國立臺灣大學園藝暨景觀學系
【園藝療法】

Chap. 12 Benefits of Natural Landscape - a study (I)

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Introduction

- Landscape
  vs. Wildlife distribution
- Landscape
  vs. Human reactions
- Landscape on both wildlife
  and humankind?

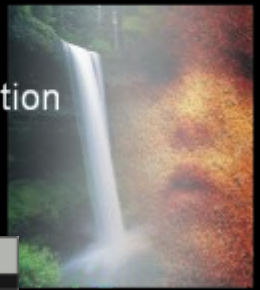
Landscape Ecology Structure

Richness
Evenness
Diversity
Capita

Richness
Evenness
Diversity
Capita

Landscape Ecology Structure

Natural Perception

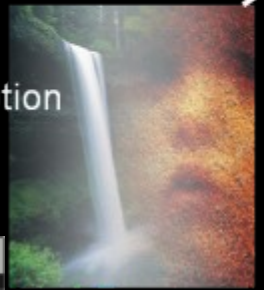


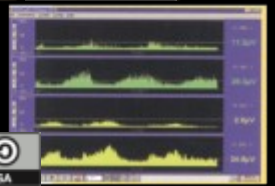
Richness
Evenness
Diversity
Capita

Landscape Ecology Structure

Biofeedback
Attention Restoration

Natural Perception





Richness
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Landscape Ecology Structure

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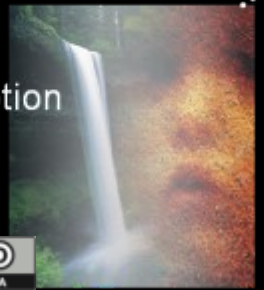
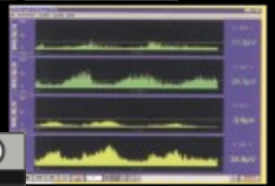
Natural Perception





Study Area

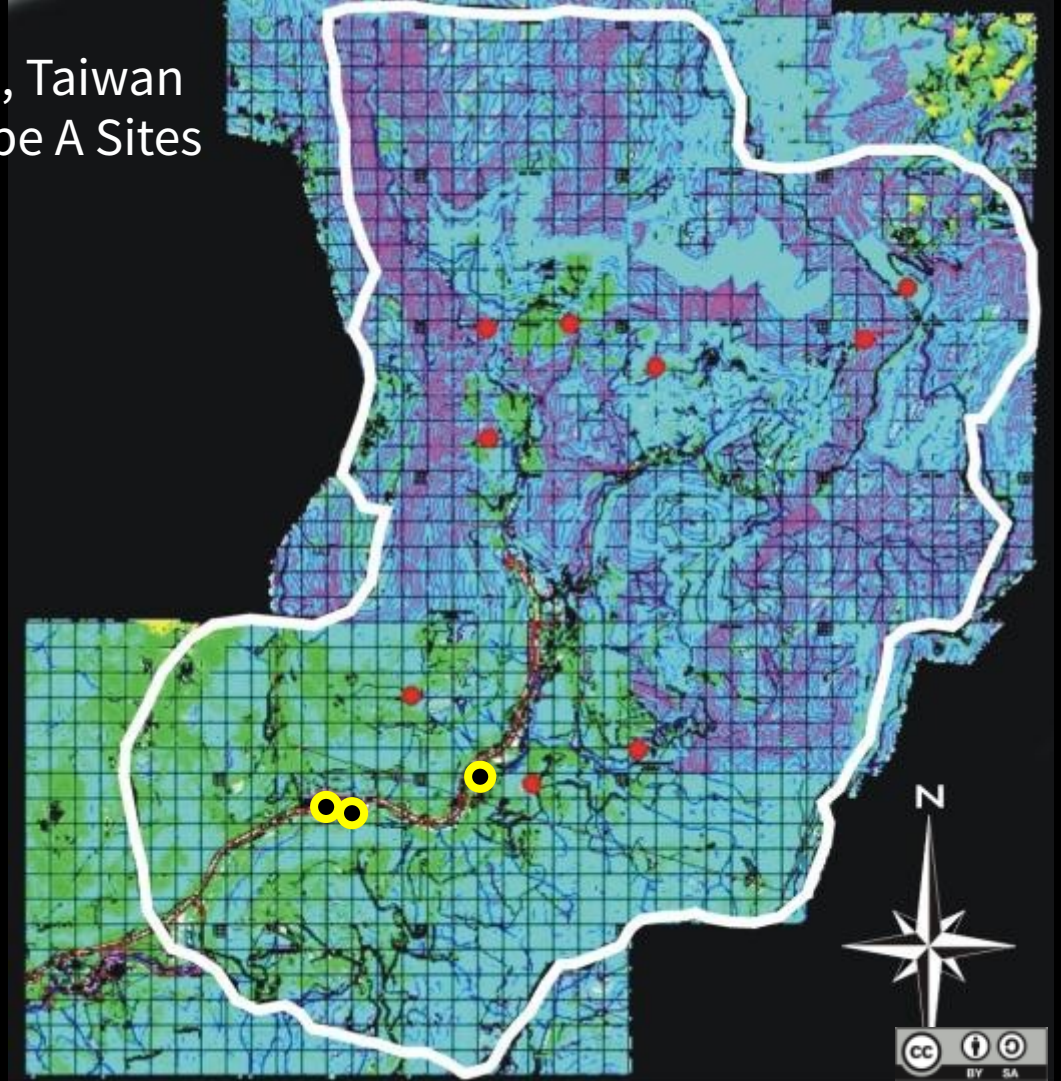
- Twelve sites along the boundary of the Yangmingshan National Park, Taipei, Taiwan

- Twelve sites along the Appalachian Trail in the Pennsylvania, USA

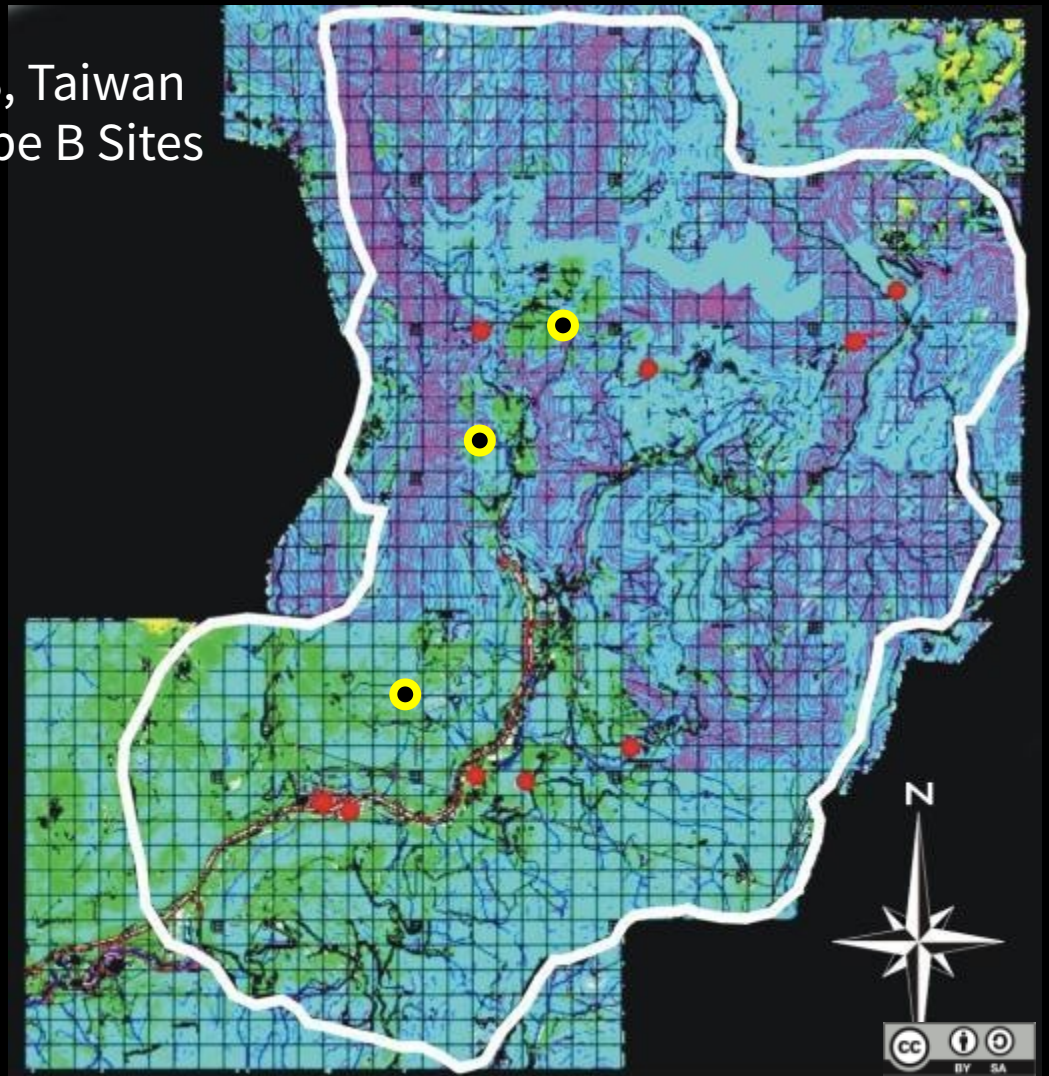
Study Area

- Testing sites were categorized according to their development level.
  - Type A: Community or buildings around, with some traffic on the paved roads.
  - Type B: Scattered houses, few traffic on the paved roads.
  - Type C: Very few house, only unpaved roads.
  - Type D: No building around, only trail access

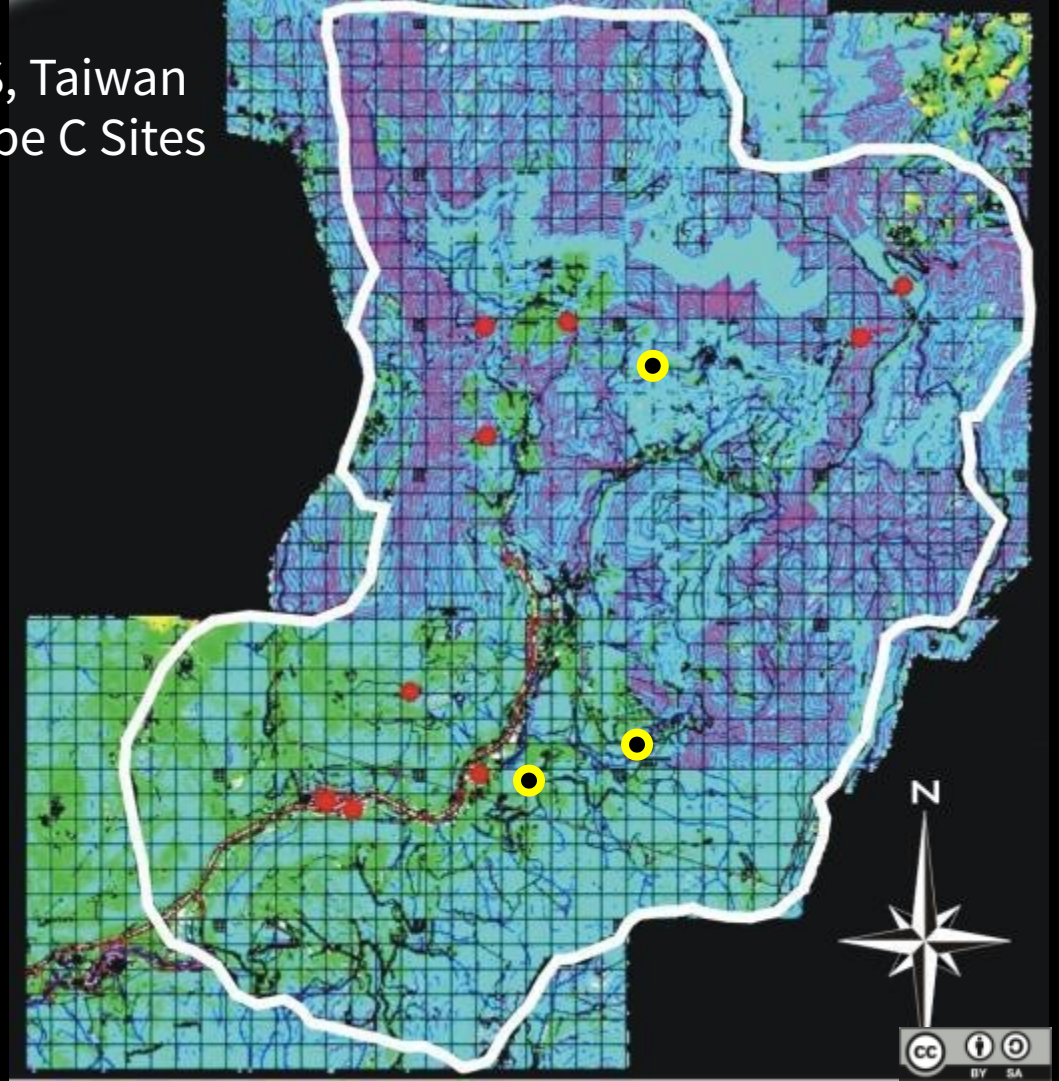
YMS, Taiwan
Type A Sites



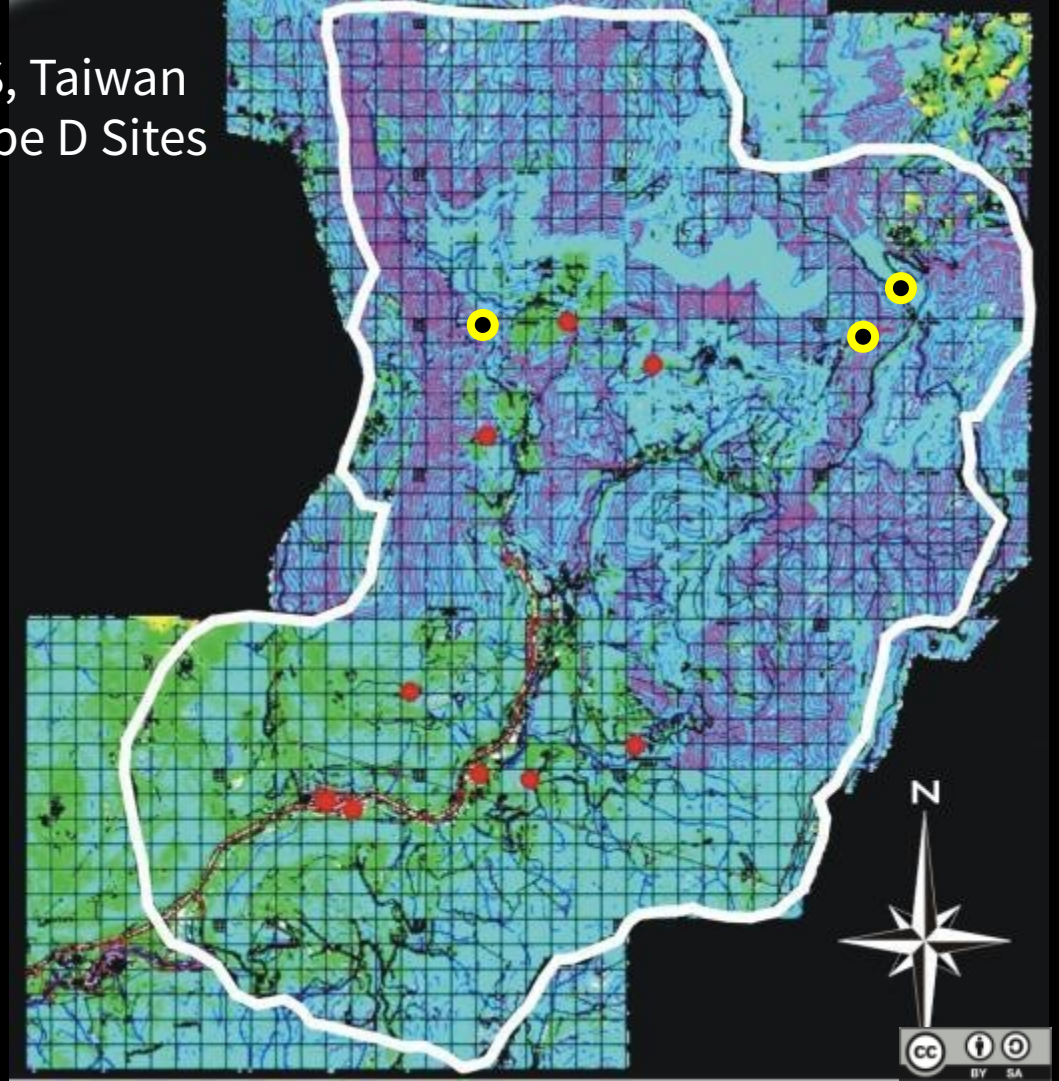
YMS, Taiwan
Type B Sites



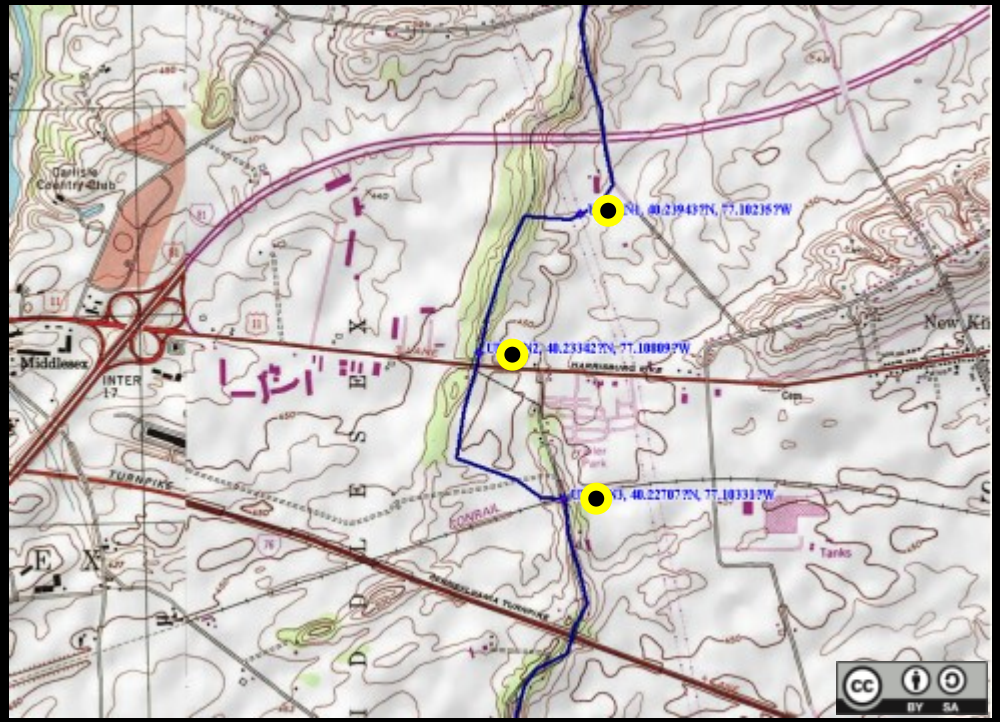
YMS, Taiwan
Type C Sites



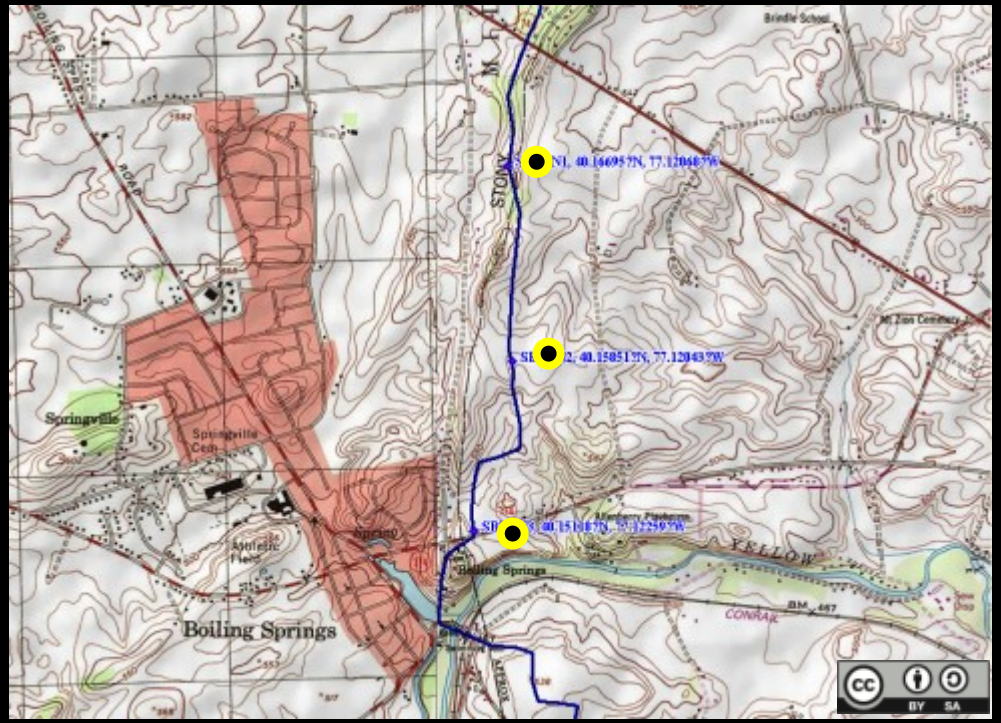
YMS, Taiwan
Type D Sites



AT, USA
Type A Sites



AT, USA
Type B Sites

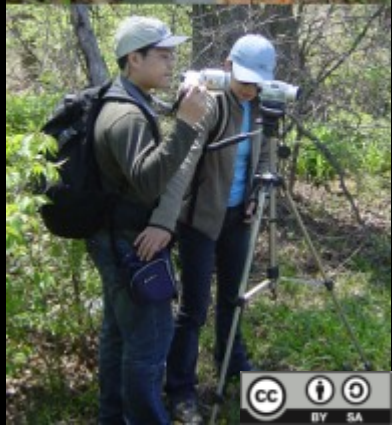


AT, USA
Type C Sites

AT, USA
Type D Sites

Research Design

- GPS positioning
- Aero photography map
  - Landscape ecological indices
- Staking
  - Bird investigation
- Taking videos
  - Natural perception
  - Psychophysiological responses



Landscape ecology indices

- Different hierarchy, circular with radius of 30m, 50m, 100m were analyzed to calculate their landscape indices in YMS, Taiwan.

- 100m, 500m, 1000m were analyzed to calculate their landscape indices in AT, USA.

- FragStats for ArcView ver. 2.0

Bird investigation

- Point Count Method

- Investigation
  - February to October, 2003
  - 20 minutes per site each time
  - Twice per month for each site
  - Weekdays

Natural perception

- Collect the “Natural” statements from the natural related magazines to establish the first stage of the “Natural Perception Scale”. Twenty most frequently mentioned vocabulary were selected.

- The scale items were interviewed at three largest train stations (Taipei, Taichung, and KauHsung city) in Taiwan to general people about their perception of natural (n=156).

Natural perception

- The scale's Cronbach's alpha = 0.96 shows the reliability of the scale.

- Factor analysis was used to reduce the number of the questioning items. It shows three dimensions of the scale, the fauna, the flora, and the environment statements.

Natural Perception Scale

1. This place grows with large trees and all kinds of plants.
2. This place has unique flowers or has wild flowers all over it.
3. This place is widely planted with verdant grass.
4. This place has diversified flora and integrated forest.

5. This place has small mammals, such as squirrel and rabbit.
6. This place has a big group of birds in term of the same or different species.
7. This place has insects, such as butterfly, bee, and firefly.
8. This place has very diversified species.

9. This place is often veiled with cloud and mist.
10. This place has specious blue sky.
11. This place has beautiful sunrise.
12. This place has beautiful sunset.

Attention Restoration Scores

- PRS Scale:
  - Adopt Laumann's PRS scale (2001), which includes 5 features and 22 items. According to Laumann's study, two of the questions with the highest PRS score in each feature category are chosen.
  - Preferences
  - Relaxation

Natural Perception and Attention Restoration Scores

Imagine you were there and report your feeling

	Not at all ◄——► Very much
In this setting I do something different than I usually do	■ ■ ■ ■ ■
I am in a different setting than usual	■ ■ ■ ■ ■
When I am here I do not need to think of my responsibility	■ ■ ■ ■ ■
I am away from my obligations	■ ■ ■ ■ ■
All the elements constitute a larger whole	■ ■ ■ ■ ■
The surroundings are coherent	■ ■ ■ ■ ■

Go to next page

Biofeedback responses

- Biofeedback instrument was used to record respondents' physical responses.

Physical Responses

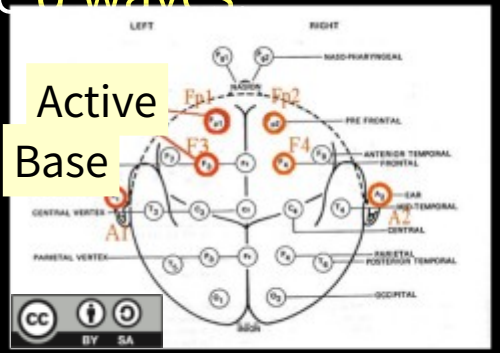
- Alpha Brain wave, Electroencephalography (EEG)
- Muscle Tension, Electromyography (EMG)
- Heart Rate (HR)

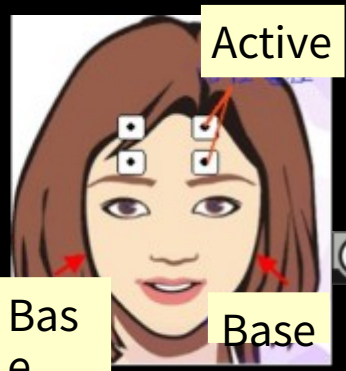
Biofeedback responses

- Instrument
  - The Procomp+/Biograph V2.0 biofeedback System by Thought Technology Ltd.

Electroencephalography (EEG)

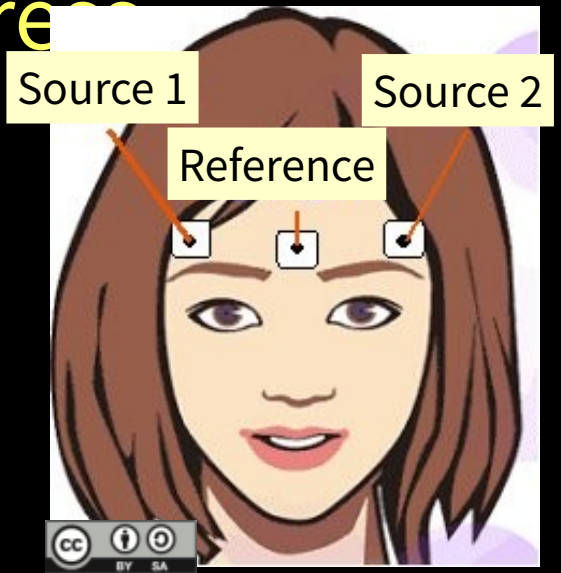
- EEG-a: left hemisphere
  - Tested at left ear (position number Fp1-F3-A1), recording the α waves.
- EEG-b: right hemisphere
  - tested at right ear (position number Fp2-F4-A2) , recording the α waves





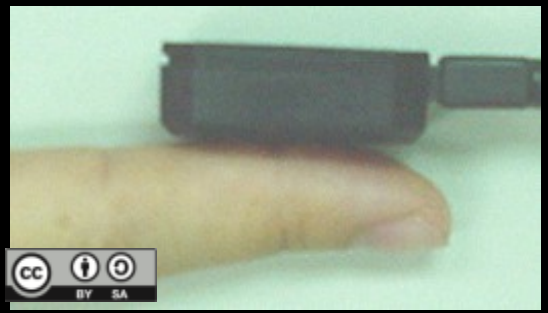
Electromyography (EMG)

- Facial muscles on the forehead can better reflect mental and emotional tension or stress



Heart Rate (HR)

- The infrared detector detects was placed at the tip of the respondent's middle finger.



Testing Procedure

- Pre-testing interpretation:
  - The purpose of the procedures is to allow participants to feel relaxed without unpredictable nervousness.
- Start testing:
  - Participants were first required to frown and EMG was recorded at this time.
  - In between pictures a blue blank slide was shown to decrease the influence of last picture.

Testing Procedure

- First participants were asked to spend 20 seconds and imagine how they would feel in the landscape shown on the video.

- The same steps were repeated until all 24 videos (2 videos for each site) were tested.

- To prevent the residual effects of the former picture on the following picture, a preview of all pictures was shown before the test, while five sets of landscapes were played randomly during the experiment.

Explanation of the test

Participants were required to frown

Preview of all of the landscapes

↓Start recording

Look at blue blank slide for 10 seconds

Look at video and think for 20 seconds

Fill out the questionnaire

↓Repeat the procedure for next site video

- 129 students participated in Taiwan, including 73 females (56.6%) and 56 males (43.4%)
- 72 students participated in the US, including 34 females (47.2%) and 38 males (52.8%)

- Z-value was used to standardize respondent's physical data.

H1: There are relationships between landscape ecology indices and bird species indices.

- Spearman Rank Order Correlation Coefficient

YMS	Richness			Diversity			Evenness			Capita		
m	500	100	30	500	100	30	500	100	30	500	100	30
Farm												
AREA			0.67*									
NP			0.61*									
MPS			0.67*									
MSI			0.61*									
MPFD												
PD												
AWMSI			0.62*									
Build												
AREA												
NP												
MPS												
MSI												
MPFD												

YMS	Richness			Diversity			Evenness			Capita		
m	500	100	30	500	100	30	500	100	30	500	100	30
Woods												
AREA			-0.63*									
NP												
MPS			-0.61*									
MSI					0.76**			0.76**				
MPFD		0.59*										
PD			0.61*									
AWMSI												
Water												
AREA												
NP												
MPS												
MSI												
MPFD								0.60*				

AT	Richness			Diversity			Evenness			Capita		
m	1000	500	100	1000	500	100	1000	500	100	1000	500	100
Farm												
AREA										0.65*		0.76**
NP				0.80**	0.58*							0.72**
MPS										0.68*		0.76**
MSI	0.84**		0.60*	0.60*						0.73**		0.72**
MPFD	0.82**			0.68*								
PD				0.77**								0.64*
AWMSI	0.81**		0.61*							0.77**		0.69*
Build												
AREA												
NP												
MPS												
MSI												
MPFD	0.60*			0.66*								

AT	Richness			Diversity			Evenness			Capita		
m	1000	500	100	1000	500	100	1000	500	100	1000	500	100
Woods												
AREA										-0.61*	-0.68*	-0.78**
NP												
MPS										-0.59*	-0.68*	-0.74**
MSI												
MPFD	-0.78**			-0.71**								
PD										0.59*	0.68*	0.74**
AWMSI												0.73**
Water												
AREA												
NP												
MPS												
MSI												
MPFD												

- Farm
- Woods

- Vegetation Cover
- Food Supply
- habitats

- 30-100m radius in YMS, Taiwan
- 100-1000 radius in AT, USA

H2: There are differences among different landscape areas in regard to people’s natural perception.

- Repeated Measure ANOVA

The Repeat-Measure ANOVA of landscape types to natural perception in YMS.

Source	Type III SS	df	F	Sig.
Natural Perception	20204.952	2.713	178.382	0.000
Natural Perception – Fauna Dimension	3103.341	2.641	176.337	0.000
Natural Perception – Flora Dimension	3024.161	2.726	154.338	0.000
Natural Perception – Environment Dimension	1238.651	2.720	62.671	0.000

The Repeat-Measure ANOVA of landscape types to natural perception in AT.

Source	Type III SS	df	F	Sig.
Natural Perception	2253.250	3.000	14.893	0.000
Natural Perception – Fauna Dimension	305.927	3.000	11.673	0.000
Natural Perception – Flora Dimension	467.177	2.693	21.936	0.000
Natural Perception – Environment Dimension	509.806	2.682	20.230	0.000

- Respondents have significant different natural perceptions among different landscape types.
  - Total natural perception
  - Fauna perception
  - Flora perception
  - Environment perception

  - YMS, Taiwan
  - AT, USA

H3: There are relationships between people's natural perception and their psychophysiology responses.

- Pearson Correlation Coefficient

- The Pearson correlation coefficient between natural perception and respondents' psychophysiological responses in YMS

Source	EEG-a	EEG-b	EMG	HR	PRS
Flora	0.08	0.02	-0.18*	0.08	0.72**
Fauna	0.07	0.06	-0.11	0.03	0.57**
Environment	-0.01	-0.05	-0.11	0.03	0.61**

The Pearson correlation coefficient between natural perception and respondents' psychophysiological responses in AT

Source	EEG-a	EEG-b	EMG	HR	PRS
Flora	0.05	-0.13	-0.08	0.09	0.44**
Fauna	0.01	-0.13	-0.10	0.09	0.34**
Environment	-0.07	-0.09	-0.15	-0.11	0.39**

- YMS vs. AT

- Natural Perception
  - Flora
- Psychophysiology Responses
  - EMG (YMS)
  - PRS (YMS and AT)

H4: There are relationships between landscape ecology indices and psychophysiology responses

- Pearson Correlation Coefficient

Woods (YMS)										
	REEG		LEEG		EMG		HR		PRS	
AREA	-0.09	(0.04)	-0.02	(0.62)	-0.22	(0.00)	0.04	(0.41)	0.61	(0.00)
NP	0.11	(0.02)	0.06	(0.16)	0.09	(0.05)	-0.01	(0.91)	-0.44	(0.00)
MPS	-0.11	(0.01)	-0.05	(0.27)	-0.16	(0.00)	0.02	(0.72)	0.59	(0.00)
MSI	0.10	(0.03)	0.03	(0.48)	0.20	(0.00)	-0.02	(0.59)	-0.61	(0.00)
MPFD	0.08	(0.05)	0.02	(0.67)	0.24	(0.00)	-0.05	(0.31)	-0.61	(0.00)
PD	0.08	(0.08)	0.01	(0.77)	0.24	(0.00)	-0.05	(0.24)	-0.60	(0.00)
AWMSI	0.08	(0.05)	0.02	(0.63)	0.19	(0.00)	-0.02	(0.66)	-0.56	(0.00)

Farm (AT)										
	REEG		LEEG		EMG		HR		PRS	
AREA	0.19	(0.00)	0.06	(0.34)	-0.12	(0.05)	-0.11	(0.07)	-0.35	(0.00)
NP	-0.27	(0.00)	-0.05	(0.39)	0.09	(0.15)	0.14	(0.02)	0.33	(0.00)
MPS	0.27	(0.00)	0.06	(0.29)	-0.12	(0.04)	-0.18	(0.00)	-0.34	(0.00)
MSI	-0.01	(0.87)	-0.04	(0.50)	0.10	(0.08)	0.01	(0.85)	0.24	(0.00)
MPFD	-0.14	(0.02)	-0.05	(0.39)	0.11	(0.07)	0.06	(0.28)	0.33	(0.00)
PD	-0.16	(0.01)	-0.04	(0.51)	0.07	(0.22)	0.03	(0.61)	0.34	(0.00)
AWMSI	0.09	(0.13)	-0.02	(0.77)	0.06	(0.31)	-0.08	(0.15)	0.16	(0.01)

- YMS, Taiwan, 100m Woods
  - Attention restoration (PRS)
  - Muscle tension (EMG)
  - Right brain alpha wave (EEG-b)

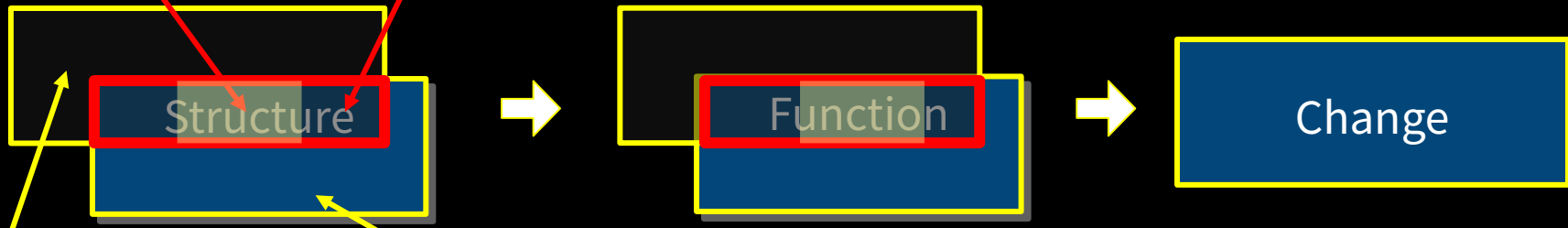
- AT, USA, 500m Farm
  - Right brain alpha wave (EEG-b)
  - Attention restoration (PRS)
  - Heart Rate (HR)
  - Muscle tension (EMG)

Questions

- Human and wildlife will be influenced by the landscape structures. But how to define a “better” landscape for “both” side?

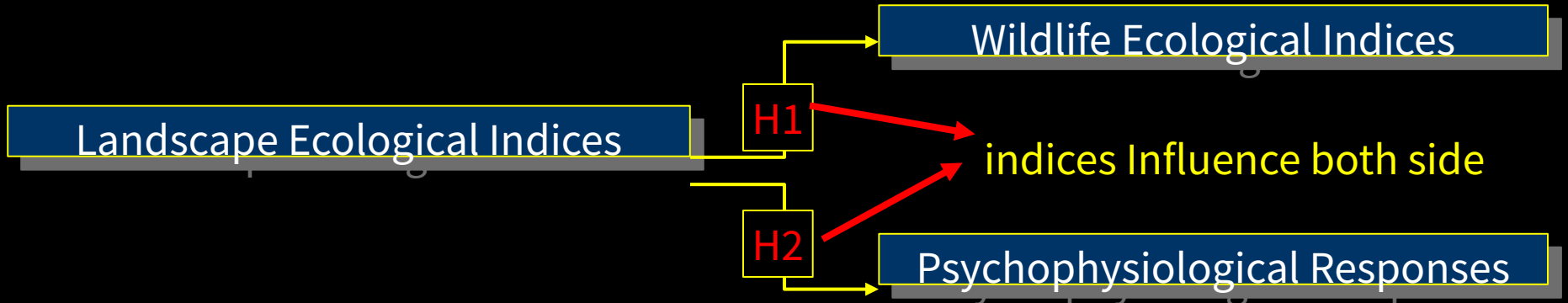
Landscape Structures that related to both humankind and wildlife

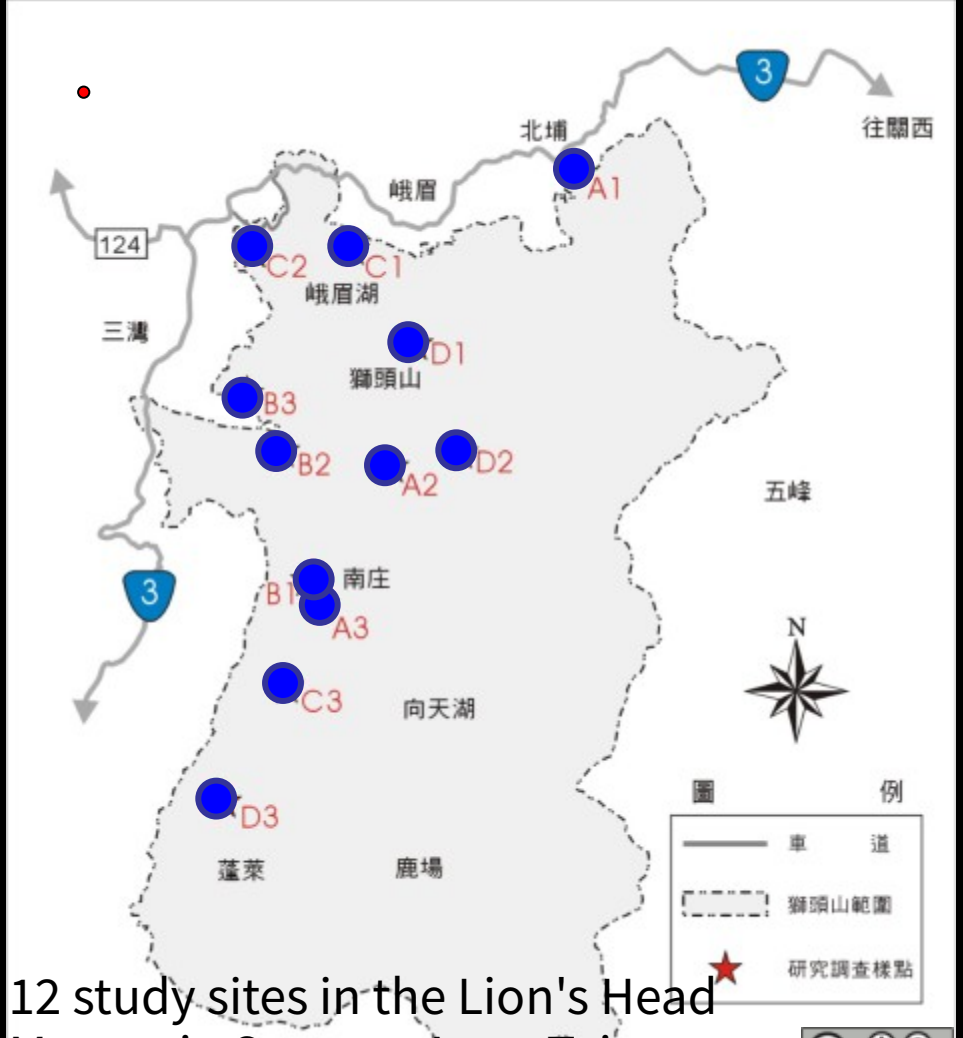
Sustainable Landscape



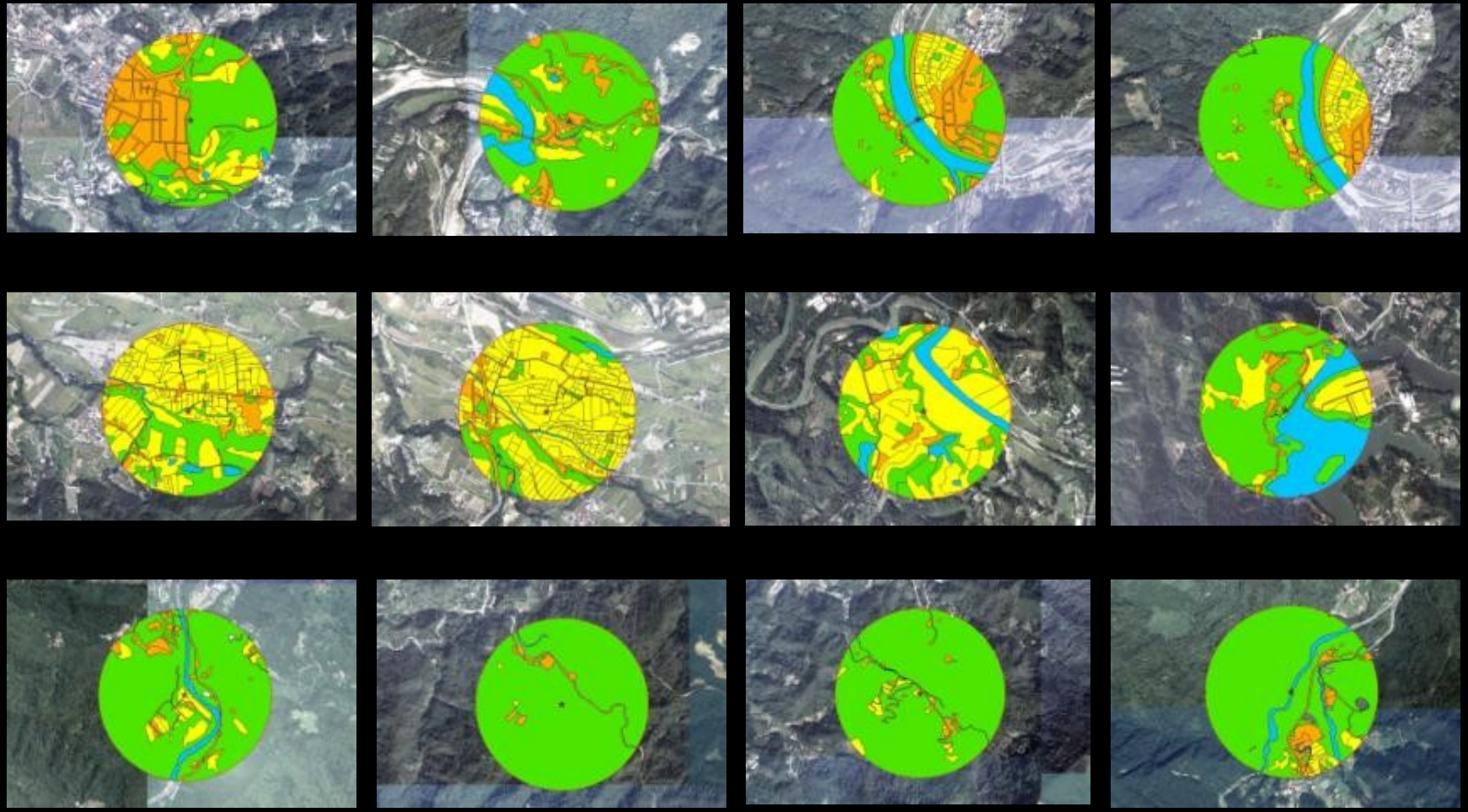
Landscape structures that influence human's perception

Landscape structures that influence wildlife

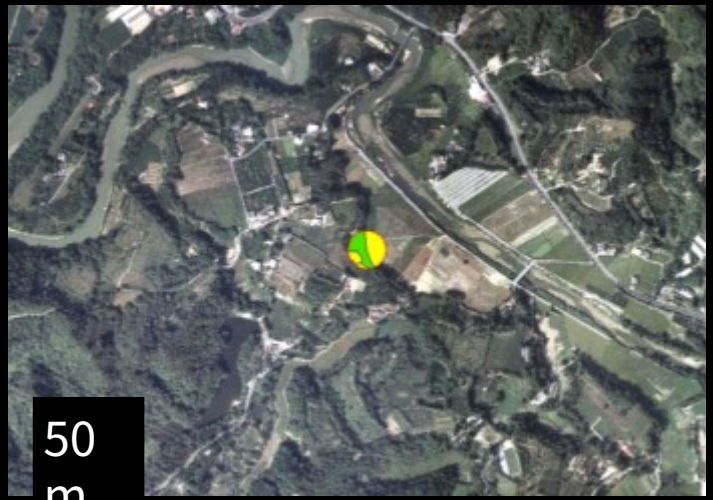


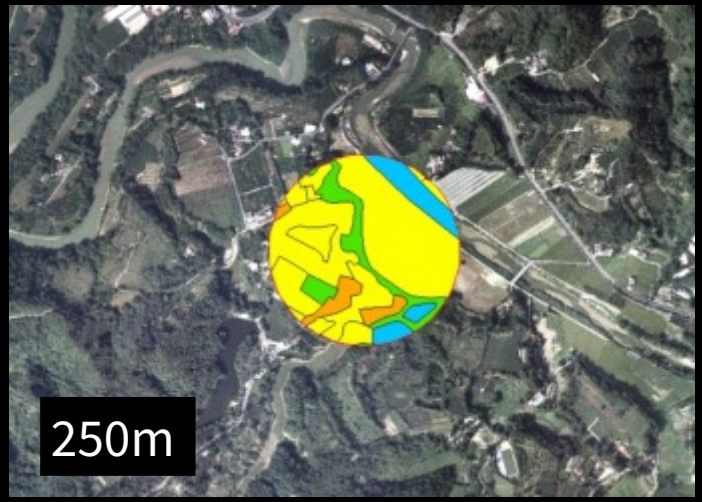


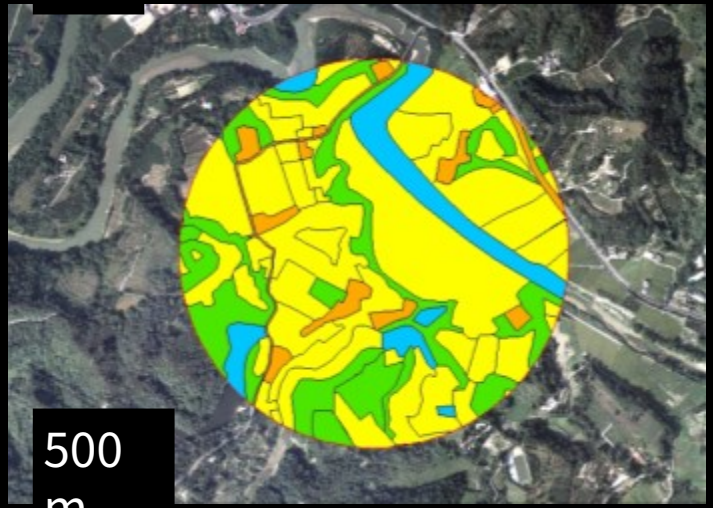
12 study sites in the Lion's Head Mountain Scenery Area, Taiwan



./5000, 0.5m*0.5m, 500m radius







Farm

Water

Woods

Build

Wildlife

- A1, 綠繡眼 (Japanese White-eye, Zosterops japonca)
- A2, 白頭翁 (Chinese Bulbul, Pycnonotus sinensis)
- A3, 小雨燕 (House Swift, Apus affinis)

- B1, 白頭翁 (Chinese Bulbul, Pycnonotus sinensis)
- B2, 紅嘴黑鵯 (Black Bulbul, Hypsipetes madagascariensis)
- B3, 斑文鳥 (Nutmeg Mannikin, Lonchura punctulata)

- C1, 白頭翁 (Chinese Bulbul, Pycnonotus sinensis)
- C2, 白頭翁 (Chinese Bulbul, Pycnonotus sinensis)
- C3, 繡眼畫眉 (Grey-eyed Nun Babbler, Alcippe morrisonia)

- D1, 繡眼畫眉 (Grey-eyed Nun Babbler, Alcippe morrisonia)
- D2, 綠繡眼 (Japanese White-eye, Zosterops japonca)
- D3, 紅嘴黑鵯 (Black Bulbul, Hypsipetes madagascariensis)

Problem 1

- Human’s eyes vs. Birds’ view
- Different altitudes, different resolution, different color, different attractions…
- Use both circular and visible area

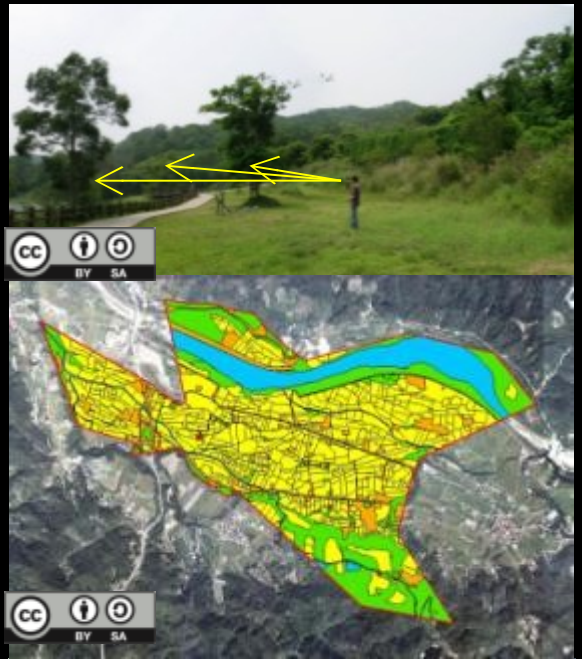
Problem 2

- Stimulus images

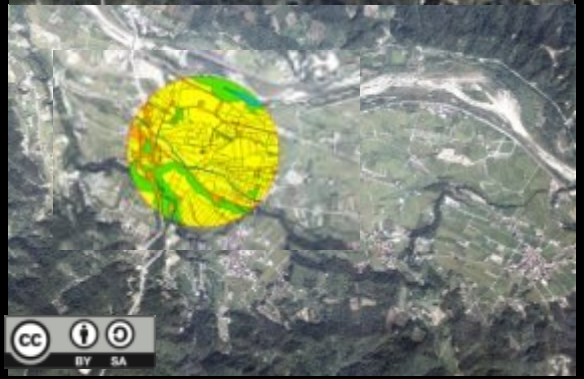
- Photo, slide, video, different shoot angle,
- Simulated images, virtual reality, verbal description…

- 360 degree circular video

Visible Area



Circular Area



Testing Media Preparation

- 360 Degree circular motor
- DV video on a tripod, horizontally

Bird Investigations

- March – December, 2004
- Weekdays, every 2 weeks
- Point Count Method, 10 minutes
- Species, Number, Behavior, Habitats

- March, 15, 2004 – March, 26, 2004
- 25 degree centigrade

Testing Procedure

Interpretation the testing procedure

↓

Video playing, 60 seconds per circle, recording the biofeedback responses

↓

For further qualitative discussions, 3 structured questions were asked:

1.Please speak out what you see, hear and feel?

2.Please speak out what would you do in this setting?

3.Please speak out how much you prefer this setting, why?

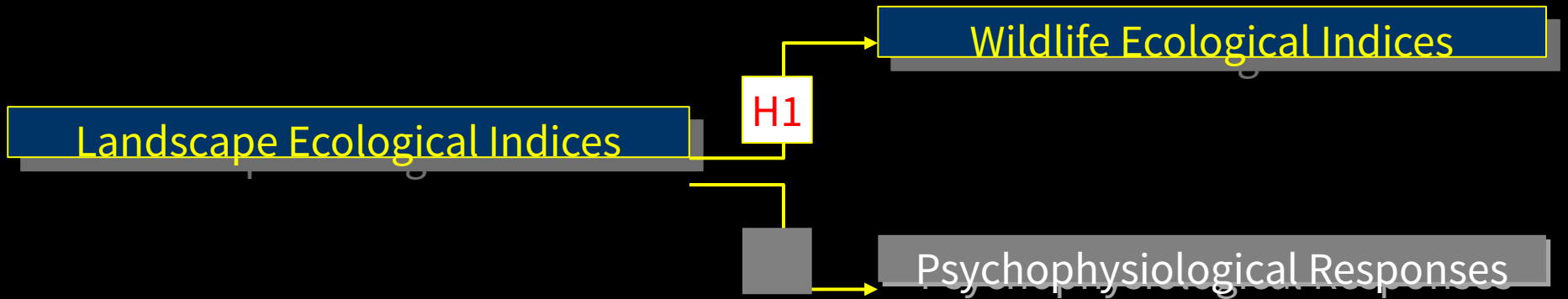
Convenient Sampling

- 22 students participated in Chung Hsing University, Taichung, Taiwan.

- Z-value was used to standardize respondent's physical data.

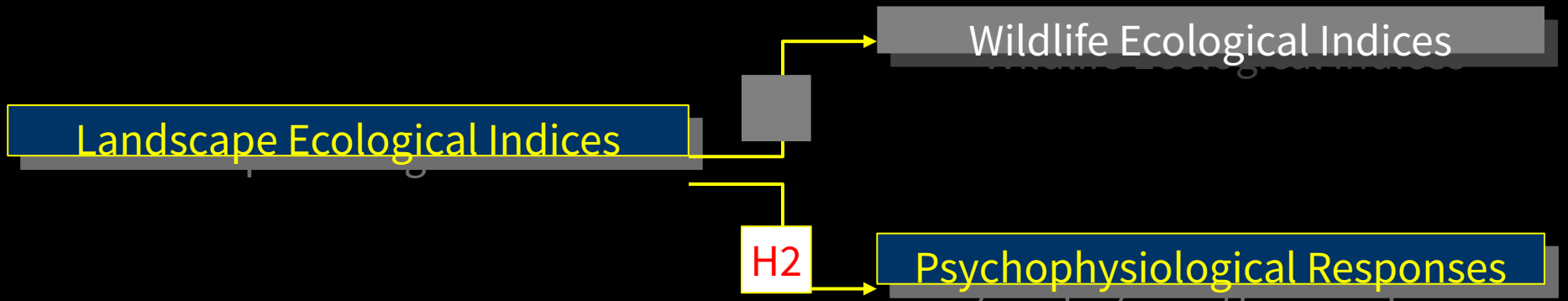
Statistical analysis

- Spearman rank order correlation coefficient

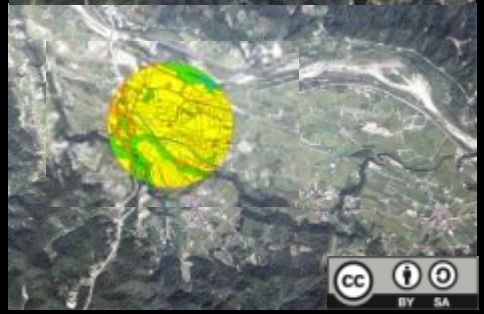


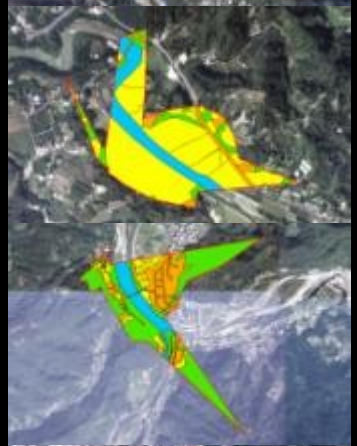
	Richness			Diversity			Evenness			Capita	
FARM	50m	250m	500m	50m	250m	500m	50m	250m	500m	250m	500m
AREA								-0.65*		0.80**	0.80**
NP											
MPS			0.61*					-0.58*			0.66*
MSI						0.59*					
MPFD								-0.59*			
PD											
AWMSI											
AWMPFD									0.69*		-0.66*
BUILD	50m	250m	500m	50m	250m	500m	50m	250m	500m	250m	500m
AREA											
NP											
MPS											
MSI											
MPFD											
PD											
AWMSI											
AWMPFD											
WATER	50m	250m	500m	50m	250m	500m	50m	250m	500m	250m	500m
AREA		0.60*	0.63*		0.58*						
NP		0.62*									
MPS					0.59*						
MSI											
MPFD											
PD			-0.75**								
AWMSI											
AWMPFD			-0.58*								
WOODS	50m	250m	500m	50m	250m	500m	50m	250m	500m	250m	500m
AREA		-0.70*	-0.63*					0.58*		-0.84**	-0.83**
NP											
MPS											
MSI											
MPFD											
PD								-0.58*		0.73**	0.78**
AWMSI											
AWMPFD		0.64*	0.60*					-0.61*	-0.66*	-0.59*	0.58*	0.67*

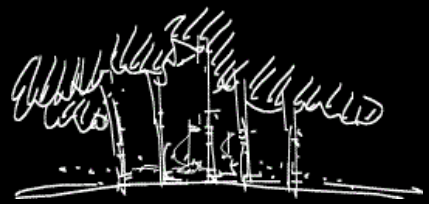
- Pearson correlation coefficient

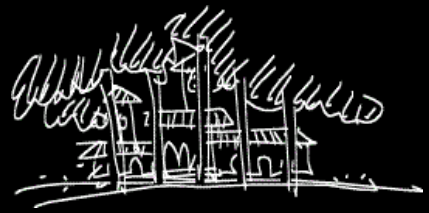


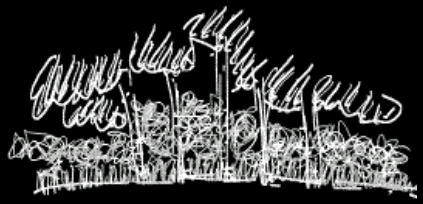
	EEG-right				EEG-left				EMG				HR				PRS			
FARM	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible
AREA				-0.19**				-0.16**												
NP				-0.18**				-0.15*												
MPS				-0.18**				-0.17**							0.15*		-0.13*	-0.21**		
MSI		0.15*	0.15*			0.15*									0.16*		-0.15*			
MPFD	-0.13*	-0.25**				-0.26**							-0.19**					-0.28**	-0.29*	
PD																	-0.38**	-0.36**	0.39*	
AWMSI															0.18*		-0.37**	-0.51**	-0.23*	
AWMPFD																	-0.36**	-0.51**		
BUILD	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible
AREA																0.13*	-0.33**	-0.33**	-0.34**	-0.14*
NP																	-0.39**	-0.32**	-0.24**	
MPS																0.16**	-0.37**	-0.20**	-0.18**	-0.26**
MSI		0.16**		0.16*		0.14*		0.22**								0.16*	-0.39**	0.20**	0.29**	-0.24**
MPFD	-0.13*			0.24**	-0.17**			0.23**					-0.14*				-0.26**	-0.37**	0.30**	-0.19**
PD																		0.27**	0.31**	
AWMSI			-0.13*				-0.13*									0.19**	-0.41**		-0.12*	-0.28**
AWMPFD																	-0.41**	0.20**	0.22**	-0.24**
WATER	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible
AREA		0.15*	0.15*										0.13*				-0.13*	-0.22**	-0.14*	
NP																		-0.17**		
MPS		0.15*	0.15*													0.15*		-0.20**	-0.20**	0.17**
MSI		-0.20**	-0.26**			-0.17**	-0.23**											0.13*	0.19**	
MPFD																	0.25**			0.24**
PD						0.13*							-0.13*							0.36**
AWMSI		-0.17**	-0.21**			-0.14*	-0.19**												0.19**	
AWMPFD			-0.18**				-0.16*												0.26**	
WOODS	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible	50m	250m	500m	Visible
AREA				0.21**				0.23**						-0.12*	-0.13*	0.16*	0.32**	0.17**		-0.29**
NP	0.16*				0.17**												-0.23**	0.23**		
MPS				0.21**				0.25**								0.13*	0.35**		0.19**	-0.27**
MSI	0.22*				0.21*										-0.14*		0.13*	-0.22**	-0.18**	
MPFD																	-0.30**	-0.34**		
PD	0.14*	-0.15*			0.17**	-0.13*											-0.31**		0.13*	
AWMSI	0.13*			0.15*				0.13*									-0.15*	-0.24**	-0.39**	
AWMPFD	0.19**			0.14*	0.17**			0.17**								0.13*	-0.14*	-0.25**	-0.22**	



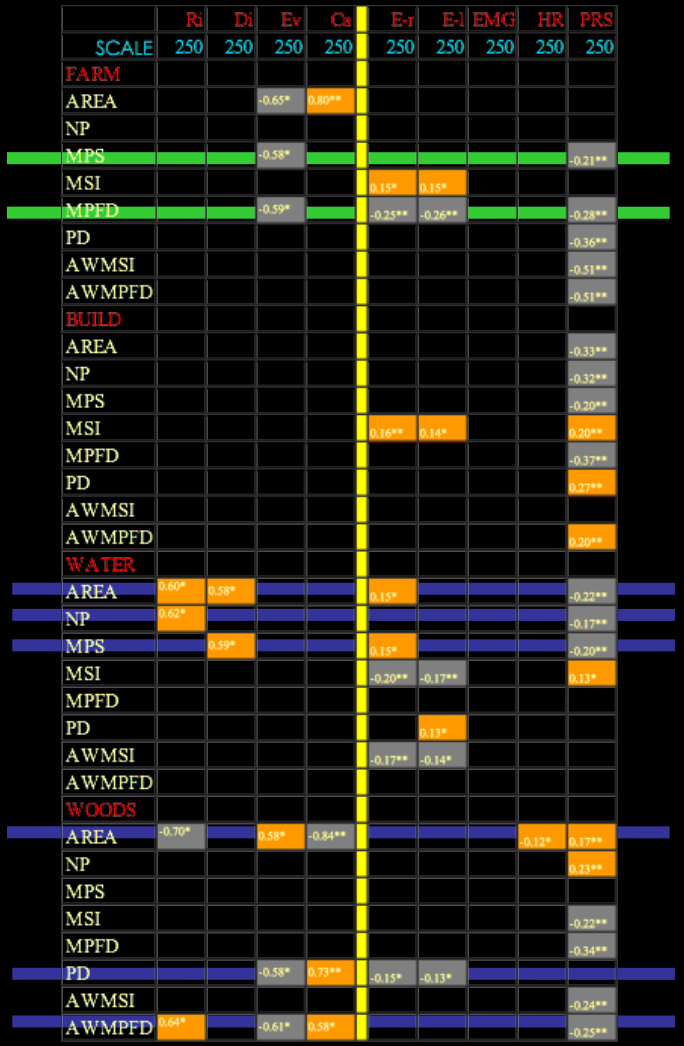








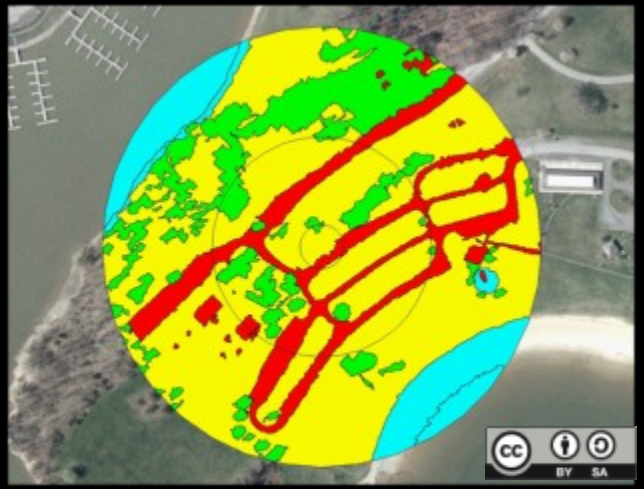
	Ri	Di	Ev	Ca	E-r	E-l	EMG	HR	PRS
SCALE	50	50	50	50	50	50	50	50	50
FARM									
AREA									
NP									
MPS									-0.13*
MSI									-0.15*
MPFD					-0.13*			-0.19**	
PD									-0.38**
AWMSI									-0.37**
AWMPFD									-0.36**
BUILD									
AREA									-0.33**
NP									-0.39**
MPS									-0.37**
MSI									-0.39**
MPFD					-0.13*	-0.17**		-0.14*	-0.26**
PD									
AWMSI									-0.41**
AWMPFD									-0.41**
WATER									
AREA								0.13*	-0.13*
NP									
MPS									
MSI									
MPFD									0.25**
PD								-0.13*	
AWMSI									
AWMPFD									
WOODS									
AREA									0.32**
NP					0.16*	0.17**			-0.23**
MPS									0.35**
MSI					0.22*	0.21*			0.13*
MPFD									-0.30**
PD					0.14*	0.17**			-0.31**
AWMSI					0.13*				-0.15*
AWMPFD				-0.59*	0.19**	0.17**			-0.14*



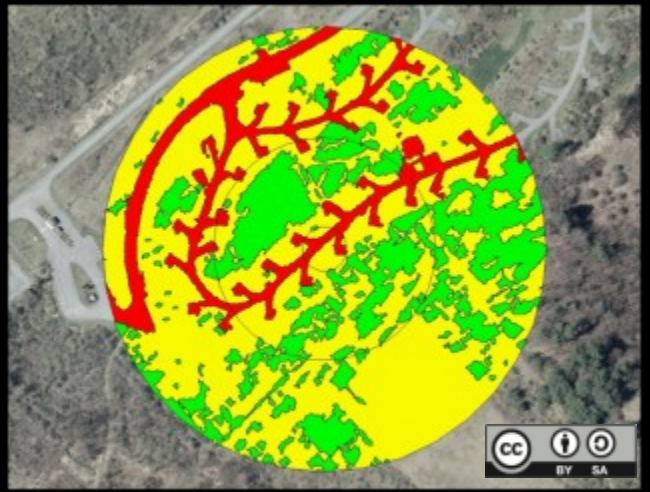
Conclusions

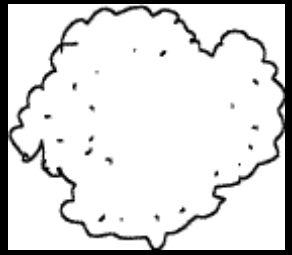
- People - Natural Relationship
- Some landscape structure indices influence both wildlife species and humankind.
  - 250/Farm, MPS, Evenness, PRS
  - 250/Farm, MPFD, Evenness, EEG-a, EEG-b, PRS
  - 500/Woods, PD, Capita, PRS

Site A3

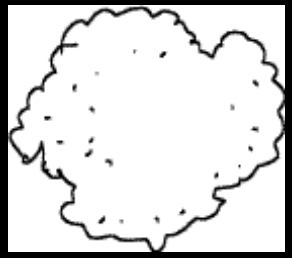


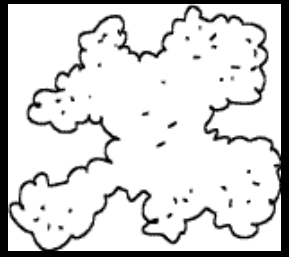
Site B3



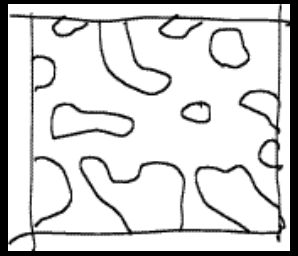


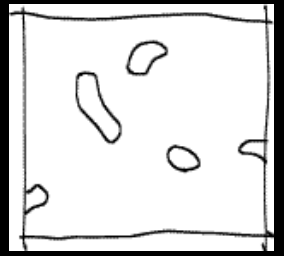
AREA



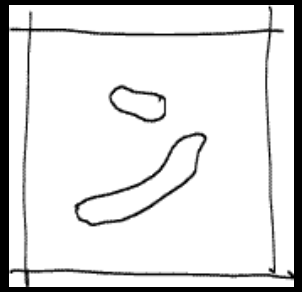


MSI (Mean Shape Index)

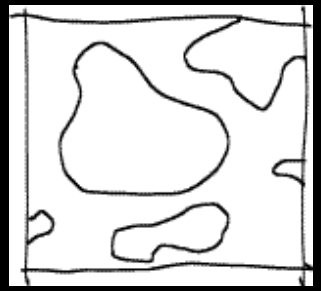


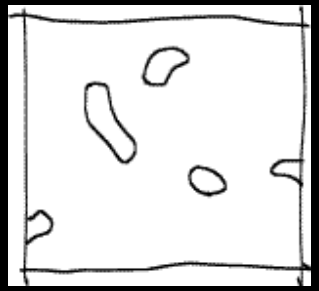


PD (Patch Density)



NP (Number of Patches)





MPS (Mean Patch Size)

- Increase variables, increase result variety …
  - Landscapes structure indices…
  - Wildlife richness, diversity, evenness, capita…
  - EEG, EMG, HR…

- Sustainable Landscape
  - Should landscape benefits both humankind and wildlife on all aspects?
  - How to define a “good” influence?

Thank You

cycmail@ntu.edu.tw

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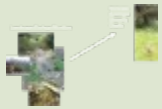
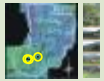
3			臺灣大學 / 張俊彥
4			臺灣大學 / 張俊彥
5			臺灣大學 / 張俊彥
6			臺灣大學 / 張俊彥
9			臺灣大學 / 張俊彥

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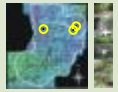
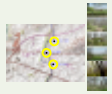
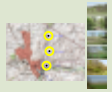
12			臺灣大學 / 張俊彥
13			臺灣大學 / 張俊彥
14			臺灣大學 / 張俊彥

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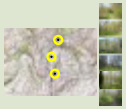
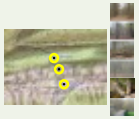
15			臺灣大學 / 張俊彥
16			臺灣大學 / 張俊彥
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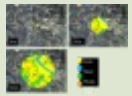
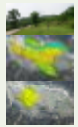
57			臺灣大學 / 張俊彥
61			臺灣大學 / 張俊彥
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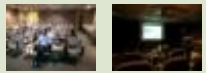
64			臺灣大學 / 張俊彥

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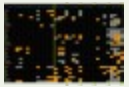
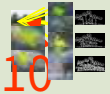
71			臺灣大學 / 張俊彥
72			臺灣大學 / 張俊彥

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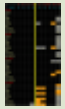
73			臺灣大學 / 張俊彥
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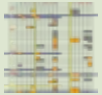
75			臺灣大學 / 張俊彥
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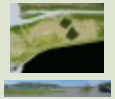
79			臺灣大學 / 張俊彥

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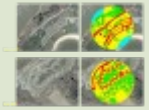
82			臺灣大學 / 張俊彥
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84			臺灣大學 / 張俊彥