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AREAS OF HIGH ACOUSTIC QUALITY: SOUNDSCAPE PLANNING

A. L. Brown[1]

[1]Griffith School of Environment
Griffith University
Nathan, Brisbane, 4111, Australia
Lex.Brown@griffith.edu.au

Abstract

This paper develops ideas on moving "soundscapes" into the mainstream of activity of environmental noise. Such a move has value in introducing a new dimension aimed at catching political attention and the engagement of other professions in acoustic management of outdoor environments. "Quiet Areas" - the EU Directive on Environmental Noise requires "preserving environmental noise quality where it is good". The paper shows contrasts and similarities between conventional noise control approaches with those in the soundscape literature. Environmental noise control deals with sounds of discomfort; soundscapes sounds of preference. Noise control measures sound by integration; in soundscapes the information content of sound is critical. Noise control manages sound as a waste product; soundscapes manages sound as a scarce resource. Managing "quiet areas" is about managing the resource of high quality acoustic environments. "Quiet" is not always (even rarely) their characteristic - instead we should adopt the terminology "areas of high acoustic quality". There is enough evidence to discount standard noise criteria (say L_{eq} or L_{den}) as criterion for such areas. Instead, a two- dimensional criterion is needed: level of sound (high level sounds versus low level sounds) and distinction between sounds that are unwanted and sounds that are wanted in particular contexts.

1. INTRODUCTION

It has been shown [1] that engineering approaches to noise control, at least in terms of the most significant environmental noise problem, road traffic noise, have failed to reduce overall urban exposure and cannot be relied upon to do so in the future. This is not a failure in acoustical expertise or effort, but more a failure to locate consideration of the acoustic environment high on the political agenda. Noise control, essentially a negative command-and-control activity, has failed to capture the attention and imagination of decision-makers and a broad range of professionals - beyond those currently engaged in noise control activities - responsible for the design and management of our urban and regional landscapes. We need to supplement noise control approaches with new approaches that can do this. This paper

argues that soundscape planning can contribute to an invigoration of interest in the outdoor acoustic environment, but first we need to develop our own profession's interest in such planning, and to develop sturdy theories and technical expertise for this task. Soundscapes has, until recently, been outside the scope of the interests of many in the acoustical field. The requirement of the Environmental Noise Directive [2] that attention be given to what it called *quiet* areas has been a landmark in environmental acoustics - an exciting advancement. It is a statement that the whole of people's acoustic experience is important and warrants management - not just the low-quality, noisy, end of the outdoor acoustic environment.

2. AREAS OF HIGH ACOUSTIC QUALITY

The terminology of the Directive needs reconsideration; it refers to "preserving environmental noise quality where it is good". *Noise* is, by all definitions, *unwanted sound*. Thus *environmental noise quality* means, literally, *environmental unwanted sound quality*, and notions that "unwanted sound" in some area may possess a quality that is "good", and that it should be preserved, are nonsensical. While most low-quality outdoor acoustic environments are *noisy* and *loud*, many, if not most, high-quality outdoor acoustic environments are far from *quiet* or *silent* - think of a forest with wind in the trees, waves on a beach, birds singing, church bells in a town square, cattle lowing on a farm, and even the sound of children playing. People enjoy and cherish these sounds in appropriate contexts; components of human experience so important to the richness and quality of life. These outdoor environments have *high acoustic quality*, and the Directive makes sense if "preserving environmental noise quality where it is good" is reinterpreted as "preserving outdoor acoustic quality where it is good".

Further, the expression that has arisen to describe the parts of our cities and countryside of interest in this context is *quiet areas* - as counterpoint to the expression *noisy areas*. But because many of these are not quiet, this is an inappropriate term that should be abandoned, replacing it with the more inclusive, and far more accurate, identifier, *areas of high acoustic quality*. This terminology needs widespread adoption.

3. NATURAL AND URBAN/RURAL DOMAINS OF HIGH ACOUSTIC QUALITY

The domains of interest are:

- natural areas,
- non-urban or rural areas, and
- urban areas.

Natural areas of interest include that broad category that are variously termed national parks, wildlife protection areas, nature reserves, wilderness areas, recreation reserves, conservation areas, RAMSAR sites, etc - many of them already declared as protected areas but also includes those that are not so declared, but are worthy of such status. They may be land-based areas or water-based areas. They may be of very different spatial scales: from vary large tracts as in national parks to very small areas.

One objective of maintaining high acoustic quality environments in this domain is the protection of wildlife. How does impairment of high acoustic quality affect wildlife? Put simply, animals depend on acoustic signals in nature for a wide range of essential functions: for communication, for navigation, for mating, for nurturing, for detection of predators, and for foraging functions (there are also some measurements of off-road vehicle noise impairing

the hearing of small desert animals). Deterioration of high acoustic quality in these contexts means the intrusion of "non-natural sounds" - that is the noise of human activities whether that be from surface or air transport vehicles, gunfire, industrial noise, amplified music, voices, and so on - that can mask these natural acoustical signals and potentially impair the performance of wildlife in any of these essential functions. Equally important as these masking effects, noise is a stressor for wildlife, particularly where they cannot escape the noise when bound to a location through their breeding, feeding or nurturing activities, or where the whole of their habitat range may be affected. Such stress contributes, along with other stressors they experience, to impact on the viability of wildlife populations.

There is some excellent research regarding the effects of noise on wildlife in which behavioural responses or physiological responses to noise have been observed and measured. Such studies contribute to our understanding of the problem. However, review of the noise and wildlife literature indicates that, overall, work in this area is still sparse and sporadic [3]. Much of the literature deals with the impact of military activities, seismic and other exploration activities and the influence of transport noise. Some studies have shown observable effects of noise on wildlife, while others have shown effects on particular species in particular contexts have not been significant. But there is very much that we do not know: effects on wildlife are more subtle that suggested by observations of gross disturbance by noise events; inter-species differences are large; dose-response studies of noise on wildlife are difficult to conduct; and there is still an absence of understanding how observed behavioural and physiological effects translate into ecological consequences for wildlife.

In this domain, it is not *quiet* that is the objective, rather it is ensuring that wildlife is not disturbed by the sounds of human activity. Maintenance of *high acoustic quality* in the natural area domain to achieve the objective of protecting wildlife can be guaranteed (conservatively) by specifying the absence of intruding human-generated sounds. It may also become possible, where particular acoustic stimuli are known to impact on wildlife, to set noise limits on these stimuli (say aircraft noise) though few studies of noise and wildlife to date have designed experiments with a level of precision that can identify a threshold level below which the target species will not experience detrimental effects. One thing though is certain: there is no scientific evidence of, or in fact any logic in, any connection between limiting integrated energy measures of all sound in an area (say by specifying a maximum L_{eq}) and wildlife protection.

Of course the other objective of maintaining the quality of the soundcape in natural areas is human appreciation and enjoyment. People value such environments, but what evidence is there with respect to the contribution of the soundscape to this value?

There is a body of literature that examines outdoor recreationists' perception of the soundscapes they experience in the natural area domain, and a useful overview is that by Krog and Engdahl [4]. Most of these studies have focused on aircraft activity in US National Parks and in natural reserves in scenic locations such as New Zealand and Norway. There tends to be three different types of study. Some describe the soundscape that people experience or notice in these areas. Others are visitor surveys seeking recreationists' perceptions of the effects of intruding sounds on their recreational experience, or their annoyance with intruding sounds.

Most of this work was conducted in locations where wilderness, isolation, or remoteness from civilisation was the prevailing context and where human appreciation of quietude, or acoustic solitude, in such areas could be expected. While thus not representative of all types and scale of the natural area domain, a selection of observations from this body of literature yields:

- Visitors to such areas have a clear and widely shared understanding of the concept of "natural quiet" and of the sounds of nature [5].

- Natural quiet does not mean silence. This raises the issue of what various authors mean by "natural quiet". It is an ambiguous term but presumably interpretable as the sounds that exist in nature without the sounds made by people. Others use a more appropriate term "natural soundscape" – the sounds of nature without the intrusion of human sounds. This term requires no inference that nature is quiet - as in fact it rarely is.
- An equal-energy hypothesis, which is what we assume when we use an L_{eq} as the noise metric, provides a weak and arguable basis for predicting visitor response to noise intrusion in wilderness areas [6].
- The effect of a sound depends on the appropriateness of the sound to that setting [7]. Human appreciation or visitor response has much less to do with loudness or with quietness than it does with whether the sounds are appropriate to that particular setting. Similarly, most authors spell out that their results cannot be generalized beyond the specific context in which they were studied (for example, generalising results from recreation studies in wilderness to human appreciation of soundscapes in all the natural area domain is problematic).

Apart from these recreationists' studies, there is limited other scientific information on human appreciation of the soundscape in the natural area domain.

Non-urban/rural areas clearly overlap that of *natural areas*, but the essential distinction is that it does not contain the elements of wildlife protection, or wilderness. It includes all those landscapes outside of urban areas: coastlines, forests, mountains, countryside and so on, in which people might undertake active or passive recreation - and also includes the much more extensive rural areas in which the primary pursuit is not recreation, but agriculture or grazing or similar. All these areas can have diverse and distinctive soundcapes which people enjoy, and the purpose of maintenance of their high acoustic quality is for human appreciation.

Equally we can observe that people live, or work, or participate in passive recreation, in urban areas – where there are parks, gardens, malls, squares and facilities such as golf courses, and part of the appeal of these places is that they too may have high quality acoustic environments that contribute to peoples' appreciation of them.

4. ACOUSTIC OBJECTIVES IN THESE AREAS

One can reduce the aims of managing the quality of the outdoor acoustic environment to two specific objectives:

- *wildlife protection* and
- *human appreciation*.

They are not incompatible objectives, but they are distinct and need quite different approaches.

The paper focuses now on the objective of human appreciation of outdoor sound, and postulates a framework for *high acoustic quality* that is common to all types of area (wilderness, countryside, rural, recreational or urban). A framework is necessary for defining, identifying, and acoustic management for human appreciation of such areas.

The scientific community has paid little attention to human appreciation of sound outdoors. While there have been seven decades of studies into "what noise annoys you" (starting with the New York surveys in the 1930's [8]) there has been very limited investigation into "what sounds do you enjoy" or "what sounds to you prefer" in particular contexts. These investigations include those by Tamura, Sasaki, Skanberg; Carles, and Berglund and others, and a brief summary of these is reported by Brown and Muhar [9].

The results are not surprising. People prefer sounds of moving water: in all its different forms - the gentle trickle of a stream, the roaring of a mountain river, the sounds of waves on the beach whether those be peaceful lapping or violent crashing, the sound of rain, of waterfalls and of fountains in urban areas. People also prefer the sounds of nature: those of birds, animals and insects, the sound of wind in trees. Finally, people prefer generally the sounds of other people (voices, footsteps, laughter, singing) to mechanical sounds (vehicles, machinery, ventilators).

What are the acoustical conditions that support such appreciation and hence define an environment as one of high acoustical quality? A simple model, or theoretical framework, is proposed. The theory is demonstrated through constructing a two by two matrix (Table 1). The level of the sounds experienced is one of the dimensions (loud sounds versus "soft" sounds, or high sound levels versus low sound levels). The second and critical dimension distinguishes situations where the sounds heard are unwanted and where the sounds heard are wanted.

Of course this second dimension begs the question "wanted by whom and where?" The response depends entirely on who is doing the listening and, more importantly, the context in which the listening occurs. This will vary between groups of people of dissimilar age (different types and intensity of music for example), social status, religion (sounds of Christian church bells or the sounds of Islamic call to prayer) etc. Such complexity can be dealt with. It is suggested that in many contexts of interest, there will be more agreement than disagreement in sounds that can be identified as "wanted".

The matrix in Table 1 describes four conditions. Those on the diagonal are straight forward: areas with loud sounds that are also unwanted are clearly "noisy areas" - locations near a busy roadway or under a flight path for example. And areas with "soft" sounds, where those are sounds that are wanted, are clearly "quiet areas" – say the sounds of birds singing in a nature area, or gentle waves lapping on a beach. Acoustic conditions in the bottom right of Table 1 enable human appreciation of the sound, and hence define an area of *high acoustic quality*.

The anti-diagonal of Table 1 is more complex. The condition in the bottom left is of "soft" sounds that are unwanted – an example might be a nature area where distant traffic sounds are audible and, while not loud, still intrusive and thus unwanted in that context. Such a condition may be quiet (with a low L_{eq}) but certainly would not be regarded by people as one of *high acoustic quality*. The remaining condition, in the top right of the matrix, is where there are sounds that people want or prefer though they are loud sounds. Examples of such conditions are near a waterfall, on a surf beach, or in a forest in high winds. Such loud sounds may even be from non-natural sources - from cattle in the countryside, close to a large fountain in an urban square, or even the mechanical sounds of agricultural pursuits in a rural area. The context of the acoustic experience is critical, but in any particular milieu these loud sounds could be wanted, part of the intrinsic sound profile of that location where there is congruence between landscape and soundscape. This condition can also be classified as possessing *high acoustic quality*.

Table 1. A two-dimensional model identifying areas of high acoustic quality

	Sounds are unwanted	**Sounds are wanted**
Loud sounds (high sound levels)	**noisy area**	**not** a quiet area, but an **area of high acoustic quality**
Soft sounds (low sound levels)	**not** an **area of high acoustic quality**	**quiet area,** and an **area of high acoustic quality**

If one accepts the model postulated in Table 1, the consequence is that *areas of high acoustic quality* can not be identified based on the level of the sound alone (for example using Leq or L_{den}). They need to be classified on the information content in the sound - it is the information content in a soundscape which determines if people want or do not want the sound - and its suitability in each particular context. This is a quite radical departure from current approaches where *sound level* tends to dominate discussion and implementation of *quiet area* concepts. One can also note that most of our noise measurement equipment and assessment procedures simply integrate all sounds from all sources - and are unable to distinguish the sounds we want from those we do not want.

In practice, most areas will have both wanted and unwanted sounds present, and the model must be extended to incorporate the concept of masking of one sound by another. *High acoustic quality* will be achieved where the wanted sounds effectively mask the unwanted sounds so that they are the only sounds that will be heard (or more realistically in most situations, where the wanted sounds largely dominate the unwanted sounds - a less stringent masking requirement).

5. COMPLEMENTARITY

There is a growing interest in the field of soundscapes, though quite a lot of the soundscape literature is still imprecise and not easily adapted for use by acousticians steeped in noise control activities. One can demonstrate both the distinctiveness, and the complementarity, of *noise control* and *soundscape planning* approaches.

Firstly, the noise control field deals with sounds of discomfort. In the soundscape field instead we need to talk about sounds of preference. The only fields in acoustics where the focus is sometimes on sounds of preference are building acoustics (for example ambient levels in a room or in a concert hall) and sound quality. Secondly, in the noise control field, sounds are measured by integrating them. In the soundscape approach the information content of the sound is critical and differentiation of sounds of different sources, and differentiating wanted from unwanted sounds, not their integration, is needed. Thirdly, noise control is most often achieved by reducing levels, at the source, in the transmission path, or at the receiver. Soundscape planning may need to utilise level reduction, but its objectives are not necessarily lower levels of sound, rather in ensuring that wanted sounds are not masked by unwanted sounds. Finally, in noise control sound is seen as a waste. In soundscape planning sound it is recognised as a resource - and the intent is management of this high acoustic quality resource.

6. CONCLUSIONS

It is this latter difference, sound as a resource rather than as a waste, that has potential to capture imaginations of decision-makers and urban and landscape design professionals - in a way noise control has failed to do. Preserving areas of high acoustic quality is an important part of preserving diversity of human experience across cities, villages, countryside and wilderness, with the associated benefits that people derive from the experience of *areas of high acoustic quality*. There is much anecdotal human experience of this benefit, though it is a quite uncharted territory and we need empirical evidence. One could perhaps look for guidance initially in the recreation literature that recognises that recreation provides benefits to human well-being and health - a significant proportion of outdoor passive recreation occurs in areas of high acoustic quality.

It is not that soundscape planning will, in itself, achieve reductions in adverse noise exposures in the population - the locations and scale of places where soundscape planning can be applied mean that its direct effects could be only very small. But it is aimed at a much wider effect - achieving a quite profound change in mind set through engaging planners, urban designers, architects, landscape architects, engineers and other design professionals in the consideration of the outdoor acoustic environment as an integral and positive design element in all their work. It is aimed at enlisting a broader base of professional and community interest and responsibility in the field. Policy-maker and decision-maker interest will follow.

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