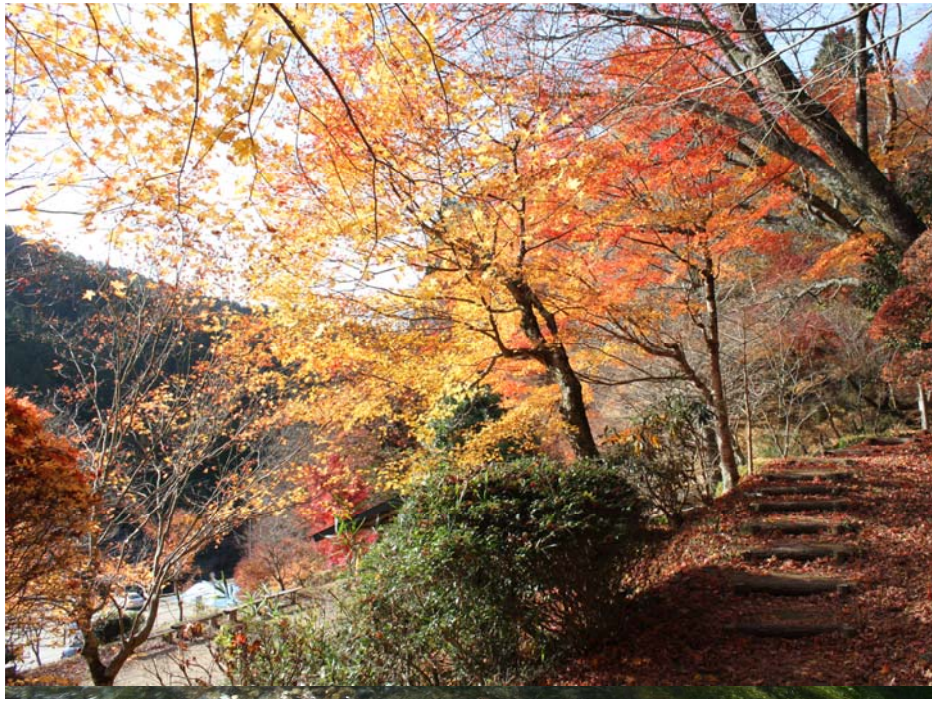


Study Objective and Method

- Urban forest has an important role for the human society.
- Citizen utilizes urban forest for many ways
  - Millennium Ecosystem Assessment, 2005
- Loss of forest means loss of a variety of ecosystem services(ESs) from forests.

- Study focus on:
  - Evaluation of forest ESs based on multi-point field surveys focused on CES(cultural ES) and Habitat
  - Assessment of the equivalency and/or alternativeness of forest ESs.
  - Case in Nagoya City, Japan
- Methods
  - Field survey on Nagoya forest (around 180 forest sits)
  - Statistical analysis including cluster analysis to categorise forest

Study Sites

- City hall: 35.181° N, 136.906° E
- Temperature in 2014 was 16.1° C
- Precipitation 1505.5 mm (JMA, 2015)
- Area: 326.4 km2
- Population 2.27 million
- Third largest city in Japan (Nagoya City, 2015).

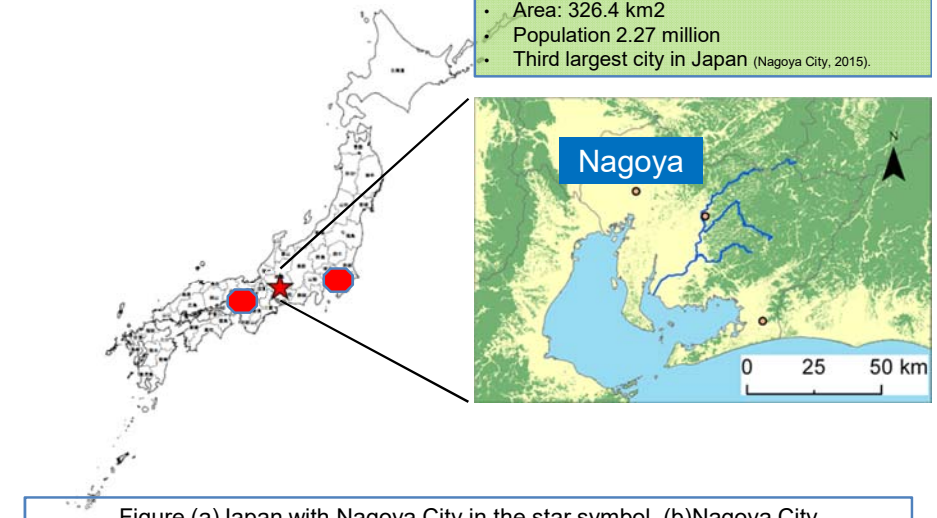


Figure (a)Japan with Nagoya City in the star symbol, (b)Nagoya City

Source: (b)ALOS Satellite image by JAXA/Distribution RESTEC, (b) Forest area in green color by Aichi, Gifu, Mie and Shizuoka prefectures and Forestry Agency, Ministry of Agriculture, Forestry



Field Survey



- Multi-point filed surveys
- Around 180 forests (≧1ha)
  - based on Nagoya green coverage GIS data by Nagoya City
- Forest ecosystem services: mainly CES and Habitat

	In 100-m^2 area	In 400-m^2 area	Entire forest area	Outside of forest
Basic survey items	Longitude, Latitude, Elevation, Slope, Topography, Temperature+, Relative humidity, Whole-sky photography++, etc.			Temperature, Relative humidity
Biomass surveys	Tree species, Tree height, DBH Crown area of each tree, Vegetation cover (tall trees, medium trees, short trees, very short trees, etc.), Recruitment (seedling growth) Mass of dead wood, etc.	Number of gingko trees (*Ginkgo biloba*) Number of large trees (DBH > 40 cm) Number of oak trees (e.g., *Quercus serrata*, *Quercus variabilis*, *Quercus glauca*, and *Quercus myrsinifolia*)	Number of large trees (DBH > 80 cm)	
Soil survey	Water content+++, Soil hardness++++, Surface soil and litter thickness, etc.			
Cultural survey			Aesthetic value, Recreation, Spiritual value, Cultural heritage value, etc.	
Habitat survey	Human intervention, Human accessibility, Human and vehicular traffic, etc.			
Other	Non-native species, Number of hollow trees			

+: illumination meter (LM-8000, MK Scientific, Inc., Japan); ++: fish-eye lens(IDF-3, Izawaopt, Japan); +++:soil water content meter (ProCheck, Decagon Devices Inc., U.S.A.)
++++: soil hardness meter (Daiki Rika Kogyo Co., Ltd., Japan); DBH means Diameter at Breast Height.

CES Category in the Study

CES14	Contents	CES7
subCES1	Aesthetic value	
subCES2	Daily recreation: walking, etc.	
subCES3	Daily recreation: play with children by play facilities	
subCES4	Daily recreation: play in forest (e.g. insect collecting)	
subCES5	Holiday recreation: holiday leisure, picnic, hiking, etc.	
subCES6	Holiday recreation: sports, etc.	
subCES7	Attracting facility	
*1	Education value: school related event	-
subCES8	Education value: nature observation meetings/classes	
subCES9	Spiritual value	
*2	Inspiration	
subCES10	Traditional festival	
subCES11	Normal festival	
subCES12	Religious value	
subCES13	Cultural heritage value	
*3	Social relations: working or schooling in the forest	
subCES14	Social relations: volunteers	

Note: *1, *2 and *3 were excluded.

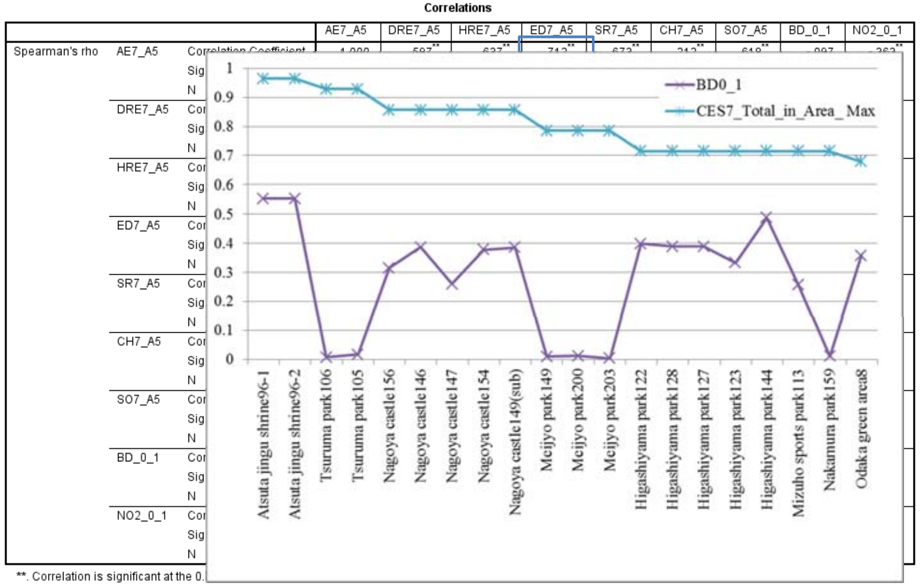
CES in 5-scale
1.very frequently
2.frequently
3.sometime
4.not so much
5.rarely used
"not enough information to make a decision"

Habitat category
Forest area
Habitat in 5-scale
- Authenticity/naturalness
- Human traffic

Source: revised from MA(Millennium Ecosystem Assessment)(2005), Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC

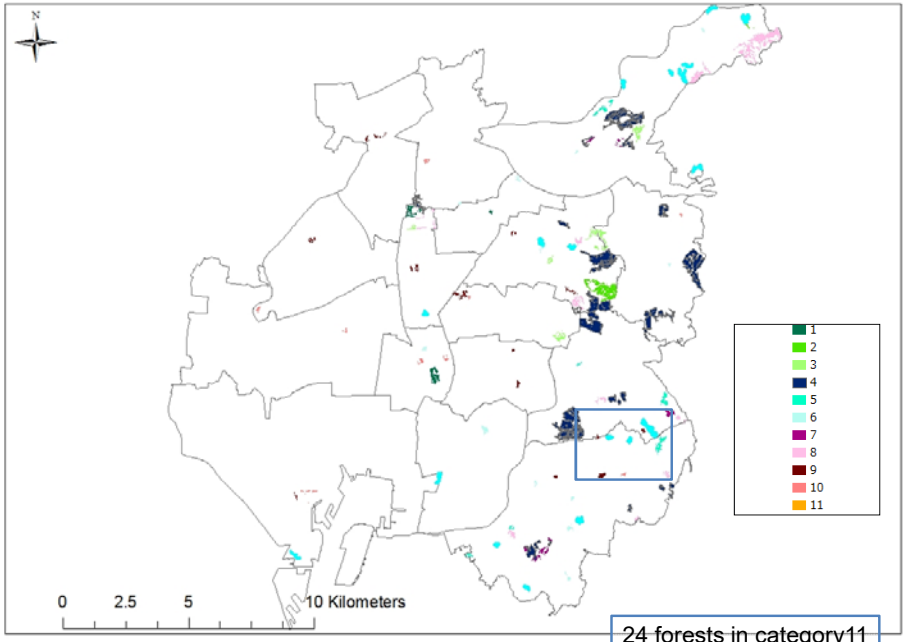
Results

Use of CESs/Habitat in Nagoya forests

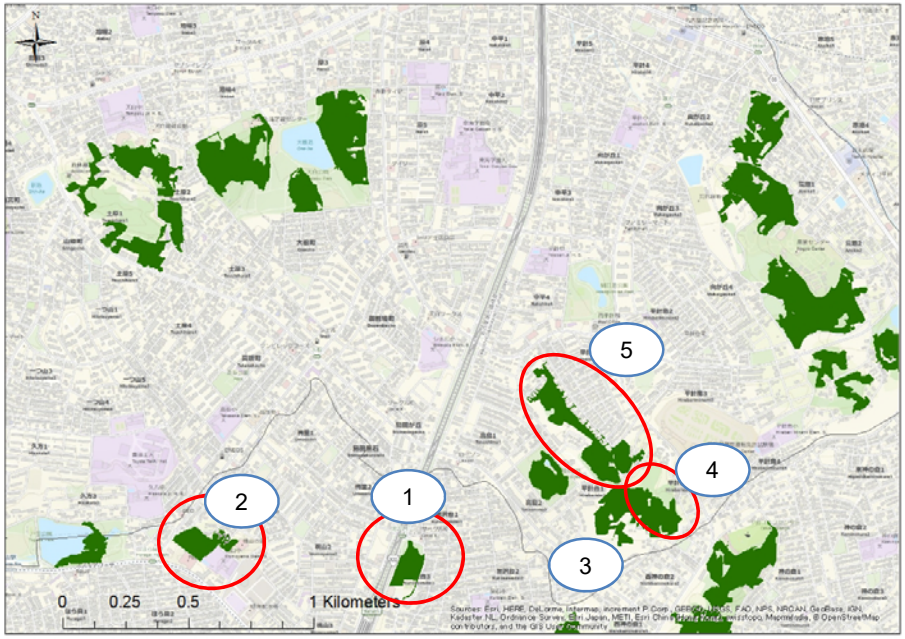

Correlations
AE7_A5
DRE7_A5
HRE7_A5
ED7_A5
SR7_A5
CH7_A5
SO7_A5
BD_0_1
NO2_0_1
Spearman's rho
AE7_A5
DRE7_A5
HRE7_A5
ED7_A5
SR7_A5
CH7_A5
SO7_A5
BD_0_1
NO2_0_1
Sig
N
BD0_1
CES7_Total_in_Area_Max
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Atsuta jingu shrine96-1
Atsuta jingu shrine96-2
Tsuruma park106
Tsuruma park105
Nagoya castle156
Nagoya castle146
Nagoya castle147
Nagoya castle154
Nagoya castle149(sub)
Meijyo park149
Meijyo park200
Meijyo park203
Higashiyama park122
Higashiyama park128
Higashiyama park127
Higashiyama park123
Higashiyama park144
Mizuho sports park113
Nakamura park159
Odaka green area8

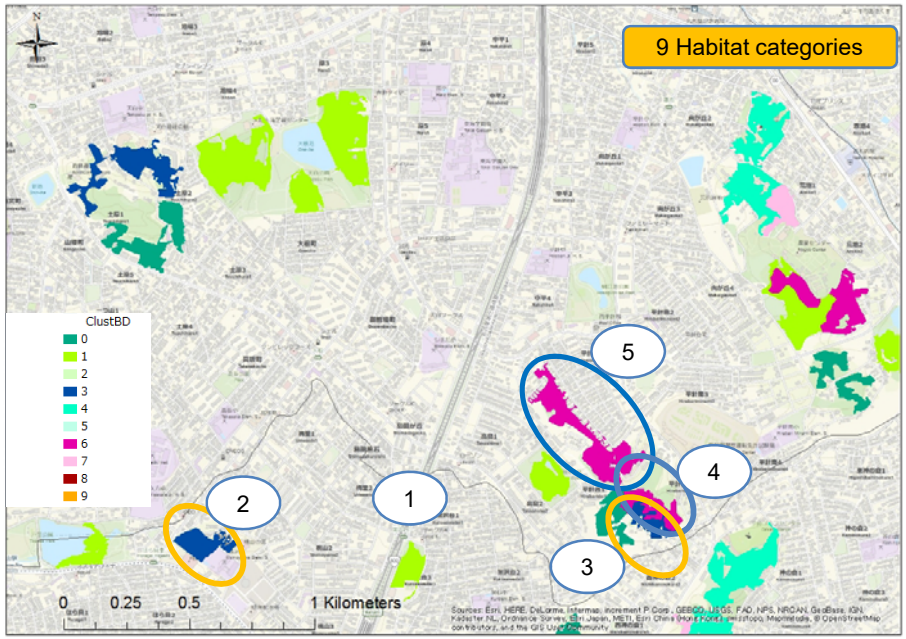
**. Correlation is significant at the 0.

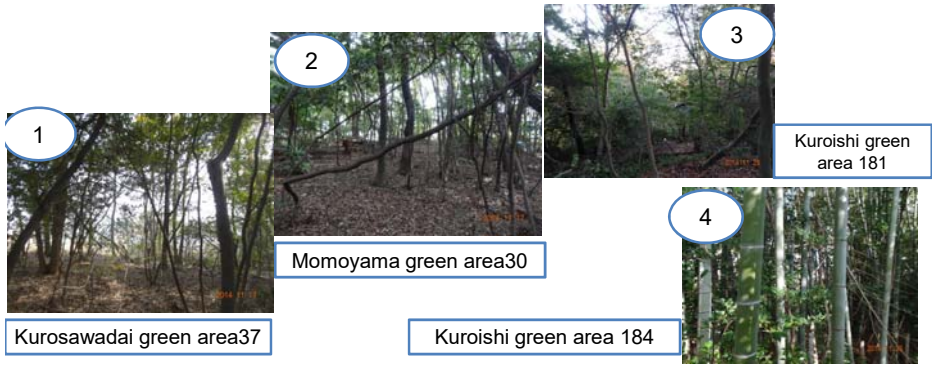
*. Correlation is significant at the 0.05 level (2-tailed).



24 forests in category11







	Forest Area(ha)	Conservation Area	Scenic Districts	Shrine or Temple	Atracting Facilities	CES AE	DRE	HRE	ED	SR	CH	SO
Kuroswadai green area37												50
Momoyama green area30												
Kuroishi green area181												
Kuroishi green area184												
Hirabari168												

Kuroswadai green area37												
Momoyama green area30												
Kuroishi green area181												
Kuroishi green area184												
Hirabari168	0.27	3	Bamboo forest			0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Equivalency and alternativeness assessment

Conclusion

- Forest categories were examined based on simple multi-points field surveys by CESs and Habitat.
- The equivalency and similarity of ES provision potential were studied.
  - Similarity or equivalency of forest ESs (CES, Habitat)
  - Evaluation of City scale ES potential
    - Risk of decrease of ESs
    - Alternativeness assessment
    - BO offset (ES perspective)
- Future issues
  - Include other ESs (such as, Regulating, supporting, species, etc.)

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