NOTATIONAL STRATEGIES FOR INTEGRATING LIVE PERFORMERS WITH COMPLEX SOUNDS AND ENVIRONMENTS

Lindsay Vickery
Edith Cowan University
l.vickery@ecu.edu.au

ABSTRACT

This paper describes strategies for integrating live performers with complex "extra-musical" sounds and environments through extended traditional and proportional notations. The subjects of the works discussed include Animals (*wardang* [2019], *kurui* [2018]) and environments (*rising water* [2018], *willsons downfall* [2018], *njookenbooro* [2018]) . The techniques include spectrographic transcription, audio processing, extended forms of notation and spatial audio.

1. INTRODUCTION

The work discussed here draws from the rich history of recording and field recording in particular. The capability and aspiration to compose with complex "extra-musical" [1] sounds found in such recordings has closely tracked the steady advances in recording technology. From the first recorded animal recording by Ludwig Koch in 1889 [2], through the emergence of Musique Concrete in which "sound recordings were raised to the status of compositional raw material" [3] and the emergence of "field recording" practice advanced through the work of Westerkamp (1946-) and Truax (1947-) and the Vancouver World Soundscape Project (1972-) at Simon Fraser University [4]. The implications of this evolving practice have proliferated supporting the emergence of numerous associated compositional specialisations, from "virtual environments" [5] to "zoomusicology"[6].

This paper describes work in one of these specialisations: the development of strategies allow for instrumental performers to emulate and interact with complex sounds and environments through visualisation and musical notation. It aims to build on the work of composers such as Robert Erickson (1917-97), François-Bernard Mâche (1935), R. Murray Schafer (1933), Barry Truax (1947), Anne LeBaron (1953), David Dunn (1953), Michael Pisaro (1961), Matthew Burtner (1970) and Joanna Bailie (1973).

The subjects of the works discussed include Animals (*wardang* [2019], *kurui* [2018]) and environments (*rising water* [2018], *willsons downfall* [2018], *njookebooro* [2018]) . While visualization and notation attend to the moment to moment emergence of sound, this paper also discusses the interconnected issue of the shaping or absence of shaping structure in these works.

2. CONTEXT

This work attempts to take into account López' criticism of filed recording as " something perverse (…) as if the encoding of a semiotic referent in the form of an audio description of place could ever be something other than a human invention"[7], and to answer Bailie's question "if we are not to simply present the sounds of the world to an audience as a kind of musical fait accompli (...), what in fact are we to do with them?" [8]. It aims to do so by entering into a compositional and performative interaction with the recordings and in some cases the environments from which they arise.

In 2008 Dunn stated that "the dual heritage of Acoustic Ecology and experimental music—in foregrounding our aural perception of the Earth—seems more urgent than ever" [9]. At the time of writing fires are raging throughout the continent from which I write and is already estimated to have killed up to a billion animals. [10]

This devastation is the most likely the result of dissonance between the principally European and South East Asian population of Australia not just with the indigenous people but the environment as a whole, it's flora and fauna. Fires. The absolute decimation of the countryside in the south-west of Australia, where 93% of native vegetation has been "cleared" [11] and is now utterly incapable of supporting an autonomous ecosystem and reliant on human intervention to grow almost anything.

These works are intended in some part to create awareness of the natural environment including its fauna, which is often found in close in proximity to the city which for most inhabitants consists only of people, technology, buildings and roads.

The interaction with sound and the unfolding of these sounds over time in these works involves listening, analysis and compositional interaction and a similar process for the performers - learning to emulate the sounds.

In these works transcription of recordings is generally the principal basis for the score. Recordings are sometimes processed using Eric Lyon's *FFTease* objects *thresher~* or purpose built *Max* patches to emphasise principal frequencies. They are then analysed using Sonic Visualiser to create a spectrogram and sometimes *Audacity*'s "Plot Spectrum" function to identify pitch content.

Scores are generally assembled in *Adobe Illustrator*, usually in direct proportion to the spectrogram, using an image size equivalent to 8-10mm of score a second of sound. A horizontally proportional pitch grid is generally added on a separate layer (PStave) and later transposed to a traditional staff (TStave). In some cases a vertical grid is also added if a metrical tempo is required. In other cases both pitch and rhythmic components are undefined globally to allow pitch and rhythmic characteristics to be defined in the score locally. In some works a background image is assembled behind the score from "field photographs" related to the recording in others it is black allowing to maximally highlights the notation.

The score is performed in scrolling mode us-ing the Decibel Scoreplayer. In the scoreplayer formatted scores (.dsz. files) can be networked if they have the same file name and are of the same format (in this case "scrolling"), however the au-diofile embedded in any instance of the .dsz need not have the same name. Therefore the number of channels of audio is only limited to the number of iPads in the network. The ability to pair with Blue-tooth speakers provides an extremely portable op-tion for multichannel audio in site specific perfor-mances.

3. ANIMALS

The two works described here are the first of a project to compositionally interact with Australian fauna beginning with two of the country's most ubiquitous animals: the possum and the crow.

3.1. kurui [2018]

The title *kurui* was derived from the name for possum in the Gubi Gubi language (South-Eastern Queensland). The work was built around a scaffolding of 'faithful' transcriptions of 9 characteristic possum (probably Trichosurus vulpecula) sounds, bridged by "interpretive" digressions veering towards the performative (and in one case improvisational) style of the performers (Erik Griswold and Vanessa Tomlinson) – long term collaborators with the author.

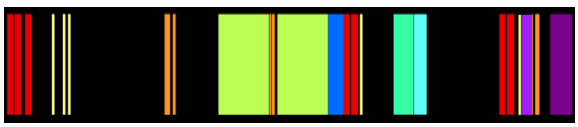

Figure 1. Proportions of the 9 transcriptions (colour coded) and digressions (in black) forming the struc-ture of *kurui*.

Figure 1 shows the proportions of the 9 transcriptions (colour coded) and digressions (in black) over the work's 8m and 32s duration.

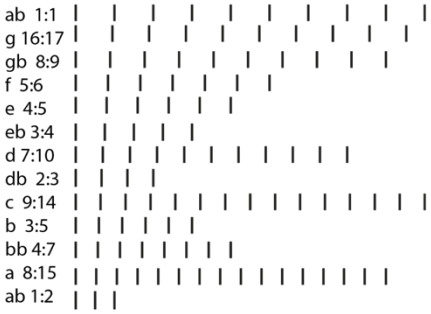

Figure 2. Grids representing proportional durations of pitches in an Ab tempo series.

The score was assembled in *Illustrator*, allowing spectrograms of the nine possum sounds to be displayed proportionally alongside the score as it was transcribed/composed. A grid layer was used to permit alternations between metrical and non-metrical material. Each vertical

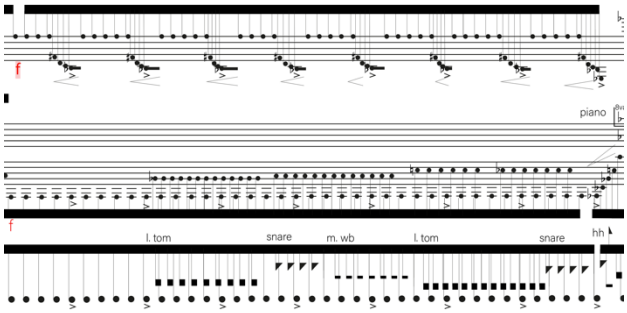

Figure 3. Polymetric digression from *kurui* [2018] for bass clari-net, melodica/piano and percussion.

grid line represented a tempo (approximately mm. 125) taken from the rhythmic grunts of the possum (shown in Figure 4). Secondary grids representing the proportional durations of pitches in a tempo series [12] (Figure 2.) were then used to create localized polyrhythms in the notation (Figure 3.).

Despite the "noisiness" of the possum sounds - significant pitch components are also evident. The contours of prominent pitched components were initially sketched directly onto the spectrogram and then "lifted-off' and adapted into a more traditionally spaced notational framework – Figure 4 is an example.

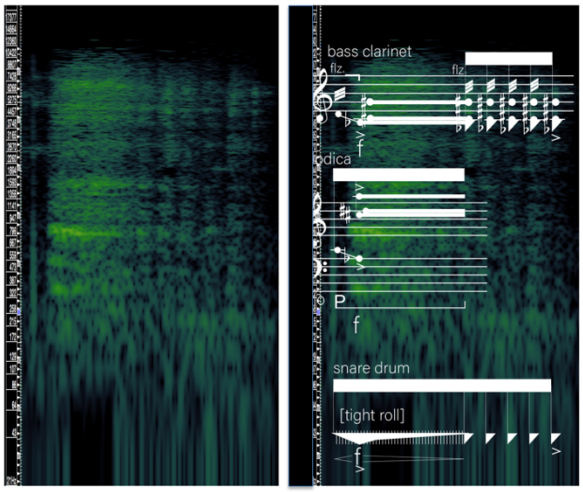

Figure 4. The opening motive of *kurui* [2018] spectrogram of Possum sound (left) and a superimposed transcription (right).

The characteristic screech emitted by the possum was transcribed for melodica and bass clarinet multiphonic (Figure 5).

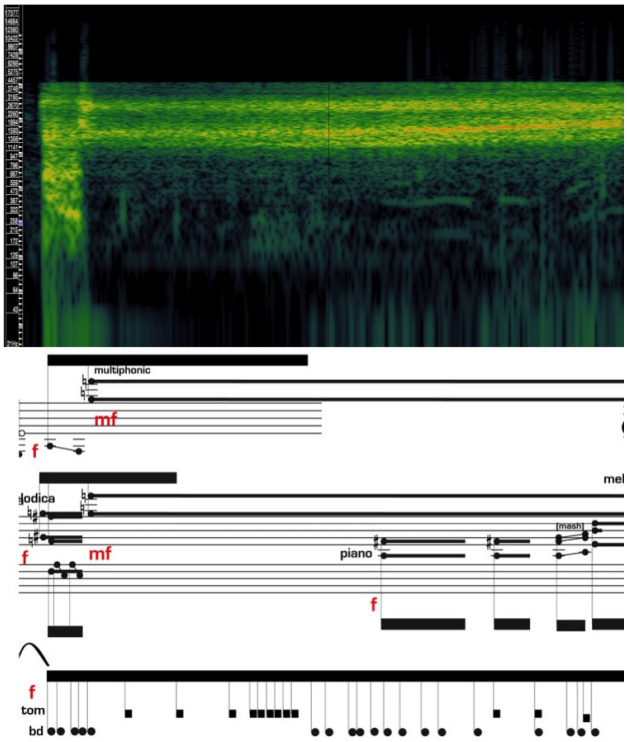

Figure 5. Possum Screech transcription from *kurui*.

In other transcriptions gestural [13], spectromorphological [14] notation and "cartoon convention" symbols [15] were used to sonically transcribe the sounds of possums moving in the trees (Figure 6.)

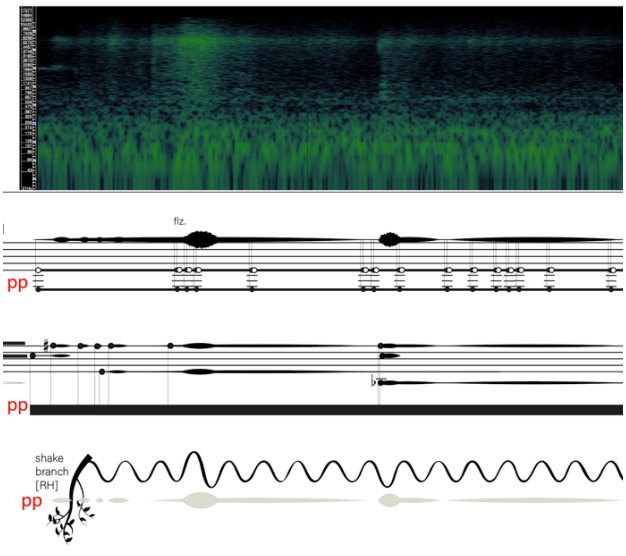

Figure 6. Gestural/spectromorphological transcription of Possum tree movements.

3.2. wardang [2019]

Wardang is the Wadjuk Noongar word for crow. The animal takes a central role in the Noongar familial lore, along with the Mannaitch (white cockatoo) defining rules of marriage and association. The recordings in this piece were made at Mooro Katta or Mount Eliza in Kings Park Perth, and include the three-part call typical of crows in this region and a peculiar almost "mewing" sound of a young crow. All of the electronic material was derived exclusively from this material and then assembled into a six-channel audio-collage.

Unlike *kurui*, which is entirely instrumental, crow recordings were used here "raw" and in combination with processed versions created using Eric Lyon's *FFTease* objects for *Max*: *thresher~* to sustain only the strongest sinusoids and *resent~* to alter the speed and phase of audio bins.

Instrumental parts were then created for flute, clarinet, electric guitar and harp, highlights and re-enforcing aspects of the collage (Figure 7).

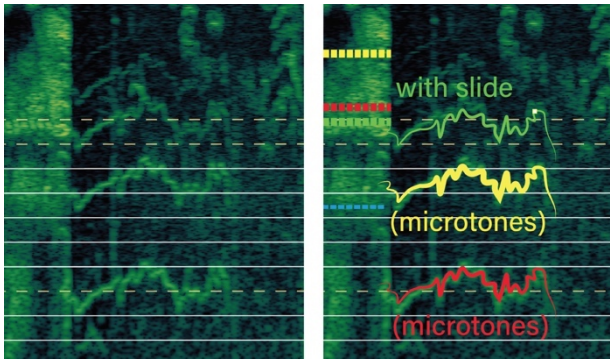

Figure 7. Transcription creating a spectral mixture in *wardang* showing greater weight on the centre har-monic (yellow = flute) and progressive less weight on the lower (red = bass clarinet) and then upper (green = electric guitar) harmonic.

Whereas *thresher~* has typically been used in these works as an audio expander to enhance spectrographic transcription, here the recordings were radically reduced to transform the recorded sounds into figures approximating instrumental music (Figure 8).

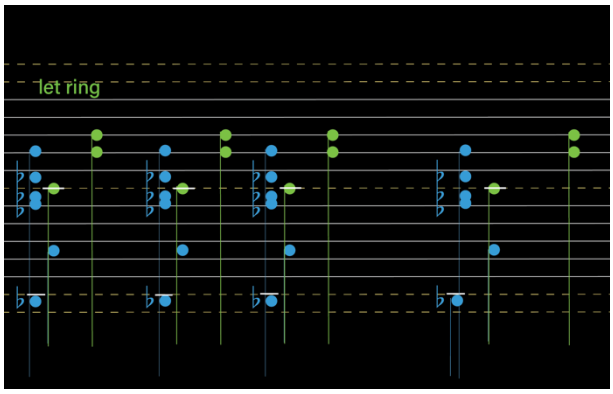

Figure 8. Instrumental figures for harp (blue) and electric guitar (green) drawn from crow recordings in *warding*.

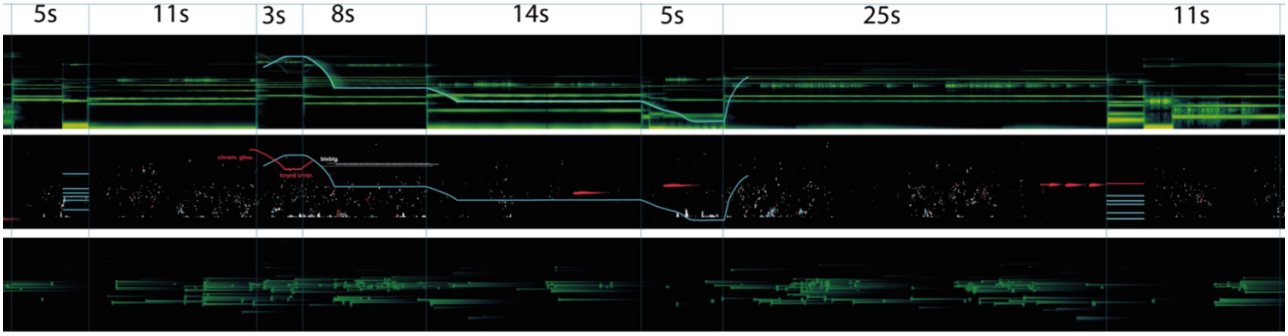

Figure 9. A segment of *rising water* showing its ecostructurally derived formal structure, created from major detected amplitude transitions causing changes in the "freeze" spectrogram (top), score (middle), original spectrogram (bottom).

In *wardang* the instrumental performance is embedded within a six audio channel audio-collage that is distributed amongst three iPads and may be output directly to bluetooth speakers, rather than output through a multi-channel interface.

4. ENVIRONMENTS

4.1. rising water

For *rising water*, a field recording by Leah Barclay of flood waters in Queensland was resynthesized using three different processes: firstly by using frequency data to control amplitude and amplitude data to control frequency; secondly by "threshing" (as described above); and finally by "freezing" the frequency spectrum at points of prominent amplitude transitions and sometimes bending their pitchtowards the next amplitude transitions.

The author's "Lyrebird" software [16] was used to cre-ate a "base" score representing strongest sinusoids in the frequency/amplitude exchanged recording and coloring them according to their timbral qualities. Illustrator was used to create notation representing the "threshed" and "frozen" recordings. The combination of these approaches permitted a rapid alternation between rapid, apparently random (but actually precisely placed) points of sound, periods of transition and complete stasis (Figure 10). This score was then separated into three colours (timbres) and distributed to the three instruments (bass clarinet, electric guitar and harp).

Then layers sometimes obscuring this score were built by transcribing shapes from the "thresh" and freeze" spectrograms. The variation in this material was used to define the sectional structure (which had been derived from the data in the original recording).

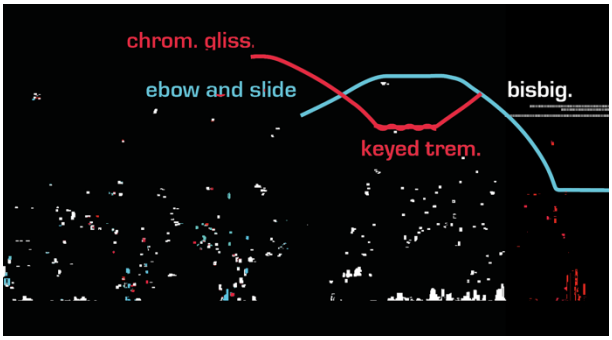

Figure 10. Excerpt of the score of *rising water* showing notation depicting rapid points of sound contrasted with frozen and gliding pitched material.

Significant changes in texture detected by spectral freeze process were then used to derive a sectional formal structure for the work (Figure 9). In this manner despite the transformation of the original field recording the work follows Ecostructural principals in which in which structural data derived from environmental sound sources "are used as the dominant material for creating the musical composition" (2006).

4.2. willsons downfall [2018]

The score for *willsons downfall* [2018] was written for a performance at Harrigan's Lane a property in the Great Dividing Range on the border of New South Wales and Queensland. LaBelle has stated that "composition becomes a form of research conveying cartographic routes in and through relations to place" (LaBelle, 2008: 198) and that is literally true of this work which relied upon satellite and terrain mapping of the Willsons Downfall locality around Harrigan's Lane.

In particular the score and structure of the work was assembled from topographical information related to three principal features: the Boonoo Boonoo River, Mount Lindesay Road and the tree line of the Bookookoora mountain ridge (Figure 11.).

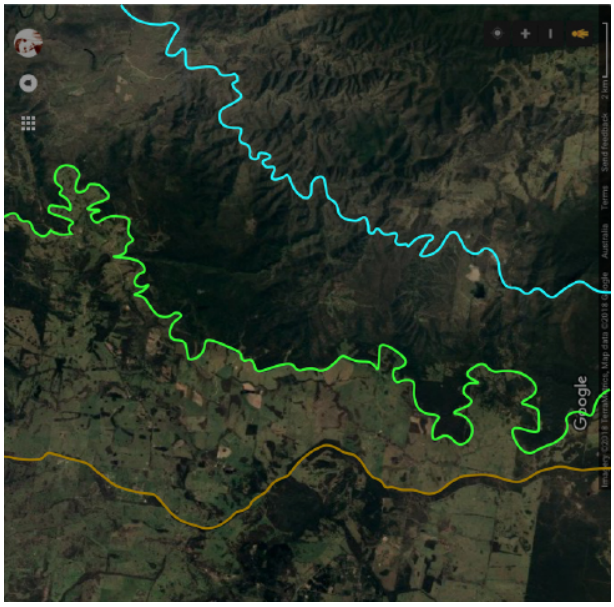

Figure 11. The Willsons Downfall locality around Harrigan's Lane with principal features: the Boonoo Boonoo River (blue), Mount Lindesay Road (brown) and the tree line of the Bookookoora mountain ridge (green).

Each feature is represented in the work by one of the performers. Other prominent topographical features – terrain, vegetation etc – were then extracted in *Illustrator* in a process roughly analogous to audio threshing. The three traced principal features were then used as "anchor-lines" to which the topographical features were attached according to their horizontal and vertical distance on the map (Figure 12). The lines (but not the topographical features) were then stretched out horizontally to represent the work's eight minute duration, spatially.

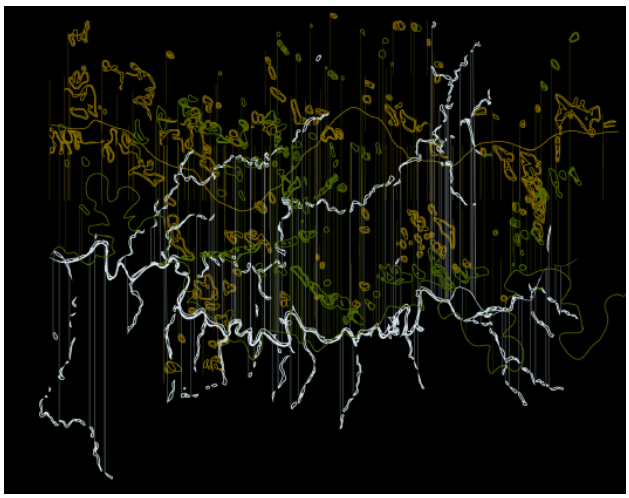

Figure 12. The three traced principal feature"anchor-lines" to which the topographical features were at-tached according to their horizontal and vertical dis-tance on the map

As a score, the traced principal feature lines were used to represent the volume for each performer and the topographical features were used to represent sonic complexes to be executed by the three performers. Several of these graphical complexes can be seen in Figure 13.

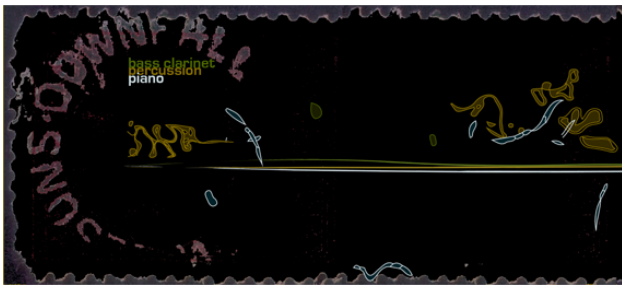

Figure 13. The opening of the score for *willsons downfall*, showing the beginning of the three "princi-pal feature"/ dynamic lines and several "topographical feature" glyphs.

Each of the three scrolling scores plays is embedded with one of the three field recordings from the Willsons Downfall region created by Jocelyn Wolfe. The recordings form the sonic connection to the terrain, forest and river topographies represented in each of the performer's scores. The "verticalised" contour of the feature was used to determine the volume and left/right spatial orientation for playback of each recording, by tracing it into a *function* object in *Max* (Figure 14). The recordings were intended to be projected through bluetooth speakers placed in the environment of throughout the audience in the case of a concert performance.

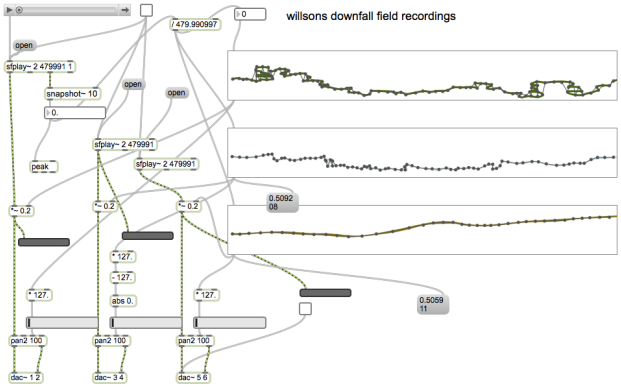

Figure 14. The "verticalised" contours of the three principal features were traced into *function* objects in *Max* and used to control the volume and left/right spa-tial orientation for playback of each recording.

4.3. njookenbooro [2018]

njookenbooro was created for the site-specific *series Limited Hangout: in the field*, instigated by the author. Works in the series were intended to explore approaches to the creation of site-specific music and means of establishing connections and interaction between sound and site. Composers were encouraged to use field recordings, topographical information, transcriptions, resonant frequencies, spectral niches [18] and other characteristics.

The site chosen for this performance was a walkway jutting into Herdsman Lake (Njookenbooro in the local indigenous language Noongar) in Perth.

The first section of the 27 minute score was created through the transcription of prominent environmental frequencies which were verified in *Audacity*'s "Plot Spectrum" function and then mapped directly onto a spectrogram of a field recording made at the location several days earlier at the same hour of the evening (photographs were also taken). Pitches were indicated via small staves before the shape denoting the sound (Figure 16).

In the central section the spectrographic renderings of the contours of bird and frog sounds were transcribed to create the notation (Figure 17).

The final section again focused on the prominent frequencies from the field recording, but verticalising the pitches into chords using a "spectral freeze" (Figure 18).

A panorama of the "field photographs" taken at the performance location was assembled in Photoshop and was used as the background for the scrolling score. Instruments were colour coded (using colours taken from photographs of the site). Partly because of the limited colour pallet, the performer's notation was also displayed as "parts" in which sits "above" the greyed-out notation of the other performers, in the Decibel Scoreplayer [19] (Figure 15).

Figure 15. Instrumental colour coding (using colours taken from photographs of the site).

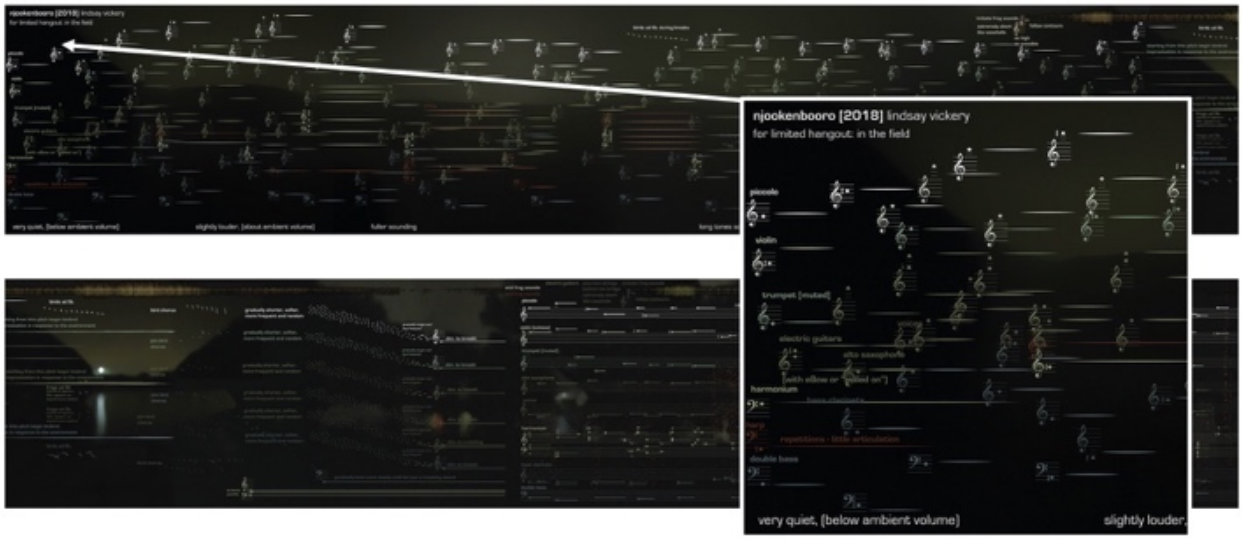

Figure 16. The first section of the score for *njookenbooro.*

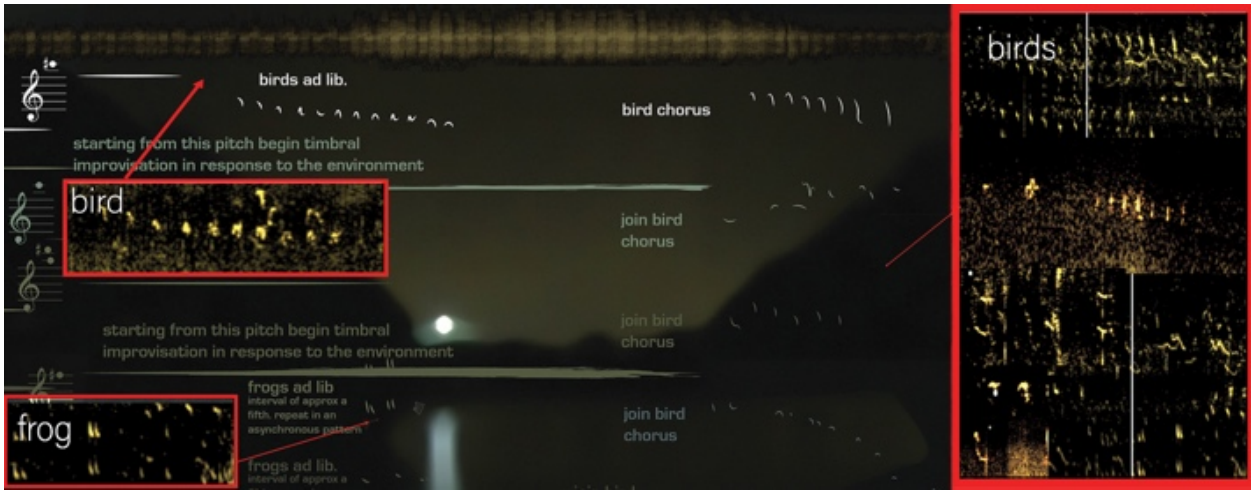

Figure 17. The central section of the score for *njookenbooro.*

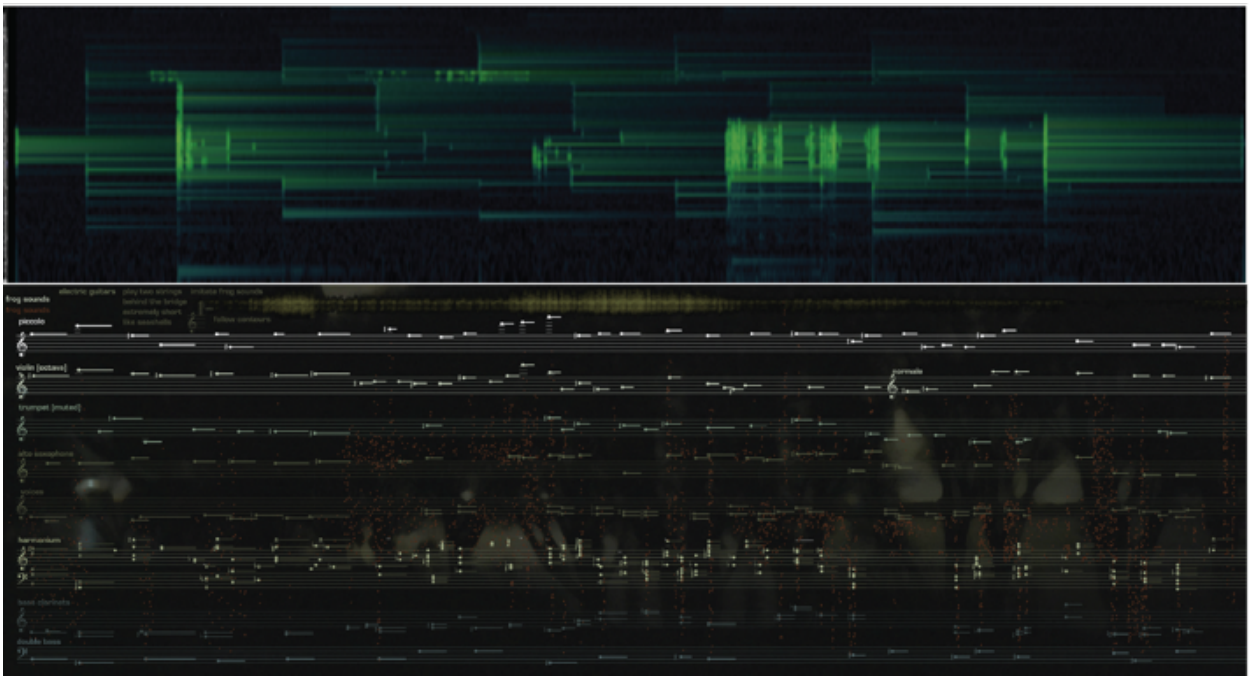

Figure 18. The final section of the score for *njookenbooro.*

Battery power allowed the performers to play from net-worked iPads, each connected via bluetooth to a speaker. An ad hoc WiFi network that was broadcast from a laptop. De-spite the extremely low ambi-ent light, the scores could read by the screenlight from the iPads. They were synchronised across an ad hoc WiFi network that was broadcast from a lap-top. Solar lights were used to mark the pathway to the per-formance for the audience.

The performers were arranged around a roughly circular area at the terminus of the walkway. Their Bluetooth speakers were arranged in a second pattern around the space. This permitted independent spatialisation of 10 unique stereo channels of audio and spatialisation of the live performers during the performance (Figure 19.)

Figure 19. Location map (above) and performer (blue circles) and speaker (red rectangles) placement in *njookenbooro*.

The field recordings used as a basis for the score comprised raw recordings mixed with threshed versions of the same audio highlighting different spectral niches.

5. CONCLUSION

The scores described here form the beginnings of a body of works seeking to interact with sounds of the Australian environment using a range of electronic tools: spectrographic transcription, audio processing, extended forms of notation and spatial audio. Other components of this pro-ject focusing on man-made sites and machines were not included in this discussion.

They aim to aid in the awareness of natural environments where they still exist, but also to the sonic environment generally, through bringing sounds into the focus of the concert hall as well as bringing audiences (and composers and performers) into the environment itself.

I mean the acoustic world in general, including that which is man-made. It's 'natural' in the sense that it's a 'given'? whether it be birdsongs, the noise of the ocean, or those of machines. One receives them and creates acoustic objects through the relation between what is given and consciousness. (François-Bernard Mâche) [20].

Acknowledgments
Thanks to Leah Barclay and Jocelyn Wolfe for permission to use their field recordings.

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