Application of GIS to the conservation of endangered plant species at a local area in Korea

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Korea National Arboretum

- Located at the center of the Gwangneung Forest
- Established in 1987 (Gwangneung Arboretum)
- Became the Korea National Arboretum in 1999
- 15 Specialized Gardens, Forest Museum, Forest Zoo, Seed Bank, National Herbarium, Tropical Plant Resources Research Center
Missions of Korea National Arboretum

- Surveying forest biodiversity and collecting information
- Conserving rare and endangered plant species
- Promoting public education and awareness about plant diversity and conservation
- Managing the arboretum, cooperating with partner institutes
- Protecting and managing Gwangneung Forest
Major Activities 1: Surveying Forest Biodiversity and Collecting Information

- Nationwide monitoring and surveying forest resources
- Collecting biodiversity information including specimen
- Developing information system, conducting systematic studies

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Major Activities 2: Conserving Rare and Endangered Plant Species

- Conservation and habitat restoration of rare plants
- Collecting and conserving genetic resources (seed bank)
- Research on economic plants and traditional knowledge

Habitat restoration of rare plants

In situ and ex situ conservation

Research on traditional knowledge

In vitro culture

Nursery

Tropical plant resource research center

Lao wild orchids return home
Major Activities 3: Managing the Arboretum and Promoting Networking and Cooperation

- Developing gardening and landscaping technology
- Collecting and conserving forest cultural heritage
- Sharing technology and information with partners
- Cooperation with other institutes and joint research

MOU contracting

Joint expedition

International cooperation with Laos National Univ. for rare orchid conservation
Application of GIS (Geographical Information Systems)

- A tool that allows the integration and analysis of large amount of data sets
- The geographical distribution of species in space and time (Johnston, 1998)
- Highway construction on a rare plant population (Wu and Smeins, 2000)
- The translocation of an endangered plant population because of the construction of a dam (Draper et al., 2001).
- GIS and the conservation of wild crop relatives (Hijmans and Spooner, 2001).
- GIS and plant conservation programs in Portugal (Draper et al., 2003)
Method for quantifying plant resources using GIS (patent 10-0573874)

Forest wetlands distribution map using GIS (patent 10-2007-043215)

Predicted distribution map of *Arisaema amurense* var. *serratum* at North area of Gyeonggi Prov. in Korea

Distribution map of newly discovered forest wetlands in Korea
Rare Plants

Field Survey
- Get GPS point of habitat
- Survey an environment statue

Buildup of GIS Datum
- 1:5,000 Digital Topo Map
- GPS Point Information reprojection
- GIS Datum conversion

Analysis of Filed Survey Data
- Topology, Plant, Density, Climate etc.

Analysis of Environmental Features
- DEM, Slope, Aspect, Sun
  and other Thematic Map

Integration of Datum
Statistical analysis (Binary Logistic regression)

Preparation of Habitat Suitability Index

Adjust

Approve
- Reject
- Accept

Prediction of conservation and restoration places
Sample Area: Ulreung Island

- E130°54' N37°29', area 72.56 km²
- A volcanic island composed of steep mountainous area and cliffs, Seonginbong (alt. 983.6m)
- Annual mean temp. 12.3°C, annual precipitation 1,236.2mm
Endemic plants in Ulreung Island: 40 taxa (Oh 1972)

**Endemic Plants of Ulreung Island**

- **Corydalis filistipes**
- **Bupleurum latissimum**
- **Hepatica maxima**
- **Abelia coreana var. insularis**
- **Scrophularia takesimensis**
- **Codoneaster wilsonii**
Bupleurum latissimum Nakai (Apiaceae)

- Very rare species distributed on Ulreung Island, endemic plant
- This species was considered as an extinct species until 2004
- Threatening factors: Herbivory by Goat, Habitat loss, Collection, etc
Distribution map of *B. latissimum*. Squares correspond to the actually known distribution of the species.
GIS Tool is ArcGIS 9.1

- Base Data - 1:5000 topo map, 1:5000 soil map, 1:25,000 forest map, 1:25,000 forest feature map
- Made 10m x 10m grid DTM
- Made an analyzed map (Solar radiation, Integrate Moisture Index, Elevation, Aspect, Slope, Curvature, Flow-accumulation, Hill-shading, Soil depth, Forest type, drainage, Forest density, Forest age)
Analyzed Maps

- Solar Radiation
- Moisture Index
- Slope
- Curvature
- Aspect
- Soil
- Flow accumulation
- Elevation
- Forest type
New Habitats were discovered
New habitats were located in northwestern slope with 550-600 Solar radiation index
We tried ecological enhancement of habitat environment
For statistical analysis, input information has a binary structure: "one" present, "zero" absent.

Based on environmental and ecological informations of 23 survey sites in Ulreung Island, a binary logistic regression was applied.

The dependent variable was 1 or zero and the independent variables were 13 environmental factors.
Habitat Suitable Index of *B. latissimum*  

\[
\frac{1}{1 + \exp} = -42.956 + 0.044 \text{sun} + 0.153 \text{imi} + 0.098 \text{curvature} - 0.001 \text{flow accumulation} + 0.335 \text{slope} - 0.008 \text{aspect} + 0.012 \text{hill shade} - 0.003 \text{elevation}.
\]

B. *latissimum* 1/(1+exp) = -42.956 + 0.044 sun +0.153 imi + 0.098 curvature - 0.001 flow accumulation + 0.335 slope - 0.008 aspect + 0.012 hill shade - 0.003 elevation.

Predicted suitable site map for restoration of *Bupleurum latissimum* at Ulreung Island. Red dots show suitable sites for restoration.
### Ecological Restoration Work for *B. latissimum*

#### Before vs. After (2008 vs. 2009)

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<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Density</td>
<td>Blooming Individuals</td>
</tr>
<tr>
<td>Restoration</td>
<td>18.6 ± 6.7</td>
<td>0</td>
</tr>
<tr>
<td>Control</td>
<td>17.7 ± 3.2</td>
<td>0</td>
</tr>
</tbody>
</table>

† Increase
↓ Decrease
Plant conservation activity is not simple because it needs to consider many factors such as climate, topography, soil, air condition, etc.

Application of GIS technology has become a very effective method for the analysis of the relationships between plants and their environment.

We are trying to find out potential areas for restoration and to produce predicted distribution map using the GIS technology.

For the restoration of a rare plant, it is very important to find a suitable habitat for the species. Habitat suitability index (HSI) is an effective method using the algorithm of suitable habitat selection by the GIS technology.

Accumulation of variable habitat information will be an essential factor in order to successfully support and design conservation programs for rare plants using GIS.
Thank You!