Soundscape - Necessary Context Information from a Geographer's Viewpoint

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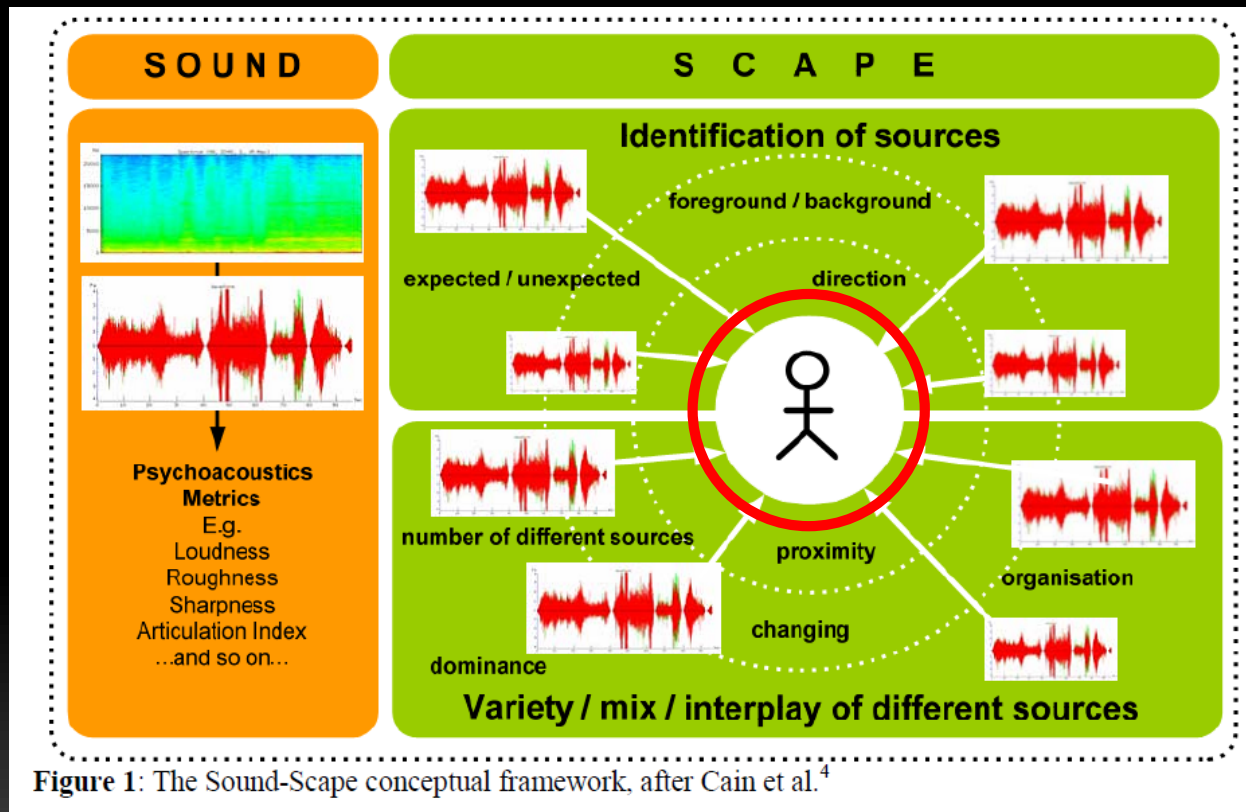**The Chinese University of Hong Kong**

Sounding Brighton Workshop

6-7 April 2011, Brighton, England

Soundscape Conceptual Framework

Figure 1: The Sound-Scape conceptual framework, after Cain et al.[4]

Soundscape

- "Sound ....."
  - Can be positive or negative
  - With a meaning to the listener
  - People-centred

- "..... Scape"
  - Totality of the acoustic environment
  - Human experience is multi-modal (senses)
  - Context specific

People-Centered Living Experience

- Man with man
- Man with the environment using our senses
  - Vision
  - Hearing
  - Smell
  - Tactile
  - Tasting

Vision
Sound

Smell
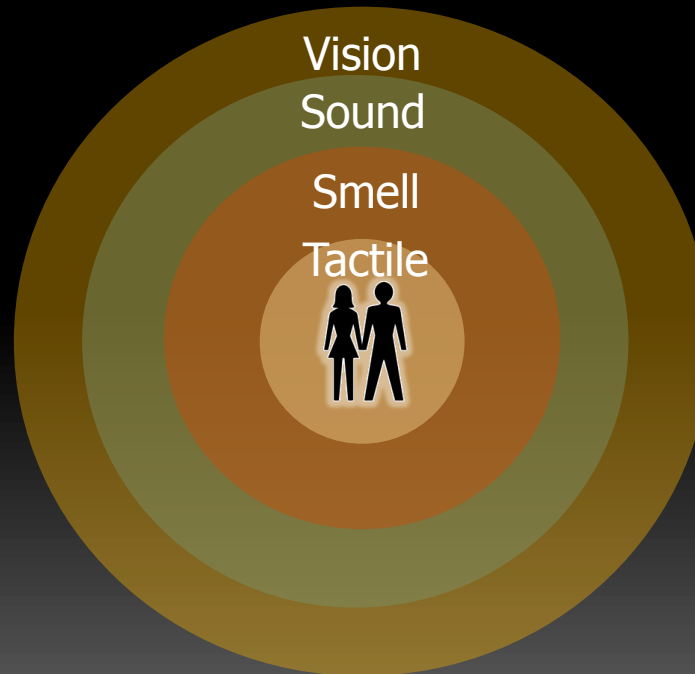
Tactile

Vision

- Human is predominantly a visual animal
- With stereoscopic vision
- Faculty to discriminate depth and orientation

Tactile Sense

- Provides a vast amount of information concerning the world
- Fingers, hands and feet
- "In touch" with nature

Smell

- More important to primates than to modern humankind
- People tend to love and "avoid" certain smells
- Odour has the power to evoke vivid, emotionally-charged memories of events and scenes

Hearing

- The eyes gain more precise information about the environment than our ears
- We are more "touched" by what we hear than what we see (e.g. music vs picture)
- "Hearing" has the connotation of "passivity" that "seeing" does not have

Perceiving the Environment with all the Senses

- Human experience is multi-modal, with all senses
- Each sense reinforces the others
- Objectivity of "seeing" – "Seeing" as an onlooker, less emotionally involved
- We can see what we cannot hear; we can hear what we do not see

Hearing goes beyond what is audible – Tranquility is both audition and a state of mind

"*Interpretation of this word (tranquility) is typically linked to engagement with the natural environment.*"
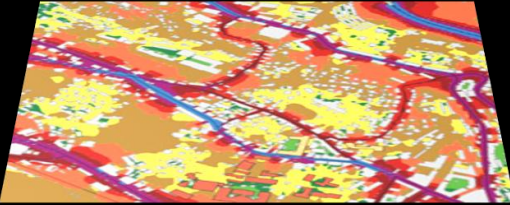
G. Watts, Internoise 2008
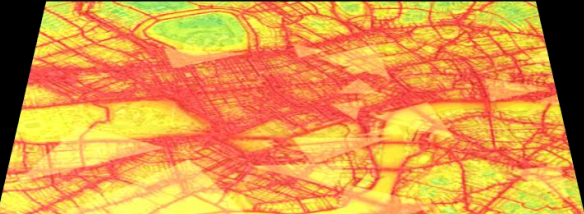
Enviro-scape

- Human response to environmental stimuli, based on our senses, is multi-modal

- The enviro-scape is multi-layered, including
  - Thermal comfort
  - Acoustic comfort
  - Air movement
  - Air quality etc.

- Different enviro-scapes may reinforce or contradict each other. Some may be a constraining factor.

Urban Enviro-scape

Acoustic Comfort

Thermal Comfort

Air Quality

Others

Human Interaction
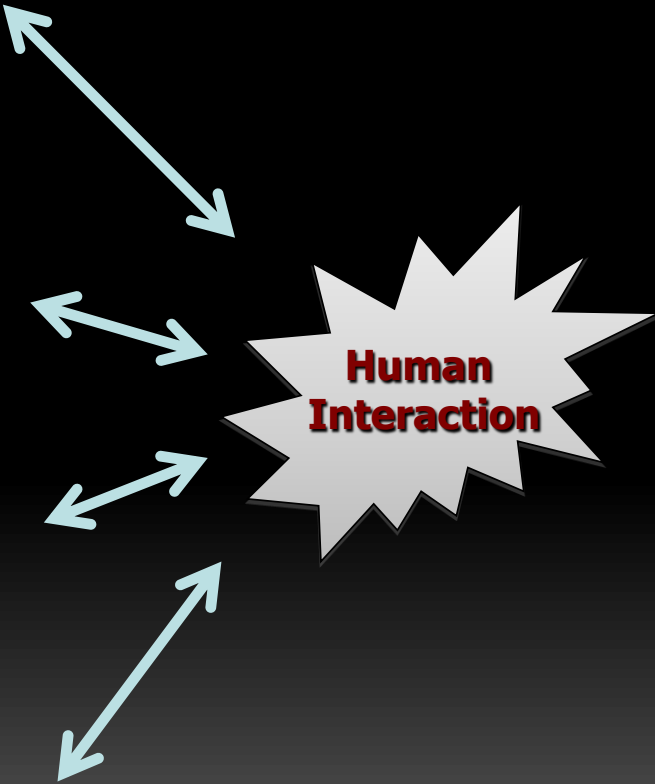
Human Needs and Aspiration

- Hierarchy of Human Needs
  - Basic, psychological and innate needs
    - No Interference with daily activities
    - Absence of disease
    - Satisfaction with the environment
    - Well being
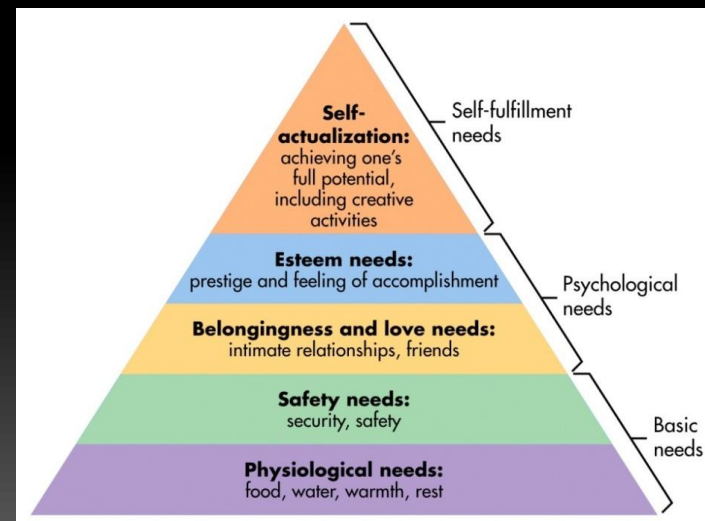
Based on Maslow (1943)

Innate Human Needs

- To interact with others

- To connect with nature

Significance of restorative environment

- Respite from urban stress
- Rejuvenation
- Different from daily chores

"You go to Central Park to escape, you come to the High Line to be elevated"

- A Park User in Manhattan

Humans in the Enviro-scape

- Enviro-scape (including soundscape) is continuous & relatively stationary
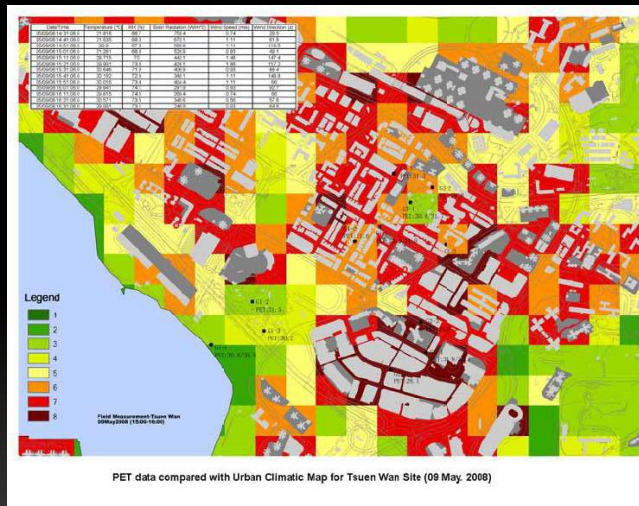
Thermal Map
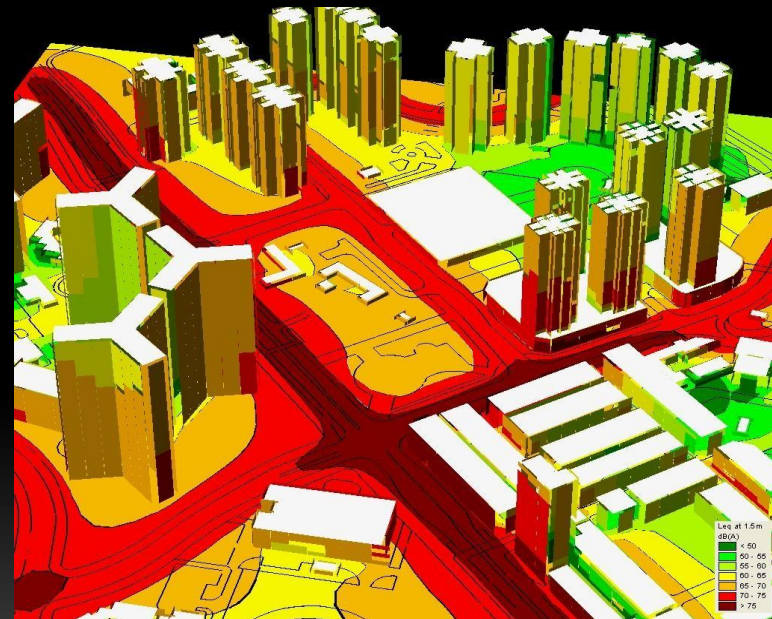
Noise Map

Humans in the Environment

- Enviro-scape (including soundscape) is continuous & relatively stationary

- Human beings are discrete & mobile
  - Activity space
  - Mental space

- Human movement
  - Necessity
  - Choice

Simulation of the dynamic sound field of sea waves on high and low tide days
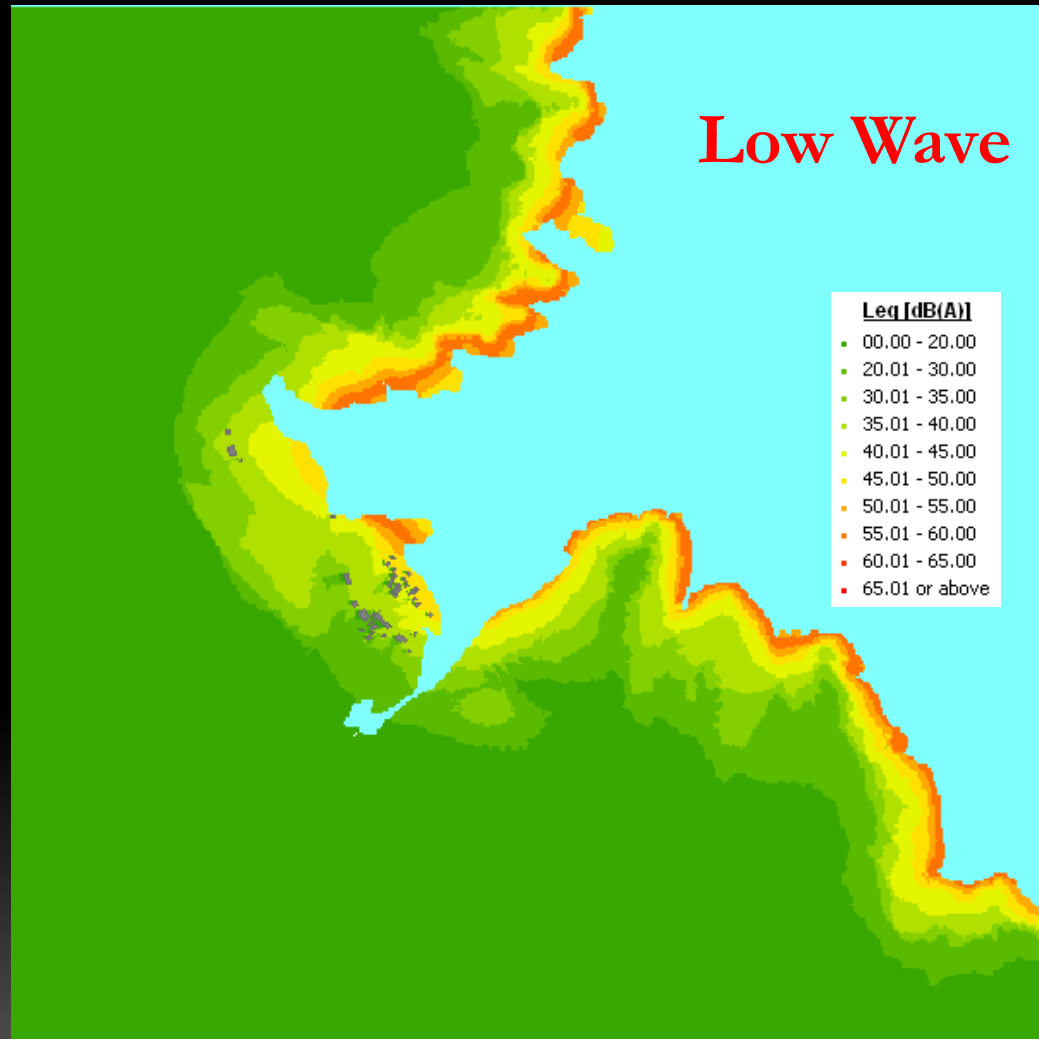
Simulation of the dynamic sound field of sea waves on high and low tide days
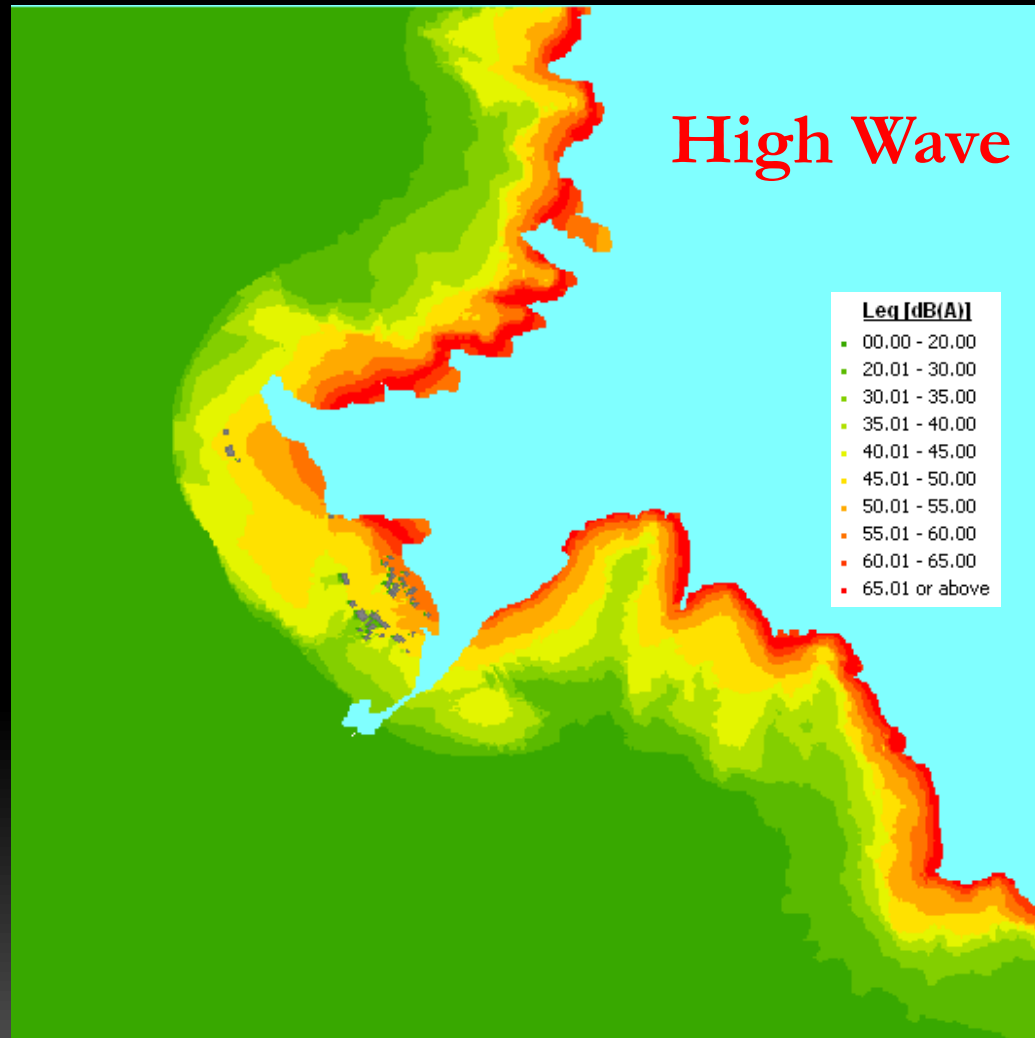
High Wave

Leq [dB(A)]
- 00.00 - 20.00
- 20.01 - 30.00
- 30.01 - 35.00
- 35.01 - 40.00
- 40.01 - 45.00
- 45.01 - 50.00
- 50.01 - 55.00
- 55.01 - 60.00
- 60.01 - 65.00
- 65.01 or above

Chinese University of Hong Kong

Office

Train Station

Option 1

Chinese University of Hong Kong

Office
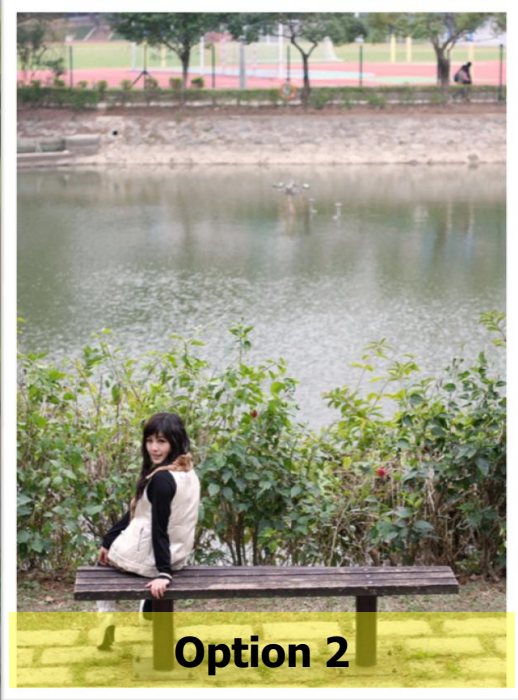
Train Station

Option 2

Chinese University of Hong Kong

Office

Train Station
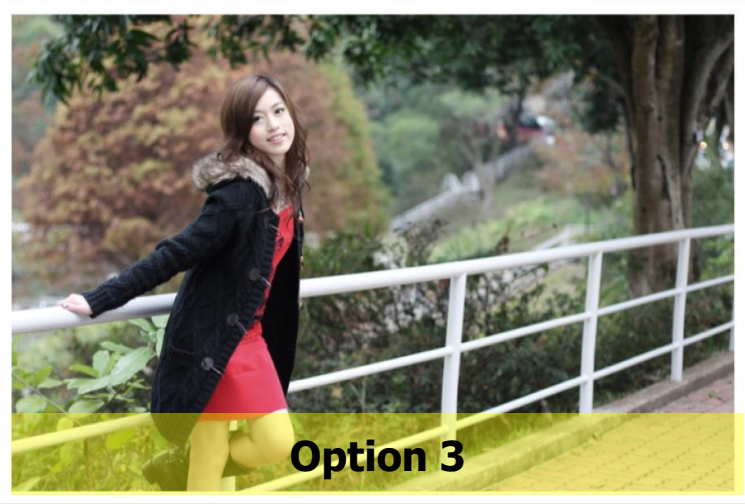
Option 3

Space context of human activity

- Movement and activity over space

- Necessity or choice
  - Route
  - Move or stay
  - Activities

- In response to environmental stimuli and daily necessities

Route of Hikers – Eastern Part Hong Kong

Sai Wan

Picnic/ camp sites with road access

Hiking zone

Coastal Scenic Spots
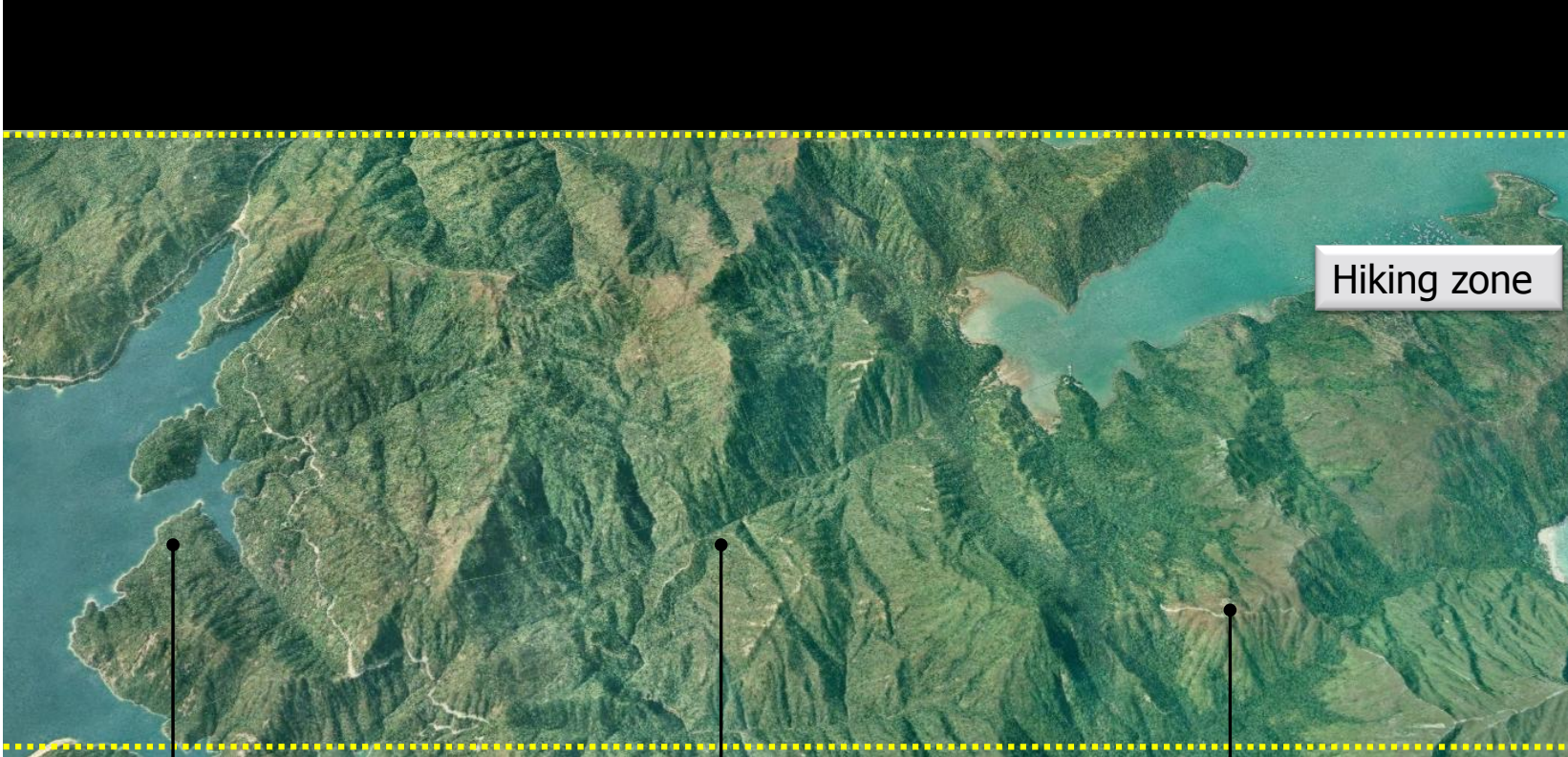
Experiential Sphere of the Countryside Visitors
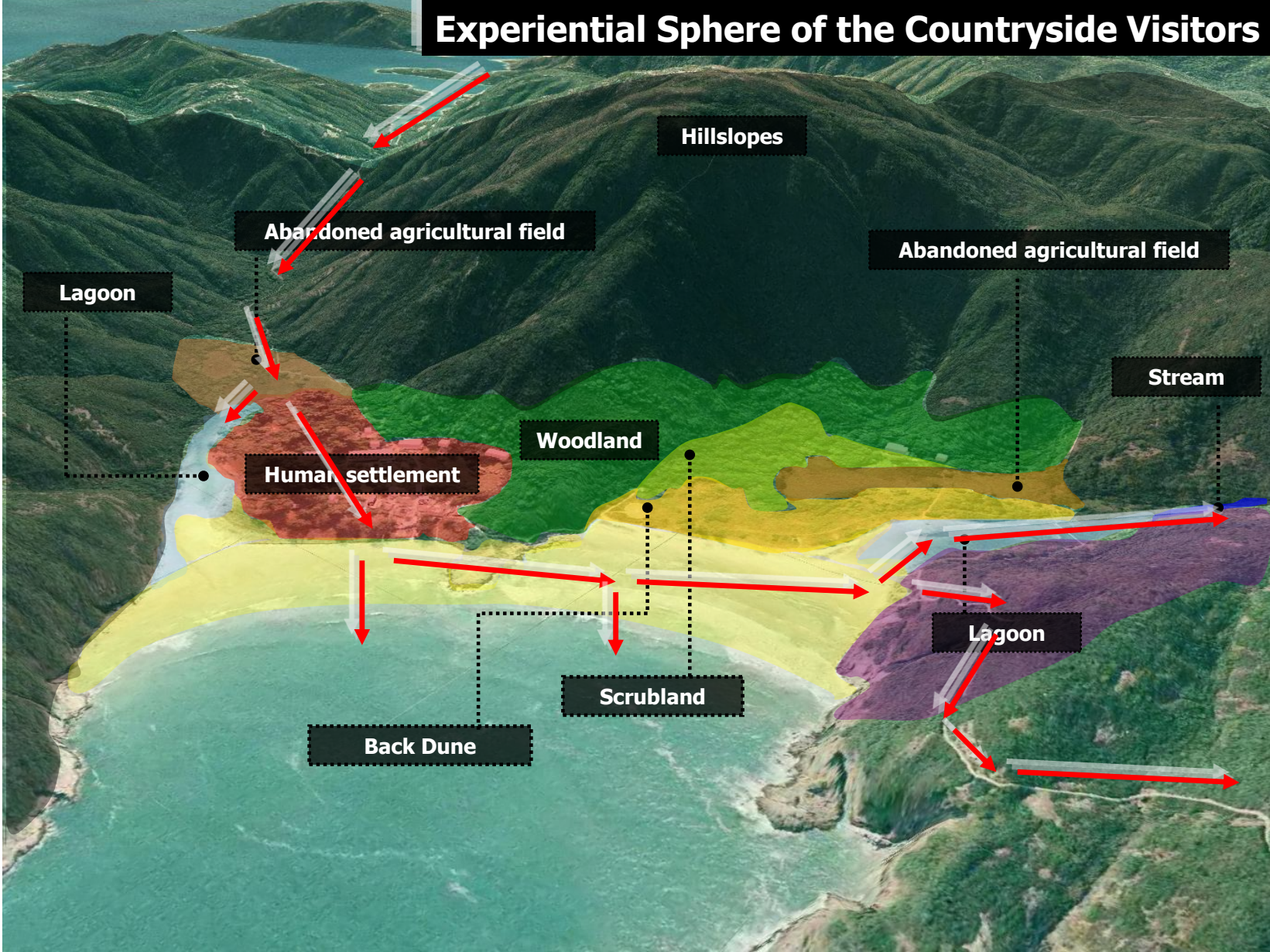
Space, "Place" and Sound

- A "place" has a special meaning to human being, for
  - Meeting with other people
  - Undertaking certain activities
  - Retreat and meditation
  - Self-rejuvenation

- Soundscape – evaluation of whether …..
  - Sound interferes with intended purpose
  - Sound enhances function and human satisfaction

Human Preference as revealed in ….

- People's choices between
  - Home – different rooms in the dwelling
  - Indoor or outdoor?
  - Urban park or shopping mall?
  - City or countryside?

Living Space of the Hong Kong People

- Dwelling

- Neighbourhood

- Community

Living Space of the Hong Kong People

- Dwelling

- Neighbourhood

- Community

Community Level

Noise Exposure Levels at and in the vicinity of Home

SH
Small houses
OS
Old development with squares
ON
Old development and small housing estates without podium
CM
Compact massive housing estates
LN
Large housing estates without podium
LP
Large housing estates with podium

Dwelling Level

Neigbhourhood Level

Community Level
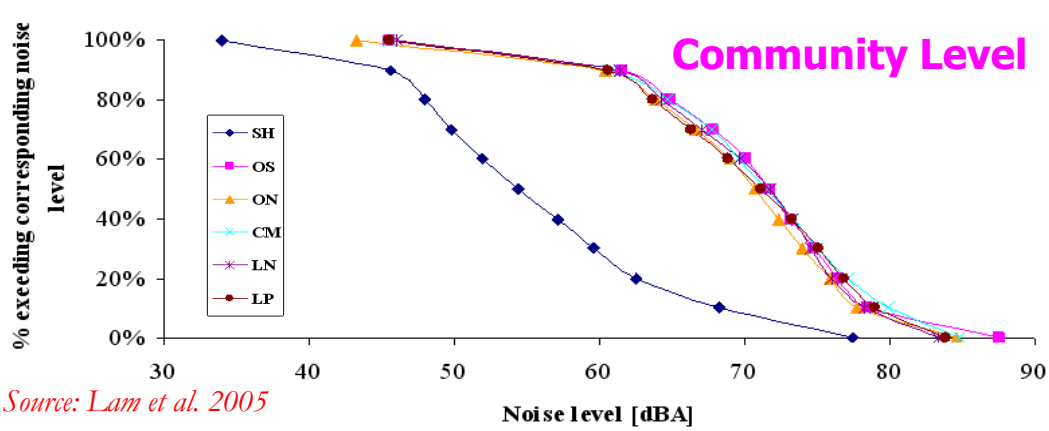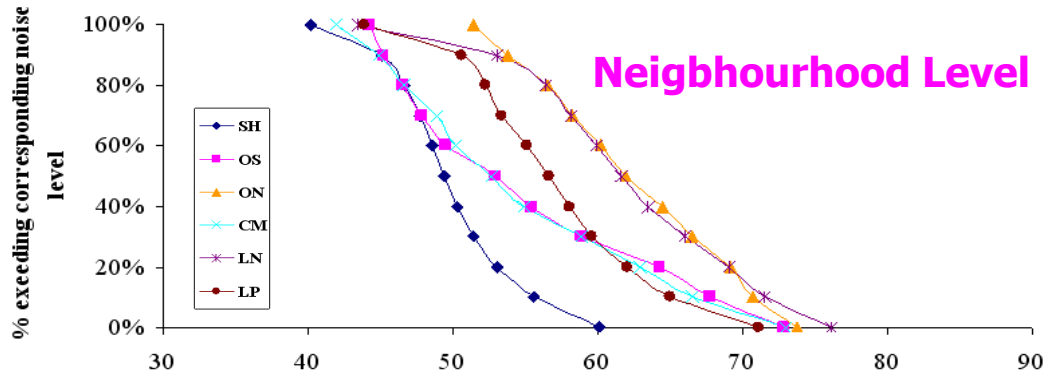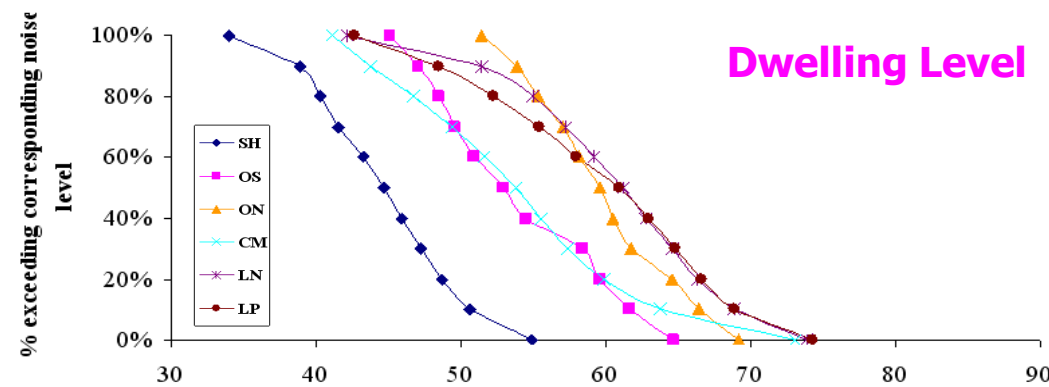
Source: Lam et al. 2005

Nature in City or City in Nature

- City

- Urban open space

- Countryside

Wanted and Unwanted Sounds in Cities

- Unwanted - Noise
  - Road traffic
  - Industries

- Wanted
  - Bird songs
  - Water sound

How do people cope?

- Coping Behaviour
  - Enjoying the sound
  - Shutting the ear
  - Creating one's own "sound bubble"
  - Escape into a quiet room or place
  - Doing something that is "insensitive" to noise

Significance of Sound with the "Context"

- Congruent with the
  - Place
  - Activities
  - Expectation

- Congruence ensures that
  - Sound adds human enjoyment/satisfaction
  - Activities/expectations are not being interfered with

Soundscapes preferred are "Place" specific

- Nature/wilderness
  - wildlife protection
  - human appreciation/ well-being

- Countryside/recreation
  - human appreciation/ well-being

- Urban
  - human appreciation/ well-being

Source: Lex Brown

What do people prefer?
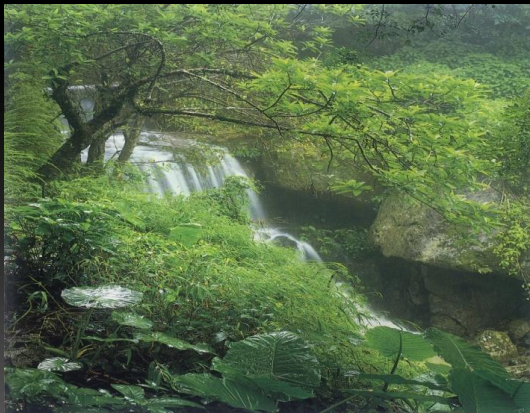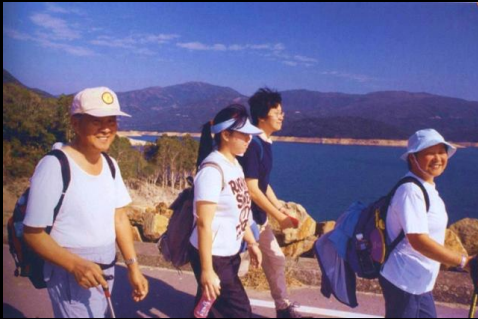
Some Findings highlighting the Importance of "Context" in human appraisal of soundscapes

- Influence of surrounding environment on human response to noise at home
- Influence of culture on human response to noise
- Effect of "wanted" and "unwanted" sound on human preference of soundscape
- Effect of activity undertaken on human response to noise intrusion
- Effect of background sound on response to extraneous noise

Human response to noise at home

- Determined not only by
  - Noise exposure at the dwelling façade; but also
  - Entire soundscape & enviro-scape
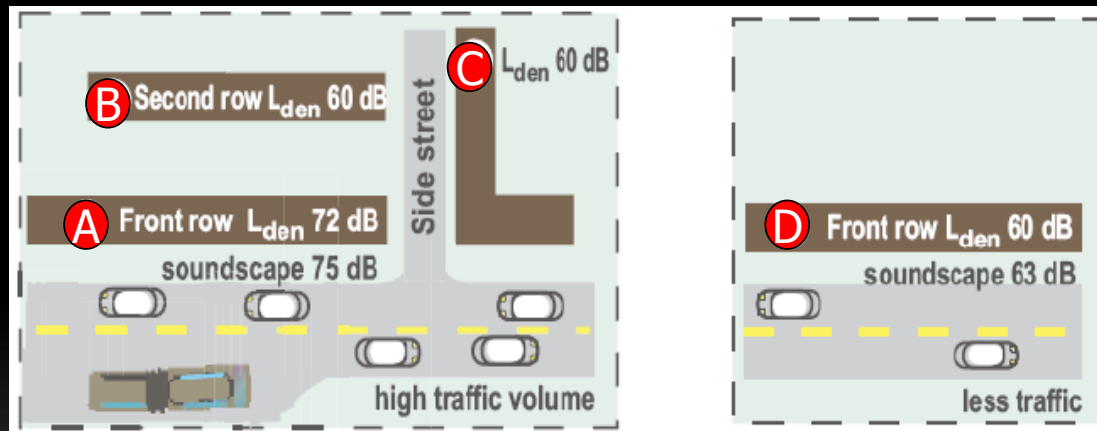
How much the noise in the neighbourhood exceeds or lies below the noise level at an apartment. Neglecting neighbourhood soundscape information results in the level of annoyance predicted for second row dwellings lying above the regression line is under estimated, while the level of annoyance is over estimated for front row apartments lying below the regression line.

(Source: Klæboe *et al*, 2004)

Access to a Quiet Room as a Factor Affecting Annoyance Response

- Highly Annoyed? – According to binary logistic ordinal regression

Variables in the Equation							
Step 1		B	S.E.	Wald	df	Sig.	Exp(B)
Demographic	POVERTY_A5F16_D	0.099	0.115	0.745	1	0.388	1.104
Demographic	QRT_TYPE_A1_D	0.132	0.098	1.812	1	0.178	1.141
Demographic	HSH_NO_A3	-0.184	0.099	3.470	1	0.063	0.832
Demographic	HSH_OWNER_A4_D	0.161	0.095	2.882	1	0.090	1.175
Demographic	CROWDING_A5C29_3FOLD	-0.077	0.088	0.767	1	0.381	0.926
Demographic	GENDR_MALE_B1_NR	-0.036	0.083	0.188	1	0.665	0.964
Demographic	AGE_B2	0.003	0.003	0.867	1	0.352	1.003
Demographic	EMPLOY_STATUS_C25_3FOLD	-0.059	0.078	0.584	1	0.445	0.942
Demographic	SHFTWORK_C27_3FOLD	-0.008	0.097	0.007	1	0.934	0.992
Demographic	YR_OF_RESDNCE_C28	0.000	0.000	2.940	1	0.086	1.000
Demographic	EDU_LEVL_ATTAINED_F5_3FOLD	0.101	0.078	1.651	1	0.199	1.106
Demographic	OCCUPATN_F9_D	0.018	0.023	0.644	1	0.422	1.018
Demographic	MTH_HSH_INCOM_F16_3FOLD	0.001	0.003	0.053	1	0.819	1.001
Living conditions	RES_SAT_C1_3FOLD	-0.561	0.055	103.528	1	0.000	0.570
Living conditions	AC_LIVRM_BEDRM_C33C34_D2	0.291	0.256	1.288	1	0.256	1.337
Living conditions	QUIETSIDE_C36_D	-0.802	0.088	82.632	1	0.000	0.448
Coping behavior	ACT_SCORE_AC_WIND_C6_D	1.219	0.084	208.762	1	0.000	3.385
Noise	NS_SCORE_C12_3FOLD	0.365	0.051	51.335	1	0.000	1.441
Sleep	SLP_OUTSIDECURF_C10_D2	-0.050	0.089	0.317	1	0.573	0.951
Sleep	SLP_DEPRIVED_C10C11_D2	0.100	0.088	1.291	1	0.256	1.106
Health	HLTH_STATUS_C14_SF36	0.001	0.002	0.292	1	0.589	1.001
Health	DISEASE_SCORE_C18_D2	0.403	0.103	15.243	1	0.000	1.496
Health	HEAR_PROB_C22	0.317	0.197	2.588	1	0.108	1.372
	Constant	-2.777	0.493	31.675	1	0.000	0.062

significant variable - equals to the higher degree of the independent variable, the likely to be NOT highly annoyed (odds ratio <1)

significant variable - equals to the higher degree of the independent variable, the likely to be highly annoyed (odds ratio >1)

Odds Ratio
> 1
< 1

Significance of a Wetland Park to Residents of nearby High-rise Apartments

LRT Wetland Park Station

Phase 1 venue of HKWP

vc

Spur Pond

FM2

Wetland Discovery Centre

FM 1

Reedbed

Woodland

Mudflat

Subjective Evaluation of Acoustic Quality of Urban Parks in HK

Mean evaluation scores of the acoustic quality of four soundscape on a scale of 1 to 5 (1= dislike most; 5 = like most)

		Acoustic Quality	
		With wanted sounds	Without wanted sounds
Sound level	Low *(< 62.3 dB(A))	3.73 (0.78) #N=582	2.96 (0.86) #N=55
	High *(≥ 62.3 dB(A))	3.40 (1.02) #N=777	2.56 (0.88) #N=196

*Figures in parenthesis are standard deviation;
#N = sample size

Adapted from Lex Brown's Framework 2006

45

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Adapted from Lex Brown's Framework

H Lin et al, in press

Human Preference Correlated with Presence/Absence of Sounds

Table VI. Stepwise regression relating overall preference for soundscape to dichotomous variables indicating the presence or absence of particular sound sources in the foreground or backround of the acoustic signal (n = 518).

	Unstandardized coefficients		Standardized coefficients				
	B	Std. error	β	t	σ	R^2	ΔR^2
(Constant)	4.450	.143		31.227	.000		
Is Background Prominent Sound Natural?	.691	.103	.314	6.709	.000	.113	.113
Foreground Sound (Aeroplanes)	-.378	.083	-.210	-4.538	.000	.148	.035
Foreground Sound (Road Traffic)	-.246	.081	-.139	-3.038	.003	.174	.026
Foreground Sound (Birds)	.309	.102	.135	2.942	.004	.195	.021
Foreground Sound (Human)	-.191	.076	-.116	-2.413	.017	.211	.016
Foreground Sound (Other Man-made)	-.301	.136	-.109	-2.223	.027	.224	.013
Foreground Sound (Other Transport)	-.240	.105	-.108	-2.198	.029	.234	.010
Foreground Sound (Insects)	.115	.069	.089	2.009	.044	.243	.008

internal use only

KC Lam et al., Acta Acustica, 2010

Human response to extraneous noise on a 7-point scale as a function of activity

- Two groups of people exposed to aircraft and human-caused noise
  - Hiking/scenery appreciation
  - BBQ/social gathering

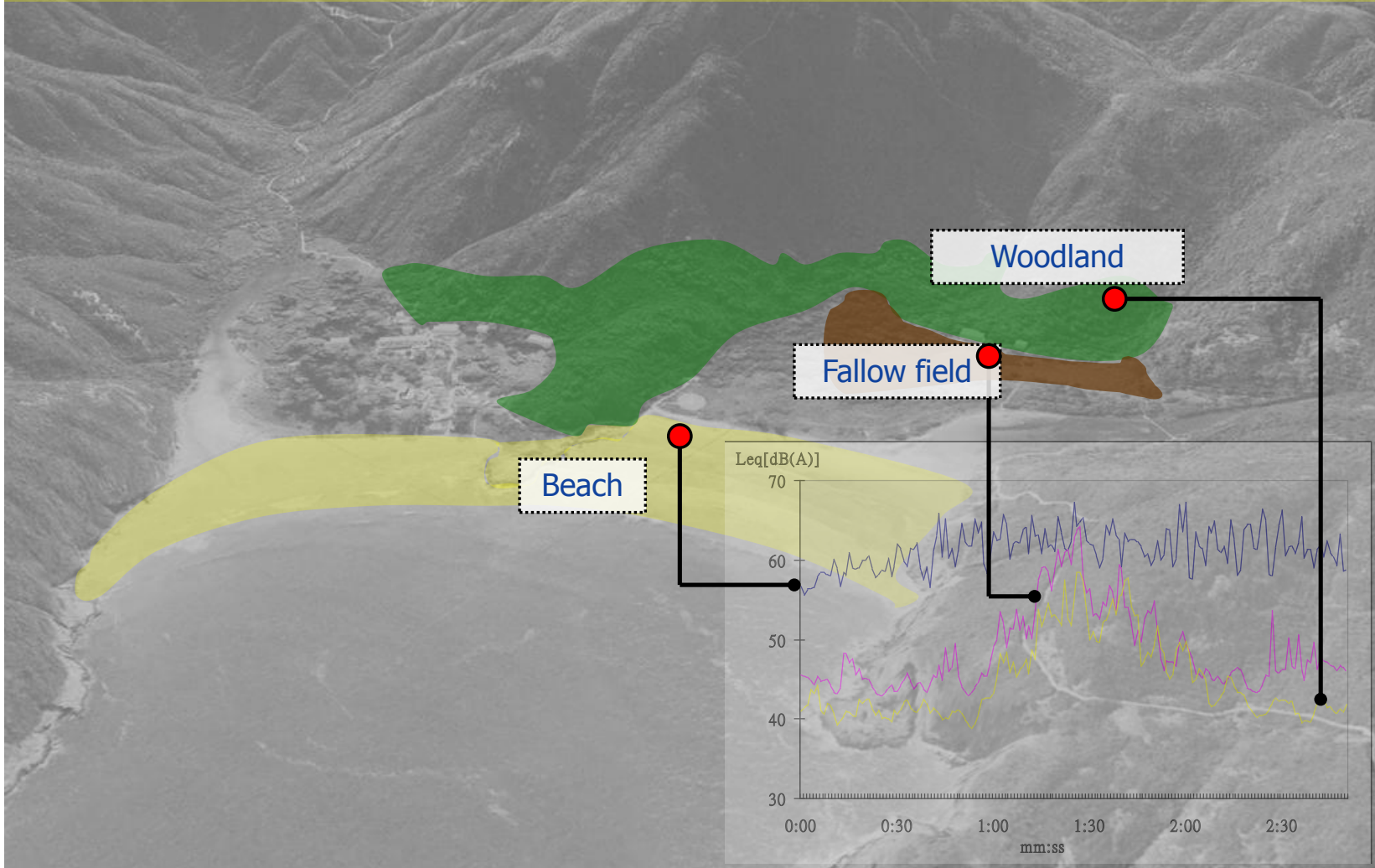# Human response to extraneous noise on a 7-point scale as a function of activity

	How much do you dislike aircraft noise?		How much are you annoyed by aircraft noise?		How much do you dislike human noise?		How much are you annoyed by human noise?	
	N	Mean Score	N	Mean Score	N	Mean Score	N	Mean Score
Hiking/ Scenery Appreciation	193	5.74	235	3.69	321	4.40	503	2.77
Picnic/ BBQ	50	5.10	53	2.77	99	3.85	141	2.68
Overall	243	5.59	288	3.42	420	4.27	644	2.73

KC Chau, L Marafa & KC Lam, NCEJ, 2010

Aircraft Noise

Masking Effect of Background Sound on Audibility of Aircraft Noise

Effect of Masking on Visitors' Response to Aircraft and Human Noise in Outdoor Sites on 1 to 7 Scale

(1: not at all; 7: very much)

	Group	Sample Size	How much do you dislike aircraft noise?	How much are you annoyed by aircraft noise?	How much do you dislike human noise	How much are you annoyed by human noise?
A	Quiet sites	383	5.83	3.81	4.33	3.03
B	Wave masked site	180	5.73	3.68	4.46	2.30
C	Traffic Noise masked sites	162	4.77	2.12	3.75	2.41
	All Sites	725	5.61	3.46	4.26	2.72

KC Chau, L Marafa & KC Lam, NCEJ, 2010

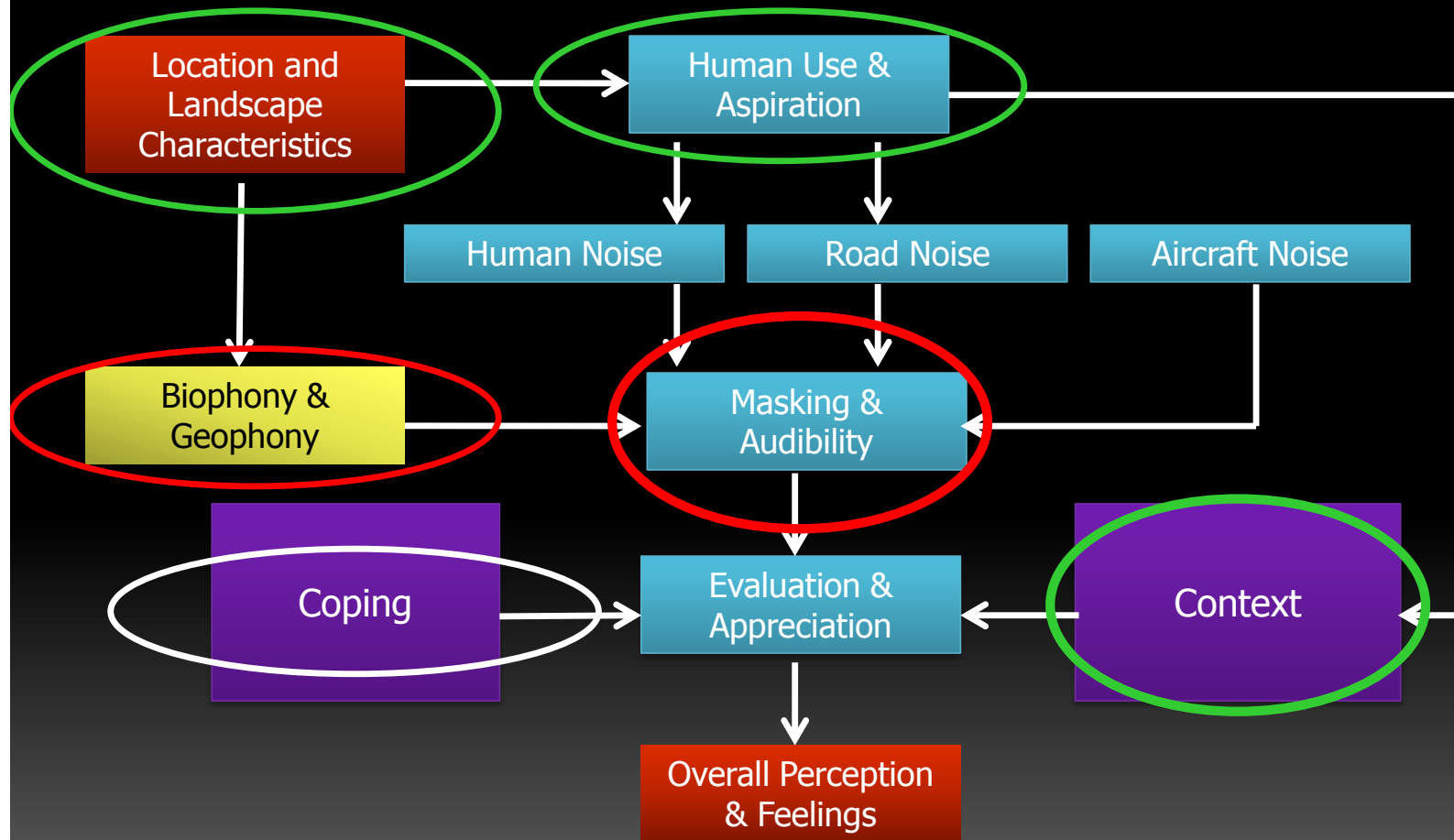# Sound Masking in the design of an urban park in Hong Kong

Two Types of Masking

- Acoustic masking

- Mind masking

Conceptual Framework of Human Response to Extraneous Noise in the Countryside

Trend of Enviro-scape in Cities

- Gradual shift
  - From a continuous to a disaggregated system
  - From an open & interconnected to discrete and closed system
  - Examples: shopping malls and gated communities
  - Increasingly human engineered

Summary

- Sound is an important aspect of living experience

- Importance of Sound to Human Well-being
  - Restorative environment
  - Home – quiet room/ quiet side
  - Urban open space – people connecting with people with people
  - Countryside – people connecting with nature

Summary

- Human beings are discrete individual moving over continuous multi-dimensional environmental space
  - They react to different environmental stimuli
  - They choose to move on or stay
  - The undertake different activities

- Human interaction with soundscape has yet to be elucidated and conceptualized

- Human appraisal of the soundscape is defined by the context of:
    - Single or in a group
    - Activity undertaken
    - Aspiration
    - Other non-sonic environmental attributes

Opportunities in Cities

- Enhancement of acoustic quality of urban open spaces

- Incorporation of soundscape features in urban design

- Urban design to guide people to areas of high acoustic quality

Welcome to Acoustics 2012 Hong Kong
14-18 May, 2012

THANK YOU

謝 謝 !

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