

## Chapter V

# Environmental Monitoring and Management of Protected Areas through Integrated Ecological Information Systems – An EU Perspective

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### ABSTRACT

*Integrated ecological information systems are characterized by a broad range of thematic spatial data layers and a variety of specific application areas. Monitoring and management tasks differ widely and cover scales from local to continental. In European Nature Conservation the implementation of the habitat directive (92/43/EEC), the bird directive (79/409/EEC) and the Natura 2000 network requires a harmonized monitoring and management of the designated protection areas. This task challenges local authorities responsible for the individual sites as well as authorities on the national and EU level that are in charge of the assessment and channelling of the huge data flow arising with observation, documentation, and control mechanisms from the local sites. Environmental information systems with integrated Earth Observation (EO) will provide an essential contribution to the monitoring of NATURA 2000 sites and other protected areas of European importance beyond established mapping and classification approaches. Data streams from EO data processing and field ecological work will converge in an operational Geographic Information System (GIS) with a harmonized design but open to regional specifications. First case studies across Europe highlight the enormous stimulus of EU legislation on the development and harmonization of environmental monitoring and management procedures.*

## OBJECTIVES

The overarching objective of this chapter is to provide an overview and a tangible work flow scheme showing how to convert data from different sources (satellite sensors, nature conservation plans, and ecological field records, down to the species level) into information indispensable for operational tasks of monitoring and management of protected areas of European importance. Comprehensive indicators will be the major medium to carry information beyond state of the art classification and interpretation approaches. Several projects within the EU Fifth framework program are exemplifying and testing various methods in Pan-European transects in order to allow comparative investigations to provide accepted recommendations for regional and European nature conservation.

The chapter addresses the technical and scientific domains of earth observation (EO) and GIS as widely used tools to support environmental management tasks specifically driven by EU legislation. Several approaches and research activities are described which are currently developed and tailored to analyze, describe, classify, evaluate, monitor and manage protected areas efficiently.

In detail the research review focuses on approaches which aim:

- to improve classification accuracy and thematic differentiation for the mapping of key habitats
- to develop standardized methods of land cover mapping
- to develop standardized methods in change detection of land cover
- to overcome the 'isolated pixel' approach by converting structural and textural features into information i.e. comprehensive indicators to evaluate the state of investigated habitats
- to investigate performance and interdependency of sensors in different resolutions in a nested multiscale approach
- to estimate key biophysical properties of land surfaces relevant for the protected sites.

This paper gives an outline of current environmental monitoring and management research activities relevant to the establishment of integrated GIS / remote sensing – based information systems and evaluates standardization progress regarding monitoring methods. It shows that EU legislation such as the habitat directive and the bird directive have strong impacts on the management of thousands of protected areas all over Europe. Furthermore, it is highlighted that these legislative implications are stimulating and channelling scientific research in various environmental disciplines.

## STATE OF THE ART—TECHNOLOGY FOR ENVIRONMENTAL MANAGEMENT

### The need for spatial tools

The main challenge of current information systems and data bases is their complexity and the heterogeneous data environment rather than the sheer volume of data produced. GIS and remote sensing together are crucial tools for the tasks

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