Orchestration of Ecology, as Ecology

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ABSTRACT

This paper will examine two ways in which orchestration can benefit from ecological models. Owing to the two different preposition in the article's title, I will discuss the notion of adapting environmental sounds to musical materials in the context of instrumental music (Orchestration *of* Ecology), and also outline an approach to orchestration based on systems of balance and unbalance found in different sonic environments (Orchestration *as* Ecology).

The first portion of the paper will outline the idea of attempting to imitate environmental sounds with orchestral instruments, especially concerning computer-assisted spectral analysis and transcription. These techniques have become familiar in some circles, but there are unique issues emerging from the transcription of field recordings as opposed to discrete sound-events. In these instances, can care be taken to represent something of the sonic environment to which it belongs?

These questions lead directly to the second focus of the paper. If musical sounds are meant to convey something of nature, can the relationships between those sounds be said to act as an ecology? I will draw comparisons between orchestrational techniques and the theories of acoustic ecology. However, the field of acoustic ecology has grown since its early days, and some of its fundamental assumptions have been questioned. The basic binary of soundscapes as a mere reflection of their spectral content has been called into question and we require a more sophisticated understanding of these concepts if we are interested in modelling ecological patterns.

INTRODUCTION

This paper will examine two ways in which orchestration can benefit from ecological models. Owing to the two different preposition in the article's title, I will discuss the notion of adapting environmental sounds to musical materials in the context of instrumental music (Orchestration *of* Ecology), and also outline an approach to orchestration based on systems of balance and unbalance found in different sonic environments, therefore applying the ideas of *acoustic ecology* toward an *orchestrational ecology* (Orchestration *as* Ecology).

The first portion of the paper will outline the idea of attempting to imitate environmental sounds with orchestral instruments, specifically concerning software-assisted transcriptions of field recordings, and some of the conceptual questions arising from such a project. How can an orchestral transcription borrow something from the character of an acoustic space? Of an environment? Rather than isolating a

natural sound and placing it into a new, abstract musical context, can care be taken to represent something of the sonic environment to which it belongs? In other words, can instrumental music *refer to ecologies*?

These questions lead directly to the second focus of the paper. If musical sounds are meant to convey something of nature, can the relationships between those sounds be said to act as an ecology? The field of acoustic ecology has long drawn a distinction between 'lo-fi' and 'hi-fi soundscapes' (Schafer 1977), where the former is spectrally dense, full of overlapping bands of acoustic information, and the latter is 'balanced' in the sense that different acoustic features occupy discrete spectral bands. This has been compared to the idea of *ecological niche* (Krause 1987), and so it is possible to view sound environments as ecologies in this way. These ideas can be drawn into parallel with familiar musical concepts such as voicing, register, the tone-noise continuum; all crucial aspects of the art of orchestration. Beyond drawing anecdotal comparisons between these features, it may be possible to organise orchestration according to these ecological models, either as a means of attempting to capture something about the sonic environment in music, or simply to generate interesting compositional material.

However, the field of acoustic ecology has grown since its early days, and some of its fundamental assumptions have been questioned. The basic binary of 'lo-fi' and 'hi-fi' soundscapes as a mere reflection of their spectral content has been called into question and we require a more sophisticated understanding of these concepts if we are interested in modelling ecological patterns. There are many natural sounds (such as water and wind) which are not spectrally discrete – essentially *noise*. How can the idea of orchestrational ecology take these complex issues into consideration, given that most western classical instruments were devised for an harmonic language? While I cannot answer all of these questions, I hope to begin a discussion on the ideas of ecology when applied to orchestration, and suggest a more nuanced and inclusive understanding of the multi-faceted concept of *noise*.

DEFINITIONS AND CONCEPTS

There are many possible ways to consider the concept of 'orchestrating ecology' (at least as many as there are interpretations of the often thickly-applied word, 'ecology,' multiplied by the dense and variously conceived notions of 'orchestration'). I have no pretence of providing a definitive explanation of either of these ideas or indeed their combination, but rather to share some ways in which these ideas have made their way into my own work and research, and this task requires some clarification.

In the first part of this paper, the limited sense in which I will predominantly discussing the idea of ecology in music is in reference to the use of field recordings, as well as other means of imitating or referencing soundscapes in music. It might be possible to suggest that the use of field recordings automatically beckons the broader and more theoretical ideas behind acoustic ecology, or other disciplinary perspectives surrounding sounding environments, but I will not address these issues in this paper. Therefore, 'ecology' in this context simply acts as a placeholder for the idea of soundscape-as-material in a musical framework. This may lead to some conceptually strange results; for instance, when we make a field recording we might not want to say that we are recording “an ecology” as such, and or that we then have “an ecology” on our hard drive or tape. Similar to Schaeffer's idea of the 'sound object', I am then adopting language which treats something quite immaterial as if it were material (Schaeffer 1966, pg. 95), if only out of convenience. However, in the second part of the paper, I will appeal more directly to theories of acoustic ecology; considering whether features of different kinds of sound environments can be modelled in instrumental music.

The conceptual 'collision' of these ideas with *orchestration*, then, simply refers to the attempt to extract features from these field recordings for use in writing instrumental music (*of Ecology*), and also the borrowing of features from such sounding environments toward decisions concerning choice of instruments, registers, dynamics, and so on (*as Ecology*). There are many other ways to consider the notion of orchestration *as* ecology; for instance, considering the relationship between instrument families as a kind of ecosystem, or the social structure of orchestras as an ecology, but in this case, I am interested in borrowing ideas from acoustic ecology toward compositional decisions involving orchestration.

MIMESIS AND SOFTWARE-ASSISTED TRANSCRIPTION

The attempt to imitate nature and its sounds is not an especially new idea in music. It is particularly familiar to the idea of programme music and its antecedents, though in most of these cases the aural result is somewhat abstracted from the source sounds (a timpani roll as thunder or a winding scalar pattern as a running river are not so acoustically similar to their inspirations, whether or not they could be said to evoke such phenomena). In the 20th century, the idea of transcribing environmental sounds became more common, perhaps most famously in the birdsong transcriptions of Olivier Messiaen (Messiaen 1994). While we now also have a thriving tradition of using environmental sounds directly in electroacoustic music, there may be aesthetic interest in adapting the idea of *soundscape composition* (Truax 1996) to instrumental writing.

More contemporary techniques have taken the project of transcribing environmental sounds to a new level of detail, possibly affording a more direct mimetic relationship (if one is interested in this approach), as opposed to simply extracting features to develop abstract musical material (though this is certainly possible as well and the two are by no means mutually exclusive). There are several software tools that can assist in this, and I will mention several in passing, highlighting the different approaches. The IRCAM Forum software duo of *AudioSculpt* and *OpenMusic* is strongly associated with the spectral school of composers, which, from its beginnings with the group *l'Itinêraire,* has often been concerned with analysis of recorded sound as a means of generating instrumental musical material. Perhaps the most famous example of this is the analysis of a trombone recording that formed the opening material of Gerard Grisey's *Partiels* (1975). While Grisey did not at that time have access to software tools like those mentioned, the spirit of spectral analysis and instrumental 're-synthesis' has carried over to these sophisticated tools, which are able to extract pitch and duration information from recordings, 'quantise' them to specified temperaments and rhythmic values, and generate notated music for instrumental composition. Michael Klingbeil's *SPEAR* software (Klingbeil 2005) is another example of a spectral analysis tool that can be applied to transcription, coming from another tradition. It is exceptionally suited toward partial-tracking, so that individual partials can be identified over time – again, particularly useful for transcription paradigms which endeavour to extract pitch and duration information from their source sounds. It is a less automated tool than *AudioSculpt* + *OpenMusic*, but one with perhaps more useful visual representation. I have found it useful in my own work to combine these three tools together.

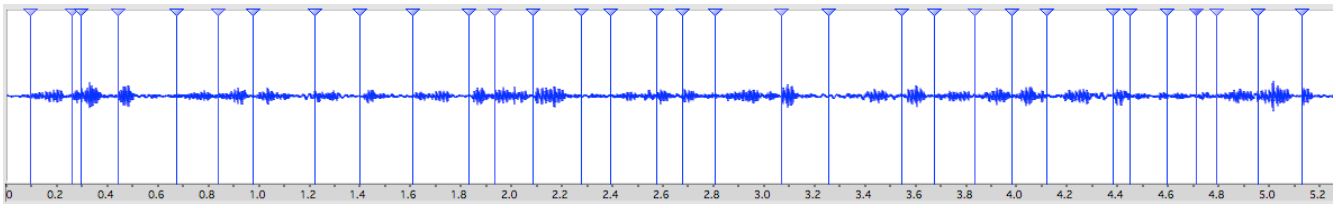

Fig 1. Generating markers in *AudioSculpt* to identify onsets of frog croaks in a field recording for use in *Isomorphia* (2013), a piece for orchestra and electronics by the author.

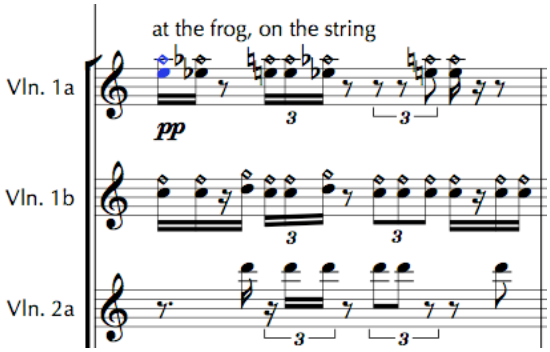

Fig 2. Part of a resultant transcription of frog sounds as it appears in *Isomorphia*, based on an analysis like the one in Fig. 1. In this case, the playing technique 'at the frog' was chosen both because the added bow pressure would thicken the spectrum to bring it closer to the density of the frog croak, and because the pun was irresistible.

The above-mentioned software all focus on transcription techniques which deal primarily with pitch and duration. They are useful tools, and there may be a point of aesthetic interest in reducing source sounds to these parameters, but their limitations become salient especially when dealing with field recordings or other sounds containing inharmonic spectra. Relatedly, they do not address questions of *orchestration*. If one is interested in transcribing birdsong, for instance, one might be able to extract a fairly reliable melodic profile with these tools, but which instrument(s) will provide a more acoustically-similar transcription? Some efforts toward this goal are under way, and the field of software-assisted orchestration is a young, but very active one.

Recent software, also coming from IRCAM, that attempts to tackle these questions are *Orchidée* (Carpentier 2012) and its in-development successor, *Ato-ms.* In these applications, a target sound is compared with a large sample bank of orchestral instruments playing with different pitches, dynamics and techniques. The software performs several types of FFT-based analyses on the input sound, and attempts to create the best 'match' with the analyses it has of its sample database. The result is a series of 'solutions' (many parameters of which can be controlled with various filters) orchestrating the input sound, including immediate aural feedback (from the same orchestral sample database) and notation. The composer is then able to audition each possibility, and make adjustments. The limitations to this approach include dependency on the corpus of orchestral samples (it will only be able to suggest instruments and playing techniques it has in its database) and that orchestration results don't take into consideration performability or balance, among other things. *Orchidée* is also not exactly time-dynamic – it more or less analyses an average of frequencies across the entire sample, while *Ato-ms* has shown some promising steps to tackling this complex problem.

By no means do these sets of tools offer perfect solutions to the problem of imitating sounds that are fundamentally different than the sounds that orchestral instruments can produce, nor do they address the challenge of whether such imitations are recognisable as similar to their source sounds or what the aesthetic or conceptual value of such a project might be. I have discussed these issues in more detail in a previous publication (O'Callaghan 2012). However, if one is interested in such a project, there are a number of considerations that are more specific to the use of field recordings, as opposed to studio recordings (which are perhaps the more conventional use).

CONCERNS UNIQUE TO THE TRANSCRIPTION OF FIELD RECORDINGS

A significant problem present in software-assisted field recording transcription is that these recordings typically contain more *noise* than studio recordings. *Noise* may have two meanings here. In the first sense, the sounds often simply have broader spectra; and in another, they may have a poorer signal-to-noise ratio: the unwanted 'background' sounds are closer to the amplitude of the desired 'signals'. Of course, that either of these things present 'problems' is an assumption, and there are many

philosophical considerations when applying these terms. I will attempt to briefly untangle these ideas in the context of their relationship with transcription.

That field recordings are often noisy in the sense that they have broad spectra is not quite so complex an issue: the 'problem' for software-assisted transcription is a fairly basic technical one. Partial-tracking software will have a more difficult time identifying salient features because there is a smaller difference in amplitude between them and others.[1] Or, many more partials become important in the saliency of a sound, either to the point that their number or complexity renders the task of 'reducing' them to something writeable (or playable for instruments) impossible, or that their breadth makes the choice of what to extract arbitrary.

To provide a concrete example: a recent piece of mine, *Isomorphia* for orchestra and electronics (2013), interpolates between various field recordings and their transcriptions. In one section, the source material is running water. It is possible to make an analysis of this sound using the tools I discussed previously and end up with a selection of pitches (and orchestrations) that sound nothing like the source sound and only like a dense cluster played on orchestral instruments. The pitches and instruments selected are essentially arbitrary: for the listener (or at least to my ears), any other set of pitches and instruments chosen would sound as similar. In this case, the transcription software is not particularly apt at its task. In the case of partial-tracking software that extracts pitch and duration information, the method of analysis is not appropriate: getting pitches from non-pitched sounds is a doomed task, *a priori*. In the case of software like *Orchidée,* one is limited by the database of orchestral samples available, and more broadly, the kinds of sounds orchestral instruments can produce. It may be possible to get better results with an extensive database of noisy playing techniques and percussion instruments (something all implementations of *Orchidée* I have seen or used lack), but one is still limited by the sounds available to the instruments, and the sometimes staggering complexity of the source sounds.

In these cases, an intuitive approach may be better. If an instrumental sound can simply be said to 'sound like' the source sound, this may suffice. A problem is, as always, that it sounds more like itself than what it is imitating. Something outside of the transcription must goad the listener into making the association that a cymbal crash is like a water splash, rather than just thinking that it sounds like a cymbal and nothing else[2]. My solution in *Isomorphia* was to try both. In one case, a dense orchestral chord with woodwind tremolos emerges from a recording of gushing water – perhaps highlighting or extending some spectral profile that was 'hidden' within the sound. In another, the water is imitated with percussive sounds on prepared snare drums and suspended cymbals played with brushes. In both cases, though, my guess is that the association with the source sound is made by its juxtaposition with the source recording played in the electronic part. An alternate version of the piece without electronics exists, titled *Isomorph*, but I am doubtful that in this case that the transcriptions betray much of their source sound.[3]

The problem is not as significant for field recordings with pitched sounds. In *Isomorphia,* as well as in previous pieces, *Iron Horses* for string orchestra (2012) and *Fashion at 30th, New York City, 1 June 2012 11:41AM* for eight instruments (2011), I have made transcriptions of animal calls, train and car horns, and sirens, to name a few examples. In most of these cases, the transcriptions were able to

1 Of course, assuming that there are salient features tied to particular partials as distinct from 'other partials' appeals already to the idea of signal-to-noise ratio. It might be simpler to say that in broadband sounds, it is more difficult to decide *what* to transcribe as there are many more options and choosing them all is not practical.

2 For good or for ill, the composer is not alone in this task. We have nearly a century of such associations made in cartoons, for instance. Another problem, though, is that this might add the extra association of 'cartoonishness'...

3 However, I am curious. A future project, then, is to take these recordings and prepare listener studies to see what kind of associations listeners do make, and whether any of them connect to the source sounds having heard only the transcription.

maintain significant acoustic similarity. One consideration for the 'success' of field recording transcription, then, is simply a matter of choosing content that can be well-imitated by orchestral instruments. A notable precedent for this idea is in Barry Truax's *Dominion* for chamber ensemble and tape (1991) where the instrumental material blends into field recordings of various Canadian *soundmarks*, most significantly represented by horns and sirens. These sounds are similar enough to instrumental sounds that they make excellent candidates for transcription.

Of course, by distilling field recordings such as these to parameters reproducible by acoustic instruments, one is necessarily robbing them of some of their most characteristic features. This begins to address the second idea of *noise* – something in the background or undesired. By ignoring the total features of a field recording and essentially 'filtering' out background, space, and environment, one is negating what makes field recordings distinct from studio recordings. Is it even conceptually sensible to speak of *signal-to-noise* in the context of field recordings, where typically, the *subject* of the recording is not just the foreground events, but the space, the environment, the soundscape? Of course, it is possible to simply view the field recording as a practical necessity to obtain sounds that are not easy to record in the studio (like the ones mentioned above). In this case, extracting the 'foreground' features in a transcription while ignoring ideas of space and environment presents no conceptual problem. But what if one is interested in addressing these aspects of the sound? Is there any way to preserve something of the sonic environment in transcription? I will share my own experiences in attempting to tackle these issues, drawing further examples from the three pieces I mentioned above.

One simple way to try and 'respect' the noise-floor in these transcriptions might be to attempt to add an *instrumental noise-floor* to the transcription. In *Isomorphia*, at certain moments, the 'foreground sound' transcriptions are accompanied by washes of noise, created through various means, such as rubbing sandpaper blocks together, or continuously dragging brushes across drumheads. *Fashion at 30th, New York City, 1 June 2012 11:41AM* attempts to accomplish this same goal with rubber ball mallets continuously dragged across a bass drum head, imitating the low frequency 'roar' of urban environments. These rather crude imitations don't directly address the complexity of noise in their source recordings, and perhaps the “just add noise” approach isn't sufficient to turn a transcription into a soundscape, but it does bring the transcriptions closer to the acoustic quality of the field recordings, and the continuous, dynamic qualities it adds acts as an imitation of the recordings' density and vitality.

Space is another significant element that may be 'lost in translation'. The constituent parts of a soundscape have their own spatial disposition, and to make a stereo field recording already constitutes a loss of information. Then, to transcribe this recording for instruments, which will have their own spatial orientation and will likely be sounding in an acoustic environment completely different from the source sounds, seems an impossible gap for considerations of space. I have attempted a few strategies in different pieces, that, while admittedly poor facsimiles of the spatial complexities in the original recordings, may transport some of their character to the concert hall, bringing the transcriptions slightly closer to a kind of *sonic environment* rather than just *musical material*.

In *Isomorphia*, many of the field recordings used contain great variety in spatial proximity. I was therefore interested in ways to make my transcriptions seem *closer* or *farther away*. One of the more literal ways this was accomplished was in turning certain instruments toward the rear wall of the concert hall. French Horns already typically play in this orientation and are sometimes noted for their 'distant' quality. So, by simply projecting sound away from the listener, one hears its reflection more than the direct source, mimicking the acoustic phenomenon of distance quite closely. This spatial 'trick' is a subtle effect, but one that accommodates typical performance configurations. In *Fashion at 30th, New York City, 1 June 2012 11:41AM*, this idea is expanded, and the instrumentalists are spatialised around the audience and on three vertical levels. These kind of spatial performances can have an

immersive quality like being in an outdoor sonic environment, rather than typical concert configurations where sound is being sent to the listener only from one direction. The vertical element in this configuration seemed particularly apt to an urban soundscape, where many of the sounds are coming from or being reflected off of tall buildings.

Iron Horses attempted to mimic some of the more complex aspects of spatial movement in its source field recordings. One simple technique to try to capture the idea of a train moving past the listener was to orchestrate the piece so that the horn transcription would move laterally across the stage according to where the instruments were positioned. This 'panning' effect mirrored the spatial movement in the recording. A more subtle technique was to attempt to recreate the *doppler effect* of a moving sound source, so that slight bends in pitch accompany the sound's movements across stage.

So, there are a number of techniques that may begin to capture something of the environmental quality of field recordings, despite the limitations that software-assisted transcription methods seem to have in dealing with these concerns. However, is there something more about the configurations and dispositions of sounds in an environment, as observed through field recordings, that can be applied to orchestration more broadly? May we take lessons from the field of acoustic ecology when we transcribe environmental sounds, or indeed orchestrate in general?

ECOLOGICAL MODELS FOR ORCHESTRATION

Until now, I have essentially been discussing transcription of environmental sounds from an isolated perspective, as if each *sound* could be hermetically sealed and reproduced in absence of its context. In short, ignoring the *ecology* of the sound. Of course, real sounds occur over time and in relationship to one another. While it is perfectly possible, again, to take a single sound event and place it into a new musical context, it may also be valuable to attempt to imitate or 'preserve' something of its own environmental context (this is essentially Simon Emmerson's distinction between *abstract* and *abstracted* syntax: *cf.* Emmerson 1986). So, there may be some features to consider when transcribing environmental sounds if one desires to preserve their sense of ecology, and, in turn, some of these concerns may be applicable toward musical structures in general (even if one is not using environmental sounds as material).

Damián Keller has written extensively on the idea of adapting *ecological models* to musical structures (Keller 2000, 2001). I will only address some of his ideas briefly, suggesting that they may be applicable in the context of transcribing environmental sounds, but his broader research should be of interest to anyone concerned with the intersection between ecology and composition. According to Keller, in *ecological modelling,* "variables are directly related to environmental processes such as excitation of resonant bodies, time patterns etc. The range of possible values that these variables can take is restricted to ecologically feasible spans. Thus, a ball cannot bounce forever and a surface cannot be perfectly regular. These sounds provide cues to feasible events in the environment." (Keller 2001) It could be assumed that in the transcription of field recordings, these concerns are 'built-in.' To take Keller's example of a ball bouncing, if one is transcribing a recording of such an event, it might be assumed that the transcription will not exceed or distort the natural pattern of the event, and will exhibit similar ecological feasibility. I am inclined to think that this is true to a certain extent, which may also give a window into the notion that by transcribing environmental sounds, one is also transcribing 'an ecology.'

However, there are many ways in which the transcription of such an event may truncate or otherwise obscure the ecological patterns suggested by the recording. One simple concern is that recordings must begin and end. If the transcription begins and ends at the same place, and is the totality of the musical work in which it has been recontextualised, then this brings up no further issue.

Referencing my own experience again, *Fashion at 30th, New York City, 1 June 2012 11:41AM,* is an example of this – the piece *is* an exposition of a single transcription, which is then looped and subjected to several abstracted processes. However, in later works I have layered many different field recordings together, woven into different kinds of sequences. In some cases, I am interested in abstracting these transcriptions into new contexts, but in others I am interested in recreating a kind of parsimonious ecological frame for them. So, to continue with Keller's bouncing ball example – if the recording ends before the final bounce, and one is interested in integrating a transcription of this recording into a broader ecological frame, one may need to apply ecological models in order to 'compose' the termination of the ball bounce in a naturalistic manner.

Another instance where one may need to apply ecological models where they cannot simply be gleaned from the recording itself alone, is where several recordings overlap in time; and this begins to address the question of *orchestration* more directly. If one is overlaying two field recordings, what concerns may be at play when considering whether they might be ecologically feasible? One issue might be whether the sound sources could be expected to co-exist in the same space. Trevor Wishart has identified different types of aural 'landscapes' in such situations, and presents a colourful example of combining different naturalistic sound sources into unrealistic contexts:

> "...imagine that, by appropriate editing and mixing procedures, we are able to animate a duet between a howler monkey and a budgerigar or a whale and a wolf, we have a landscape in which the sound-sources are real and the perceived space is real, yet the relationship of the sound-images is impossible. This bringing together of normally unrelated objects in the virtual space created by loudspeakers is closely parallel to the technique of bringing together unrelated visual objects in the space defined by a painting, a technique known as surrealism and I therefore propose to call this type of imaginary landscape (*real-objects / real-space) surrealist.*" (Wishart 1996)

So one issue is simply a matter of *which* sounds to overlap. If, however, one is working with sounds from a cohesive environment, are there additional concerns?

One concept that might apply is Bernie Krause's *Niche Hypothesis* (Krause 1987). Summarised basically, the hypothesis states that 'balanced' sound environments will exhibit features that occur in non-overlapping spectral 'niches', and by extension, 'unbalanced' ones will involve spectral overlap and *masking*. These ideas essentially correspond to Schafer's *hi-fi* and *lo-fi* soundscapes (Schafer 1977), where in balanced soundscapes, *signals*, or those sounds communicating information (such as animal calls) are not masked by noise-based sounds (like traffic). In Krause's hypothesis, in natural ecologies, for example, if there are two different kinds of birds, their calls will fit into different spectral 'pockets'. In *Isomorphia,* I combined recordings of seagulls and crows (recorded from the same ecological space of coastal British Columbia) and was interested to find that indeed the bird calls took place in different registers. And so, in my transcription of these calls, the seagull calls, orchestrated to the flutes and violins, fit nicely above the crow calls, orchestrated to the oboes and clarinets. Interestingly, Krause draws a parallel to orchestration in his discussion of the hypotheses: "Experienced composers know that in order to achieve an unimpeded resonance the sound of each instrument must have its own unique voice and place in the spectrum of events being orchestrated." (Krause 1987) So, the idea has comfortable parallels.

In this same section of *Isomorphia*, the bird calls gradually transform into gibbon calls, which have a remarkably similar morphology and spectral disposition. In this way, the piece moves between different spaces, allowing for a brief point of *surrealist* contact, and then settling into a different ecosphere, where the same niche is filled by a different sound-source.

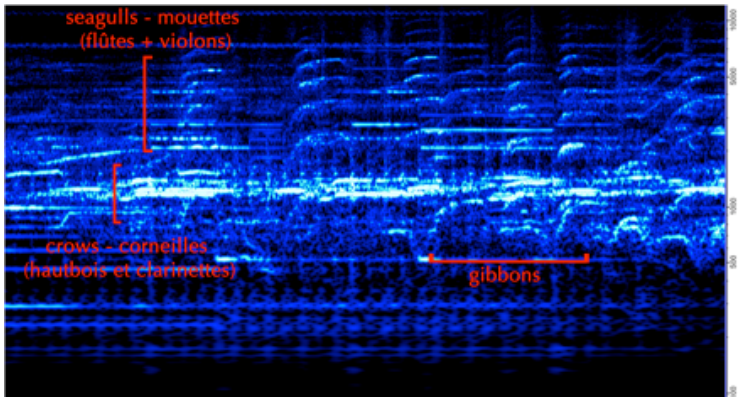

Fig. 3 – Spectrograph illustration of *Isomorphia*, mm. 14-19. The seagull and crow call transcriptions occupy different spectral 'niches', and the gibbon transcriptions gradually replace both, occupying the same niches.

As a point of contrast, a later section of *Isomorphia* orchestrates traffic sounds, taken from several different sources. In this case, the car horns overlap in spectrum, creating dense clusters of material (anyone who has been in a traffic jam can attest that this is ecologically valid).

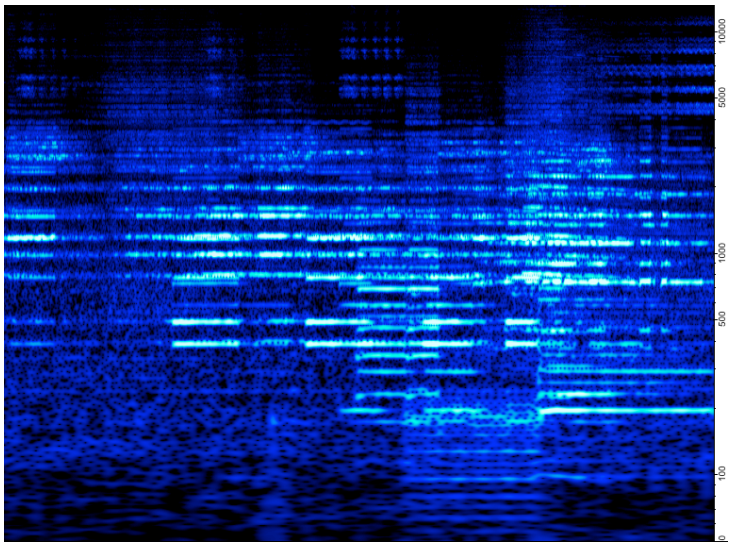

Fig. 4 – Spectrograph illustration of *Isomorphia*, mm. 125-133. Car horn transcriptions overlap in the same spectral space, creating a dense, overlapping sonic environment.

CHALLENGES, CONCLUSION

So, it would appear, at least from these examples, that my experience transcribing field recordings has helped anecdotally confirm Krause's hypothesis, and that drawing comparisons between the hypothesis and orchestrational techniques has assisted in delineating form and creating contrast from a musical perspective. However, there are many significant challenges to the basic binary assumptions behind Krause's and Schafer's work, and indeed the fundamental assumptions of acoustic ecology. A good summary of many of these concerns can be found in: McCartney 2010. To identify just one and relate it to my experience transcribing field recordings, the issue of *noise* again is a complex one that poses problems for the ideas behind the distinction between 'lo-fi' and 'hi-fi' soundscapes, and indeed the niche hypothesis.

In the first part of this paper, I discussed noise in the context of field recordings, suggesting that field recordings often exhibit very broad-band spectra, and this is equally true of 'natural' and 'urban'

recordings.[4] Simply put, many natural sounds are *noisy*; they have overlapping spectra, and can mask other sounds. My previous example of transcribing rushing water is applicable here. One might surmise that attempting to transcribe the rush of water and washes of traffic might have the same results (minus the car horns, which ironically are more 'harmonic'). It may be appealing to consider that balanced ecologies all feature such 'clean' spectra, whereas human-meddled urban ecologies all are dense and noisy, but it is not that simplistic.

Indeed, when applied to orchestration, the niche hypothesis could come dangerously close to a kind of apologetic for consonant harmony as somehow more naturalistic. There are some undertones of this in Krause's own parallel with orchestration, where he suggests that musical elements must have unique spectral dispositions "in order to achieve an unimpeded resonance." (Krause 1987) Is unimpeded resonance an assumed goal of composition? Is 'resonance' really a feature found so commonly in the natural world? Speaking only anecdotally, I have encountered many sentiments echoing the idea that the harmonic series is somehow especially natural in a way that other spectral patterns are not. Again, one need only listen to water running or wind rustling leaves for extreme examples of *noise* in nature.

So, it seems that in order to move forward with the idea of orchestrational ecology, we require a more sophisticated understanding of the idea of *noise,* both in the case of transcribing field recordings, where imitating noisy elements poses a serious problem for software-assisted approaches, and in the case of applying ecological models to orchestration, where ideas of balance and unbalance are more complex than may appear at first glance. I am confident that there will be philosophical and aesthetic value in examining these issues further, but for now there may remain more questions than answers.

For those interested, a small collection of related sound examples is available online:
http://jamesocallaghan.tumblr.com/orchestration

4 The distinction between what is 'natural' and what is 'urban' is a related problematic concept, but I will not be able to go into detail here.

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