Structure and psychoacoustic perception of the electroacoustic soundscape

ABSTRACT

Soundscape is a term that has been defined in different ways by communication researchers, sound artists and composers. It has become part of the musical materials that have been used in the electroacoustic realm for more than a half century. Aesthetics and theory about the musical structural aspects of electroacoustic soundscape have not yet been much developed. This author has realized various sound works using soundscape textures as their main structures, making a catalog of different types of psychoacoustic constructions that involve aspects like foreground, background, figures in relation to the two precedent spaces, etc. Starting from precedent ideas, it is the aim of this author to set some bases on the soundscape concept, and through musical analysis, to find a set of main and essential structures. The result of this investigation could help others to discover different types of listening experiences of daily sounds both in towns, cities and nature.

1. INTRODUCTION

The Canadian Murray Schafer probably proposed the term soundscape at the end of the sixties, and since then, various researchers and composers have conceived it in different ways. It is important to bring back these different definitions, and from them, to propose one that will fit the needs of this paper.

The origin of soundscape is tied to artistic works build up from recorded sounds in concrete music, first in Germany in 1930 with the piece *Week End* by Walter Ruttman, and then with Pierre Schaefer at the end of the forties, when he created the conceptual bases of this music [2].

The objective of this research is to propose a personal definition of the electroacoustic soundscape, as well as to analyze different basic structures that can exist in recorded soundscapes[1], both in towns, cities, rural areas and nature. We believe that soundscape, when recorded, can be converted in a sound work capable of containing aesthetic qualities that exist in music.

It is impossible to expose here all the formal combinations existing in the aural experience of electroacoustic

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[1] I assume that recorded soundscapes become electroacoustic soundscapes.

soundscapes, but it is possible to propose analysis tools that will lead us to understand the different essential combinations.

2. ORIGIN AND DEVELOPMENT OF THE SOUNDSCAPE CONCEPT

The soundscape concept was born with the *World Soundscape Project* created by composer and researcher Murray Schafer and his students at the Simon Fraser University in Canada in the beginning of the seventies. For Schafer, "soundscape is any acoustic field of study…we may speak of a musical composition as soundscape, or a radio program as a soundscape or an acoustic environment as soundscape" [3]. As we can see, this definition is very broad, but here we will only deal with his last sentence: listening to a determined acoustic environment.

Composer and researcher Barry Truax differentiates what are a sonic environment and a soundscape. The first comprehends all the sound energy in a given context, while the second deals with understanding this sonic environment by the people that live in it and are continuously creating it [5]. For him, the listener is an essential part, because he becomes the interface between the environment and sound, and then, soundscape becomes the resulting system of the addition of those two components.

Abraham Moles defines it like this: "Sound image of an animated place" [1], and the electroacoustic soundscape he defines it like: "Closed collection of ordered elements in time through a tape, that expresses more or less a situation, that is, an *idea sound scene*".

I agree with Schafer and Truax's definitions, although they do not specify in what type of acoustic spaces there are soundscapes. We would have to ask if an interior space where there is almost non-acoustic activity is a soundscape. These definitions are too general and they do not specify situations. We will concentrate on exterior recorded soundscapes.

To be able to talk about electroacoustic soundscape, we have to create a new definition: It is the recording (mono, stereo or multi track) of a soundscape, where the particularities of the recording, types of microphones and their position (if they are static or they move) will determine its qualities.

3. SOUNDSCAPE CHARACTERISTICS

Schafer states that the main qualities of a soundscape are: *keynote sounds*, the particular sounds that characterize and give sense to a place, and for that reason, are not listened in a conscious way and remain in the background; *Signal sounds,* the sounds that exist in the foreground and are listened in a conscious way, they represent more figures than ground, and most of the times they are codes (in Mexico the noise of the street knife sharpener, the siren of an ambulance, etc); *Sound marks,* the sounds that the individuals identify as key sounds of their community (the bell of their church, etc). Schafer is talking here of the characteristics of a soundscape form a social anthropological point of view, while I will concentrate on the psychoacoustic characteristics. Nevertheless, Murray talks about sounds that manifest as *ground,* which I interpret as *background sounds,* and as *figures* manifested in the foreground, and also about a third level called *field,* which is the place where one listens the soundscape. The first two characteristics will be fundamental in my later analysis of electroacoustic soundscapes. For me, *background* and *figure* are two types of distinct structures that can be both in the first or second planes, *backgrounds* have a continuous character while *figures* have a discontinuous character. The third characteristic is eliminated when the soundscape becomes a stereo recording, although in it will remain an image of the position that the individual had towards the soundscape, and which Moles defines as a: *proxemic perspective system* [1].

Other two important characteristics defined by Schafer are important for the analysis of soundscapes, *Hi-Fi* and *Lo-Fi* situations. In the former, sounds are over imposed less frequently and we have *perspective* (*background amplitude*)*, foreground* and *background*. These soundscapes exist more in the countryside than in the city and more in the old times than in modern times. In *Lo-Fi* situations "individual acoustic signals are obscured in an over dense population of sounds", it is very difficult to distinguish figures and clear backgrounds, and there is no perspective. *Lo-Fi* soundscapes are typical of big cities, due to traffic noise in the streets and highways [3].

Even though Schafer describes different types of sounds that exist in the different soundscapes, the aim of our research is far from entering in such details. However, there are important sounds that almost always end up functioning as background sounds, and that have proliferated in the technological modern age (from the industrial revolution to today), these are the *flat line* sounds [3], constituted in nature by the remote sound of a cascade, the ocean listened from a distant place, the constant sound of the wind against the leaves, different insects in tropical places, etc, and in modern times by ventilators, constant electric sounds, the highway afar, etc. Although I will not go into descriptive details, these flat sounds are very common in different types of soundscapes and are part of the background, from which we can sometimes perceive figures in the first plane.

Other two terms used by Schafer and that could be of use to us are *Gesture* and *Texture*. The first one refers to a figure constituting the only distinguished event, and the second one refers to "the generalized aggregate, the mottled effect, the imprecise anarchy of conflicting actions" [3], like the sound of many people talking in a restaurant. Relating to texture, Schafer also makes the following classification: *Texture of the listened sonic environment*: *hi-fi*, *lo-fi*, *natural*, *human* (I would specify if its human in nature, towns, rural areas or cities) and *technological*.

On the other hand, Truax talks about *density* as a possible descriptive parameter. In the next section I will develop these variables and will introduce new ones.

4. ELECTROACOUSTIC SOUNDSCAPE CHARACTERISTICS

The electroacoustic soundscape is the recording of a soundscape transformed into a *Phonography*. *Phonographying* is an activity described by Abraham Moles that consists in the capture of a moment of consciousness, that is, an *idea scene* relevant to us with the goal of finding it again and recreating it. This is like photographing sound, in order to be able to relate with reality in a more intimate way [1].

The first characteristic of the electroacoustic soundscape is the format in which it was recorded and the microphones that were used. The usual thing is to use a stereo microphone, or else, two cardioids microphones with different configurations. We could also have electroacoustic soundscapes recorded in more than two channels, which would lead us to a closest impression to what we really hear in reality, because we listen in an angle of 360 degrees and not in a frontal way, and it would not be a forcible reduction such as the electroacoustic stereo soundscape. The second essential characteristic is the panning, because in a stereo recording the panoramic position of sounds becomes more concrete and clear due to the limited fact of using two loud speakers. In this way, we get abstracted from the sounds that were behind us at the moment of recording it, and there is less information. Finally, the last essential characteristic is what I call *background amplitude,* which is the number of listened layers (high amplitude if they are a couple, and little amplitude if they are one or two). In fact, this parameter as well as panning, are the two most important in electroacoustic composition with fixed sounds in stereo format.

Lets talk about other parameters that could help us for the analysis of an electroacoustic soundscape:

Murray Schafer proposes various parameters for the analysis of sound objects that make part of soundscapes (not necessarily recorded), and I think that some of them can serve us. Those that I have chosen are:

1. - Heard distinctly, moderately distinctly, or indistinctly over general ambience.
2. - Isolated occurrence, repeated, or part of a larger context of message.

3. - Environment factors: no reverb, short reverb, long reverb, eco, drift, and displacement.

At the same time, Abraham Moles [1] proposes other significant traces of the sonic environment, from where I find relevant the following ones:

1. - Relative number of elements. Global density of events.

2. - Complexity of the elements set: number and variety of relationships.

3. - Relationship between the "nearer" elements mass and the "further" elements mass (notion of "first plane").

4. - "Static" character: non-evolved permanence, or "dynamic".

5. - Intensity. Density of the micro events by time unity.

There are two aspects not studied by any of these researchers that are to me essential:

1. - Linear listening in opposition to non-linear listening of a determined soundscape. By linear I refer to a listening in which we can concentrate and follow the course of events, and by non linear to a listening where our attention goes constantly from one place to the other, not letting us assimilate or perceive a continuity and rest a bit. This type of listening demand much more from us, and listening for a long period of time in this manner can produce tiredness and out of focus attitudes.

2. - The continuous and discontinuous character of soundscape structure. There can be soundscapes essentially continuous but with discontinuous elements, or the other way round. I will deal with these variants in section 5.

With the description of all these elements, I think that I cover all the basic formal characteristics of the electroacoustic soundscape. Starting from these elements, it is now time to conform a personalized system for the analysis that I will define in the next sections.

5. STRUCTURE IN THE ELECTROACOUSTIC SOUNDSCAPE

According to Barry Truax, structure in soundscape includes not only the elements of the sonic environment and their relationship, but also the pragmatic level of the context where it all occurs. Without context, soundscape can't exist. This is not necessarily valid for the electroacoustic soundscape, because at the moment of transforming it into a stereophonic sound fragment, we are converting it into concrete electroacoustic phenomena distant from reality, and it becomes a musical[1] fragment. However, Truax concedes that "soundscape is an *organized sound system*, because the design, the structure and the form are not restricted to human artifacts" [5]. We can agree that form and structure are aesthetic categories of human perception, and that with the development of music in the XXth century they have evolved and proliferated in a multiplicity of varieties. Soundscapes comprehend a very particular

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[1] In the Cageian sense where Music is a fragment of time where all the sounds we can hear become a composition in our mind.

sonic complexity. They deal with different kinds of periodic sounds and noises, and the last ones have always constituted a problem for musicological analysis, because up to this date no musicologist has been able to create a linear system of classification and structure starting from timbre, as it has indeed happened with the field of frequencies, where the occidental tonal harmonic system is a clear example.

Until this day, electoracoustic music hasn't been able to develop an analysis system of the different aesthetics that have appeared since the end of the forties until present time, and this is probably due to our inability to agree in the way of transcribing in a score the different morphological (Smalley, 1986) and non periodic sounds that exist in the world, as well as to describe their movements and their different layers. Yet, some composers and theoreticians as Schafer, have developed their own ways of describing sound events which could be useful to us. In this paper it is impossible to develop a precise transcription method of sound events. We are mostly interested in their essence and in their interplay, in their contrast and in their action in time, in their *panning* and *background amplitude* parameters.

6. ANALYSIS OF THE ELECTROACOUSTIC SOUNDSCAPE

6.1. Methods of classification.

Starting from my experience on listening and on the recording of soundscapes, and in the subsequent work in electroacoustic composition using these recorded materials, I ended up doing two works based entirely on soundscape stereo recordings: *El Eco está en todas partes* (2003), and *B-36-A* (2004). In the first piece I had the aesthetical necessity of creating virtual sound walls connected between each other with sound lines travelling between them. For obtaining these walls, I decided to make a selection of recorded soundscapes from different countries of the world (1998-2003). This selection led me to generate classification methods, and later to a second piece where I had to create a sonic history of a place, the *Plaza de Bellas Artes* in the historic center of Mexico City. For this purpose, I recorded urban soundscapes of the perimeter of the plaza (a square with a diameter of one kilometre). In this second work, different variables of structural listening were born, enabling me to classify the soundscapes in a new way in order to transform them by way of temporal granular synthesis.

In the first work I distinguished these soundscapes:

Presque riens, *natural soundscapes* (particularly insects), *natural soundscapes with humans,* and *urban soundscapes*. The concept of *Presque rien* belongs to the composer Luc Ferrari, who in 1970 composed the work *Presque rien No. 1 'Le Lever du jour au bord de la mer',* where he recorded a day of environmental sounds in a Yugoslavian beach, and through edition, created a 21 minutes piece. The use of this term here was inspired in

Ferrari, but my definition originated from personal listening experiences and has to do with soundscapes where the most part of the sound objects belonging to them are afar from us, and where there isn't a neat differentiation between figures and background. A typical situation of a *Presque rien* to me is listening in a park to the distant sounds of the city, children playing, someone sweeping the floor, an airplane passing by, etc. The *Presque rien* soundscape does not consist necessarily on a particular structure, but on a way of listening the soundscape. For it, we need a particular concentration, and it is interesting that even though there are far away sounds at low dB levels, this permits us to concentrate more in their details.

In my second work (*B-36-A*) I did not find any *Presque riens* situation because I was dealing with urban soundscapes. Instead, I had backgrounds and figures in different combinations.

The different combinations were:

1. - *Background*, where all the soundscape remains in the background and if there are any figures, they are somehow in fusion with it.

2. - *Figures,* where there are only clear figures in the first plane, and sometimes a soft background that is not very much well perceived loosing then its background character.

3. - *Figures-Background,* where the figures stand out from the background, but the background is important and can be also listened to.

4. - *Background-Figures,* where the background predominates and the figures are attached to it, but they can be distinguished clearly.

Finally, I came to the conclusion that to be able to make an electroacoustic soundscape analysis, we require of *structural polar axes,* because they can help us to find the different sound combinations that exist. The most important axes are:

Dense-Empty, Amplitude-Flatness, Continuous-Discontinuous, Stasis-Movement, Texture-Frequency, Background-Figure, Linear-Non Linear.

6.2. Frame and structural elements for the analysis
My work as a listener and analyzer of soundscapes is based in what Barry Truax defines as *Natural found composition,* that is, a recorded soundscape whose organization takes attention for its variety, textures, timbres, etc, and whose recording can be listened with the same appreciation as one listens to music [5].

My analyses of soundscapes are made from stereo recordings with two fixed microphones, where eventually, I move just a little to detect more clearly one of the relevant elements of the soundscape. Even though my recorded soundscapes last always more that a minute, I decided to take representative segments, considering that the minimum time for understanding the structure of a determinate soundscape, as well as for analyzing its complexity, is of 40 seconds approximately.

A big part of the soundscapes recordings made by me have been in movement, but in this case, I consider the resulting recording as *Real time soundscape composition*, where all my decisions of how to walk and turn the microphones stereo field are of structural character and of an active conscious way of composing. This way of working would be found at the middle way of the Truax's continuum, where at the furthest extreme we can find what he calls *Abstract soundscape composition*, a stage where the composer can manipulate the sounds, edit them, substitute them for other similar ones, etc, and which is for me an electroacoustic composition.

This is the Truax continuum, but adding the middle stage of soundscape recorded in movement:

Found soundscape (fixed recording) – *Real time soundscape composition* (microphones in movement) – *Abstract soundscape composition* (edition, manipulation, mixing, etc).

My decision has been to realize structural analysis of the *Found soundscape*, because I think that it can learn us in a more or less objective way the different sonic structures that exist in the world around us, and that it could suggest us as composers, structures that we could then imitate or develop in electroacoustic music or instrumental composition.

In these analysis I am not interested about references and recording contexts, they are based in *reduced listening* [2] in which, even though we can recognize the original sources, what we are interested in is in recognizing the sound objects and their interaction in the different recorded layers.

Retaking all the precedent considerations, the structural characteristics for the analysis of electroacoustic soundscapes that I undertook are:

1. - Type of soundscape. *Presque rien* (where there isn't a clear idea of the combinations of *backgrounds* and *figures* and there is a particular kind of listening), *background*, *figures*, *figures-background*, *background-figures*.

2. - Classification of the soundscape. *Natural, natural with human elements*, *rural*, *towns*, *cities*, *technological,* etc.

3. - Temporal structure. If they are *continuous*, *discontinuous*, *continuous with discontinuous*, *discontinuous with continuous*. If they evolve or do not evolve.

4. - Density (much, average, little). I do not refer here to density in the sense of sound mass, but as Moles describes the parameter of *Intensity*: *the density of micro events by time unity,* but where I contemplate the quantity of different events, because this is what provides us with a more or less difficulty for a concentrated and analytical listening of the different actions that take place.

5. - Listening. *Linear* and *Non-linear.*

6. - Background Amplitude. If the soundscape is flat (all the elements are in one same layer), or how much background or different layers can be distinguished. In

this point we have to take account of the reverberation and natural echo factors described by Schafer and Moles.

In the last structural analysis frame, I did not include all the variables proposed by Schafer, Truax and Moles, but only the ones relevant to me. The electroacoustic soundscapes that I analyzed are just a number of examples of some of the more typical structures of the contemporary world, but there has to be a much more ample work of analysis of other soundscapes to be able to advance in the discovery of a possible set of essential structures.
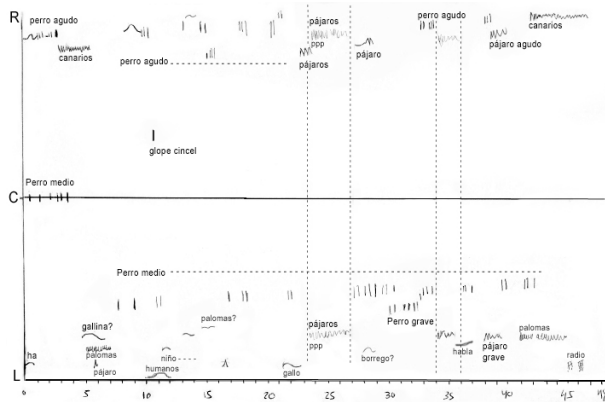
7. SOUND EXEMPLES

Exemple 1

Figure 1. Soundscape at Chichicastenango Guatemala.

1.- Type of soundscape: *presque rien.* 2.- Classification: *rural.* 3.- Temporal structure: *discontinuous* (there is not any element that repeats with an equal rhythm) with out evolution. 4.- Density: *High* with two pauses 5.- Listening: *non linear.* 6.- Background amplitude: *average.*
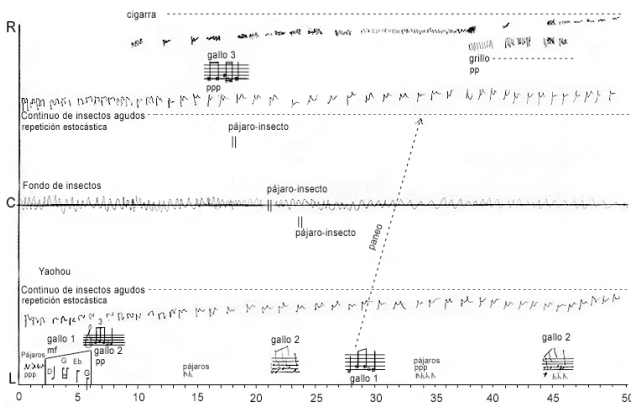
Exemple 2

Figure 2. Soundscape at Hoi An in Vietnam.

1.- Type of soundscape: *presque rien.* 2.- Classification: *rural.* 3.- Temporal structure: *continuous* with *discontinuous elements* with out evolution 4.- Density:

average 5.- Listening: *linear.* 6.- Background amplitude: *high* with reverberation and echo's.
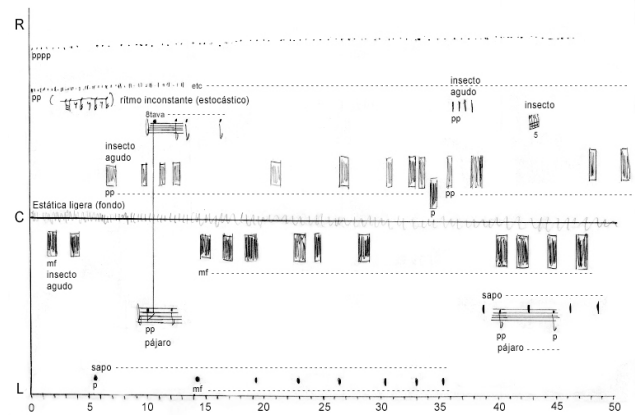
Exemple 3

Figure 3. Soundscape at the Caura river in Venezuela.

1.- Type of soundscape: *figures-background.* 2.- Classification: *nature.* 3.- Temporal structure: *continuous* (syncopated counterpoint) 4.- Density: *average* 5.- Listening: *linear.* 6.- Background amplitude: *high.*

Exemple 4

Soundscape in Mexico City (with out graphic representation).

1.- Type of soundscape: *background-figures* 2.- Classification: *urban.* 3.- Temporal structure: *continuous* with a little evolution. In this soundscape the background constituted by car's motors is in the first plane and the figures attached to it are voices, transit police whistles, klaxons and an *organillo* instrument. 4. - Density: *average*. 5. - Listening: *linear*. 6. - Background amplitude: *low.*

9. CONCLUSIONS

In this research I have developed the principles of a new method of electroacoustic soundscape analysis based in the considerations of specialized composers and researchers in this area, and in my personal experience as an electroacoustic composer, sound artist and researcher.

The most important part of my research was based on field recording work, and in composing with these materials. This way of getting involved with the sounds that surround us led me to deeply understand the genesis of a soundscape aesthetic, and later to a reflection and development of various theoretical aspects for the analysis of the *electroacoustic soundscape*, as well as to be able to detect different types of structures.

My work is the continuation of other people's work, it is not innovator, but my personal focus and my analysis of recorded soundscapes is, and constitutes a personal vision

of how to listen to the world that surround us. I consider as Murray Schafer that composition works based on soundscapes, as well as research developed from this practice, "can open new modes of perception and to represent alternative forms of life" [3].

I consider also as Truax, that the ability to record and reproduce sound is the most fundamental fact of electroacoustic communication, and that it has helped to change the listener attitude towards sound [5].

Electroacoustic soundscape is a reduction of reality, but the recording and the analysis of soundscape constitute a way for learning the sound complexity of the world where we live.

Finally, this work and its possible continuation, offer us the possibility to detect different types of structures that could be inspiring for the composition of electroacoustic abstract music pieces, and even instrumental music based in the field of timbre and sound textures.

10. REFERENCES

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