspection of enormous acoustic datasets. Kyle N. Armstrong, Ken P Aplin, and Stephen Crotty
- Bring Big Data to Many People: Environmental Audio Classification and Searching. Jinglan Zhang, Xueyan Dong, Jie Xie, Paul Roe
- Measuring Frog Chorus with Acoustic Indices. Karlina Indraswari, Jie Xie, Lin Schwarzkopf and Paul Roe
- Can you picture what is in a thirteen-month recording?. Yvonne Phillips, Michael Towsey and Paul Roe
- Using acoustic indices to study the impact of traffic noise on urban forest soundscapes in south-eastern Australia. Jasmine Munro, Ian Williamson and Susan Fuller
- Disentangling landscape and vegetation drivers of soundscape quality in urban forest remnants. David Tucker, Stuart Gage, Ian Williamson, Susan Fuller

2.10 to 2.40pm Afternoon Tea (S636)

Session 4 –Analysis of Vocalisations (S636)

Scope: research that examines issues relating to manual and automated analysis of vocalisations

2.40 to 3.00pm Keynote Presentation (20 min) Assoc. Prof. Paul McDonald

3.00 to 4.00pm Poster session

- Keeping an ear out for change on the Great Barrier Reef. Graham Hemson and Matthew McKown
- Cockatoo screams suddenly useful – a new age of avian conservation technology. Kate Trewin
- Vocal individuality, but not stability, of palm cockatoos on Cape York Peninsula. Zdenek, C.N., Heinsohn, R., Langmore, N.E.
- Successful use of automated recording systems and call recognition software in the conservation management of the critically endangered Kroombit tinkerfrog. Harry Hines
- Using population-specific calls to investigate the ecology of the blue whale complex. Rogers, T.L., Tripovich, J.R., Truong, G.
- Investigating the presence of Omura's whale in Australian waters. Elisa Girola, Craig McPherson and Julien Delarue

4 to 5pm Collaboration & Networking (drinks on P Block Level 6 Terrace)

6pm Dinner at Plough Inn (NB dinner is 'buy your own' and is not included in registration fee)

PROGRAM – FRIDAY 3 February 2017

Queensland Conservatorium, Griffith University Southbank Campus

Day 2 of the workshop comprises topical discussions, meet-the-experts sessions and the listening room program. Following on from the speed presentations & posters of day 1, these sessions are intended to provide more focused opportunities for discussion and networking amongst researchers interested in similar subtopics. The day will begin with an opening session and keynote presentation in freshwater ecoacoustics by Dr Simon Linke followed by three parallel streams. Day 2 closes with a discussion and preparation of the 2018 ISE Congress pitch followed by drinks in the Conservatorium Foyer.

Topical Discussions

Topical discussion sessions are group discussions around a particular subtopic of ecoacoustics. These sessions are intended to allow researchers who specialise (or are interested) in a particular area to share ideas.

Meet the Experts

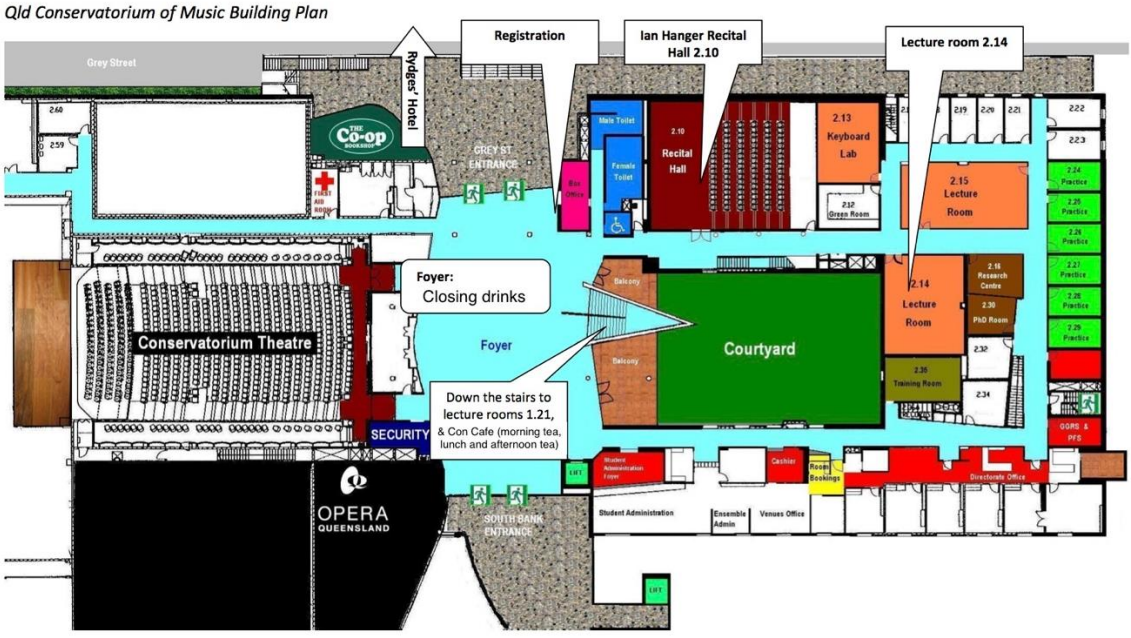
These sessions are intended as an opportunity for emerging (or established) researchers in a particular area to seek practical advice from experienced researchers (the experts). Each session has a facilitator and other experts knowledgeable in the area, able to field questions. The idea is to get down to details, particularly practical aspects of methodology that are often omitted from publications due to seeming trivial, but may save a lot of time and frustration for new researchers if understood from the start.

Listening Room

The Listening Room provides an opportunity for participants to experience recordings from a diversity of ecosystems. This space will feature work from across the Australia and also showcase select recordings from the international ecoacoustic community. We encourage participants to refrain from talking in this space.

Venues

Day two of the workshop is hosted at the Queensland Conservatorium, Griffith University Southbank Campus which is located at 140 Grey Street. Most sessions will be conducted on level two of the building in the Ian Hanger Recital Hall (IHRH) and lecture rooms 2.14 and 2.15 which are located directly down the hallway from the IHRH. Morning tea, lunch and afternoon tea will be provided on the ground floor, near the Conservatorium Café.



PROGRAM – FRIDAY 3 February 2017

Queensland Conservatorium, Griffith University Southbank Campus

9am	**Welcome Back** - *Toby Gifford & Leah Barclay* - Ian Hanger Recital Hall (IHRH)		
9.10 – 9.30am	**Keynote Presentation** - *Simon Linke* - Ian Hanger Recital Hall (IHRH)		
9.30 – 10.45am Session 1	Topical Discussion: 2.14 **Interdisciplinary and creative approaches in ecoacoustics** *Facilitator: Leah Barclay*	Meet the experts: 2.15 **Ultrasonic applications in ecology** *Facilitator: Kyle Armstrong*	Listening Room: IHRH *Aquatic recordings in freshwater and marine environments*
10.45 – 11.15am	Morning Tea: Conservatorium Café (Ground Floor)		
11.15 – 12.30pm Session 2	Topical Discussion: 2.14 ***Practical Issues in Technology for Ecoacoustics*** *Facilitator: Michael Maggs*	Meet the experts: 2.15 **Aquatic recording techniques** *Facilitator: Toby Gifford* *Experts: Simon Linke, Leah Barclay and Craig McPherson*	Listening Room: IHRH *Ecoacoustic Soundscape Compositions*
12.30 – 1.15pm	Lunch: Conservatorium Café (Ground Floor)		
1.15 – 2.30pm Session 3	Topical Discussion: 2.14 **Underwater ecoacoustics** *Facilitator: Simon Linke*	Meet the experts: 2.15 ***Hands on Sensor Workshop*** *Facilitator: Mark Calder* *Experts: Frontier Labs (Michael Maggs), Faunatech, Titley Scientific and Jasco (Craig McPherson).*	Listening Room: IHRH *Terrestrial Environments*
2.30 – 3pm	Afternoon Tea: Conservatorium Café (Ground Floor)		
3 – 4pm	Society business, discussion of 2018 ISE Congress pitch (IHRH)		
4 – 5pm	Mingling and sound demos Conservatorium Foyer		
5pm	Meeting close		

ABSTRACTS

Acoustic Sensor Networks and Artificial Intelligence: Advancing Evidence-based Conservation

McKown, M.W.; Fleishman, A.B.; Schlueter, J.; Savage, D.T.; Earl, A.; Roberts, P.E.F.; Tarango, C.; Kline, D.J.

Conservation Metrics, Inc.

Outcome based decision frameworks have transformed medicine, education, agriculture, and development. Conservation has often lagged other fields in embracing the data-driven revolution, largely because of the difficulty and expense of collecting meaningful ecological data over large areas or long time-scales. The reality of declining forest cover, species loss, and global change makes it imperative that we test and compare conservation actions to identify new solutions and retire ideas that don't produce desired results. Recent technological advances in distributed sensor networks and artificial intelligence can help provide the robust and cost-effective metrics of ecological change needed to compare outcomes. We present case studies of how we have applied artificial intelligence to analyze terabytes of data from a variety of sensor networks. Examples include surveys for seabirds, songbirds, owls, rails, frogs, insects, and the sound of anthropogenic impacts. Our approach has contributed to dozens of projects monitoring endangered species and/or measuring ecosystem responses to management and restoration actions around the globe. Our goal is to collaborate with practitioners, regulators, and funders, to help realize evidence-based decisions in conservation.

Acoustic surveys for Western Ground Parrots.

Sarah Comer, Abby Berryman, Saul Cowen, Jeff Pinder, Cam Tiller, Chris Powell and Allan Burbidge

Department of Parks and Wildlife, 120 Albany Hwy, Albany WA 6330

We have been surveying the Western Ground Parrot (WGP) (*Pezoporus flaviventris*) by acoustic methods for decades using human observers, and extensively through the use of autonomous recording units (ARUs) for more than five years.

Challenges include the difficulty of distinguishing WGP calls from those of Tawny-crowned Honeyeaters (for both humans and software), time required to obtain an adequate library of reference calls for automated recognition, time required to develop recognisers or manually scan field recordings, and deterioration of microphones during extended field use.

Lessons include
1. the need to understand the ecology of the target species in order to optimise sampling strategies, particularly with respect to temporal activity patterns,
2. survey results differ between humans and ARUs (each will detect some that the other misses, and vice versa); results may also differ between different ARUs, and
3. there is a high error rate (especially false positives) from recognisers we have been able to develop using currently available software, meaning that scanning of spectrograms by a skilled observer may be more efficient.

Despite these difficulties, acoustic surveys (human and ARU) are the only practical way of determining occupancy by WGPs, and also reveal apparently meaningful population trends.

Bioacoustics for conservation: New technology for endangered black-cockatoo monitoring

Daniella Teixeira[1], Richard Hill[2,4], Guy Castley[5,6], Martine Maron[3,4] and Berndt Van Rensburg[1]

[1] School of Biological Sciences, The University of Queensland
[2] Department of Environment, Land, Water and Planning, Victorian Government
[3] School of Geography, Planning, and Environmental Management, The University of Queensland
[4] South-eastern Red-tailed Black-cockatoo Recovery Team
[5] School of Environment, Griffith University
[6] Glossy Black Conservancy

The Glossy Black-cockatoo (*Calyptorhynchus lathami*) and the South-eastern Red-tailed Black-cockatoo (*C. banksii graptogyne*) are of conservation concern. Both are listed threatened species, and the latter is included in the Australian Government's 20 Birds by 2020 Priority Species for Conservation. However, existing monitoring efforts by human observers are limited and potentially biased, since these birds tend to be rare, cryptic and often occur on private land or in rural areas. Bioacoustic technology may offer an alternative monitoring approach. As part of my PhD research, I aim to devise bioacoustic techniques to improve the monitoring of the South-eastern Red-tailed Black-cockatoo and the Glossy Black-cockatoo. Specifically, I am interested in quantifying breeding success. To do this, I will first describe the species' vocal behaviour at nests and examine the reliability of call recognisers. Following this, I aim to implement the technology to answer questions such as (1) What proportion of nests successfully fledge a chick? (2) Does fledging success relate to nestling or adult female begging behaviour and food availability? and (3) Can bioacoustics identify fledglings in a flock? In 2016, bioacoustic recorders were installed at nests of the South-eastern Red-tailed Black-cockatoo in Victoria and at those of the Kangaroo Island Glossy Black-cockatoo (*C. l. halmaturinus*) in South Australia. In 2017, this study will expand to include the Glossy Black-cockatoo in Queensland.

Assessing the Status of Koalas in Forests using Acoustics and an Occupancy Modelling Framework

[1]Brad Law, Traecey Brassil[1], Leroy Gonsalves[1], Anthony Truskinger[2] and Anna McConville[3]

[1]Forest Science Unit, NSW Industry-Lands, Parramatta, NSW (brad.law@dpi.nsw.gov.au)
[2]QUT
[3]EchoEcology, Crescent Head NSW

Koalas are a cryptic species that are surprisingly difficult to survey, especially in tall remote forests. We are undertaking a large-scale survey of Koalas in forested environments of north-east New South Wales to assess their current status and response to timber harvesting. So far we have deployed SongMeters (SM4) at >100 sites, each for a period of 7 nights, over an extensive area to record male bellows during the breeding seasons of 2015/16. Recordings are scanned by Ecosounds software at QUT and then we manually checked all computer matches of Koala bellows to rule out false positives. Our sample from a wide range of forests in 2015 found that Koalas had a probability of detection of ~ 0.3, indicating that this must be accounted for before relating occupancy to habitat type or successional stage. The seven nights of acoustic data are highly suitable for accounting for imperfect detection prior to occupancy modelling. Surveys are now targeting modelled higher quality habitat in forests of a range of successional stages. Preliminary results reveal naïve occupancy levels of ~ 80 % across a broad range of forests – such high detection rates were unexpected based on results from previous survey methods. Once imperfect detection is accounted for, we will estimate probability of occupancy for a range of forest types in relation to timber harvesting. Acoustic detection is proving to be a highly successful and efficient technique at recording Koalas in forested areas where traditional surveys have had limited effectiveness.

Using BARs to monitor the *Zoothera* Thrushes of the Tweed Range in northern New South Wales.

Elliot Leach

Griffith University

The Zoothera thrush complex is represented on the Australian mainland by the Bassian Thrush Z. lunulata and the Russet-tailed Thrush Z. heinei. These species are sympatric at several locations on the eastern coast. Often, these populations occupy different elevations, with the Bassian Thrush preferring higher elevations, though reasons for this are poorly understood. I present data from automated acoustic recordings made of these species in the Border Ranges and Mebbin National Parks of north-eastern New South Wales between ~300 m and 1100 m above sea-level over a 1-year period from June 2015 to May 2016. Bassian Thrushes were recorded most frequently in October, typically at or above 900 m. Russet-tailed Thrushes were recorded most frequently in August, at or below 700 m. Differences in elevational preference between the species may be driven by several factors including adaptation to cold, avoidance of interspecific competition and avoidance of hybridisation.

Finding the elusive Eastern bristlebird by engaging citizen scientists with bioacoustics.

Jessie L Cappadonna[1], Margot Brereton[1], David M Watson[2], Paul Roe[1]

[1] School of Electrical Engineering & Computer Science, Queensland University of Technology
[2] Institute for Land, Water and Society, Charles Sturt University

Many researchers have experienced the exhaustive effort required to sift through acoustic data in the hopes of finding that elusive vocalization, particularly for species with calls poorly-suited to automatic detection. Citizen science has the potential to offer creative ways to optimize finding these needles in haystacks, while engaging people with acoustic research. Few citizen science projects have explored acoustic data analysis, and those that have done so have suffered from relatively low participation and found that engagement was difficult to maintain. We investigated how to engage citizen scientists with acoustics to look for endangered Eastern bristlebirds (*Dasyornis brachypterus*). These furtive songbirds sneak about in dense impenetrable heathlands, and estimating population sizes and finding new breeding localities are two key management priorities. The largest stakeholder group for this species is Eastern Bristlebird Recovery Team, which has been working together for over 10 years, comprising representatives of conservation-focused state agencies, NGO's, and environmental consulting firms to conserve the species. The recovery team and members of the broader citizen science community collaborated to design engaging ways to analyse environmental recordings collected in likely bristlebird localities. Challenges to learning and accurately identifying vocalisations were revealed, including that calls of this species are poorly-known to even experienced birders. To enable learning of vocalisations, sustained engagement, and correct identification of bird calls, designs must include example target vocalisations, a means of peer-to-peer interaction, and a procedure to review and validate suspected bristlebird calls. This project is empowering people to learn about unfamiliar species through acoustics, while offering novel ways to experience nature and engage with nature conservation.

Does artificial light at night affect acoustic communication?

Michelle L Hall, Ashton L Dickerson and Therésa M Jones

The University of Melbourne

Animals, including birds and insects, often use acoustic communication to compete for resources and attract mates. In many of these species, acoustic signals peak at dawn and dusk with the shift between daylight and darkness. However, the timing of the onset of darkness and the start of a new day has changed dramatically since the advent of electricity, resulting in many species in urban environments no longer experiencing true night time darkness. This unprecedented shift in the brightness of the night sky has a range of fitness consequences.

We are currently investigating the effects of the presence of artificial light at night on birds and arthropods by recording soundscapes in unlit (rural) and artificially lit (urban) environments. The presence of artificial light is often also associated with increases in noise and temperature that may have interacting effects on acoustic communication. Key focal species that call both during the day and at night will include the Australian black field cricket and the Willie wagtail. The function of male field cricket song in attracting females is well understood and they are particularly amenable to experimental laboratory studies to investigate causal mechanisms underpinning correlations between song, light, and other anthropogenic factors. Willie wagtails, also known as 'Australian nightingales', are diurnal insectivorous birds known for their prolific nocturnal song, which could be particularly affected by artificial light at night. However, the function of their nocturnal song is currently unknown. We will investigate how wagtail singing behaviour is affected by artificial light at night, and the fitness consequences of variation in their singing behaviour.

Our preliminary analyses indicate that individual wagtails have repertoires of around 2 to 5 different song types, and song types are often shared among individuals, allowing interacting birds to match song types. The high degree of stereotypy in wagtail song types makes them amenable to automated detection and analysis.

Using acoustic techniques to monitor wetland faunal responses to environmental water deliveries in the Goulburn Broken Catchment

Jo Wood, Simon Casanelia

Goulburn Broken Catchment Management Authority, Shepparton, Vic 3630, Australia

Wetlands in the Goulburn Broken Catchment (Victoria, Australia) provide habitat for a diverse fauna assemblage including many of conservation significance. Environmental water is delivered to a number of these wetlands to provide more natural wetting regimes, which have been impacted by infrastructure development, diversions and drainage works. Acoustic monitoring has been routinely used since 2008 in wetlands of the Goulburn Broken Catchment as part of the management agency's broader monitoring program to gauge fauna response to environmental water management deliveries.

Here I report on some of the ecological responses recorded using event-based acoustic monitoring at five wetlands that have received environmental water between 2008 and 2016. This information has provided insight to population dynamics and has given insight into species presence, activity periods and succession during periods of flooding, drawdown and drying at these ephemeral sites. In addition, the finding of distant anthrophony affecting some faunal vocalisations.

Acoustic monitoring has broadened our knowledge of these sites, assisted with natural resource management decision making, and improved the basis for future planning of environmental water deliveries.

Citizen scientists are 'Communities Listening for Nature' in Victoria, Australia

Christine Connelly1 and Karen Rowe2

1 Victorian National Parks Association, Level 3, 60 Leicester St, Carlton, christinec@vnpa.org.au
2 Sciences Department, Museums Victoria, GPO Box 666, Melbourne, karowe@museum.vic.gov.au

Citizen science has the potential to be a powerful tool in bioacoustics research and monitoring. In 2016, the Victorian National Parks Association (VNPA), with Museums Victoria, established the 'Communities Listening for Nature' project. We're working collaboratively with scientists, local community groups and land managers to develop locally-relevant studies that improve monitoring and inventorying of bird species. This project is an expansion of VNPA's NatureWatch citizen science program. So far, we have found that volunteers are readily trained in the field aspects regardless of their previous skills and experience. Community volunteers collect field data using automated recorders and the recordings result in large datasets, providing a permanent, interrogable record of species presences. These data ultimately contribute to both discrete, local studies and provide a representative, state-wide digital call reference library, which will be made publicly available in Museums Victoria's online collections database. This library will serve as a valuable resource for researchers investigating birds in Victoria, now and into the future. In addition to the data collected, this project provides important social and nature conservation outcomes from involvement in citizen science. Participants report valuable learnings and upskilling after taking part in our projects, as well as a greater interest in and concern for local natural values. Here we share our project design model and insights into managing a successful citizen science project.

How analysis of underwater sound is affected by intra- and inter-site acoustic variation in a freshwater stream.

Chris Karaconstantis, Simon Linke and Toby Gifford

Griffith University

Sound travels much further in deep ocean water than in air; for example, whale songs can be heard for hundreds of kilometres. This has given rise to a common conception that underwater bioacoustic monitoring can cover a large spatial range using a single hydrophone. Whale sounds however can exceed 210dB at the source, while fish and insect sounds in freshwaters are produced at much lower levels, generally 120-130dB. Additionally in shallow waters, a number of attenuation and reflection processes limit the distance over which sound propagates underwater, which creates acoustic patchiness and subsequently acoustic sampling can under-represent a system. This Honour's project investigates spatial differences in underwater biological sound, observed both within a site and between similar sites (two local regions of the same river). An array of hydrophones was used to record sounds at several sites of the same river; recordings are being compared using a variety of acoustic indices. Playback experiments using artificial sounds were also undertaken to investigate how sounds propagate at these locations.

A pipeline and app for massive filtering and assisted inspection of enormous acoustic datasets

Kyle N. Armstrong[1,2,3], Ken P Aplin[4], and Stephen Crotty[5]

[1] Department of Genetics and Evolution, The University of Adelaide, South Australia;
[2] South Australian Museum, Adelaide, South Australia;
[3] Specialised Zoological; http://szool.com.au
[4] Ken Aplin Fauna Studies Pty Ltd; Smithsonian Institution;
[5] Department of Mathematics, The University of Adelaide, South Australia.

In the past few years the popularity of using field-deployable full spectrum ultrasonic recorders has led to the collection of massive datasets, which in turn has led to an improvement in levels of species detection and discrimination in certain situations. However, it is not feasible for an analyst to manually inspect every single full spectrum sound file to identify bats present, nor to manually tally bat calls as part of monitoring projects. Thus, semi-automated systems of analysis are now unavoidable. Our bespoke system provides a means to massively filter full spectrum data for bat calls via pulse shape detection, perform multivariate statistical analysis, and then subset the results according to recording site and date. The final step allows the analyst to manually check the output identifications provided by the statistical analysis via a tiny subset of the original dataset. The pipeline consists of an inexpensive commercially available software programme, followed by a series of steps undertaken using an R language script that has been packaged into a 'shiny' app. The pipeline has been applied routinely to datasets collected from northern Australia, Papua New Guinea and beyond, and has resulted in tremendous savings in time—even in regions where bat assemblages and their calls are relatively poorly known—and without significant losses in detection rate.

Bring Big Data to Many People: Environmental Audio Classification and Searching.

Jinglan Zhang, Xueyan Dong, Jie Xie, Paul Roe

QUT

Environmental monitoring is becoming critical as human activity and climate change place greater pressures on biodiversity. Australia is one of the most biologically diverse regions on Earth and also has unique fauna and flora. However, Species are undergoing exceptional loss of habitat, leading to an increasing need for data to make informed decisions. Acoustic sensors can help collect data across large areas for extended periods so they are very attractive in environmental monitoring. However, analysing large volumes of environmental acoustic data is a great challenge and is consequently hindering the effective utilization of the big dataset collected.

This talk presents an overview of our current techniques for analysing large volumes of acoustic data and for presenting the results to people, focusing on automated classification and retrieval techniques.

Measuring Frog Chorus with Acoustic Indices.

Karlina Indraswari[1], Jie Xie[1], Lin Schwarzkopf[2] and Paul Roe[1]

[1]Electrical Engineering and Computer Science School, Queensland University of Technology, Brisbane, Australia
[2]College of Science and Engineering, James Cook University, Townsville, Australia

There has been a grown interest in measuring ecosystem dynamics through soundscape. The soundscape has been defined as all kinds of sounds that come from the environment, which includes sounds from biological sources (biophony), geological sources (geophony) and antropological sources (antrophony). Inside the soundscape, temporal and spatial distribution of sound is suggested to be related to the systematic interactions between humans, animals and the environment. Acoustic indices measure this diversity and distribution of sound energy. Studies have shown positive correlations between indices and species richness of species during dusk and dawn chorus. However, little work has looked into correlations between the indices with animal calling behaviour, such as calling intensity (how often a species call) and duration of calls. This work aims to look at the relationship between 2 acoustic indices, the Acoustic Complexity Index (ACI) and the Acoustic Entropy Index (H), with calling behaviour of frog choruses. It is expected that both indices will increase in value with the increase of frog chorus duration and its calling intensity.

Can you picture what is in a thirteen-month recording?

Yvonne Phillips, Michael Towsey and Paul Roe

QUT

Long-duration audio recordings are becoming more common. Longer recordings contain more information but the audio format makes it time-consuming and difficult to access due to the time it takes to listen. Using thirteen months of continuous recordings collected from two different regional ecosystems we clustered and visualised the contents. The recordings were pre-processed and summary and spectral acoustic indices were calculated. The clustering produced sixty clusters, which were sampled and allocated to one of seven classes: wind, rain, birds, cicadas, insects other than cicadas, quiet and planes. Visualisation reveals the daily and seasonal occurrences of these classes.

Using acoustic indices to study the impact of traffic noise on urban forest soundscapes in south-eastern Australia.

Jasmine Munro, Ian Williamson and Susan Fuller

Earth, Environmental and Biological Sciences, Queensland University of Technology

While the negative impacts of road infrastructure on faunal diversity and abundance have been extensively studied, many traffic noise studies have been conducted in the presence of confounding factors. Therefore, the extent to which traffic noise alone is responsible for impacts is not well known and a better understanding is required to inform urban planning and management decisions. This study examined the impact of traffic noise on soundscape patterns at road edges in urban forests. Acoustic sensors were deployed at road and powerline edges, as well as within interior habitat, at three sites in south-east Queensland, Australia. Powerline edges were included to separate edge effects from traffic noise impacts. Soundscape patterns were investigated using indices of technophony (noise generated by technology, primarily traffic in this case, and calculated as the relative soundscape power in the 1-2 kHz frequency range) and biophony (sounds produced by organisms and calculated in this study as the relative soundscape power in the 3-11 kHz frequency range). The results showed that biophony was consistently lower at road edges and was negatively correlated with traffic noise and positively correlated with distance to road edge. Technophony was significantly higher at road edges and was found to correlate negatively with distance to road edge and positively with traffic noise. Technophony and biophony at powerline edges generally exhibited values comparable to interior habitat. These results indicate that traffic noise affects urban forest soundscape patterns at road edges in south-eastern Australia.

Disentangling landscape and vegetation drivers of soundscape quality in urban forest remnants.

David Tucker1, Stuart Gage2, Ian Williamson1, Susan Fuller1

1 Earth, Environmental and Biological Sciences, Queensland University of Technology

2 Michigan State University

Natural landscapes are increasingly subjected to anthropogenic pressure and fragmentation resulting in biodiversity loss and reduced ecological condition. Previous studies in eastern Australia have revealed a strong relationship between soundscape patterns, ecological condition and the extent of landscape fragmentation. However the effect that vegetation structure and species richness has on soundscape patterns remains little studied. Our goal in the current study was to examine the vegetation/soundscape relationship in urban forest remnants characterized by two different vegetation communities, spotted gum open forest and scribbly gum woodland.

Our results indicate that landscape attributes, particularly patch size and extent of road fragmentation, are the primary drivers of soundscape patterns in both vegetation communities. Large, remnant forest patches close to conservation areas exhibit higher soundscape quality (normalized difference soundscape index; NDSI) than small urban fragments. However, soundscape quality was also related to a number of different vegetation structural attributes in spotted gum and scribbly gum forests. For example, native shrub cover was negatively correlated with soundscape quality in spotted gum forests, but positively correlated in scribbly gum woodland. Neither vegetation type displayed any significant correlation between NDSI and native vegetation species richness. We did not identify any one vegetation attribute that could be positively correlated with soundscape patterns in both vegetation communities.

Comparison to a benchmark (or 'natural') site revealed that different patterns were related to disturbance and reduced vegetation quality; spotted gum forests in an undisturbed state have sparse shrub cover, while scribbly gum woodlands are characterized by a shrubby heath layer when in pristine condition. We conclude that soundscape patterns in urban forest remnants are strongly influenced by landscape fragmentation, disturbance and resultant changes in vegetation quality.

Keeping an ear out for change on the Great Barrier Reef.

Graham Hemson[1] and Matthew McKown[2]

[1] Queensland Government, Department of National Parks, Sport and Racing, 61 Yeppoon Rd, Parkhurst, 4702, AUS
[2] Conservation Metrics, Center for Ocean Health, 100 Shaffer Rd. Santa Cruz, CA 95060, USA

Each summer more than half a million wedge-tailed shearwaters arrive in the Capricornia Cays archipelago in the Southern Great Barrier Reef to breed. This population is a key natural value for management and an iconic component of the areas ecology. Recent efforts to monitor the population have uncovered a 40% decline since 2001. However these same efforts are time con summing and logistically challenging requiring the Queensland Government to project volunteers and staff onto the islands to count burrows for several days. Aware of this costly potential, we have been working with Conservation Metrics to develop an automated acoustic system for monitoring. After three years of testing and validation we now have a network of 45 sensors deployed across the cays and a bespoke deep neural network call recognition program. Not only can we reliably estimate the size of the breeding population we can now examine the phenology of shearwater breeding and the reproductive output of the population. The resulting removal of observer bias and increase in the time over which data are recorded means that not only are the data gathered cost effectively, the results are also more precise and useful. These advances should provide data that can help shed light on the causes of the decline, not just document its magnitude.

Cockatoo screams suddenly useful – a new age of avian conservation technology.

Kate Trewin

University of Melbourne, Museums Victoria

Automating the process of species identification in field recordings using vocalisations has the potential to greatly improve the speed and reliability of monitoring efforts for conservation. In order to test emerging recogniser development methods, I am exploring three different algorithms of automated recognition – Hidden Markov Models (SongScope/Kaleidoscope), Spectrogram Cross Correlation, and Binary Point Matching (R package, monitoR) - comparing specificity (reduced false positives), and sensitivity (reduced false negatives). Further to this I am assessing detection probabilities in 22 species of South Eastern Australian parrots.

Parrots are readily identifiable by their frequent vocalisations, thus they serve as an ideal group for evaluating the performance of automated recognition methods in the context of monitoring species presences. A recent long-term analysis of observations records by BirdLife Australia has shown that many populations of South Eastern Australian parrots are declining in numbers. Suggesting that Australian parrots may be of increased importance for conservation priority, requiring greater effort in monitoring species presences. Thus, to better assess the use of recognisers in conservation monitoring I will also develop case studies for a rare species and a common but declining species.

Preliminary results from a pilot study focusing on Gang-Gang Cockatoos demonstrate the differences in the developed recognisers abilities. The final results from my study can be used to make informed decisions on which recogniser algorithms to use for different conservation problems, as well as understanding the applicability of automated recognition for conservation studies in general.

Vocal individuality, but not stability, of palm cockatoos on Cape York Peninsula.

Zdenek, C.N., Heinsohn, R., Langmore, N.E.

The ability to identify individuals within a population is often essential for a detailed understanding of the ecology and conservation of a species. However, some species, including large parrots, are notoriously difficult to catch and mark for individual identification. Palm cockatoos (Probosciger aterrimus) are a large, poorly understood species of parrot which are likely in severe decline within the eastern part – and possibly the western part – of their range on Cape York Peninsula, Australia. Here, we investigated whether three different palm cockatoo call types are sufficiently individually distinctive to function as a non-invasive "marker" for identifying individuals over time. Using Discriminant Function Analysis, overall identification accuracy among 12 putative individuals for all call types was 81% (i.e. 148 out of 183 calls were assigned to the correct individual) on the basis of multiple temporal, energy (amplitude) and frequency measurements on the spectrogram. For three different call types, individual identification accuracy among males and females ranged from 69 to 95%. However, based on a limited sample sizes of five putative individuals between years, our data suggest that individual call structure, as quantified by call parameters, was not stable between years. We discuss the applicability of these results for future studies of palm cockatoos and other parrot species.

Successful use of automated recording systems and call recognition software in the conservation management of the critically endangered Kroombit tinkerfrog.

Harry Hines

Kroombit tinkerfrog, *Taudactylus pleione*, is a critically endangered species restricted to 12 rainforest patches totalling 596ha at Kroombit Tops in central Queensland. Most of these rainforest patches are difficult to access as they are very steep, narrow gullies, lying below the eastern escarpment.

Despite many years of targeted research, eggs and tadpoles have not been observed and females and juveniles very rarely. As Kroombit tinkerfrogs are small (maximum length ~30mm), cryptically patterned and inhabit rock piles and leaf litter, detectability is dependent upon the male advertisement call. Males tend to call more or less continuously for extended periods. The call is relatively loud and simple in structure. Combined, these factors suggested the use of automated recording systems and call recognition software may efficiently significantly enhance knowledge of the seasonal and daily patterns of calling and thus refine survey and monitoring methods and target conditions under which breeding was most likely occurring.

Song Meters and more recently BARs were used to capture ~700K one minute field recordings (typically 1 min every 30 min throughout the day) from up to nine sites over seven seasons. Batch analyses using SoundID has confirmed the local extinction from three sites. Detailed calling phenology was obtained from extant sites.

Whilst more detailed analyses are pending, it is clear that in the case of Kroombit tinkerfrog the combination of automated recording systems and call recognition software has greatly enhanced knowledge of calling phenology, detectability and assessment of site occupancy, and will remain a significant tool in the conservation management of this species.

Using population-specific calls to investigate the ecology of the blue whale complex.

Rogers, T.L., Tripovich, J.R., Truong, G.

E&ERC, School of BEES, UNSW Australia

Passive acoustic monitoring is quickly proving a powerful and cost-effective ecological tool to reveal information on occurrence and distribution of species, and populations, where there has been an inability to observe animals directly.

The blue whale remains critically endangered, the species has not recovered post whaling. They have been extremely difficult to survey which has hindered the understanding of their recovery. The blue whale complex is particularly diverse within the Southern Hemisphere, there are different blue whale subspecies, and several distinctly different acoustic populations. Although the subspecies look identical they are easily distinguishable by distinctly different acoustic signals.

We have been using the differences in acoustic signals to investigate the ecology of the blue whale complex. We use underwater passive acoustic data collected continuously from 2009–2012 and from five sites spanning over 7,370 km across the southeast Indian Ocean and southwest Pacific Ocean. To date we have found new blue whale populations around the coast of Australia, and we have found that not all Antarctic blue whales return to the Antarctic to feed in the austral summer. We have detected Antarctic blue whale vocalizations year-round in mid and low latitude northern waters and as far north as the Lau Basin - but this does not happen every year.

We are now examining what drives these changes in Antarctic blue whale distribution patterns across the Southern Hemisphere. We are looking across the ocean basins of the southern hemisphere. We detect blue whale vocalizations in continuous multi-year (over 16-years at some sites) recordings using different arrays, including the world-wide network of underwater hydrophones that listen for nuclear explosions (the UN General Assembly CTBT Nuclear Test Ban Treaty system). It is poetic that infrastructure developed to prevent nuclear warfare is perfect to answer questions about one of the world's most secretive mammals – the blue whales.

Investigating the presence of Omura's whale in Australian waters.

Elisa Girola[1], Craig McPherson[1] and Julien Delarue[2]

[1]JASCO Applied Sciences (Australia), Brisbane, Australia
[2]JASCO Applied Sciences (Canada), Halifax, Canada

Very little is known about the presence of the Omura's whale (*Balaenoptera omurai*) in Australian waters. Vocalisations of this species were described for the first time in 2015 in Madagascar, and no studies using this information have been conducted in Australian waters. This poster contrasts calls detected in Australian waters with those from Madagascar to demonstrate similarity. We also present an initial look into the spatial and temporal distribution of the Omura's whale from the Pilbara through to the central Timor Sea determined through analysis of long term acoustic recordings.

Six key challenges to operationalising ecoacoustic monitoring in freshwater environments

Simon Linke, Toby Gifford, Camille Desjonqueres

Traditional methods of aquatic survey techniques a) bear risks to the health of the organisms, b) introduce bias, c) only assess populations at single times instead of continuously and d) incur high costs, particularly in remote areas. Acoustic monitoring - a noninvasive, continuous real-time technique can address all of the above issues. We argue that passive acoustics presents a viable, uninvasive and largely unexplored approach to freshwater ecosystem monitoring, yielding information across three key ecological elements of freshwater environments: (i) fishes, (ii) macroinvertebrates, and (iii) physico-chemical processes.

In a recent literature review, we recovered 2,360 articles from a Google Scholar search of the key-words "+freshwater+bioacoustics". These can be categorised into two groups: (1) mechanisms of biological sound production and behavioural studies, and (2) the effect of anthropogenic noise on aquatic animals. The application of bioacoustics to freshwater monitoring is virtually non-existent in the literature.

We believe that freshwater ecoacoustic monitoring can be operationalised by overcoming six key challenges

- linking sounds to organisms and ecosystem processes and
- developing a central repository for freshwater sounds
- estimating intra-specific call variations
- evaluating and considering diurnal variation
- modelling spatial sound propagation
- deriving links between ecological condition and sounds

We review progress in addressing all these challenges and conclude that passive acoustics represents a potentially revolutionary development in freshwater ecology, enabling dynamic monitoring biophysical processes to inform conservation practitioners and managers.