

A thematic contribution to the
National Biodiversity Strategy

The Ecoregions of Italy



A thematic contribution to the

National Biodiversity Strategy

The Ecoregions of Italy



Ministry of the Environment, Land and Sea Protection
Nature Protection Directorate
General Director Aldo COSENTINO



Italian Society of Botany onlus
President Francesco Maria RAIMONDO



Interuniversity Research Center "Biodiversity, Plant Sociology and Landscape Ecology"
Sapienza University of Roma
Director Carlo BLASI



University of Salerno
Department of Civil Engineering
Director Luigi ASCIONE

Authors

Carlo Blasi, Giulia Capotorti, Daniela Smiraglia, Domenico Guida, Laura Zattero, Barbara Mollo, Raffaella Frondoni, Riccardo Copiz

Research director

Carlo Blasi

Scientific coordination of the research project

Carlo Blasi, Giulia Capotorti, Daniela Smiraglia, Domenico Guida

Advisory group

Piera Di Marzio, Vincenzo Siervo, Leopoldo Michetti, Lorenzo Teodonio

Assistants to the editors

Ilaria Anzellotti, Sandro Bonacquisti

Photos by

M.M. Azzella, S. Burrascano, G. Capotorti, R. Copiz, R. Frondoni, C. Lasen

Front cover

Majella National Park. Photo G. Capotorti

© 2010

All rights reserved: Ministry
of Environment, Land and Sea
Protection
Nature Protection Directorate

Design by:

Progetto Artiser - Roma
www.artiser.it
info@artiser.it

FOREWORD

Ecosystems are the result of complex interactions between the physical environment, wildlife and human culture. Recent interest in both biodiversity conservation and sustainable land management stimulated improved knowledge on structure, function, services and distribution of ecosystems at the landscape level. Management of the natural resources may best be accomplished by means of an ecosystem-based approach (Convention on Biological Diversity 2000), which requires ecosystems to be spatially delineated and their occurrence and status considered as conservation targets (Sayre *et al.* 2008).

Within this context, ecological classifications of land, such as the ecoregion classification, provide an appropriate framework for environmental surveys, resource assessment and monitoring programmes. The ecoregion classification process allows land units whose level of natural potential and influence upon human activities is comparable to be delimited, characterised and hierarchically arranged according to the scale and importance of the main environmental factors. This process is being adopted throughout the world by international organisations (e.g. Food and Agriculture Organization of the United Nations - FAO), governmental and intergovernmental agencies (e.g. U.S. Environmental Protection Agency - EPA; European Environment Agency - EEA) and environmental associations (e.g. World Wildlife Fund - WWF).

In Italy, ecoregion classification, based on detailed scientific data, represents a framework that is used to effectively address national strategies for sustainability and harmonise landscape planning according to European policies (Habitats Directive; European Landscape Convention; Pan-European Biological and Landscape Diversity Strategy) and national laws (L. 394/1991 for Protected Areas; Code of Cultural Heritage and Landscape).

The National and Regional Biodiversity Strategies can thus adopt the "Ecoregions of Italy" project, which is being conducted by a multidisciplinary team coordinated by the Interuniversity Research Center "Biodiversity, Plant Sociology and Landscape Ecology", as a tool to draw up guidelines and plans of action based on the natural potential and conservation status of ecological land units as opposed to administrative boundaries.



Cilento and Vallo di Diano National Park. Southern Italy. Photo S. Burrascano

WHAT ARE ECOREGIONS?

Definitions and synonyms

Ecoregions are broad and discrete **ecologically homogeneous areas** of the Earth's surface within which **natural communities** and **species interact** with the **physical characteristics** of the environment.

Ecoregions delineate zones of **similar potential** as regards the climate, physiography, oceanography, hydrography, vegetation and wildlife, and as such provide a geographic framework for interpreting ecological processes, disturbance regimes, vegetation patterns and dynamics

Synonyms: environmental zones - land systems - natural geographic divisions - ecological land units - ecosystem regions - regional ecosystem patterns - environmental units

Hierarchical organisation

Ecoregions can be defined as geographical units of varying size at the global, continental, regional and local level. Depending on the scale of observation, various environmental factors may explain the current state of ecological discontinuity and the processes that have led to such a state. Ecoregions can thus be delimited and hierarchically arranged within a framework of nested levels. Since the broader patterns and functions within this framework control the character of the lower systems, the classification is usually based on a deductive, or top-down, process: the highest level contexts, which are defined first, are subdivided into progressively smaller areas of increasing ecological homogeneity.

Boundary criteria

Incremental interaction of climatic regimes, biogeographic influence, landform features and soil properties, and their constraints on potential vegetation distribution, allow ecological boundaries to be defined on different scales, with certain variations being expected between different geographical areas.

Owing to their diagnostic value as regards the environmental conditions and the overall biological diversity, natural vegetation communities are usually used to delineate ecological regions. However, where potential vegetation cover has been altered considerably by human intervention, significant variations in physical components of the environment (e.g. climate, physiography, soils, and hydrography) may be used to indirectly delineate ecological boundaries.

As ecological systems are, by definition, open and permeable, the boundaries between ecoregions usually mark transition zones whose size may vary (Bailey 2005; Marshall & Schut 1999).

Majella National Park. Central Italy. Photo G. Capotorti



WHAT HAVE ECOREGIONS BEEN CONCEIVED FOR?

Ecoregions are designed to address environmental, social and economic strategies toward a holistic ecosystem approach within a common geographic framework (Omernik 2004; Bailey 2005; Marshall & Schut 1999).

Purposes, objectives and general use of ecological units at the *global* and *continental* levels

- Critical ecological information for ecosystem *conservation* and *management*, calculation of *ecosystem goods and services* values, and ecosystem *GAP analysis* (GEO 2008)
- International *conservation planning* (Olson *et al.* 2001)
- Ecosystem-based *strategic policy* (Bailey 1996)
- *Global Forest Resources Assessment* according to the structural and functional characteristics of vegetation as opposed to national boundaries (FAO 2000)
- Implementing *ecosystem management* for different expressions of biodiversity in Europe (EEA 2000)

Purposes, objectives and general use of ecological units at the *national* level

- Integrating multiscale and long-term management activities between agencies that have different responsibilities for the same geographic area (United States of America: Omernik 2004)
- Ecosystem services assessment, climate change impact studies, biodiversity conservation and resource management (South America: Sayre *et al.* 2009)
- Planning of national protected areas and management of forests (Australia: Commonwealth of Australia, <http://www.environment.gov.au/parks/nrs/science/scientific-framework.html>)
- Ecoregional orientation of environmental policy, including susceptibility assessment, predictive modelling and environmental quality assessment (The Netherlands: Klijn & de Haes 1994)

Torre Salsa Natural Reserve. Sicily. Photo R. Copiz

Why promote the ecoregion classification and mapping in Europe?

Conservation of natural resources according to the ecosystem approach of the Convention on Biological Diversity (Rio de Janeiro 1992; Johannesburg 2002)

Scientific-based adaptation strategies toward climate changes and desertification according to the United Nations UNFCCC and the UNCCD conventions (Rio de Janeiro 1992)

Landscape protection, management, and planning according to the European Convention on Landscape (Florence 2000)

Assessment of regional representativeness of the Natura2000 Network according to the European Habitats Directive (92/43/CEE)

“The primary purpose for delineating ecological units is to identify land and water areas at different levels of resolution that have similar CAPABILITIES and POTENTIAL for MANAGEMENT” (Cleland *et al.* 1997)

THE ECOREGIONAL APPROACH THROUGHOUT THE WORLD

Global mapping of terrestrial ecoregions

ECOREGIONS OF THE CONTINENTS (Bailey 1995)

Levels	Diagnostic criteria
4 Domains	Climatic groups and climate-controlled vegetation structure
30 Divisions	Climatic types, dominant plant life-forms and pedogenetic features and one mountain variant for each division

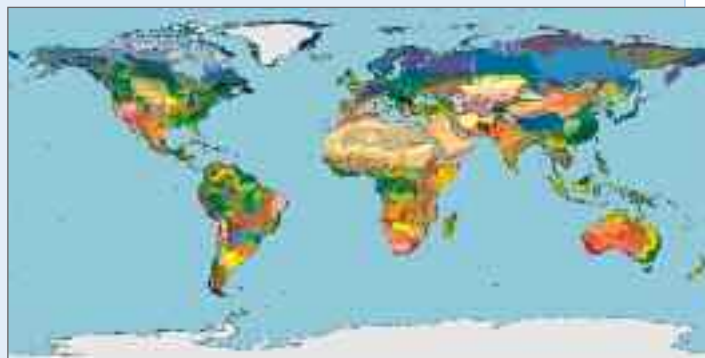


GLOBAL ECOLOGICAL ZONE (FAO 2000)

Levels	Diagnostic criteria
5 Domains	Global Köppen-Trewartha climatic groups
20 Ecological zones	Köppen-Trewartha climatic types combined with vegetation physiognomy and one orographic zone within each domain

TERRESTRIAL ECOREGIONS OF THE WORLD (Olson *et al.* 2001)

Levels	Diagnostic criteria
8 Realms	Global biogeographic realms
14 Biomes	Global and regional biogeographic and ecoregion systems maps
867 Ecoregions	Global floristic and zoogeographic provinces, global and regional distribution of plants and animals, broad vegetation types



Regional and national ecoregion mapping



Digital Map of European Ecological Regions

The DMEER maps delineate and describe distinct ecological areas in Europe on the basis of updated knowledge of climatic, topographic (Bunce 1995) and geobotanical European data (Bohn 1994) as well as the opinion of a large team of experts from various European nature-related Institutions and the WWF.

<http://www.eea.europa.eu/data-and-maps/data/digital-map-of-european-ecological-regions>



National Hierarchical Framework of Ecological Units in the U.S.A.

The Framework provides a standardised method for classifying, mapping and describing ecological units on various geographic planning and analysis scales to stratify the land into progressively smaller areas of increasingly uniform ecological conditions and potential. This hierarchical framework consists of eight levels of nested map units.

<http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/>

U.S.A.		
Application scale	Ecological units	Map unit design criteria
National (Ecoregions)	Domain	Broad climatic zones or groups
	Division	Regional climatic types, vegetational affinities
	Province	Dominant potential natural vegetation, mountains
Regional (Subregions)	Section	Geologic stratigraphy and lithology, soils
	Subsection	Surficial geology, soils
National forest (Landscapes)	Landtype association	Geologic formation, elevation, soils
Project (Land units)	Landtype	Landform and topography, rock type, soils
	Landtype phase	Landform and slope position, soils

Interim Biogeographical Regionalisation for Australia

Regionalisation supports the National Strategy for the Conservation of Australia's Biological Diversity (1996) and the National Forest Policy Statement (1992, 1995). The map of Australia's 85 bioregions is derived from the work of state and territory agencies who map vegetation communities and land systems. The fundamental ecoregional map is further refined to map Australia's 403 subregions. <http://www.environment.gov.au/parks/nrs/science/ibra.html>



AUSTRALIA	
Levels	Map unit design criteria
Biogeographic realms	Global biogeographic realms from Olson <i>et al.</i> 2001
Terrestrial habitats	Global biome systems from Olson <i>et al.</i> 2001
IBRA Bioregions	Climate, geology, landform, soils and plant and animal communities
IBRA Sub-bioregions	Patterns of landforms and vegetation
Regional ecosystems	Vegetation types

THE ECOREGION CLASSIFICATION PROCESS IN ITALY

Methodology and basic data

The identification and delineation of the ecoregions in Italy is also based on a hierarchical deductive approach. The hierarchical levels, diagnostic criteria and scale ranges follow the North-American model (Cleland *et al.* 1997), though significant changes have been made to adapt it to the highly complex conditions found in Italy. Basic environmental data have been collected, processed and integrated by the multidisciplinary team involved in the project, which includes climatologists, geomorphologists, geobotanists and ecologists.

BASIC DATA		
Biophysical attribute	Classes	Sources
Bioclimate	Macroclimatic regions	Bioclimatic map of Europe (Rivas-Martinez <i>et al.</i> 2004)
	Bioclimatic type	Updated Phytoclimatic map of Italy (Blasi & Michetti 2005 and unpublished data)
	Bioclimatic belt	
Biogeography	Regions/Subregions	Biogeographic map of Europe (Rivas-Martinez <i>et al.</i> 2004) modified according to recent national and local schemes (Biondi <i>et al.</i> 2006; Blasi <i>et al.</i> in press)
	Provinces	
	Sectors	
Geomorphology	Orographic systems	Structural Model of Italy (Bigi <i>et al.</i> 1992)
	Litho-structural regions and morpho-tectonic sectors	Geological sheets of the National Geological Service
Vegetation	Structure and physiognomy of zonal vegetation	Map of Natural Vegetation of Europe (Bohn <i>et al.</i> 2003) Map of Vegetation Series of Italy (Blasi 2010)
	Characteristic species of main vegetation types	
	Combination of vegetation series	
	Prevalent vegetation series	
Land cover	CORINE Land cover classes and environmental state indicators	CORINE Land Cover 2000 and change 1990/2000 (APAT 2005)
	Land cover change typologies and patterns and environmental pressure indicators	Risk of forest fires (Marchetti <i>et al.</i> 2004)

HIERARCHICAL CLASSIFICATION SCHEME FOR ITALIAN ECOREGIONS				
Application level	Ecological units	Scale	Principal map unit design criteria	Natural vegetation descriptors
Continental and National	Division	1:5,000,000	Macroclimatic zones Biogeographic regions /subregions	Structure and physiognomy of major zonal vegetation types
National	Province	1:1,000,000	Orographic systems Biogeographic provinces	Dominant, common and distinctive vegetation physiognomies
National and Regional	Section	1:500,000	Litho-structural regions Biogeographic sectors Bioclimatic type	Characteristic combination of vegetation physiognomies
National and Regional	Subsection	1:250,000	Morpho-tectonic sectors Ombrotype and thermotype Characteristic combination of vegetation series	Prevalent vegetation series

The national classification scheme

The multidisciplinary team drew up a national classification scheme consisting of four hierarchical levels, spanning the continental, national and subnational application scales. Map units were designed according to biophysical diagnostic criteria and described through the main characteristics of potential natural vegetation. Further levels may be identified on finer scales according to the proposal for ecosystem classification and mapping drawn up for the Italian landscapes (Blasi *et al.* 2000), which would lead to the delineation of Land systems, Land facets and Environmental units on the basis of detailed information on local morphostructures, surface lithology, topography and specific vegetation series.

ECOREGIONS OF ITALY

The ecoregional classification process applied to Italy led to the identification and mapping of 2 Divisions, 13 Provinces, 33 Sections and approximately 80 Subsections.

Each unit in the legend has an alphanumeric code that indicates its hierarchical level and a full name that indicates its geographic location and main diagnostic factor.

1 TEMPERATE DIVISION

11 Northern Alpine Chain Province

- 11A Ligurian Range Section
- 11B Western Range Section
- 11C Retic Alps Section

12 Southern Alpine Chain Province

- 12A Prealpine Range Section
- 12B Orobic Alps Section
- 12C Dolomite Section

13 Ligurian-Padanian Basin Province

- 13A Po Plain Section
- 13B Langhe-Monferrato Hills Section

14 Apennine Chain Province

- 14A Tuscan-Emilian Apennine Range Section
- 14B Tuscan Basin Section
- 14C Umbrian-Marchigian Apennine Section
- 14D Latium Volcanic Complex Section
- 14E Latium-Abruzzi Apennine Range Section
- 14F Campanian-Lucanian Apennine Section

15 Adriatic Foredeep Province

- 15A Central Adriatic Hills Section

2 MEDITERRANEAN DIVISION

21 Tyrrhenian Borderland Province

- 21A Tuscan Section
- 21B Roman Section
- 21C Latium-Campanian Section

22 Sardinia-Corsica Block Province

- 22A Gennargentu Mountains Section
- 22B Campidano-Sassarese Lowlands Section
- 22C Iglesias Mountains Section

23 Pelagian Block Province

- 23A Pantelleria and Linosa Islands Section
- 23B Lampedusa and Lampione Islands Section

24 Apulian-Hyblaean Foreland Province

- 24A Hyblaean Mountains Section
- 24B Apulian Lowlands Section
- 24C Gargano Promontory Section

25 Bradanic-Sicilian Foredeep Province

- 25A Sicani Basin Section
- 25B Bradanic Lowland Section

26 Sicilian Apennine Chain Province

- 26A Etna Volcano Section
- 26B Nebrodi-Madonie Mountains Section

27 Aeolian Arc Province

- 27A Aeolian Islands Section

28 Calabrian-Peloritani Arc Province

- 28A Peloritani Range Section
- 28B Calabrian Section



ITALIAN DIVISIONS

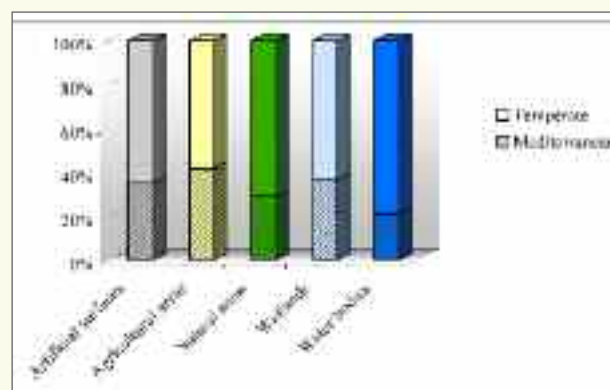
According to the global classification systems, Italy belongs to the Humid Temperate Domain, characterised by marked differences between seasons in temperature and precipitation and winter frost. Within this Domain, Italy is subdivided in two distinct Divisions, i.e. Temperate and Mediterranean, which are related to the latitudinal extent of the peninsula, the influence of the Mediterranean sea and the position of the Alpine and Apennine ranges.

The Divisions provide a framework for strategic planning and assessment, such as the preparation and development of a National Strategy for Climate Change Adaptation. Moreover, detailed land cover information (APAT 2005) for each Division offers the opportunity to more effectively define urban, agricultural and environmental sectoral policies.



DIVISIONS AND SECTORAL POLICIES

LAND COVER CLASSES DISTRIBUTION



Basic data source: APAT 2005.

1 Temperate Division

Geographic distribution. The Alps, the Po Plain, central-northern Apennines, and part of the southern Apennines as far as the Pollino range that straddles Basilicata and Calabria. The Temperate Division accounts for 64% of the area of Italy, which covers an overall area of approximately 300,000 km².

Climate. Brief or absent summer aridity, with precipitation concentrated during the spring-summer period; difference between winter and summer temperatures is usually marked, with an ocean-type climate (temperature difference of 17/18 °C) along the western side of the Apennines and the Insubric prealpine zone, a semicontinental-type climate (temperature difference of 17°C to 21°C) along the Alpine range and the eastern side of the Apennines and a subcontinental-type climate (temperature difference of 21°C to 25°C) in the Po Plain. The Ligurian coast is characterised by a Mediterranean-type variant.

Vegetation features. Potential natural vegetation prevalently consists of forest, the few exceptions being the shrublands and prairies found in the higher mountain belts and along the coastline. The Italian part of the Temperate Division belongs to the Alpine-Caucasian Subregion of the Eurosiberian biogeographic Region, which means the broad-leaved deciduous species of the genera *Quercus*, *Fagus*, *Carpinus*,



Monti Sibillini National Park. Central Italy. Photo S. Burrascano

Acer and *Fraxinus* prevail and the needle-leaved species of the genera *Picea*, *Abies*, *Pinus* and *Larix* only prevail in the upper mountain and subalpine belts. Reference classes: *Quercus roboris-Fagetea sylvaticae* and *Vaccinio-Piceetea*.

Land cover and land use. Natural and semi-natural areas represent the most widespread cover class (47.1%), closely followed by agricultural areas (46.6%); artificial surfaces cover 4.7% of this Division, whereas wetlands and water bodies respectively cover 0.2% and 0.6%.

2 Mediterranean Division

Geographic distribution. Large and small islands, Tyrrhenian coasts south of eastern Liguria, southern Apennines south of the Pollino range, Ionian sector and southern Adriatic coasts. The division accounts for 36% of the area of Italy.

Climate. Presence of summer aridity, precipitation concentrated during the autumn-winter period, and reduced difference between winter and summer temperatures. Mountain reliefs of southern Apennines, Sicily and Sardinia represent an orographic variant with a temperate climate but low level of continentality (less than 17°C).

Vegetation features. Potential natural vegetation prevalently consists of forest, with mixed woods of evergreen and deciduous *Quercus* species whose presence is due to the moderately dry summer seasons; forests and shrublands consisting exclusively of evergreen sclerophyllous species (*Quercus ilex*, *Q. suber*, and Mediterranean maquis) characterise a narrow coastal strip along the peninsula, significantly penetrate inland areas only in Sardinia and the Apulian plateau (the "heel of the Italian boot"). The subdivision between the Western and Eastern Mediterranean biogeographic Subregions results in a peculiar mixture of Mediterranean, Illyrian and Subatlantic elements. Reference orders: *Quercetalia pubescenti-petraeae*, *Quercetalia ilicis*, *Pistacio-Rhamnietalia alaterni*.



Vendicari Natural Reserve. Sicily. Photo R. Copiz

Land cover and land use. Agricultural areas cover more than natural and semi-natural areas (61.5% vs 32.9%); artificial surfaces and wetlands cover areas that are comparable to those in the Temperate Division, accounting respectively for 4.7% and 0.2%, while the presence of water bodies, which cover 1.3% of this Division, is more significant.

ITALIAN PROVINCES



Vegetation series in the Italian Provinces

- 11 NORTHERN ALPINE CHAIN Province
- Coniferous forests and subalpine heaths and scrubs
Alpine and subalpine natural grasslands
 - Fagus sylvatica* forests; *Quercus petraea* forests
 - High altitudinal grasslands with *Sesleria*, *Carex*, *Festuca* and herbaceous *Salix* species
- 12 SOUTHERN ALPINE CHAIN Province
- Fagus sylvatica* forests
 - Coniferous forests and subalpine heaths and scrubs; *Picea abies* forests and *Abies alba* forests
 - Pioneer *Pinus sylvestris* communities with *Ostrya carpinifolia*
- 13 LIGURIAN-PADANIAN BASIN Province
- Carpinus betulus* and *Quercus robur* forests
Riparian and hygrophilous forests
 - Quercus petraea* forests
 - Halophilous meadows and scrubs of the northern Adriatic lagoons
- 14 APENNINE CHAIN Province
- Quercus cerris* forests
Quercus pubescens forests
 - Fagus sylvatica* forests; mixed forests with *Ostrya carpinifolia*
 - Plain and riparian forests with *Quercus robur*, *Carpinus betulus* *Salix* species and *Alnus glutinosa* of the Apennine intermountain basins
- 15 ADRIATIC FOREDEEP Province
- Mixed *Quercus pubescens* forests
 - Riparian and hygrophilous forests; mixed *Ostrya carpinifolia* forests
 - Mixed forests with *Quercus pubescens*, *Q. cerris* and *Ostrya carpinifolia*



Natural vegetation descriptors for Provinces

- dominant potential vegetation physiognomies
- additional widespread potential vegetation physiognomies
- distinctive vegetation physiognomies

Basic data source: Blasi 2010

- 21 TYRRHENIAN BORDERLAND Province
- Quercus cerris* forests
Riparian and hygrophilous forests
 - Other deciduous oak woods (prevalently *Quercus frainetto* and *Q. pubescens*); *Quercus ilex* forests
 - Subcoastal plain forests with *Fraxinus oxycarpa*
- 22 SARDINIA-CORSICA BLOCK Province
- Quercus ilex* forests
Quercus suber forests
 - Sardinian endemic *Quercus ichnusa* forests
- 23 PELAGIAN BLOCK Province
- Mediterranean *Pinus* forests
 - Mediterranean pre-desert scrubs with *Euphorbia dendroides*; *Quercus ilex* forests
 - Mediterranean scrubs with *Euphorbia dendroides*, *Juniperus turbinata* and *Periploca angustifolia*
- 24 APULIAN-HYBLAEAN FORELAND Province
- Quercus ilex* forests
 - Quercus virgiliana* forests; *Q. trojana* forests
 - Salento *Quercus ithaburensis* subsp. *macrolepis* forests; Murge *Quercus trojana* forests; Sicilian Mediterranean maquis with *Rhus tripartita*
- 25 BRADANIC-SICILIAN FOREDEEP Province
- Quercus virgiliana* forests
 - Riparian and hygrophilous forests; mixed forests with *Quercus pubescens*
 - Pioneer grasslands and maquis with *Pistacia lentiscus* of Lucanian badlands
- 26 SICILIAN APENNINE CHAIN Province
- Quercus virgiliana* forests
 - Quercus congesta* forests; *Q. suber* and *Q. ilex* forests
 - Mediterranean mountain coniferous forests with *Abies nebrodensis*
- 27 AEOLIAN ARC Province
- Quercus ilex* forests
 - Quercus virgiliana* forests
 - Mediterranean pre-desert scrubs with *Euphorbia dendroides*
- 28 CALABRIAN-PELORITANI ARC Province
- Quercus virgiliana* forests
 - Fagus sylvatica* forests; *Quercus cerris* forests
 - Mediterranean mountain coniferous forests with *Pinus nigra* subsp. *calabrica*

Applications

At the Province level, ecological regionalisation offers the opportunity to better define actions for biodiversity conservation and sustainable development.

In Italy these broad ecoregions represent a common framework within which both national and regional policies can be harmonised. Concertation between central government and local bodies for environmental policies should dispose of an ecological land classification so to avoid divisions and inconsistencies.

The application fields span global and European strategies, including numerous commitments made by the Convention on Biological Diversity, the Global and the European Strategies for Plant Conservation, the Mediterranean Strategy for Sustainable Development and the Mediterranean Action Plan, the European Habitats Directive - 92/43/EEC, the Pan-European Biological and Landscape Diversity Strategy, the Climate Change White Paper of the European Union - COM (2009) 147, and the Strategic Guidelines for Rural Development within the EU Common Agricultural Policy.

PROVINCES AND DRIVERS OF BIODIVERSITY LOSS

LAND COVER CHANGE

Land cover change between 1990 and 2000 significantly involved the Northern Alpine Chain and the Apennine Chain Province within the Temperate Division and the Sardinia-Corsica Block Province within the Mediterranean Division.

As an example, the main trends of change between the third level CORINE land cover classes are shown in the transition matrix for the Apennine Chain Province. Values are expressed in hectares (in colour values exceeding 1000 or 5000 ha).

Basic data source: APAT 2005.

1990	2000								
	112	121	221	242	243	311	313	324	334
211	2616	3170	1146	3160	1330	28		364	
221	67	22		1486	20				
242	4024	807	2064		113			295	
243	1720	297	49	188		4880	151	8833	
311	146	24			27		92	4458	260
312								247	1243
321	12				240	137		7412	
324	6				95	24337	2763		96

112 Discontinuous urban fabric
 121 Industrial or commercial units
 211 Non-irrigated arable land
 221 Vineyards
 242 Complex cultivation patterns
 243 Land principally occupied by agriculture, with significant areas of natural vegetation
 311 Broad-leaved forest
 312 Coniferous forest
 313 Mixed forest
 321 Natural grassland
 324 Transitional woodland/shrub
 334 Burnt areas

FOREST FIRES

National Provinces and forest fire risk in winter (left) and summer (right) according to climate conditions, vegetation cover and topography.

Basic data source:

Marchetti et al. 2004.



ITALIAN SECTIONS

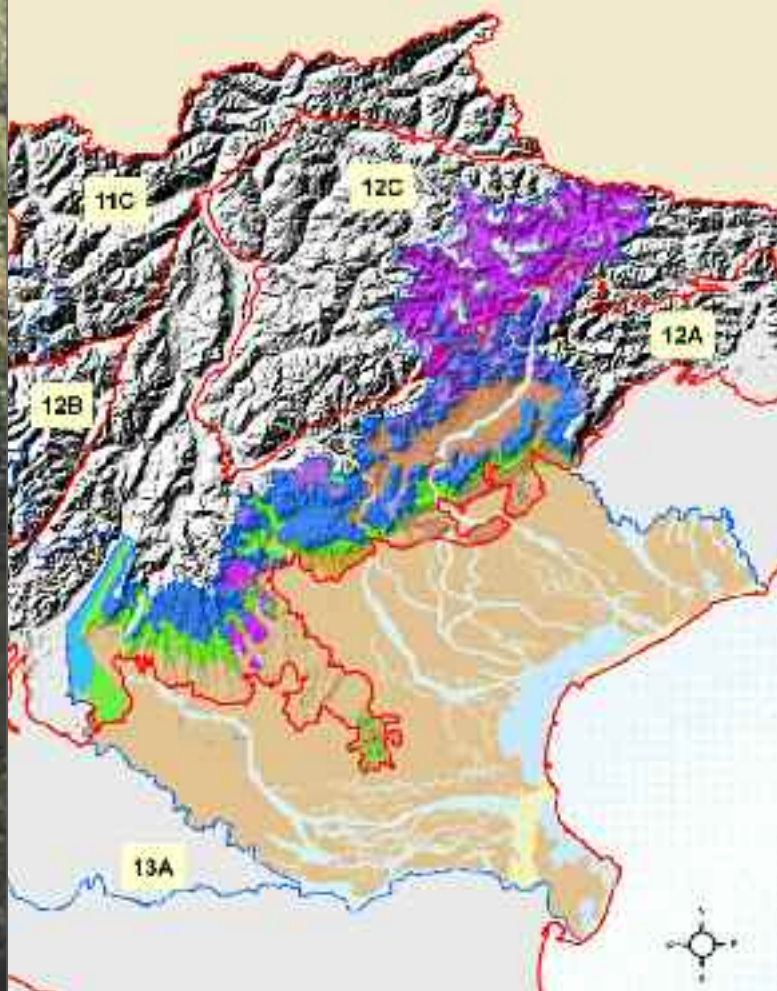
Within this project, 33 Sections were recognised on the national scale: 15 within the Provinces of the Temperate Division and 18 within the Provinces of the Mediterranean Division.

The Section units provide a uniform form of support for planners and scientists involved in communication and coordination at the national level whose task is to study environmental management problems, organise data collection for broad-scale resource inventories and compare results. Furthermore, they provide a scientific basis for broad land planning, region-wide assessment and monitoring programmes. For these reasons, the section level provides an important ecological framework for the drafting of regional landscape plans, of the management plans of the Natura2000 network and for the regional rural development policies.



Italian Sections

Vegetation series in Sections of the Veneto administrative region.
Basic data source: Blasi 2010.



Dolomiti Bellunesi National Park. Northern Italy. Photo C. Lasen

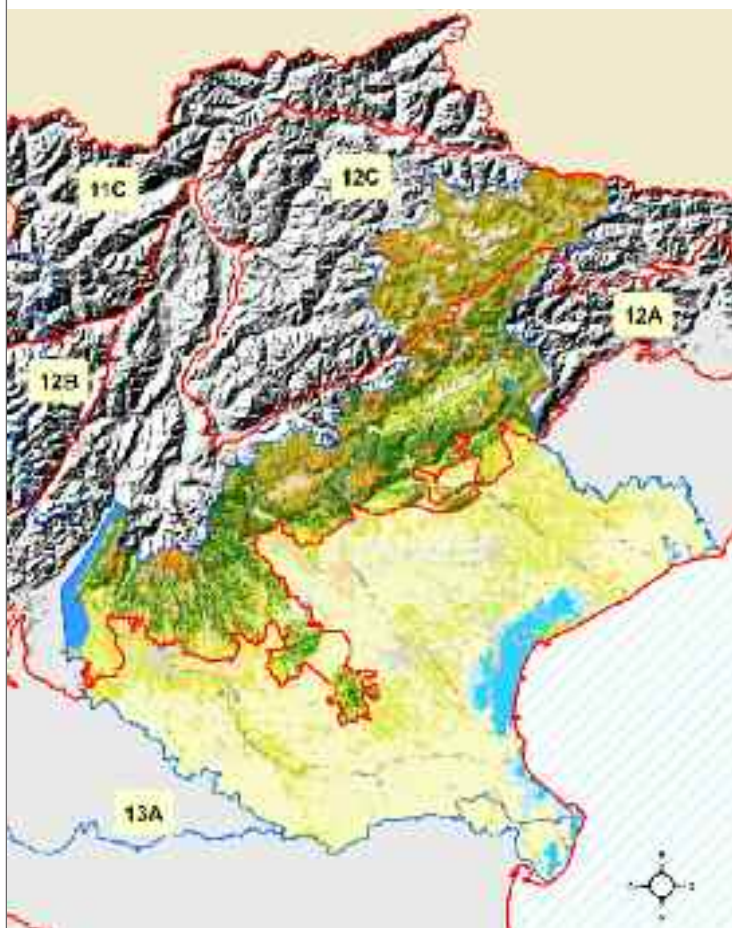


Applications

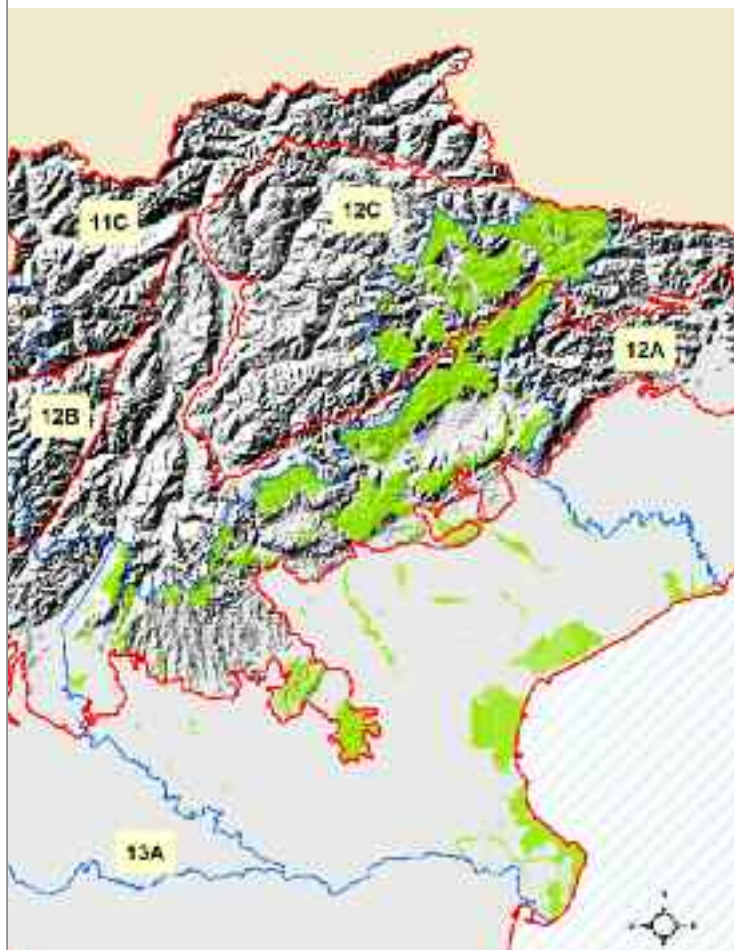
Example: ecoregional classification at the Section level to support the compilation of management plans for Natura2000 sites and the habitat monitoring programmes. The Veneto administrative region (north-east Italy) as a case study.

12A Prealpine Range Section: located in the north-west of the region, this Section covers 32% of the total area. Temperate semicontinental-subcontinental bioclimate. Potential for basiphilous *Fagus sylvatica* forests, neutrobasiphilous *Quercus robur* and *Carpinus betulus* forests, and *Ostrya carpinifolia* and *Fraxinus ornus* forests. Land cover consists primarily of broad-leaved forests and secondarily of coniferous forests. Prevalent agricultural areas of complex cultivation patterns with significant areas of natural vegetation. Natura2000 sites cover 191,685 ha (10% of region's area).

CORINE land cover classes (first level)
in Sections of the Veneto administrative region.
Basic data source: APAT 2005.



Natura2000 sites in Sections of the Veneto administrative region.
Basic data source: <http://www.minambiente.it>

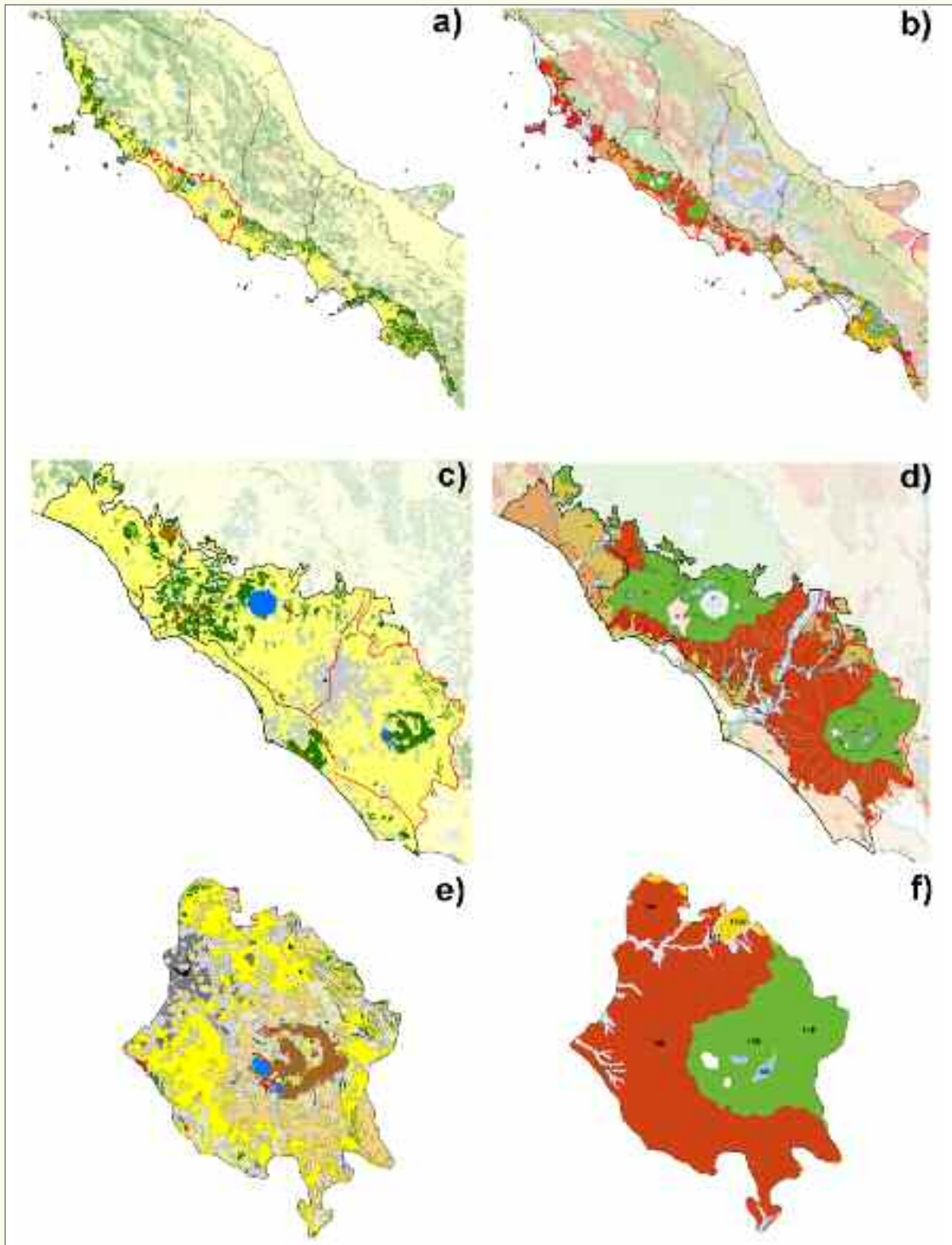


12C Dolomite Section: located in the north of the region, this Section covers 10% of the total area. Temperate oceanic bioclimate. Potential for mosaics of acidophilous vegetation series dominated by *Picea excelsa*, locally with *Fagus sylvatica*, and basiphilous *Picea excelsa* forests with *Pinus prostrata* shrubs. Potential for *Rhododendrum ferrugineum* shrubs and high mountain primary communities in the alpine belt. Current vegetation dominated by coniferous forests, natural grasslands and bare rocks at higher elevations. Natura2000 sites cover 108,957 ha (6% of region's area).

13A Po Plain Section: located in the south-east, this Section covers 58% of the total area. Temperate subcontinental bioclimate. Potential vegetation series of neutrobasiphilous *Quercus robur* and *Carpinus betulus* forests, and mosaic of hygrophilous vegetation series of river plains. Agricultural land dominated by arable land. Natura2000 sites cover 112,952 ha (6% of region's area), and are prevalently located along the coast.

ITALIAN SUBSECTIONS

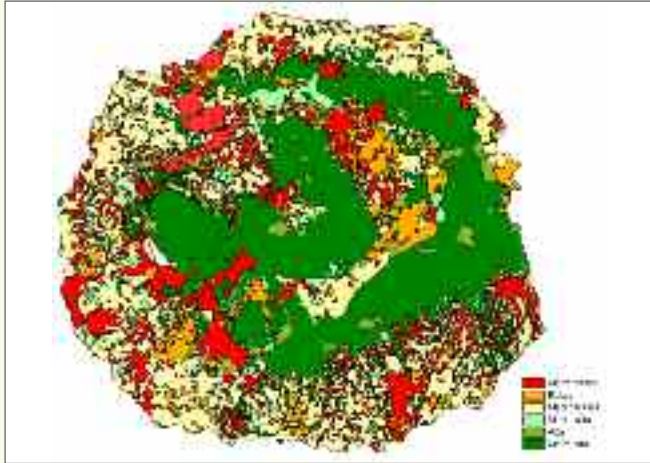
The hierarchical deductive delineation and characterisation of Subsections. The Colli Albani as a case study (western side of central Italy)



Patterns of Vegetation Series (left) and of Land cover classes (right) in Tyrrhenian Borderland Province of the Mediterranean Division (a/b), Roman Section (c/d) and Colli Albani Subsection (e/f).

Applications

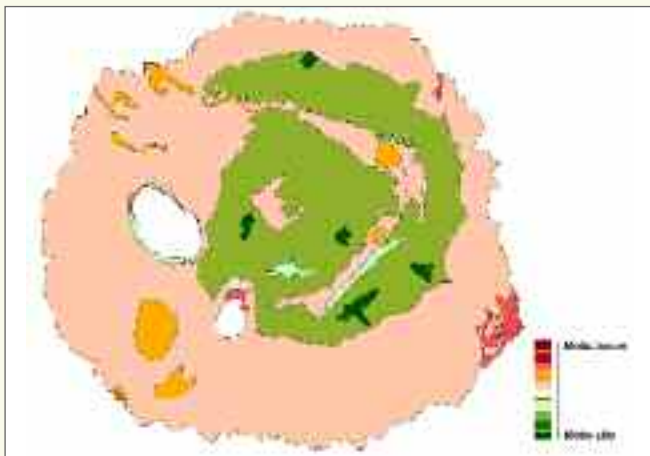
Land cover quality and landscape conservation assessment designed to help define the Ecological Network for the Territorial Plan in the Province of Rome (Blasi *et al.* 2008; <http://ptpg.provincia.roma.it>).



Portion of the Colli Albani Subsection:
Land cover environmental quality



Province of Rome: Land Ecological Network



Portion of the Colli Albani Subsection:
Landscape conservation status



Province of Rome: Structural Design for the General Territorial Plan



Colli Albani near Giulianello Lake.
Central Italy. Photo R. Copiz



Badlands of Val d'Agri. Southern Italy. Photo M.M. Azzella



Canterno Lake Natural Reserve. Central Italy. Photo R. Copiz

CONCLUSIONS

Our research team has been working on the ecological classification of land for approximately 10 years. It was in 2000 that a hierarchical deductive land classification, aimed at identifying areas with similar abiotic and vegetational features on progressively finer scales (Land Regions, Systems, and Subsystems and Environmental Units), was first proposed.

In order to avoid discrepancies in the identification and mapping of land units due to non-homogeneous basic data at the national level, new Phytoclimatic, Geomorphologic and Vegetation Series Maps of Italy were drafted for the whole country on a small (1:250,000) though relatively detailed scale (in relation to the continent). Numerous experts in various disciplines from different geographic areas throughout Italy have been involved in these projects.

At last, after almost 10 years of research and the achievement of results whose importance has been recognised by the international scientific community, we now have the opportunity to define and map the *Ecoregions of Italy* (Divisions, Provinces, Sections and Subsections) according to a divisive, "top-down", approach, from the initial continental-scale levels down to the highly detailed units required for local scale applications. The ecological classification of land thus represents, as regards both ecoregional integration and separate thematic information, a model that is essential for environmental, landscape and territorial planning purposes.

The ecological classification of Italy led to the identification of 2 Divisions, 13 Provinces, 33 Sections and almost 80 Subsections. The integration of these ecoregions with the Vegetation Series Map and the land use/land cover information offers a unique panorama at the European level.

This project supports the targets of the National Biodiversity Strategy by strengthening the scientific basis for *actions* and *priorities*, even on detailed scales (Provinces, Municipalities, Protected Areas), as well as for choosing *indicators* and planning *monitoring programmes* according to the physical and biological potential and most suitable land use of specific geographic areas.



Pontina Plain littoral zone. Central Italy. Photo R. Copiz



Lagorai Range. South-eastern Alps. Photo R. Frondoni

REFERENCES

- APAT 2005. *La realizzazione in Italia del progetto Europeo Corine Land Cover 2000*. Rapporti, 61/2005: 86 pp.
- Bailey R.G. 1995. *Ecoregions of the Continents*. U.S. Department of Agriculture, Forest Service. Washington.
<http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-continents/#>
- Bailey R.G. 1996. *Ecosystem Geography*. Springer-Verlag, New York.
- Bailey R.G. 2005. Identifying Ecoregion Boundaries. *Environmental Management* 34(1):S14–S26.
- Bigi G., Cosentino D., Parotto M., Sartori R., Scandone P. (eds) 1992. *Modello strutturale tridimensionale d'Italia in scala 1: 500 000*. CNR-Centro Nazionale delle Ricerche, Roma.
- Biondi E., Allegrezza M., Casavecchia S., Pesaresi S., Vagge I. 2006. Lineamenti vegetazionali e paesaggio vegetale dell'Appennino centrale e settentrionale. *Biogeographia* XXVII: 35-129.
- Blasi C. (ed) 2010. *La Vegetazione d'Italia con Carta delle Serie di Vegetazione in scala 1: 500 000*. Palombi & Partner S.r.L., Roma.
- Blasi C., Carranza M.L., Frondoni R., Rosati L. 2000. Ecosystem classification and mapping: a proposal for Italian Landscapes. *Applied Vegetation Science* 2: 233–242.
- Blasi C., Filibeck G., Burrascano S., Copiz R., Celesti-Grapow L., Di Pietro R., Ercole S., Lattanzi E., Rosati L., Tilia A. (in press) Primi risultati per una nuova regionalizzazione fitogeografica del territorio italiano. *Biogeographia* XXVIII: 1-15.
- Blasi C., Michetti L. 2005. *Biodiversity and climate*. In: Blasi C., Boitani L., La Posta S., Manes F., Marchetti M. (eds) *Biodiversity in Italy*. Contribution to the National Biodiversity Strategy. Palombi Editori, Rome. pp 57-66.
- Blasi C., Zattero L., Marignani M., Smiraglia D., Copiz R., Rosati L., Del Vico E. 2008. The concept of land ecological network and its design using a land unit approach. *Plant Biosystems* 142 (3): 540-549.
- Bohn U. 1994. *International project for the construction of a map of the natural vegetation of Europe at a scale of 1:2.5 million - it's concept, problems of harmonisation and application for nature protection*. Working text, Bundesamt für Naturschutz (BfN).
- Bohn U., Neuhausl R., Mitarbeit U. (eds) 2003. *Map of the Natural Vegetation of Europe. Scale 1: 2 500 000*. Bundesamt für Naturschutz (BfN)/Federal Agency for Nature Conservation, Bonn.
- Bunce R.G.H. 1995. *A European Land Classification*. Institute of Terrestrial Ecology, Merlewood
- Cleland D.T., Avers P.E., McNab W.H., Jensen M.E., Bailey R.G., King T., Russell W.E. 1997. *National Hierarchical Framework of Ecological Units*. In: Boyce M.S., Haney A. (eds) 1997. *Ecosystem Management Applications for Sustainable Forest and Wildlife Resources*. Yale University Press, New Haven, CT. pp. 181-200.
- EEA (European Environment Agency) 2000. *Digital Map of European Ecological Regions*. <http://www.eea.europa.eu/data-and-maps/data/digital-map-of-european-ecological-regions>
- FAO (Food and Agriculture Organization of the United Nations) 2000. *Global Forest Resources Assessment. Main Report*. FAO Forestry Paper, 140.
- GEO (Group on Earth Observations) 2008. *Ecosystems*. Work plan activities: Geneva, Switzerland, Group on Earth www.earthobservations.org/geoss_ec_wpa.shtml.
- Klijn F., Udo de Haes H.A. 1994. A hierarchical approach to ecosystems and its implications for ecological land classification. *Landscape Ecology* 9(2): 89-104.
- Marchetti M., Bertani R., Scatarzi I. 2004. *Zonizzazione del territorio italiano in funzione del rischio di incendio*. In Blasi et al. (eds) *Incendi e complessità ecosistemica*. Palombi & Partner. pp 121-132.
- Marshall I.B., Schut P.H. 1999. *A national ecological framework for Canada*. Ecosystems Science Directorate, Environment Canada and Research Branch, Agriculture and Agri-Food Canada. Ottawa, Ontario, Canada.
- Olson D.M., Dinerstein E., Wikramanayake E.D., Burgess N.D., Powell G.V.N., Underwood E.C., D'Amico J.A., Strand H.E., Morrison J.C., Loucks C.J., Allnutt T.F., Lamoreux J.F., Ricketts T.H., Itoua I., Wettengel W.W., Kura Y., Hedao P., Kassem K. 2001. Terrestrial ecoregions of the world: a new map of life on Earth. *BioScience* 51(11): 933-938.
- Omerik J.M. 2004. Perspectives on the Nature and Definition of Ecological Regions. *Environmental Management* 34, Suppl. 1: S27-S38.
- Rivas-Martínez S., Penas A., Díaz T.E. 2004. *Bioclimatic and biogeographic maps of Europe*. www.globalbioclimatics.org/form/maps.htm
- Sayre R., Bow J., Josse C., Sotomayor L. Touval J. 2008. *Terrestrial Ecosystems of South America*. In: Campbell J.C., Jones K.B., Smith J.H., Koeppel M.I. (eds) *North America Land Cover Summit*. Washington, DC. Chapter 9.
- Sayre R., Comer P., Warner H., Cress J. 2009. *A new map of standardized terrestrial ecosystems of the conterminous United States*. U.S. Geological Survey Professional Paper 1768, 17 p. <http://pubs.usgs.gov/pp/1768>



Majella National Park. Central Italy. Photo G. Capotorti



Ministry of the Environment, Land and Sea Protection

Via Cristoforo Colombo, 44 - I - 00147 Roma

Telephone: +39 06 57 221

www.minambiente.it



Italian Society of Botany onlus

Via G. La Pira, 4 - I - 50121 Firenze

Telephone: +39 055 27 57 379

Fax: +39 055 27 57 467

www.societabotanicaitaliana.it

sbi@unifi.it



Interuniversity Research Center

"Biodiversity, Plant Sociology and Landscape Ecology"

Sapienza University of Rome – Department of Plant Biology

P.le Aldo Moro, 5 - I - 00185 Roma

Telephone: +39 06 49 91 25 61

Fax +39 06 49 91 24 37

www.uniroma1.it/cirbfep

cirbfep@uniroma1.it



University of Salerno

Department of Civil Engineering

Via Ponte don Melillo - 84084 - Fisciano (SA)

Telefono: +39 089 964046

Fax: +39 089 964045

www.diciv.unisa.it