Evolution of An Ecological Network: Case Study of Sichuan

Saini Yang Dr. Prof.
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Academy of Disaster Reduction and Emergency Management
Part 1  BACKGROUND
Part 2  THE QUESTION
Part 3  DATA AND METHODOLOGY
Part 4  CASE STUDY
Part 5  RESULT ANALYSIS
Part 6  DISCUSSION AND FUTURE STUDY
Ecological network: patches + corridors

Resource:
- ✓ provide the source for the adjacent
- Conduit
  - ✓ protect the biodiversity
- Barrier
  - ✓ prevent soil erosion
- Filter
  - ✓ filter contaminants
• Natural hazards and human activities, especially urbanization, have made large-scale habitats more fragmented and islanding.
How does ecological network evolve with disturbance?

Source: Jung et al, sustainability, 2014
- National dataset of Geographical Information

**DATA AND METHODOLOGY**

1. Data Preparation
   - Land cover
   - NPP
   - NDVI
   - Road network

2. Geographical spatial analysis
   - Core habitat
   - Building
   - Water
   - Big patch abstract

3. Ecological network modelling
   - Patch
   - Cost surface
   - Least-cost path
   - Minimal spanning tree
   - Network analysis and optimization
   - All to all regular network

4. Network analysis
   - All to all regular network
RESEARCH AREA

- Sichuan Province, China
- Wenchuan Earthquake 2008
- Rapid urbanization process
The overall spatial distribution pattern of ecological patches remains stable;
Ecological patches clustered in the northwestern Sichuan, but there is a huge vacant area in the east.
2. Properties of ecological networks

- **Scale-free**, with the same core patch;
- **Local variation:**
  - ① The location of the core patch is unchanged, but the size varies.
  - ② The number of nodes (patches)

Fig. 2 schematic diagram of ecological networks (with boundary of the core patch):

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patches (nodes)</td>
<td>228</td>
<td>248</td>
<td>231</td>
</tr>
<tr>
<td>Core patch size (km²)</td>
<td>160320</td>
<td>153243</td>
<td>153313</td>
</tr>
</tbody>
</table>
3. Topological importance-based patch categorization

Fig. 3  Distribution of 3 topological importance level patches (with typical local change circled)
Landscape Changes based on Municipal Administrative Regions

\[ FN_i = \frac{NF_i - 1}{MPS_i} \]

\( NF_i \): Number of patch of \( i \)th administrative region
\( MPS_i \): Mean patch size of \( i \)th administrative region

\[ FS1 = 1 - \frac{1}{MSI} \]

\( MSI \): Mean Shape Index
<table>
<thead>
<tr>
<th>排序</th>
<th>斑块号</th>
<th>度</th>
<th>斑块号</th>
<th>介数</th>
<th>斑块号</th>
<th>接近数</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>160</td>
<td>22</td>
<td>0</td>
<td>14899</td>
<td>0</td>
<td>0.309</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>15</td>
<td>162</td>
<td>11936</td>
<td>160</td>
<td>0.304</td>
</tr>
<tr>
<td>3</td>
<td>162</td>
<td>14</td>
<td>160</td>
<td>10036</td>
<td>162</td>
<td>0.283</td>
</tr>
</tbody>
</table>
**DISCUSSION**

Critical corridors + Core patches → Core area of an ecological network

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Key Corridor</th>
<th>Patch</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0,162)</td>
<td>10</td>
<td>160</td>
<td>95930.8</td>
</tr>
<tr>
<td>(0,173)</td>
<td>9</td>
<td>0</td>
<td>39729.9</td>
</tr>
<tr>
<td>(162,41)</td>
<td>8</td>
<td>161</td>
<td>26348.4</td>
</tr>
<tr>
<td>(0,21)</td>
<td>7</td>
<td>162</td>
<td>23513.4</td>
</tr>
<tr>
<td>(0,2)</td>
<td>6</td>
<td>163</td>
<td>6592.31</td>
</tr>
<tr>
<td>(160,186)</td>
<td>5</td>
<td>164</td>
<td>4167.62</td>
</tr>
<tr>
<td>(160,163)</td>
<td>4</td>
<td>1</td>
<td>4074.25</td>
</tr>
<tr>
<td>(3,170)</td>
<td>3</td>
<td>165</td>
<td>3979.78</td>
</tr>
<tr>
<td>(0,167)</td>
<td>2</td>
<td>2</td>
<td>3860.27</td>
</tr>
<tr>
<td>(11,5)</td>
<td>1</td>
<td>166</td>
<td>3753.23</td>
</tr>
</tbody>
</table>

- North west
- Most key corridor: (0,162)
- Most core patch: Patch 0
The different damage mechanism of natural hazards and human activities

Model validation – field study

The recovery process of an ecological network
Thank you!

Questions?

✉️ yangsaini@bnu.edu.cn