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

### CES and Habitat

#### Basic survey items:
- Longitude, Latitude, Elevation, Slope, Topography, Temperature, Relative humidity, Shade-sky photography, etc.
- Crown area of each tree
- Vegetation cover (all trees, medium trees, short trees, very short trees, etc.)
- Recruitment (soil condition)
- Mass of leaf wood, etc.

#### Soil survey:
- Water content, soil hardness, surface soil and leaf thickness, etc.

#### Wildlife survey:
- Human invasions, Human accessibility, Human and vehicle visits, etc.

#### Other:
- Native species, Number of indoor trees

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

### CES Category in the Study

<table>
<thead>
<tr>
<th>CES14</th>
<th>Contents</th>
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</thead>
<tbody>
<tr>
<td>subCES1</td>
<td>Aesthetic value</td>
</tr>
<tr>
<td>subCES2</td>
<td>Daily recreation: walking, etc.</td>
</tr>
<tr>
<td>subCES3</td>
<td>Daily recreation: play with children by play facilities</td>
</tr>
<tr>
<td>subCES4</td>
<td>Daily recreation: play in forest (e.g. insect collecting)</td>
</tr>
<tr>
<td>subCES5</td>
<td>Holiday recreation: holiday leisure, picnic, hiking, etc.</td>
</tr>
<tr>
<td>subCES6</td>
<td>Holiday recreation: sports, etc.</td>
</tr>
<tr>
<td>subCES7</td>
<td>Attracting facility</td>
</tr>
</tbody>
</table>

#### 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"

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

Use of CEsSs/Habitat in Nagoya forests

Quantitative analysis of the use of CEsSs/Habitat in Nagoya forests indicates the following:

- **Daily recreation:** Walking, etc.
- **Daily recreation:** Playing with children or using play facilities.
- **Holiday recreation:** Holiday leisure, picnicking, hiking, etc.
- **Holiday recreation:** Sports, etc.

**Education value:** Nature observation, meetings/classes.

**Spiritual value:** Traditional festival, religious value.

**Cultural heritage value:** Normal festival.

**Social relations:** Volunteers.

*Correlation is significant at the 0.05 level (2-tailed).*
Forest category
• CES: 11 category by – CES7 w S_D, S_T and A_F
• Habitat: 9 category – C_A, Authenticity, Human traffic, Forest type
N=180
13 24 forests in category11

<table>
<thead>
<tr>
<th>Forest Area (ha)</th>
<th>Conservation Area</th>
<th>Scenic Districts</th>
<th>Shrine or Temple</th>
<th>Attracting Facilities</th>
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<tbody>
<tr>
<td>Kurosawadai green area 37</td>
<td>1.39</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Momoyama green area 30</td>
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<td>0</td>
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<td>Kuroishi green area 181</td>
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<td>Kuroishi green area 184</td>
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<tr>
<td>Hirabari</td>
<td>4.65</td>
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<td>0</td>
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</table>

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<tr>
<th>Forest BD Area</th>
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<th>Shrine or Temple</th>
<th>Attracting Facilities</th>
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<tbody>
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<td>5</td>
<td>Evergreen forest</td>
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<tr>
<td>Kuroishi green area 181</td>
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<td>5</td>
<td>Evergreen forest</td>
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<tr>
<td>Kuroishi green area 184</td>
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<td>3</td>
<td>Bamboo forest</td>
<td>0.09% 0.08% 0.09% 0.00% 0.09% 0.00% 0.18%</td>
</tr>
<tr>
<td>Hirabari</td>
<td>0.27</td>
<td>3</td>
<td>Bamboo forest</td>
<td>0.00% 0.00% 0.00% 0.00% 0.00% 0.00% 0.00%</td>
</tr>
</tbody>
</table>

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.)

Reference

- Kumar, M., Kumar, P. 2008. Valuation of the ecosystem services: A psycho-cultural perspective. Ecological Economics, 64, 808-819.
- Nagoya City. 2010. Green coverage GIS data. [J]