

The World Soundscape Project (WSP) was established as an educational and research group at Simon Fraser University during the early 1970s and documented soundscapes in Canada and Europe as part of an over-arching concern to draw attention to the importance of the sonic environment. One unique feature of the WSP collection of recordings is its longitudinal documentation of the Vancouver Soundscape over a 40-year period, with recordings from the 1970s, 1990s and the present day. Over that same period, soundscape composition practices have evolved from a documentary mode to an artistic practice. Multi-channel audio reproduction currently provides listeners with a highly immersive auditory experience that has greatly benefitted the practice of soundscape composition by creating aesthetically enhanced experiences that are based in real-world experience but move the listener into an abstracted or even a completely imaginary space. The concept and perception of acoustic space is discussed, as well as issues of creating such spaces electroacoustically, with examples drawn from the composer's practice. The presentation discusses how the artistic use of created acoustic space can relate to (and potentially enhance) our understanding of the human relationships to real-world soundscapes, and hence acoustic ecology.

1. The World Soundscape Project

The basic concept of the World Soundscape Project (WSP) and its establishment by R. Murray Schafer occurred at Simon Fraser University (SFU) during the late 1960s and early 1970s. It grew out of Schafer's initial attempt to draw attention to the sonic environment through a course in noise pollution, as well as from his personal distaste for the more raucous aspects of Vancouver's rapidly changing soundscape. This work resulted in two small educational booklets, *The New Soundscape* [1] and *The Book of Noise* [2], plus a compendium of Canadian noise bylaws. However, the negative approach that noise pollution inevitably fosters – always being against something – pointed to a lack of knowledge about what one wanted to achieve as a positive example. It also proved not to engender enthusiasm in students, but rather cynicism and a fatalistic attitude that nothing much could be done. A more positive approach had to be found, the first attempt being an extended essay by Schafer [3] called "The Music of the Environment," in which he describes examples of acoustic design, good and bad, drawing largely on examples from literature.

Schafer's call for the establishment of the WSP was answered by a group of highly motivated young composers and students, and, supported by The Donner Canadian Foundation, the group embarked first on a detailed study of the immediate locale, published as *The Vancouver Soundscape* [4], and then in 1973, on a cross-Canada recording tour by Bruce Davis and Peter Huse. In 1975, supported by another research grant, Schafer led a larger group on a European tour that included lectures and workshops in several major cities, and a research project that made detailed investigations of the soundscape of five villages, one in each of Sweden, Germany, Italy, France and Scotland. The tour completed the WSP's analogue tape library that includes more than 300 tapes recorded in Canada and Europe, all of which have been catalogued, their subject matter classified. The work also produced two publications, a narrative account of the trip called *European Sound Diary* [5] and a detailed soundscape analysis called *Five Village Soundscapes* [6]. Excerpts of the field recordings were prepared to accompany both documents, though only those for the latter were published. Schafer's definitive soundscape text, *The Tuning of the World* [7], and my reference work for acoustic and soundscape terminology, the *Handbook for Acoustic Ecology* [6], completed the publication phase of the original project.

2. Soundscape Composition

The pioneering work of the WSP at Simon Fraser University, although primarily intended as educational and archival, nevertheless fostered the development of a style of electroacoustic music that I have termed "soundscape composition" [9, 10, 11, 12]. At first, the intent was to document and re-present recordings of various sonic environments to the listener in order to foster awareness of sounds that are often ignored, and hence to promote the importance of the soundscape in the life of the community.

The studio techniques used during the 1970s consisted mainly of transparent editing and mixing of untransformed original recordings, selected for their aural interest and representativeness of the soundscape in question. Of equal technical importance was the attention given to the recording technique, and today the tape archive which remains from those efforts, as recorded across both Canada and Europe between 1972 and 1975, is of excellent quality, having been recorded with a stereo Nagra IV-S and a pair of AKG condenser microphones. The complete catalogue and subject index on the studio website, with all of the audio tracks digitized, make this collection accessible to users for a wide variety of purposes.

During the production in 1974 of a 10-part radio series for the CBC called *Soundscapes of Canada*, a significant change occurred in the use of the recorded material, in this case derived from the cross-Canada recording tour in 1973. As with *The Vancouver Soundscape*, collectively authored works were assembled such as the "Summer Solstice" where short segments from each hourly recording over a 24-hour period were transparently edited together to create a one-hour experience of that specific soundscape. A similar technique was used in 1975 with one of the five European villages that the WSP studied, namely Cembra, Italy. However, most of the other radio programs in the *Soundscapes of Canada* series were individually authored. In several cases, the radio documentary format was used, although with many more sound examples than in the conventional approach. However, in other cases, more extensive transformation was used with the sounds and their composition, such as Bruce Davis' *Work and Games*, Barry Truax's *Soundscape Study* and *Maritime Sound Diary*, and Howard Broomfield's *A Radio Program About Radio Programs*, all composed in 1974.

After 1975, when Schafer left SFU, both teaching and compositional work continued on an individual basis. most

notably with Hildegard Westerkamp's work which ranged from soundwalking and radiophonic programming [13], which influenced *Kits Beach Soundwalk* (1989), through to concert pieces such as *Fantasia for Horns* (1978), *A Walk Through The City* (1981) and *Cricket Voice* (1987), all based on environmental sound and its processing in the analog studio. Except for the text-soundscape work, *The Blind Man* (1979), my electroacoustic work centred on digital sound synthesis up to 1986 and digital signal processing of sampled sounds ever since. Most of these early synthesized works had a strong environmental character, particularly those realized in the quadraphonic format, culminating with *Riverrun* (1986), realized entirely with real-time granular synthesis [14, 15]. My works in the 1990s were often based on environmental sounds processed with a granulation technique [16, 17], such as *Pacific* (1990), *Basilica* (1992) and *Song of Songs* (1992).

In the early 1990s, the WSP tape collection was extended with DAT recordings from the Vancouver area made by Robert MacNevin, and in 1996, with the assistance of the Goethe Foundation, four composers, two Canadian (Darren Copeland and Claude Schryer) and two from Germany (Sabine Breitsameter and Hans Ulrich Werner), were invited to visit SFU and work with the entire tape collection. The results were performed at the studio's first 8-channel concert at CBC Vancouver in June, 1996, and published in 1997 as a two CD set, including the *The Vancouver Soundscape 1973* and *Soundscape Vancouver 1996* [18]. The two CDs document how both the soundscape of Vancouver had changed during that period, as well as how far soundscape composition had evolved.

In 2010-11, we embarked on a new round of recordings of Vancouver's ever-changing soundscape, and so today we have a collection spanning 40 years of the city's acoustic history. Particular attention has been given to re-visiting locations that were previously recorded so that comparisons can be made, along with the many new additions to the city's soundscape. This collection, along with all of the published material of the WSP, plus lectures, interviews, compositions and other material has been collected into the WSP Database that is now available for scholars and researchers.

During the past 10 years, soundscape composition both at SFU and elsewhere has become centred on the standardized digital audio workstation approach of multi-track assembly and digital signal processing. At SFU, we have been developing computer control of the 8-channel spatialization of environmental sound [19], first via a prototype unit called the DM-8 created by Harmonic Functions of Vancouver, and then with Richmond Sound Design's 16-channel matrix mixer called the AudioBox, and now with the TiMax2 Soundhub, both also designed by Harmonic Functions, with the latter marketed by Outboard Inc in the UK. We are using software with these units that facilitates dynamic sound trajectories in a multi-speaker space. Although these systems have also been used for other types of electroacoustic music, their surround-sound application to soundscape composition seems particularly effective and has become extremely popular with audiences. A large catalogue of pieces by composers associated with SFU as well as others has been created and concerts of these works are regularly performed

internationally. In less than 30 years, the soundscape composition appears to have come of age, ranging from the documentation of acoustic spaces through to the creation of abstracted and virtual spaces. An example of the latter is my work *Chalice Well* (2009) that takes the listener through an imaginary underground network of spaces created with hybrid sounds that result from the convolution of, for instance, water sounds with other textured materials [20].

3. Acoustic ecology and the design of acoustic space

If acoustic ecology is concerned with the relationship of the individual listener and communities of listeners to their environment as mediated by sound, then the individual and collective perception of acoustic space must play a fundamental role. Perhaps the most basic role is that of orientation. The habitual sounds we experience daily both reflect and confirm our sense of physical space, as well as our place within it. Individuals and communities have a definite sense of "what belongs" in their acoustic space, and what kinds of noise are "invasions" of that space. The World Soundscape Project has referred to such intrusions as "sound pollution" as distinct from noise pollution that is generally defined by degrees of harmfulness. In other words, familiar sounds and their temporal patterns define and characterize our sense of space. Even subtle changes to the habitual pattern (which we usually take for granted) may be noted; for example, "it seems too quiet here today" when we sense that something is missing, or the opposite, "something special must be going on". The characteristic ambience of a given space adds to the "feel" of it, even if we would be hard pressed to define what contributes to that character. Often it is what the WSP calls the "keynote" sounds – those that are in the background of our perception but most typify a space. Foreground sonic events, or "signals", may provide specific information that we know how to interpret, even if fleetingly, and culturally important sounds recognizable to all in a community can be termed "soundmarks" [8, 9].

I have suggested that an information rich, balanced soundscape contributes to the sense of an acoustic community, one where sound plays a formative role in the definition and life of a group of people, no matter how their commonality is defined [9, 10]. Sound will define what is the boundary of the community, whether the scale is small or large, by distinguishing between what is "local" from what comes the "outside". In one study of an acoustically defined neighbourhood of Vancouver that is bisected by a busy thoroughfare, some locals referred to those passing through as "the others". In other words, traffic moving in one set of directions was regarded as "other", and that moving in a different set of directions was "local" – and in fact, the latter was characterized by a greater pedestrian component along with slower moving cars. The two sonic components of the soundscape thus created a mental map to the locals that reflected these intersecting spaces, and in fact most of the people interviewed could draw a version of such a map [21].

The "enemy" of the acoustic community is not so much noise per se, but rather any element that lessens the clarity and definition of an acoustic space, or dulls people's

inclination to listen. In other words, the acoustic community depends on information exchange, and anything or any habit that detracts from or inhibits that exchange weakens the sense of community. Bland, uniform sounds that lack character or are not perceived to be on a human scale might be the most obvious culprits, such as broadband noise from ventilators or machinery or excess amounts of traffic. Although such sounds may be acoustically complex in some sense, they are usually perceived as lacking in information or character. Even worse, they frequently mask other, more individualistic sounds. In the language of ecology, a few dominant species with little diversity crowd out numerous smaller species that are able to co-exist. Just as the loss of genetic diversity is a problem, so is the loss of aural complexity.

Besides the effects of orientation and the communication of information, an acoustic space can also encourage various types of interaction. An early study of the soundscape of Boston termed the positive character of such interactions as "responsive spaces" [22]. In other words, the fundamental acoustic principles of reflection, resonance and absorption, all of which contribute to the sense of acoustic space, are the main variables that can be designed to promote (or deter) human interaction. The details and variety of approaches to this topic are beyond the scope of the paper, but perhaps a brief look at the extreme of the continuum will clarify its nature. At one end we have the "free field" where there is little or no reflection because of the lack of any barriers to reflect the sound (though in real situations there is always the ground). The extreme end is the anechoic chamber where absorption is maximized and reflection minimized, and usually this type of acoustic space is disorienting to the individual because there is no interaction, no feedback, and essentially no acoustic "space". The other end of the continuum is the "diffuse sound field" which maximizes reflection (and resonance if the space is smaller) and minimizes absorption. A marble-lined space, an indoor swimming pool with highly reflective glass and water, or a gymnasium with polished floors and high ceiling are common examples. Sound comes from everywhere and nowhere; the acoustic space is omnidirectional and often equally disorienting as the anechoic room, except for the opposite reason. If one did not have to act or communicate in such a space, one could enjoy the womb-like envelopment, but otherwise the eyes have to be alert for orientation, verbal communication is almost impossible, and noise levels tend to become exaggerated. As noted earlier, the sound *is* the space, and vice versa. In between these two extremes lie the truly interactive acoustic spaces where a balance between intimacy or envelopment is balanced with the needed sense of clarity and definition.

Vancouver's spectacular natural setting and its dramatic layout of modern building, particularly around the harbour area, provide strong visual imagery for the city, one that is used to attract tourists. As documented on the *Soundscape Vancouver 1996* CD [18], many of these visually striking environments are accompanied by bland, technologically derived soundscapes. Sound examples from the CD include the Seabus crossing the harbour, the noisy exhaust fans from the architecturally striking Canada Place, and the bland drones and hums from Arthur Erickson's otherwise dramatic Museum of Anthropology with its marvelous

collection of West Coast artifacts. One wonders whether in these environments, the eyes take over and cause the ears to ignore what is accompanying these visual splendours. Fortunately, there are also many examples of planned urban re-development in the city that are designed on a more human scale, not unlike the village model which the WSP encountered in its European study [6, 9]. Examples of this approach which have proved popular with the Vancouver public are Granville Island, Gastown, many parts of the West End, Commercial Drive and some other neighbourhood based town centres. In each of these, acoustic space is controlled, at least to some extent, and populated by a wide variety of human oriented sounds. Such information rich environments seem to create a positive model of acoustic ecology.

4. Multi-channel diffusion and the Soundscape Composition

In an age that seems intoxicated by "virtual reality", we often assume that these artificial illusions of space are the only ones, particularly as they acquire increasing degrees of realism. Even if given less public profile, multi-channel and multi-speaker re-creations of acoustic space are just as impressive, and more easily achieve the effect of total immersion, since it is relatively easy to surround an audience with arrays of loudspeakers. Our work at Simon Fraser University over the last decade has shown that this type of aural representation is particularly effective for creating immersive acoustic environments, through what we call soundscape composition [8, 9].

The multi-channel approach is an extension of earlier arrays or "orchestras" of loudspeakers where a stereo track was sent to an arbitrary number of speakers with dynamic changes controlled by a composer/performer, usually centrally located. This technique is called "diffusion", a term drawn from acoustics where it refers to the spread of sound in a space. By emphasizing a sound coming from a particular speaker one could create the illusion that the speaker location was the momentary source of the sound, but in general only one, or at most two sounds could be localized at a time.

One of the earliest multi-channel installations occurred at the Brussels World's Fair in 1958, where Edgard Varèse's multi-track work, *Poème Électronique*, was projected through 425 loudspeakers attached to the curvilinear walls of the Corbusier designed Philips Pavilion. Early four-channel formats (quadraphonic sound) doubled the number of possible sources, but could only create a coherent sense of space in a relatively small room because the distances between the speakers left gaps in the spatial illusion unless a lot of reverberation was added. Today, the 8-channel configuration works best for medium sized rooms, as long as the material on each channel is kept uncorrelated, that is, as independent sources such as is the norm in the acoustic world. The spatial layout of these speakers can vary, but the choices are generally circular, equally spaced around the audience, or more clustered in front of the audience, given that our ability to localize is better in front than behind.

Larger, better equipped halls, have extended this principle to even larger numbers of channels and speakers to which independent sources or tracks can be sent. The ZKM at Karlsruhe, for instance, has a rig of 16 speakers, 8 that are elevated, and 8 around the audience. The Sonic Arts Research Centre in Belfast has an amazing array of up to 32 channels, two sets of 8 that are suspended at varying heights, another set of 8 around the audience, and another set of 8 beneath the audience but audible through the grid flooring. The acoustic panels on the walls are also variable to add or omit reflecting surfaces. These arrays, both at the listener's ear level, and those that incorporate height and depth, are excellent for creating a vivid sense of acoustic space that is totally immersive. With the flexibility and precision of digital control, the composer can literally design a detailed acoustic space, and move the listener through it. It is not an exaggeration to suggest that this approach creates a 3-dimensional "audible architecture".

In my opinion, the key to designing such a space is to treat the loudspeaker as a point source, and avoid the illusion of what are called "phantom images" that appear between the speakers but collapse when the listener is not placed exactly between them [19]. Just as we can distinguish multiple sound sources in a soundscape (assuming their levels are balanced), so too can we hear the definition of multiple speakers emitting different signals. When some of these channels incorporate a similar sense of reverberation, ambience, or other environmental cues, then those speakers will connect to form an ordered sense of acoustic space. Strategies exist for moving a sound smoothly between speakers (or not), hence adding the possibility of moving sound sources, and/or apparent movement of the listener through different acoustic spaces. Simultaneous "streams" of sound images can also be created, though it is unclear as to how many a listener might optimally follow. The artistic potential of such immersive audio environments is just beginning to be understood and put into practice.

I have argued above that soundscape composition during recent decades has moved towards a more abstracted approach, one that leads to the creation of virtual soundscapes. The digital game world has undergone a similar evolution, but within the form of a fairly small number of narrative scenarios. It would be a simplification to say that the distinction is merely between art and entertainment, though those identities are still very much present. From the perspective I have offered here, the most significant differences are the respective concepts of the listener's relationship to place. Whether using an iPod or a game device, the listener is choosing to imbed him or herself within a virtual environment that is set apart from the real world, often characterized as an escape from it. The soundscape composer on the other hand always seems to be drawing the listener back into the real world, perhaps to stress an ecological perspective, or to rejuvenate the listener's aural sensibilities. The progression from phonographic documentation to a more abstracted approach to ultimately a virtual synthetic soundscape is one that takes the listener from surface level of an environment, recognizing its sound sources and ambiances, to the mental world of psychological and cultural associations, memories and symbolism provoked by those sounds, and then to the unbounded world of the imagination.

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