European Landscapes and Habitats – Spatial identification and associated changes

Sander Mücher

Remote Sensing of the Environment
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Wageningen University and Research Centre (WUR), Wageningen, NL
Introduction

- Increased human pressures have caused dramatic declines in the quality and the extent of habitats across Europe.
- Habitat degradation and loss – mainly resulting from land use changes - are a primary reason of biodiversity loss.
- Therefore, there is a clear need to monitor LULC!
- These impacts are nowadays widely recognised and have forced national and international agencies to identify protected sites for natural areas with high biodiversity value.
Introduction

- Natura 2000 sites are a good example of protecting valuable sites, but it does not guarantee the preservation of biodiversity in the wider countryside.
- Therefore need to develop a Pan-European Ecological Network (PEEN) to improve the spatial coherence of remaining and fragmented habitats.
- **Spatial information about distribution European habitats is a prerequisite** for the development of a European network.
Objective

- However, **NO actual distribution maps of European habitats existed** and
- Therefore our **objective was to develop a methodology** for their **spatial identification across Europe**.
Methodology

The methodology should enable the spatial identification of all European habitats using state of the art European databases and decision rules on basis of:

- their description in the Annex I of the Habitat Directive
- Additional expert knowledge
- Available environmental data sets
Five-step approach

- Identification, processing and integration of available core spatial data sets covering entire Europe.
- Establishment of knowledge rules for each habitat derived from the descriptions in the Annex I.
- Incorporation of additional ecological knowledge from experts, especially, where the availability of information from the Annex I was limited.
- Construction of predictive spatial distribution models.
- Validation of the results.
Core data: The Map of the Natural Vegetation

Source: Bundesamt für Naturschutz, Bonn

- Scale 1:2.5 M
- Distribution of plant communities, excluding human impact.
- Legend has 699 vegetation classes grouped in 19 main formations.
- It has a very extended database with many attributes.
Potential Natural Vegetation
Core data: Land Cover

Integration of Corine LC, GLC2000 & PELCOM

- Continuous urban fabric
- Discontinuous urban fabric
- Industrial or commercial units
- Road and rail networks and associated areas
- Port areas
- Airports
- Mineral extraction sites
- Dump sites
- Construction sites
- Green urban areas
- Sport and leisure facilities
- Non-irrigated arable land
- Permanently irrigated land
- Rice fields
- Vineyards
- Fruit trees and berry plantations
- Olive groves
- Pastures
- Annual crops associated with perennial crops
- Complex cultivation patterns
- Land principally occupied by agriculture
- Agro-forestry areas
- Broad leaved forest
- Coniferous forest
- Mixed forest
- Natural grasslands
- Moors and heathland
- Sclerophyllous vegetation
- Transitional woodland-shrub
- Beaches, dunes and sands
- Bare rocks
- Sparsely vegetated areas
- Burnt areas
- Glaciers and perennial snow
- Inland marshes
- Peat bogs
- Salt marshes
- Salines
- Intertidal flats
- Water courses
- Water bodies
- Coastal lagoons

[Map of Europe showing various land cover types]
Core environmental data layers

**BIOGEOGRAPHIC**

- ECOREGIONS
- GRID_CODE
- BIOGEOGRAPHIC

**SOIL**

- Major soil groups
- ESDB_v2 (BGDB64)
- FA098_L1

**Elevation models**

- DEM
- SRTM
- Value
  - High: 5588
  - Low: -246

**Atlas Florae Europaeae**

- Family
- Genus
- Species
- Subspecies
### Example expert knowledge

**H9150. Medio-European limestone beech forests of the Cephalanthero-Fagion**

<table>
<thead>
<tr>
<th>CLC:</th>
<th>311 - Broad-leaved forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapping rules:</td>
<td>Atlant. Central (all altitudes), Alpine South / Continental (400 m-1200 m) + Calcareous soils + <em>Fagus sylvatica</em></td>
</tr>
<tr>
<td>Indicator species:</td>
<td><em>Fagus sylvatica, Carex digita, Cephalanthera spp., Neottttia nidus-avis.</em></td>
</tr>
<tr>
<td>GHC (BioHab):</td>
<td>Forest phanerophytes / Winter deciduous + <em>Fagus</em> over 70% + shallow dry calcareous soils + steep slopes + ground flora species.</td>
</tr>
<tr>
<td>Field identification:</td>
<td>A well defined category but grades into 9130.</td>
</tr>
<tr>
<td>Occurrence:</td>
<td>Widespread in large patches but often replaced by <em>Picea abies</em> in the Alps.</td>
</tr>
<tr>
<td>Direct threats:</td>
<td>Felling withy deeper soils conversion to conifer.</td>
</tr>
<tr>
<td>Climate change:</td>
<td>Thermophilic species will be favoured.</td>
</tr>
<tr>
<td>Succession:</td>
<td>Climax.</td>
</tr>
<tr>
<td>Distribution</td>
<td>aln</td>
</tr>
</tbody>
</table>
Top-down implementation for H9150
Validation – Visual Comparison

**H9150**

- **Natura 2000**
  - 2 Medium probability
  - 3 High probability

- 1 Low probability
Validation – Natura 2000 sites
Validation with Natura 2000 sites
Limitations of used method

- The distribution maps involve only the likely occurrence of the habitat concerned i.e. probability.
- Over- and underestimation of the actual area due to spatial resolution.
- Therefore, we can not directly assess the surface area of the habitats.
- Alternative, is to use stratified sampling approach (e.g. BIOHAB / UK country side), but this does not provide spatial distribution of the habitats.
Opportunities of used method

- Integration with in-situ data and survey samples to calibrate model/knowledge rules and to improve areal estimates.
- Further integration with RS derived land surface parameters (e.g. FAPAR, surface albedo) and phenology.
Assessment of impact LCC at Landscape level

Landscapes (LANMAP)

CORINE LCC

Natura 2000 sites
Variation in habitat types per landscape type
Urbanisation per European Landscape Type

Period: 1990-2000
Afforestation per European Landscape Type

Period: 1990-2000 based on CLC

Afforestation (ha)

- Mediterranean hills dominated by rocks (Mhr)
- Coastal and halophytic habitats (Nr 1)
- Coastal sand dunes and inland dunes (Nr 2)
- Fresh water habitats (Nr 3)
- Temperate Heath and Scrub (Nr 4)
- Scleropyllous scrub (Nr 5)
- Natural grassland formations (Nr 6)
- Raised bogs, mires and fens (Nr 7)
- Rocky habitats (Nr 8)
- Forests (Nr 9)

Total of habitat types: 139
Recent developments

Trends in Phenology
GIMMS NDVI time series 1983-2003

Wit & Mücher
Impact of land cover changes are site specific

- Strong variation in land cover dynamics over the different landscapes.
- Landscapes differ very much in richness of habitat types and,
- Impact on biodiversity of these land cover dynamics depends on habitat types present in the landscape and the spatial range of the habitat types affected.
Concluding

- The presented method is very useful but provides only an indication of likely occurrence.
- Uncertainties in the mapping results remain in case of poor habitat descriptions, inaccuracies or lack of environmental data sets.
- Habitats with a wider European distribution were easier to identify than local and dispersed habitats.
- Integration with vegetation relevés and survey samples needed to calibrate model/knowledge rules and to improve areal estimates.
- Further integration needed with indicators derived from Remote Sensing.
- Landscapes are suitable for analysing impact of land cover dynamics on biodiversity and shows that impacts are very site specific.
Thank you for your attention!
Result H6170

H6170 ALPINE AND SUBALPINE CALCAREOUS GRASSLANDS

Photos: Thomas Wrba