Geomatics Department - Humboldt-Universität zu Berlin

Using remote sensing to assess land use change and biodiversity in the Carpathian Ecoregion

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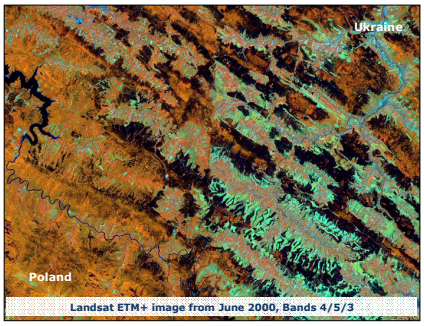
Remote Sensing & Biodiversity

- Remote Sensing (RS) encompasses the ability to translate traditional ecological field data to regional and global extent through its continuous spatial information
- Assessing land cover data can reflect human interactions by revealing the underlying land use
- RS of biodiversity may be measured directly (hyperspatial/hyperspectral) and indirectly
- Indirect measures combine habitat requirements with land cover derived from RS
- Therewith estimation of potential species ranges and patterns of species richness possible
- Essential environmental parameters such as primary productivity, climate and habitat structure serve as key indicators to determine biodiversity from RS data



Landsat ETM+ image from June 2000, Bands 4/5/3

- Landsat data longest of any satellite (30 years) with a resolution (30 m) able to detect subtle environmental changes
- Satellite measurements of broad scale trends in vegetation (e.g. deforestation) provide direct estimates of habitat loss
- Landscape ecology offers rich toolset to describe landscape composition, to map changes in patterns (e.g. forest fragmentation) and to relate these to biodiversity change
- Challenge lies in finding the appropriate scale between imagery and species richness data
- Question is why species are located where they are (habitat suitability), why certain areas are species rich, and therefore what areas need to be conserved

Carpathians & Biodiversity

- The Carpathians are Europe's largest temperate forest ecosystem:
  - high biodiversity, many endemic species
  - high carbon sequestration potential
  - habitat for large carnivores and herbivores
- Belonging genetically to the European alpine bio-geographic region, comprising an area of more than 200,000 km²

- Eastern Europe has still large forest resources, some of them remained relatively undisturbed (300,000 ha of natural montane forests)
- Many forest parcels returned to rightful owners within process of land restitution
- Parcels now managed under marked oriented aspects

- Drastic institutional, political, societal and economic changes followed the transition after 1989/90
- This triggered extensive land-use and land-cover change, with corresponding impacts on ecosystems and biodiversity

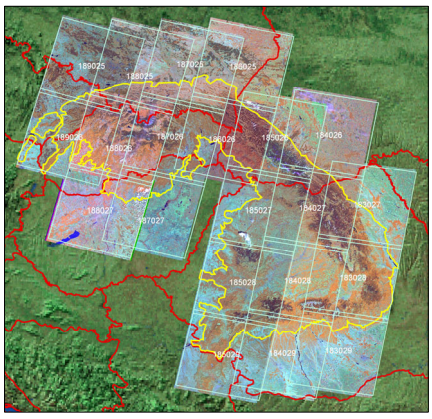
Data base

- Due to the extent, biodiversity indicators may be assessed only with RS
- The area comprises 21 Landsat TM scenes, each 185x185 km large

Biodiversity hotspot

- Over 300 bird species (e.g. pied flycatcher, Ural owl, white-backed woodpecker)
- Many species included in habitat directive (e.g. Tatra pine vole, Carpathian marmot)
- Europe's biggest population of large carnivores (8,000 bears, 4,000 wolves and 3,000 lynx), about 40% of EU total

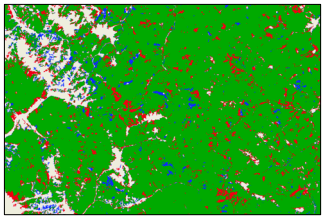
The study region together with a Landsat ETM+ mosaic from 2000 (band combination R=4, G=5, B=3) and the encompassed paths and rows of Landsat TM 5

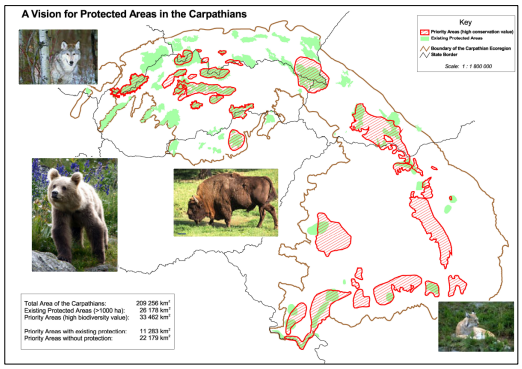


Project Goals


Above: Illegal clear cutting in the Ukrainian Carpathians; resulting landslides (Slovakia)

- Investigating the relationship of land-use change & biodiversity
- Examining consequences of recent land-use change on wildlife and biodiversity
- Testing the effectiveness of protected areas and their surroundings in this context (comparing land-change inside and outside)
  - Therefore apply landscape-pattern-oriented and species-oriented approaches
  - assumption that biodiversity patterns can be explained by heterogeneity in primary productivity or landscape structural properties
  - Spatially explicit fragmentation measures such as forest fragmentation will be used to map changes in landscape pattern
  - habitat requirements of Flagship/umbrella species (top carnivores or top herbivores) will be correlated with habitat suitability (e.g. landscape heterogeneity) to assess biodiversity and its change


Forest cover change map from the Ukrainian Carpathians between 1988 and 2007
(green=permanent forest; blue=afforestation; red=deforestation; gray=no forest)



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