Edinburgh, Scotland EURONOISE 2009 October 26-28

The outdoor acoustic environment as resource, and masking, as key concepts in soundscape discourse, analysis and design.

A.L. Brown^a Urban Research Program Griffith University Nathan, Brisbane, 4111 Australia

ABSTRACT

Several underutilized concepts warrant further development in soundscape discourse, analysis and design. The first set of concepts consider the outdoor acoustic environment as a resource, including notions of different beneficial uses of this resource (a term borrowed from water resource management), and maintenance of *diversity* as a resource management approach. The second set encompass the notion that, underlying human experience of a soundscape, any individual (or group), in any particular context, will invariably be able to hear sounds that are wanted (by them, in that context) and sounds that are unwanted. This is a fundamental starting point for soundscape analysis and, by extension, soundscape management and design. These wanted and unwanted sounds need to be distinguished one from the other in measurements of human perception of a soundscape and measurement of its physical acoustic properties. Identification and quantification of the wanted and unwanted sounds allows introduction of acoustic masking as a key determinant of human perception of a particular soundscape, and as a tool for acoustic management and design. These concepts are illustrated through two different acoustic environments: an urban park in which there might be sound from both a water structure and from city noises/road traffic; and a wilderness area in which natural sounds predominate.

1. INTRODUCTION

This paper discusses several concepts that are underutilised in the current discourse on outdoor soundscapes. They are not new concepts, but warrant more exposure and discussion. They broadly fit into two categories:

- Underutilised concepts in exploring outdoor soundscapes:
 - The need for disaggregation in analysing the outdoor acoustic environment
 - o "Wanted" and "unwanted" sounds
 - o Masking as a key concept
- Underutilised concepts in promoting the concept of outdoor soundscapes:
 - o The acoustic environment as a resource

^a Email address: lex.brown@griffith.edu.au

- o "Beneficial use" as a management concept
- Diversity as a principle in managing natural resources sustainably

2. DISAGGREGATION OF SOUND SOURCES AND MASKING

We are largely interested in *outdoor* soundscapes, and the primary concern is *human appreciation* of these soundscapes, or human comfort, or *well-being*. This requires knowledge of

- How people experience these acoustic environments?
- What sounds do they prefer?
- How do they describe these acoustic environments?
- Physical quantification of sounds in a way that reflects this?

In nearly all places where there is an interest in the outdoor soundscape there will be multiple sources of sound, and these sources may vary over different times of the day and with different activities in the place.

Too often, approaches in soundscape studies have been to measure "aggregates":

- Aggregate measures of human experience of that soundscape (e.g. enjoyment, annoyance etc)
- Aggregate measures of the sound (e.g. integrated energy measures such as Leq, and a wide range of other physical measures)

While these types of aggregate measurements may have utility in some circumstances, the thesis of this paper is that, in order to study soundscapes in most places, analysis needs to start with an idea fundamentally different to aggregation - disaggregation:

It is becoming clear that outdoor sound quality cannot be determined by simple measurement—particularly not energy integrative measurement—and that meanings attributed to sounds determine sound quality¹. The type of sound sources present is critical in judgements about outdoor sound quality². Within any particular context, and for any particular individual, there will sounds that are wanted, and sounds that are not wanted, and there is a need to identify and measure the wanted sounds and the unwanted sound separately³.

Human perception of an outdoor soundscape is likely to be determined, again within any particular context, by the nature and relative intensities of the sounds that are present. Preference (on some particular human outcome dimension: enjoyment, relaxtaion, excitement, comfort etc) is likely to depend on whether sounds that are wanted there are heard and sounds that are not wanted are not heard. Disaggregate a soundscape by its component sources

In acoustical terms, the key concept here is of masking – ensuring that wanted sounds are not masked by unwanted sounds, or that wanted sounds mask unwanted sounds.

This is the simplest statement of a key principle in soundscape study, analysis, and planning/design. There already are some applications of this principle in the soundscape field, though not always recognised specifically as masking:

- soundscape criterion based on audibility (certain sounds required to be inaudible
- Partial masking (proportion of time wanted sounds are heard above unwanted sounds)
- Two soundsnatural sounds (natural quiet).....and human intrusion sounds
- Supplement overall quantification with quantification related to its components:
 - Perceptual measurement
 - Physical quantification (difficult)

SLIDE

SLIDE Grand Canyon

I said this idea is not NEW. Been part of soundscape research and management in US National Parks. :

SLIDES couple of examples: seascape, square

- these are examples of places in which we are interested in the soundscape 1.
- In places like this there are multiple sources of sound 2. 3.
 - A common approach in soundscape studies has been to measure the aggregate:
 - a. Aggregate measures of human experience of that soundscape (loud, sharp, pleasant, liveliness etc)
 - b. Aggregate acoustic measures (Leq, various frequency measures + whole range of other measures)

In my view, these types of measurements have some, but limited, value by themselves.

My thesis is that, If we are going to study soundscapes in any place like this, analysis needs to start with a fundamental idea:

WITHIN ANY PARTICULAR CONTEXT, AND FOR ANY PARTICULAR Α. INDIVIDUAL, THERE WILL SOUNDS THAT ARE WANTED, AND SOUNDS THAT ARE NOT WANTED

B. WE NEED TO SEPARATELY EXAMINE AND MEASURE THE WANTED SOUNDS AND THE UNWANTED SOUND (IN THAT CONTEXT)

C. A KEY CONCEPT IN ACOUSTIC ANALYSIS OF THESE SITUATIONS IS THAT OF MASKING.

SLIDE Westerkamp

Came out of soundwalks

Part of some early work I did in sounds of water structures – and I coined a few terms to describe my experience:

- Zone of detection (detected water structure amongst city noises)
- Zone of influence (the background of city noise is masked by the water structure, and while peaks from the traffic are only partially masked and still audible—this ia a pleasant zone in which the water structure has softened the the city sounds, and is used by people for relaxing, reading and communicating)
- Zone of exclusion—close to the water structure (constant high level of sound from the water structure. City noise has been completely masked. Very loud—but people enjoy and utilise this zone, even though it is far too loud for relaxed conversation.

MASKING IS THE KEY – and in order to do this, soundscapes need to be analysed in terms of their components.

And the only way to do this is to disaggregate the soundscape.

SLIDES Three different contexts

In each of these three contexts, soundscapes would have considerable similarities - BUT:

- Aggregate measurement of people's perception
- Aggregate measurements of sound level

Would tell us very little.

SLIDE A new emphasis in exploring soundscapes....in ANY CONTEXT

- Disaggregate
- Quantification perceptual and physical
- Masking

SLIDE Physical measurements?

SLIDE Promoting soundscapes. These are not academic concepts—but more political ones. How do we convince policy-makers to and shift resources towards soundscape management in our cities and countrysides?

Here are a few concepts that are worth trying.

- Resource
- Beneficial use (I went looking for paralles in other areas of resource management)
- Diversity

Beneficial use:

from sound quality:

5. Quality in beneficial term

There are many reasons for creating a new product. Consequently, a wide range of benefits for users of a product exist which can be related to quality. The most important ones are described in the following. This aspect of quality is named "Nutzqualit" at" in German, which would translate into English terms like "quality due to utility, due to usability, or due to benefit from usage". (a) Benefits of quality for the custome As the quality of available products can only be experienced by individual customers or user (from Jekosh, ute 2004)

IN ADDITION: made me think about the concept of "quiet". Many examples that "quiet" is likely only a small part of human preference for soundscapes—particularly in urban areas. I believe a lot of attempts at mapping "quiet places" is quite misdirected – they focus on the overall level, not the context nor the components of the soundscape

Most often we are part of a larger "acoustic" -most often "noise" conferences. There are other fora in which the ideas of soundscapes are discussed—in fact originated—The World Forum on Acosutic Ecology for example—but unfortunately there is ;little active crossover as yet between this and what I call mainstream acoustics.

It is fascinating to observe how the ideas of soundscape studies, analysis and soundscape design of outdoor space has started to infiltrate into the conferences and journals of the acoustics profession over the past decade – particularly given it paid little or no attention to the pioneering work of Schaeffer and others in the previous two decades.

They are good second beginning for "soundscape ideas".

But there is a weight of history of practice in the way acousticians have approached the outdoor acoustic environment—both physically and perceptually—and this is reflected in our measurement approaches, our assessment approaches, and politically in the way we approach management of environmental noise—that is providing some constraints on the development of soundscape concepts.

To provoke discussion over the next day or so, I will focus on just a couple of concepts which I believe warrant more attention in the soundscapes field—I have not called them NEW concepts...they are far from new_but I regard them as UNDERUTILISED concepts_and ones that we should examine critically.

Soundscape approaches have been described as a new paradigm in the outdoor acoustic environment -I don't think we have advanced that far yet....but if there is a to be a new paradigm, we need to clearly articulate how it is differentiated from the old paradigm.

SLIDE

In this respect, I note how there is starting to be significant devaluation of the term "soundscapes:

We could usefully spend part of the time in this symposium refining some requirements to ensure that the term is used in way that adds value, rather than is devalued.

+ have a look at c:\soundscapes\WG54 folder + have a look at material submitted

Keen on:

Soundscape as an enabler Soundscape as a resource Soundscape as an approach

Indicators of soundscapes outcomes:

- well-being
- comfort
- pleasantness

- identification ???
- place attachment
- potential enabler

Sound identification Sound recognition

My final summary:

- 1. should be Action oriented:
- 2. useful to enumerate the sort of places where soundscapes concept can have application. eg wilderness, urban square or park,active design and analysis
- 3. action is designing or managing soundscape
- 4. what is needed is analyses that can contribute to this
- 5. there are problematics in a whole range of disciplinary areas (source recognition, physical sciences, cognitive sciences, perceptual sciences. designers) that need to be addressed.

www.last.fun??????? what is this web site??? www.last is correct

cognitive sciences perceptual science physical sciences

What are the new problematics that soundscapes pose for different disciplines.



Figure 1. The fundamental role of masking in the soundscapes of outdoor spaces. "Wanted" sounds can be differentiated from "unwanted" sounds, and even in the same place, with the same sound sources, these depend on context: water structure sound desireably masking traffic noise at top, both water structure and traffic undesireably masking an outdoor concert in the middle, and water structure sounds potentially masking safety information from traffic for pedestrian at bottom.

4. CONCLUSIONS

Please follow these paper preparation instructions carefully. Please make sure that you paper is between four and twelve pages in length.

REFERENCES

- 1. D. Dubois, C.Guastavino and M. Raimbault, "A cognitive approach to urban soundscapes: using verbal data to access everyday life auditory categories", Acta Acustica United with Acustica, 92, 865-874 (2006).
- C. Lavandier and B. Defréville, "The contribution of sound source characteristics in the assessment of urban soundscapes", Acta Acustica United with Acustica, 92, 912-921 (2006).
- 3. A.L. Brown ????????2006 wanted unwanted
- 4. G. Mark, C. leffam and P.D. Strong, "Title of the paper", in *Proceedings of Euronoise 2001*, Patras, 2001, pp. 379-382 or paper n°124.
- 5. S. Tom and R. Franco, Virtual Noise, *Journal of Sound and Vibration* **375**, pp.171-175, (2002).
- 6. K. Alvarez and M.P. Brown, Modern Physics, McGraw-Hill, London 1998, pp.20-33.

Dubois et al 2006

Lavandier and Defréville 2006

ISO (2003). Acoustics - Assessment of noise annoyance by means of socio-acoustic or social surveys (ISO/TS 55666:2003). Geneva: ISO.

Jekosch, Ute (2004) Basic Concepts and Terms of "Quality", Reconsidered in the Context of Product-Sound Quality. *Acta Acustica United With Acustica*, 90, 999 – 1006

The web site for the WG54 or similar

ISO

Borrowed from WG54 brief.....need checking:

[1] ISO (2003). Acoustics - Assessment of noise annoyance by means of socio-acoustic or social surveys (ISO/TS 55666:2003). Geneva: ISO.

[2] Brown, A. L., & Muhar, A. (2004). An approach to the acoustic design of outdoor space. *Journal of Environmental Planning and Management*, 47(6), 827-842.

[3] De Coensel, B., & Botteldooren, D. (2006). The quiet rural soundscape and how to characterize it. *Acta Acustica united with Acustica*, 92, 887-897.

[4] Berglund, B., & Nilsson, M. E. (2006). On a tool for measuring soundscape quality in urban residential areas. *Acta Acustica united with Acustica*, 92, 938-944.

[5] Nilsson, M. E., & Berglund, B. (2006). Soundscape quality in suburban green areas and city parks. *Acta Acustica united with Acustica*, 92, 903-911.

Instructions to authors for preparation of papers for the Euronoise 2009 proceedings

Bernard F Berry^b General Chairman, Euronoise 2009

Linda Canty ^c Conference Secretariat, Euronoise 2009

ABSTRACT

Prepare your paper using a word processor such as Microsoft WORD. However, you **must** submit your paper as a pdf (Portable Document Format) file.

The instructions for preparing your paper, given below, are in the format of sections etc, and font that should be used in preparing your paper. Failure to comply with these formatting instructions may result in the omission of your paper from the CDROM of Proceedings.

^b Email address. Bernard@bel-acoustics.co.uk

^c Email address. <u>Linda.canty@ioa.org.uk</u>

1. INTRODUCTION

The Euronoise 2009 Proceedings will be published on a CD, and given to each conference delegate. The Proceedings CD will also be available for purchase after the conference.

The purpose of these instructions is to ensure uniformity in the layout and typography of Euronoise 2009 conference papers. Papers, including figures, tables, illustrations and references may be any number of pages from 4 to 10. The headings and subheadings used in these instructions are in the format required in the preparation of the paper. The type font used here and for the paper is WORD Arial in 11 point font, fully justified left and right, normal text style.

The exclusive use of SI units is strongly recommended. If the English conventional system of units is used, the SI equivalents should be inserted in parentheses following the English values. Only manuscripts in the English language will be accepted. The technical program chairs reserve the right to reject any paper based on the final submission, even if the abstract was previously accepted. Note that the final conference program will include only accepted full-length papers (for which a registration fee has been received). Colour may be used.

2. MANUSCRIPT FORMAT

A. Margin Settings

The paper size should be A4. Do not use headers, footers, or page numbers in the paper (except for author email addresses, as noted below). Set the top margin to 40 mm, the side margins to 27 mm, and the bottom margin to 25 mm. Tab stops should be set at 0.25 inches (6 mm).

B. Top of the First Page

At the top of the first page, the three lines:

Edinburgh, Scotland EURONOISE 2009

October 26-28

must be centered on the page. The type font is Arial, with the first and third lines 10-point bold and the middle line 16-point bold. A similar sans-serif font (e.g., Helvetica) may be used if Arial is not available.

C. Title of the Paper

The paper title is in Arial 16-point bold. Capitalize only the first word of the title: e.g., **How much noise is too much?**. The title should be left-justified.

D. Author Information

Author information must be left-justified below the title, and is in Arial 10-point type. Include the author's name (first name or initial followed by middle name or initial and last or family name), affiliation and address (city, state, zip code or equivalent, and country). Do not include personal titles (e.g., Dr., Prof.) with the author names. For multiple authors, group authors with the same affiliation/address: e.g.,

Name1 Name2 Affiliation1 Name3 Affiliation 2

If you would like to include author email addresses, do so with footnotes using letters, as indicated in this template.

E. Headings

Major headings must be centered in 12-point **Arial** bold type, in all capital letters and must be labeled numerically: e.g., **1. INTRODUCTION** and **2. METHODS** Leave a line space above a major heading, but not below. Subheadings should be in 12-point **Arial** bold type, in upper and lower case, and labeled alphabetically: e.g., **A. Applications** and **B. Numerical Analysis**. Leave a line space above but not below subheadings.

F. References

The list of references should be labeled numerically in the order they are referred to in the text. Use superscripts in the text to indicate references: e.g., "...health effects can be considered⁵⁻⁸ ..." Examples of reference listings are given below.

G. Figures, Tables and Equations

Include figures and tables either within the text, or at the end of the paper (your choice). Shown below are some examples of tables and figures, along with their caption formats. Table captions should be centered above tables, and Figure captions should be centered below figures. The table and figure identifiers should be in bold 10 point Arial font, and the table and figure titles in normal 10 point Arial font. Indent, punctuate and number your equations like this:

$$L_{VA} = 10 \log \left[\frac{17}{24} 10^{L_{VAd}/10} + \frac{7}{24} 10^{L_{Vad}/10} \right] \quad \text{dBA}$$

Table 1: This is a table caption.

(1)

Item 1	Item 2	Item 3
Description 1	123	456
Description 2	234	567



Figure 1: This is a figure caption.

3. NAMING AND SUBMISSION

Name your file "EN09_xxx.pdf" where "xxx" are the final three digits of the assigned entry number you received when you submitted your abstract. For example, if your entry number was123, name your paper file "EN09_123.pdf". Please ensure that the pdf file is 1 MB or smaller. Submit your paper as a pdf file using the link on the congress website www.euronoise2009.org.uk.

4. CONCLUSIONS

Please follow these paper preparation instructions carefully and make sure that you paper is between four and ten pages in length.

ACKNOWLEDGMENTS

We gratefully acknowledge all authors for submitting their work to Euronoise 2009!

REFERENCES

References should be in this format: <u>4.7.</u>G. Mark, C. leffam and P.D. Strong, "Title of the paper", in *Proceedings of Euronoise 2001*, Patras, 2001, pp. 379-382 or paper n°124.

2<u>-8</u>.S. Tom and R. Franco, Virtual Noise, *Journal of Sound and Vibration* **375**, pp.171-175, (2002).

3.9. K. Alvarez and M.P. Brown, Modern Physics, McGraw-Hill, London 1998, pp.20-33.

Formatted: Bullets and Numbering

Formatted: Bullets and Numbering

There is a complementarity between soundscape and environmental noise approaches in management of the outdoor acoustic environment, though the nature of this has not been clearly articulated. Some realignment towards soundscapes has been forced by the EU Environmental Noise Directive and by notions of the restorative capacities of soundscapes on human health and well-being and the value of high acoustic quality environments to people in noisy urban areas. This paper encourages further convergence of soundscape and noise control approaches, introducing the idea of sound as a resource to be managed for different beneficial uses and for diversity. It recognizes that there are impediments to integrating soundscape and environmental noise management approaches largely through different approaches to measurement. Soundscapes introduces a new dimension, aimed at catching political attention in the way that noise management has failed to do so, and the engagement of other professions, in management of the outdoor acoustic environment.

INCE Classification Codes:

1 Soundscapes and Environmental Noise Management

Amongst many other matters in his pioneering thesis on soundscapes, Schafer [1] recognised the need for integrating the knowledge and skills of the many disciplines that have an interest in the acoustic environment. Within this context, he challenged engineers and others involved in noise abatement or control (as well as architects, musicians, music educators, and others) to develop new approaches to the analysis, study and management of sound—particularly, though not exclusively, sounds experienced outdoors.

Despite this call for integration, there has, until relatively recently, been little engagement between the soundscape and the environmental noise fields. Even a cursory examination of the voluminous literature on environmental noise and its management over more than three decades, and the smaller quantum of literature on soundscapes, testifies to the paucity of this interaction [3]. EXPAND MAYBE LERCHER AND FORT KAMP ETC OTHERS??? In fact, soundscape concepts remain largely alien to most environmental noise practitioners, even sometimes inappropriately assumed to be little different to "environmental" or "community" noise. [REFS....BROWN? ORIGINAL IN INTERNOISE].

There has always been some commonality between these different fields in work on the acoustic experiences of recreationists in wilderness, and in noise and wildlife [REFS??], but more recently there has been some convergence of interests on a broader canvas. Some significant realignment towards soundscapes has been forced by the EU Environmental Noise Directive, part of which is driving identification of "quiet areas" in Europe-more appropriately termed "areas of high acoustic quality" [4]-and attempts to define and map these. Researchers in environmental and community noise are also beginning to investigate the contribution that soundscape approaches can make to an understanding of human response to sound, in both urban and non-urban contexts, and its potential role in environmental noise management. This includes the effect of source and context in human experience of noise [5], notions of the restorative capacities of soundscapes on human health and well-being, including the value of high quality acoustic environments to people otherwise living in noisy urban areas [6, 7, 8]. Influence is even reflected in small redirections such as concern with people's response to noise while outside their dwellings in addition to their response inside their dwellings [9]. There are also shifts in the longstanding emphasis in studies of human perception of environmental sound; from annoyance and disturbance towards understanding human interpretation and preference for different sound environments [10].

2 Sound as a Resource, Beneficial Uses and Diversity

At a fundamental level, both the distinctiveness, and the complementarity, of *environmental noise management* and *soundscape* approaches are illustrated in Table 1.

Table 1. Complementarity and distinctiveness of environmental noise management and soundscape approaches.

Environmental Noise Management Approach	Soundscape Approach
sound managed as <i>a waste</i>	sound perceived as a resource
focus is on sounds of discomfort	focus is on sounds of preference

Firstly, in the environmental noise field, sound is seen as a waste product that, as with all wastes, is to be reduced and managed: at source, in the propagation path, or at the receiver. By contrast, the soundscape field regards sound largely as a resource—with the same management intent as in other scarce resources such as water, air and soil: rational utilization, and protection and enhancement where appropriate. Resource management has a particular focus on the usefulness of a resource to humans and its contribution to the quality of life for both present and future generations. The concept of soundscape as a resource has been recognized in national park management (e.g, US National Park Service, 1995 [11]), but not outside of this restricted application.

Secondly, the noise control field nearly always deals with *sounds of discomfort*: sleep disturbance, annoyance, interruption to communication or cognitive processes etc. In the soundscape field, instead, the focus is more on *sounds of preference* [EXPAND AND REFS?]. This is an important divergence, as the only areas in environmental acoustics where the focus is on sounds of preference have tended to be building acoustics (say preferred ambient levels for rooms, or preferred reverberation time in halls for speech and music) and sound quality of products [ref???].

Three notions elaborate on the idea of environmental sound as a resource:

- the concept of beneficial use
- the management and enhancement of diversity
- soundscape as the aural equivalent to landscape.

These notions are interrelated and are examined further below.

2.1 Beneficial Uses of the Acoustic Environment

To develop further the concept of the managing the acoustic environment as a resource, it is useful to borrow from experience in the management of another resource—water.

Management of water resources uses the concept of "beneficial use". Whereas water quality management previously focused on limits to discharges (in the same way environmental noise control currently specifies noise emission limits, say for aircraft, or construction machinery, or domestic appliances), the US Clean Water Act now requires standards be set for overall quality of water bodies, based on the designated beneficial use(s) of that water body, identifying maximum concentrations of pollutants which would not interfere with the designated use [24]. The idea is that water has many different uses, and that it does not have to be of the same quality for each use. Different management criteria apply, for example, depending on whether that water is used for, say, water supply, aquaculture, wildlife habitat, recreation (primary contact recreation, sport fishing, boating), commerce and navigation, industry, or even aesthetic appreciation.

By analogy, much of our current management of the acoustic environment can be recognized as based on a single "beneficial use"—namely the residential use of dwellings. External façade acoustic criteria are set to protect that use based on, for example, limiting the annoyance or sleep disturbance of residents inside the dwelling. However, just as in the management of water resources, there is a much wider range of beneficial uses of the acoustic environment other than that of residential use of dwellings. "Uses" of the outdoor acoustic environment may include, for example:

- wilderness experience
- restoration of health and well-being
- respite, relaxation
- enjoyment or excitement
- enhancement of culture
- wildlife habitat protection.

This list of beneficial uses could be extended, but it is sufficient to demonstrate that there are many "uses" that draw benefit from the acoustic environment, other than that of living in a dwelling. Different 'standards', and quite likely different ways of measuring achievement of these standards (physical noise limits for some; suitability of the sound in that particular context for others) will be required to benefit different uses.

Current water resource management practice thus provides a precedent for a parallel approach to management of the acoustic environment, with soundscape concepts extending, and complementing the existing environmental noise control approach. The concept of beneficial uses can assist in explaining to decision-makers the relevance of soundscape approaches, and the inadequacy of applying a single criterion (minimizing annoyance) in the management of the outdoor acoustic environment.

2.2 Diversity in the Outdoor Acoustic Environment

Another concept pertinent to considering the acoustic environment as a resource is that of diversity. Diversity in genes, species and ecosystems underpins the management of biological systems. Maintenance of natural diversity (and equally cultural diversity) is often an underlying principle in the planning of regions, natural areas, the countryside and urban areas. The same principle has relevance to management of the acoustic environment. For example, the 5th Dutch Spatial Planning Policy Memorandum [REF] included the acoustic environment in part of its discussion of diversity and sustainability, suggesting that matters such as the characteristic of local sounds, and tranquility, are important elements of the spatial quality of rural and urban areas. Current noise management approaches may be aimed at preventing excessive exposure of the community to noise, but have little to say about the grey blurring that is occurring in terms of transport noise sources becoming the dominant background in many communities, masking natural sounds or local community sounds. Managing diversity in the acoustic environment resource in urban and rural areas is an important part of preserving diversity of human experience, and soundscapes studies have the potential to articulate and describe this diversity and contribute to its management.

2.3 Soundscape as the Counterpart of Landscape

The field of soundscapes (less appropriately, called acoustic ecology) has eclectically encompassed nature sound recording; compositions based on, or of, natural sounds; bioacoustics; soundscape studies of villages and rural environments; the analysis of sound descriptions in history and in literature; the description of all types of acoustic environments; and the creation of acoustic designs and sound installations (see, for examples, reviews by Hiramatsu of soundscape studies in Japan [2], and Lercher and Schulte-Fortkamp [3]). Such different uses of the term "soundscape" may initially appear perplexing, but this is no different to the many ways in which its namesake "landscape" is conceived: landscape as geographical form; landscape as vegetation system; landscape as both determinant and reflection of culture (painting, literature and music); landscape as a focus of recreation; and a design activity as in landscape planning or architecture. Various authors have drawn the useful analogy of soundscape as the aural equivalent of landscape [1, 6, 15, 19]INTERMOISE09.

It can be noted that, through urban and rural planning, and land management activities, governments devote considerable resources to protection and enhancement of landscape resources, including visual resources, and their diversity. A parallel can be drawn to the need for equivalent attention to the outdoor acoustic resource—generally restricted at present to limiting exposure to excessive noise.

Maybe this

COPY FROM INTERNOISE....argued that percepriopn is major difference...no it is not...it is the different outcome of interest

3 MEASUREMENT IN NOISE MANAGEMENT AND IN SOUNDSCAPES

A constraint to the integration of soundscape concepts with environmental noise control is the weight of history in the way acousticians have approached measurement of the outdoor acoustic environment.

Environmental noise management is rooted in physical measurement. Even in psychoacoustic studies of human perception of sound and response to noise, emphasis has been on a search for physical descriptors that correlate with human response based on acoustical parameters of exposure: level, frequency and temporal dimensions of environmental noise. Environmental noise management then uses these physical descriptions of sound to set limit criteria for human exposure and consequently for noise management and design of noise mitigation. Further, a significant component of professionals involved in noise policy, management and control have been trained as engineers for whom objective physical measurement is fundamental. Soundscape concepts present challenges to conventional environmental noise approaches given the primacy of physical measurement in the latter. There is growing acceptance that outdoor sound quality based on human appreciation or preference cannot be determined by a simple physical measurement, such as the A-weighted sound pressure alone [14, 15]. Matters such as context, the information in the sound, and individual attitudes and expectations, all play an important role in judgments of outdoor sound quality, either more important than level of sound or even to the exclusion of level.

In particular, the energy-integrative approaches to sound measurement that have become the norm in environmental noise are particularly unsuitable in assessing soundscapes. Human assessment of soundscapes appears to depend critically on distinguishing between different sound sources: mechanical sounds from natural sources; human voices and footsteps from the sounds of transport, etc. Integrating sound may be intuitive to noise measurement, but counter to the way people experience much of the outdoor acoustic environment. Evidence has been presented by Dubois et al [17], through psycho-linguistic studies, that meanings attributed to sounds act as determinants for sound quality evaluations. People categorize urban soundscapes by source when specific sound sources can be isolated, and by the presence of human sounds where many sources contribute to the background. Their conclusion is that soundscapes need to be conceived and investigated by first identifying relevant semantic features, and only then by correlating them with quantifiable (acoustic) parameters. A similar notion is that areas of high acoustic quality are identified by whether sounds are wanted or unwanted in particular contexts, not just by the levels of sound [4]. Lavandier and Defréville [18] provide experimental evidence that explained variance of hedonic judgments of sound in Paris streets and other locations is increased by combining identification of the source with perceived loudness.

Despite the growing evidence that measurements are unable to account for much of human preference for outdoor soundscapes, the search for physical acoustical correlates continues. Genuit and Fiebig [19], amongst others, propose that hearing-related physical parameters, other than the averaged intensity of the acoustic stimulus, will be necessary to characterize environmental sounds. Measures such as sharpness, roughness and fluctuation strength of sound have been suggested [Raimbault *et al.*, 2003; Semidor, 2005], as have acoustic properties of sound events [19], and "music-likeness" [22, 23], with emphasis on the spectral and temporal properties of sound.

These observations show a strong divergence between soundscape and noise control in measurement approaches. While further empirical evidence is required—and there is currently increasing research interest in these areas—hypothesized differences are shown in Table 2. In the noise control field, sounds are measured by integrating them, generally independent of source. In the soundscape approach, the information content of the sound is critical and identification of source) that we predominantly use in noise control (the Leq), are likely to be found wanting as a way to measure sound in a way that relates to human preference. Further, management of noise is most often achieved by reducing these integrated levels of exposure. Management in soundscape approaches may need to utilize level reduction, but its objectives are not necessarily lower levels of sound, rather in differentiating wanted from unwanted sounds and ensuring that wanted sounds are not

masked by unwanted sounds [REF..BROWN – PAPER 1?]. This raises interesting technical questions for acousticians regarding how we define, measure and control sound where human preference is the criterion.

Table 2. Hypothesized differences in measurement and management approach in environmental noise and soundscape fields.

Environmental Noise Management Approach	Soundscape Approach
measures by <i>integrating all sounds at a receptor</i> (Leq or similar)	requires <i>differentiation between</i> <i>sound sources</i> (sound source identification)
focuses on <i>reducing levels</i>	requires wanted sounds not being masked by unwanted sounds

One observation using objective measurement may prove useful in soundscape appraisal in specific situations. The time ratio of sound source presence [18] was found to be a better predictor than source sound level in typical urban settings such as markets and parks. A model based on this principle is already in use in the management of soundscapes by the US National Park Service [25], with indicators including 'percent time above natural ambient', and 'percent time audible'. While these are objective predictors, they are firmly based in soundscape approaches, requiring rejection of integration of sound energy measurement. They replace it with discrimination between sound sources - some sounds are wanted in particular contexts (natural, or other wanted sounds, setting the ambient) and some unwanted, and with time limits placed on the intrusion of the unwanted sounds above the wanted sounds.

Given evidence that exists to date, it would be unfortunate if the continuing enquiry into physical acoustic correlates of soundscape perception leads to inertia in applying soundscape principles in outdoor acoustic management, or for continuation of the current inappropriate approach of defining "quiet areas" by maximum level of integrated sound energy alone [REFS?? END]. Such inertia is possible given the traditional anchoring of policy and control of the acoustic environment in physical measures of sound, and the difficulty for many environmental noise practitioners in navigating the unfamiliar territory of a less dominant role for physical measures.

4. MAPPING

There different ways in describing and measuring sound have implications in mapping outdoor sound.

The EU Environmental Noise Directive has lead to large acoustic mapping exercises in urban and some rural areas in Europe to allow estimates of population exposure. But apart from mapping areas of high noise exposure—the maps are, in fact, largely maps of levels of

road traffic noise as aircraft noise and industrial noise would dominate over relatively small proportions of the areas mapped--the Directive has also encouraged identification of areas where the sound quality is good, or "quiet areas". For the most part, identification of such areas has, inadequately, been based on low levels of integrated sound, with no distinction between sound sources. Whilst a low level of sound may be a characteristic of some areas that are of high acoustic quality, *quiet* is not the antithesis of *noisy* [4]. Many areas that people might judge to be of high acoustic quality are not quiet, and areas that have low levels of sound may not necessarily be preferred. There is increasing evidence that it is the congruence of the type of sound heard in a particular environment that determines its acoustic quality [26]. A quite different approach is tranquility mapping in England, which overlays a range of visual and acoustic characteristics that people prefer [27].

Noise mapping needs to be supplemented by large scale soundscape mapping [19]. De Coensel and Botteldooren [22] reviewed and partially tested a range of indicators for the quiet rural landscape. They attempted a multi-criteria assessment amongst which perception-based criteria were suggested to be of high importance, perhaps supplemented by perception of what they termed non-fitting sounds. However they also included a range of physical acoustic parameters in their work, part of the on-going search for physical correlates described above. Raimbault and Dubois [15] largely reject physical acoustical parameters, suggesting that mapping for urban areas should be disaggregated according to soundscape categorization - transportation soundscapes as against soundscapes generated by people, for example.

As a first step, and without there necessarily being agreement as to how the outcomes will be used or soundscapes classified, those involved with noise mapping can apply the identical mapping skills they currently apply, but not to total sound levels, but to levels differentiated by sound source. Current (largely transportation) noise maps can be supplemented by separately predicting and mapping levels generated by sources that people appear to prefer: natural sounds, the sounds of people, and iconic sounds such as church bells. While this alone will not provide the answers, the complementary mapping of sounds of preference will redress the current imbalance in available data of the outdoor soundscape. This can provide a starting point for assessing the relative presence of wanted and unwanted sound in different contexts, either in terms of masking, or through measures such as percent time audible, and for progressing both research and practice in ways to link conventional noise control with soundscape planning.

5. SOUNDSCAPE PLANNING/ACOUSTIC DESIGN

As Kang (2007) suggests, the study of soundscapes is not just one of passively understanding human preference, but can be *....placed into the intentional design process comparable to landscape...and into the design process of urban public spaces.* The same ideas can also contribute to management in rural and wilderness areas.

The outdoor acoustic environment is not just a problem requiring mitigation, abatement, control, or any of the other negative terms with which we are familiar (see, for example, Zwerling [12] and Porteus and Martin [13]). Of course, given the magnitude and extent of noise problems, such approaches will continue to be a major locus of activity. But

soundscapes open up the potential for the same expertise that is brought to the negative control of the acoustic environment to be applied positively - to the management of those parts of the outdoor acoustic environment that are of high quality and are valued by people - by soundscape planning or acoustic design of outdoor space.

Soundscape planning has the potential to capture imaginations. This is in contrast to noise abatement and control which, as much as we might wish otherwise, has failed to ignite much interest amongst politicians, most city and planning officials [15], and the design professions responsible for building and infrastructure - traffic engineers, architects and urban designers. At present, outdoor sound only enters the design parameters for most of these professions in a negative way: where there is a problem and where there is community reaction to high levels of noise resulting from their activities. Management of waste—noise as acoustic waste—is always a responsibility, but it does not capture imaginations. Introducing the concepts of soundscape planning, and particularly by providing approaches and tools to do so, has the prospect of spreading responsibility for the urban acoustic environment in a positive way to a much wider range of professions— planning, landscape design, architecture, road engineering, housing—and has the potential for a much-needed reinvigoration of interest in acoustic management of the urban environment.

While the long term objective would be positive design of the whole acoustic environment, some of the literature to this end appears overly utopian. It is more useful to focus initially on a less ambitious scale, building experience and success through relatively small demonstration projects. In fact there are usually only a small number of locations in urban environments where acoustic design is feasible at any point in time. Candidates for immediate action include:

- urban parks and gardens
- country parks
- national parks & wilderness
- recreational areas
- malls and pedestrian precincts
- the preservation and reinforcement of sound marks

At present, environmental noise control approaches have limited application in the design of such areas, but various authors [28, 29, 30, 31] have shown how soundscape concepts can be positively applied in design.

Broader acceptance of soundscape approaches amongst the environmental noise community will require not only more evidence-based research, but also the presentation of these approaches as complementary, not competing, to mainstream noise activity. Personal experience in discussing soundscapes with government agencies involved in noise control work suggests that initial skepticism regarding soundscape approaches was replaced with enthusiasm when presented as complementary to their activities. One complementary niche that had particular appeal was that of soundscape planning and management in areas of high acoustic quality - a topic on which most noise control authorities have had no experience, even no mandate, to date.

6. CONCLUSIONS

Schafer [1] described soundscape studies as ... the middle ground between science, society and the arts, and the foundations of a new interdiscipline - acoustic design. As a step in this direction, the way in which environmental noise control approaches and soundscape approaches need to be recognized, and utilized, by those who work with the outdoor acoustic environment.

The outdoor acoustic environment is a resource whose diversity is to be managed and enhanced, complementing the waste management approach of noise control. The concept of beneficial use of this resource, borrowed from water quality management, can assist in explaining to decision-makers the relevance of soundscape approaches, and the inadequacy of applying a single criterion (minimizing annoyance) in the management of the outdoor acoustic environment.

A major impediment to integration is the dominance in noise control practice of physical descriptors of the acoustic environment, and there will need to be a broader acceptance of matters such as context and information content in the sound by noise practitioners. Current acoustic mapping of areas needs to be extended, as a first step, to map sources other than the dominant transport noise sources. The immediate focus for soundscape planning/acoustic design should be on small areas as demonstration projects for the application of soundscape principles.

The essential message for integration is that it is not a matter of noise control versus soundscape approaches, but noise control supplemented by soundscape planning. Further, the real value of soundscape approaches may be in their capturing the imagination of politicians, policy makers, and a range of design professions, in a way that environmental noise control has so obviously failed.

REFERENCES

- [1] Schafer, R. M., *The Tuning of the World* (Alfred A. Knopf, New York, 1977).
- [2] Hiramatsu, K., "A review of soundscape studies in Japan", Acta Acustica United with Acustica, 92, 857-864 (2006).
- [3] Lercher, P. and Schulte-Fortkamp, B., "The relevance of soundscape research to the assessment of noise annoyance at the community level". de Jong, R. Houtgast, T. Franssen, E.A.M. and Hofman, W.F. (eds), *Proceedings of the 8th International Congress on Noise as a Public Health Problem, Rotterdam, 226-231* (Foundation ICBEN 2003, Schiedam, The Netherlands, 2003).
- [4] Brown, A.L., "Rethinking "Quiet Areas" as "Areas of High Acoustic Quality", Proceedings of INTER-NOISE 2006, Honolulu (2006).
- [5] Raimbault, M., "Qualitative judgements of urban soundscapes: questioning questionnaires and semantic scales". Acta Acustica United with Acustica, 92(6), 929-937 (2006)

- [6] Kilman, T., "Exploit the soundscape and reformulate traffic noise goals". Journal of the Acoustical Society of America, 112 (5), 2435 (2002).
- [7] Gidlöf-Gunnarsson, A. and Öhrström, E., "Noise and well-being in urban residential environments: The potential role of perceived availability to nearby green areas", Landscape and Urban Planning (In Press, 2007).
- [8] Öhrström, E., Skånberg, A., Svensson, H. and Gidlöf-Gunnarsson, A., "Effects of road traffic noise and the benefit of access to quietness", Journal of Sound and Vibration 295, 40-59 (2006).
- [9] Nilsson, M. and Berglund, B., "Noise annoyance and activity disturbance before and after the erection of a roadside noise barrier", Journal of the Acoustical Society of America, 119 (4), 2178-2188 (2006).
- [10] Guastivino, C., "The ideal urban soundscape: investigating the sound quality of French cities", Acta Acustica United with Acustica, 92(6), 945-951 (2006).
- [11] U.S. National Parks Service Report to congress. Report on effects of aircraft overflights on the National Parks system. Washington D.C. (1995). Retrieved from http://www.nonoise.org/library/npreport/intro.htm#top
- [12] Zwerling, E., "Noise enforcement in cities", Journal of the Acoustical Society of America, 115 (5), 2593 (2004)
- [13] Porteous, J.D. and Mastin, J.F., "Soundscape", Journal of Architecture and Planning Research, 19, 169-196 (1985).
- [14] Schulte-Fortkamp, B., and Fiebig, A., "Soundscape analysis in a residential area: an evaluation of noise and people's mind", Acta Acustica United with Acustica, 92(6), 875-880 (2006).
- [15] Raimbault, M. and Dubois, D., "Urban soundscapes: experiences and knowledge". Cities 22(5), 339-350 (2005).
- [16] Schulte-Fortkamp, B., Brooks, B.M. and Bray, W.R., "Soundscape: an approach to rely on human perception and expertise in the post-modern community noise era", Acoustics Today, 7-15 (January, 2007).
- [17] Dubois, D., Guastavino, C. and Raimbault, M., "A cognitive approach to urban soundscapes: using verbal data to access everyday life auditory categories", Acta Acustica United with Acustica, 92, 865-874 (2006).
- [18] Lavandier, C. and Defréville, B., "The contribution of sound source characteristics in the assessment of urban soundscapes", Acta Acustica United with Acustica, 92, 912-921 (2006).
- [19] Genuit, K. and Fiebig, A., "Psychoacoustics and its benefit for the soundscape approach", Acta Acustica United with Acustica, 92(6), 952-958 (2006).
- [20] Raimbault, M., Lavandier, C. and Berengier, M. "Ambient sound assessments in or urban environments: field studies in two French cities". Applied Acoustics 64, 1341-1256 (2003).
- [21] Semidor, C. "Characterization of urban soundscape using psychoacoustic criteria". *Proceedings of INTER-NOISE 2005*, Rio de Janerio (2005).
- [22] De Coensel, B. and Botteldooren, D., "The quiet rural soundscape and how to characterize it". Acta Acustica United with Acustica, 92(6), 887-897 (2006)
- [23] Booteldooren, D., De Coensel, B. and De Muer, T., "The temporal structure of urban soundscapes". Journal of Sound and Vibration 292, 105-123 (2006).

- [24] Copeland, C., Clean Water Act: A summary of the Law. (CRS Report for Congress, January 24, 2002). http://usinfo.state.gov/usa/infousa/laws/majorlaw/cwa.pdf [Accessed 22 June, 2007].
- [25] Rossman, B., 'The science of sound: acoustics and soundscape measurement'. In Harmon, D. (ed) People, Places and Parks: Proceedings of the 2005 George Wright Society Conference on Parks, Protected Area, and Cultural Sites. Hancock, Michigan: The George Wright Society (2006)
- [26] Brambilla, G. and Maffei, L., "Responses to noise in urban parks and in rural quiet areas", Acta Acustica United with Acustica, 92(6), 881-886 (2006).
- [27] Campaign to Protect Rural England, "Tranquility". http://www.cpre.org.uk/campaigns/landscape/tranquility. [Accessed 22 June, 2007].
- [28] Hedfors, P. and Berg, P.G., "The sounds of two landscape settings: auditory concepts for physical planning and design" Landscape research 28(3) 245-263 (2003).
 [29] Brown A.L. and A. Muhar, A., "An approach to the acoustic design of outdoor
- [29] Brown A.L. and A. Muhar, A., "An approach to the acoustic design of outdoor space", Journal of Environmental Planning and Management, 47(6), 827-842 (2004)
- [30] Zhang, M. and Kang, J., "Evaluation of urban soundscapes by future architects", Journal of the Acoustical Society of America, 115(5), 2497 (2004).
- [31] Derbal, C.R. and Zeghlache, H., "Recomposition of the urban sonic environment", Journal of the Acoustical Society of America, 119(5), 3261 (2006).

Noise Control Approaches and Soundscape Approaches

and this is reflected in our measurement approaches, our assessment approaches, and politically in the way we approach management of environmental noise—t.

To provoke discussion over the next day or so, I will focus on just a couple of concepts which I believe warrant more attention in the soundscapes field—I have not called them NEW concepts...they are far from new_but I regard them as UNDERUTILISED concepts_and ones that we should examine critically.

Soundscape approaches have been described as a new paradigm in the outdoor acoustic environment – I don't think we have advanced that far yet....but if there is a to be a new paradigm, we need to clearly articulate how it is differentiated from the old paradigm.

SLIDE

In this respect, I note how there is starting to be significant devaluation of the term "soundscapes:

We could usefully spend part of the time in this symposium refining some requirements to ensure that the term is used in way that adds value, rather than is devalued.

In explores a range of opportunities, impediments and pragmatic issues that need to be considered in clarifying and building the relationship, including some cautions given the largely unfamiliar territory that soundscapes represents to most environmental noise practitioners.

While the work on quiet areas has largely arisen in the context of noise control (its origins lie in the EU Directive on Environmental Noise) there is another field of endeavour with overlapping interests termed *Soundscapes* - also called, less satisfactorily, *Acoustic Ecology*. Unfortunately, quite a lot of the literature on soundscapes is still imprecise and not easily adapted for use by acousticians, but we need to integrate the fields of soundscapes and noise control, and this paper has been an attempt to bridge that divide

Overuse ONE IMPORTANT RAMIFICATION IS TO ENSURE THAT THEY ARE MAINTAINED AS DISTINCT. OVERSUSE OF TERMINOLOGY...

Soundscapes has appeared in the noise lexicon comparatively recently. While its definition as "the sonic environment - technically any portion of the sonic environment regarded as a field of study" [1] is hardly restrictive, there is some danger that this useful term can become so variously adopted and interpreted that it will become less useful [3]. The primary concern is its uninformed use as a synonym for "community noise" - a community noise survey, for example, becoming a soundscape survey; a map of urban noise being described as a soundscape map. MUST FIND REFERENCES>>>I THINK ISTANBUL...

BITS LEFT AFTER PREPARATION OF ISTANBUL SOUNDSCAPE PAPER

IN ADDITION: made me think about the concept of "quiet". Many examples that "quiet" is likely only a small part of human preference for soundscapes—particularly in urban areas. I believe a lot of attempts at mapping "quiet places" is quite misdirected – they focus on the overall level, not the context nor the components of the soundscape

6a??? Discussion

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.

There is perhaps some over-eagerness to embrace soundscapes as a paradigm shift in the environmental noise field. Certainly, as Schulte-Fortkamp and Fiebig [13] suggest, the soundscapes focus on sound-exposed subjects represents a shift in environmental noise research - though they do note that "the consequences have not been clearly drawn". The caveat is critical, as it is important to distinguish, for environmental noise practitioners, between new directions in research and clear departures for new policy and practice.

The utility of soundscape concepts to the environmental noise field lies in two major ideas. The first is that human experience of the outdoor acoustic environment and reaction to it (and, more generally, human experience of the holistic outdoor environment) is far richer and complex than is presumed, largely tacitly, in most of the work in environmental noise. Soundscape approaches provide new dimensions to explore in both environmental noise research and management. The second is that While not wishing to be too restrictive in an area that is rapidly evolving, the term soundscape should be used in the environmental noise domain in ways which reflect these principal ideas, not indiscriminately.

Suggests splitting: "Soundscapes" from "Soundscapes Approach"

Keen on:

Soundscape as an enabler Soundscape as a resource Soundscape as an approach

<mark>Soundscapes studies (also called acoustic ecology) are eclectic, encompassing areas as</mark> diverse as nature sound recording, compositions based on natural sounds, and description of acoustic environments.

Soundscapes terminology being used in different contexts:

- synonomous with acoustic ecology
- as a modifier of annoyance response
- as a more phenomonological spproach to studying noise
- in acoutic design of outdoor space.

This paper focuses on the latter, but does not mean that others are not relevant, nor that the ideas in this paper are not applicable to ther fields.

Taken 30 years of co-existence (in each others knowledge) time to bring them together.