GREENING ROME

The Urban Green of the Metropolitan Area of Rome in the Context of the Italian MAES Process

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

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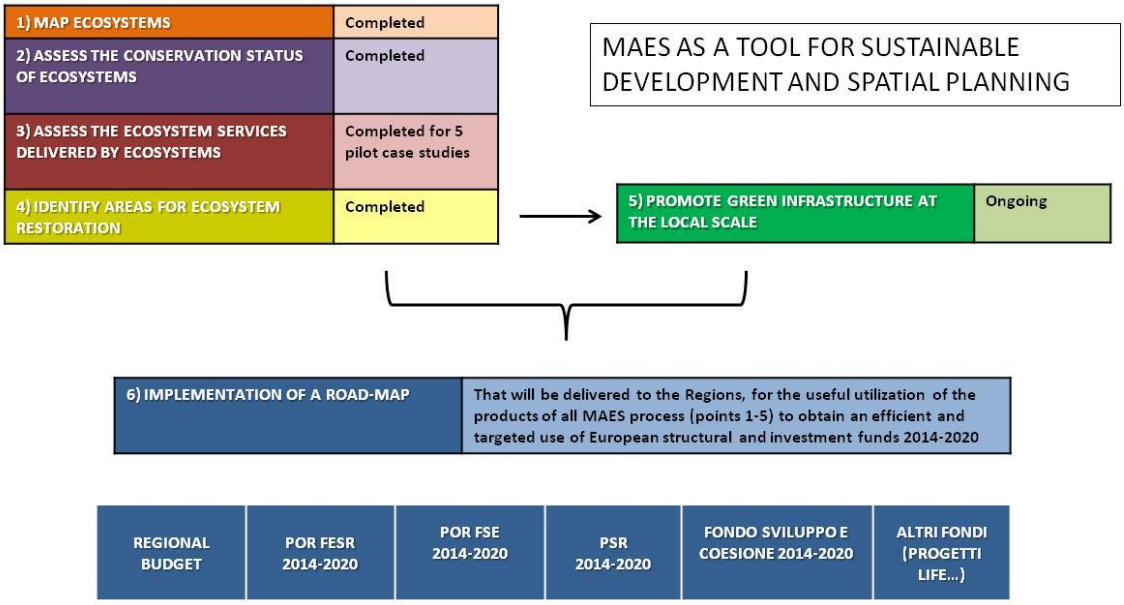
1. Introduction

The Italian Ministry for the Environment provides financial support to academia (Italian Botanical Society – SBI and Italian Zoological Union – UZI) for the implementation of the MAES process in Italy. A preliminary collection of updated and detailed basic data at the national level was carried out, including ecoregions, land units, bioclimate, biogeography, potential natural vegetation and CORINE land cover at the fourth level. Starting from these data, the Italian MAES process has been organised into six steps.

The outcomes of this process have provided the Ministry for the Environment with a reliable body of information targeted to:

- an effective implementation of the National Biodiversity Strategy (MATTM 2010);
- the improvement in biodiversity data within the National Biodiversity Network (Martellos *et al.* 2011);
- the further development of the environmental accounting system (Capotorti *et al.* 2012b);
- the implementation of a road-map to be delivered to the regions (sub-national level);
- the effective use of the products of all MAES process to concretely support European structural and investment funds 2014-2020 through the Joint Committee on Biodiversity, the governing body of the Italian National Strategy (Capotorti et al., 2015).



2. Policy context

In 2013, Italy adopted the national law on the development of **green urban areas** (Law n° 10, 14.1.2013) aiming at promoting the green areas for ecosystem services (air quality, hydrological risks, soil protection and cultural dimensions). The law identifies a set of measures including green urban planning and monitoring, support to local-level initiatives, safeguard of trees and tree lines as significant features for landscape, heritage, nature, history and culture.

The **Italian Metropolitan Cities** have been juridical defined by the National Law n. 56 in 2014 and represent large areas merging major urban centres with satellite minor municipalities. The National Law aims at a strategic territorial development of the metropolitan cities promoting the integrated management of services, infrastructures and communication networks. The main tool to achieve these goals is the strategic territorial plan. Each metropolitan city adopts a statute and its own strategic plan. Currently, the plans are under definition and endorsement while the statutes are already adopted. Urban ecosystems, green infrastructure, ecosystem services are a vital part and key for the urban sustainability, health and well-being. In this promising policy and planning context, the MAES process and outcomes are central to any integrated management and need to be adequately communicated and used as implementation, monitoring and evaluation tools.

As for a possible comparison at the international level, the 10 Metropolitan Cities can be conformed to the European LUZ (Larger Urban Zones; www.espon.eu), to the third level of European NUTs (Nomenclature of Territorial Units for Statistics: ec.europa.eu/eurostat) and to the various metropolitan areas/regions found all over the world (such as New York City Metropolitan Region in USA, Brisbane Metropolitan area in Australia, and Metro Manila in the Philippines).

	Bari	Bologna	Firenze	Genova	Milano	Napoli	Reggio di Calabria	Roma	Torino	Venezia
Artificial areas	5.5	5.9	5.7	6.2	34.5	31.8	3.2	12.8	6.9	10.0
Agricultural areas	88.3	68.1	43.6	11.3	61.3	50.9	49.6	58.5	35.0	67.5
Forest and semi-natural areas	6.1	25.4	50.3	82.4	3.7	16.9	47.2	27.2	57.5	0.8
Wetlands		0.3	0.2							6.1
Water bodies		0.4	0.3	0.1	0.5	0.4	0.0	1.6	0.5	15.7

Table 1. Land cover and land use in the metropolitan areas (Corine Land Cover data, 2006)

3. Mapping the Urban Ecosystem

Through the integration of the CORINE land cover with potential natural vegetation, bioclimatic and biogeographic information, a new Map of the Ecosystems of Italy was drawn at 1:100,000 scale, with 91 legend classes and counting 37 types of forests. Ecosystem types have been defined according to biogeographic and bioclimatic setting, geographic location and vegetation physiognomy. These types could properly been expanded or further merged according to specific classes of ecosystem services.

Method adopted	**Main results**
Definition and mapping of ecosystem types on a vegetation, phytogeography and bioclimatic basis at the national level Data and basic mapping: Corine Land Cover IV level (scale 1:100.000); Map of Ecoregions of Italy (scale 1:100.000); Map of the Vegetation Series (scale 1:250.000); Bioclimatic and biogeographycal Information; Map of Natural Potential Vegetation (scale 1:250.000)	Map of Ecosystems of Italy: - Scale 1:100.000 with MMU 25 ha; - Full cover of the national level; - Legend with 91 types: 78 ecosystems, 10 agricultural systems, 3 artificial systems; - 37 forest ecosystems; - Map of regional level ecosystems derived from the national level.

Besides the artificial and agricultural land cover types, the system of Italian metropolitan cities includes 58 out of the 77 natural and semi-natural ecosystem types identified at the national level. Forest ecosystem types are quite well represented in temperate metropolitan cities except for Milan. On the contrary, Mediterranean metropolitan cities show a narrow extent of forest cover except Reggio Calabria, which is characterised by the presence of both deciduous and evergreen forest types.

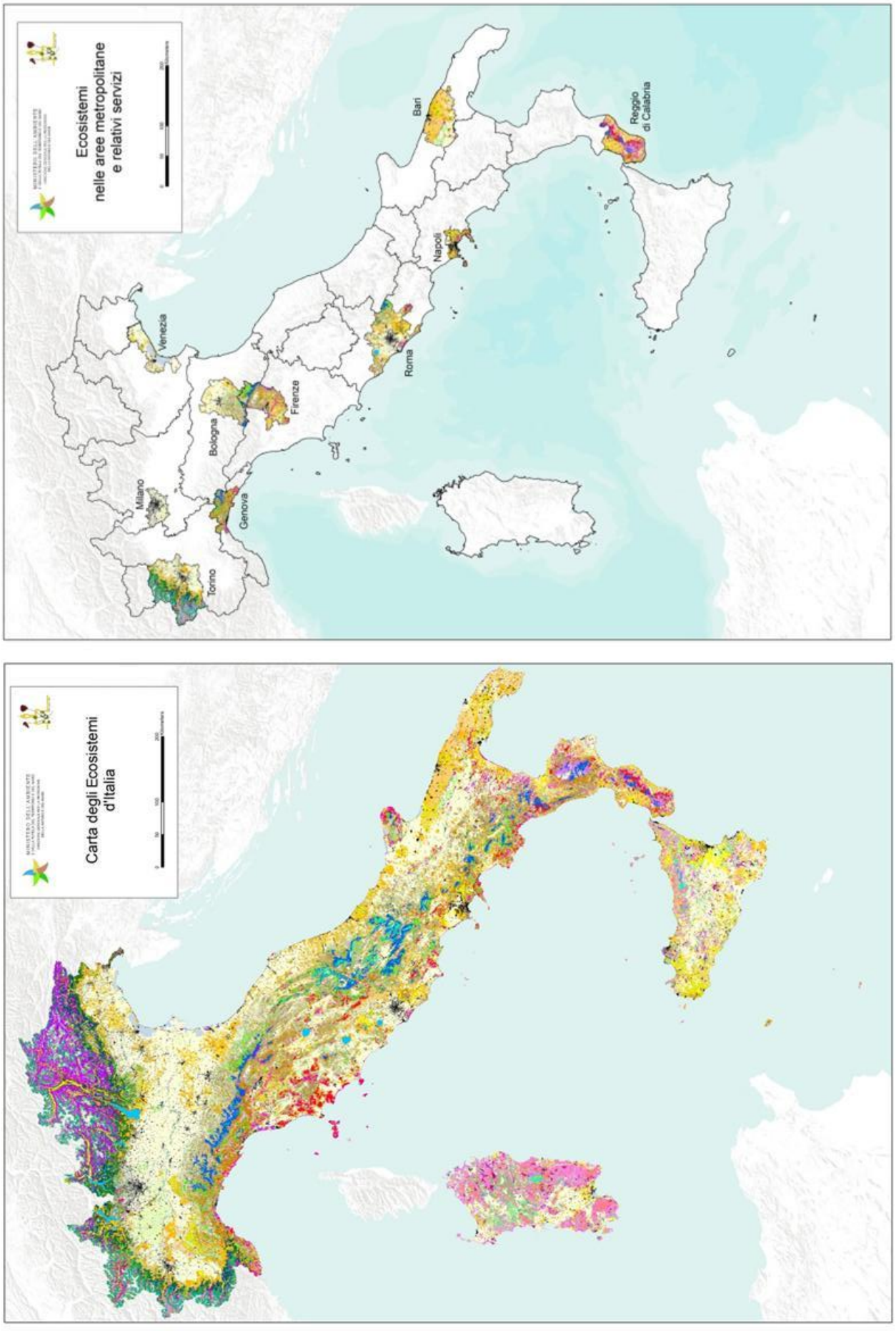


Figure 1. Map of Ecosystems of Italy

4. Mapping ecosystem condition

Selected parameters are coverage and spatial configuration of the ecosystem types, while potential natural vegetation is adopted as a reference model. The assessment is completed for all ecosystems at national, regional level and ecoregional level.

Method adopted	**Main results**
Assessment of the state of ecosystems conservation based on the following criteria: • Actual and potential cover comparison: an ecosystem with limited extension in compared to its potential area is assessed in critical conditions; • Analysis of the spatial configuration of each ecosystem referred to the quality of its surrounding contacts: the higher the percentage of contacts with natural types, the higher is the state of conservation. Ecosystems with prevailing alien species, agricultural and urban systems are excluded in the assessment. They have nevertheless a key role in the assessment of contacts.	Map of ecosystems conservation status Table comparing the assessment of ecosystems at the national level with the assessment of ecosystems at the regional level of each administrative region. For each of the administrative region a synthetic factsheet has been delivered with the assessment of each ecosystem found in the region (cover in ha and % of the total regional area, number of polygons, average area, actual/potential ratio, quality of contacts e % of protection under protected areas scheme). Overall framework of the state of ecosystems assessment at the regional level. The state of ecosystems assessment maps allow to: 1) identify the differences, for each ecosystem, between the assessment at the national and at the regional level; 2) compare for each ecosystem the assessment done in the different regions.

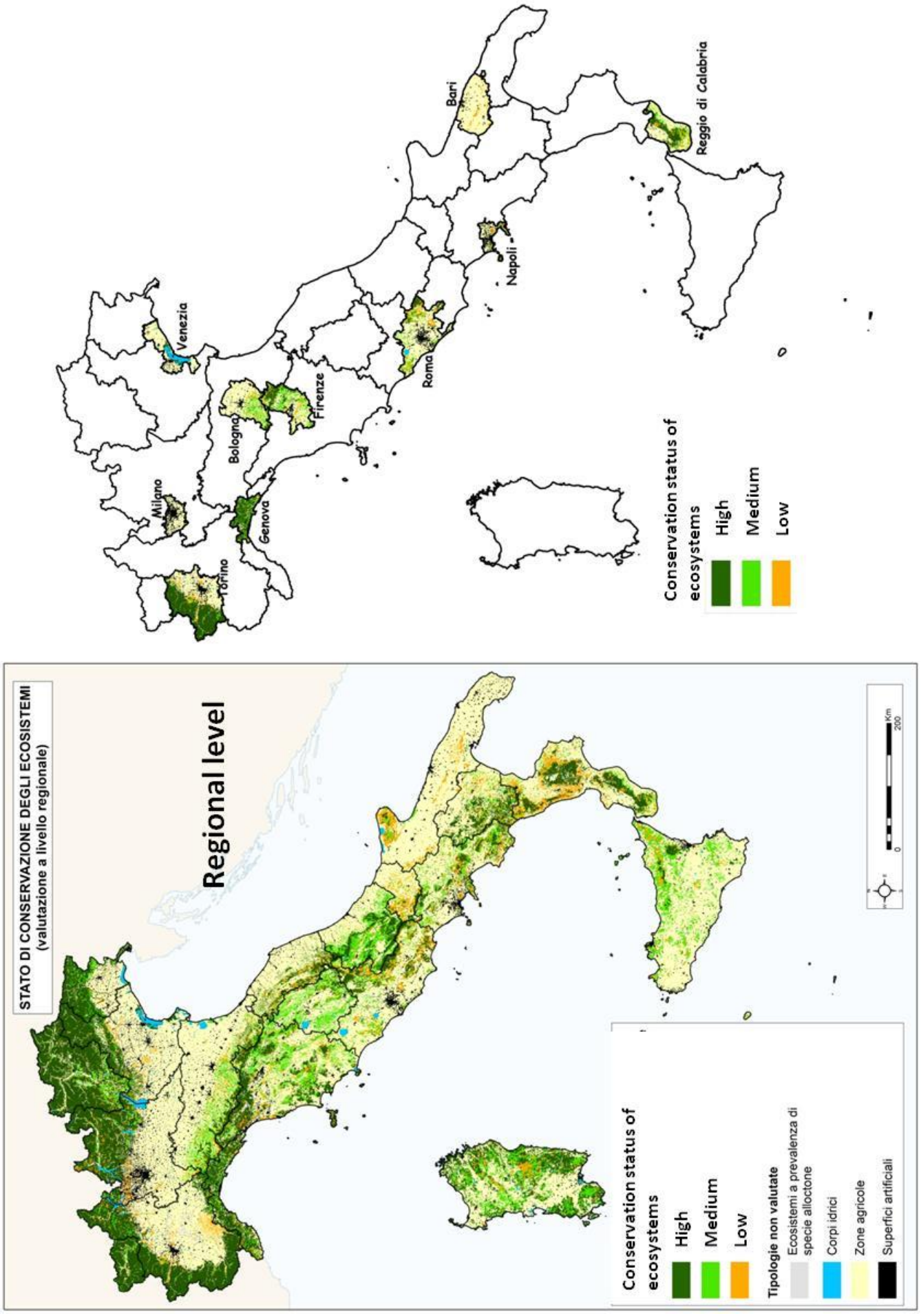


Figure 2. Map of ecosystems conservation status. Overall conservation status framework and conservation status of the metropolitan cities the administrative Regional level

Ecosystem types of Metropolitan City of Rome	**Conservation status**
Chasmo-chomophytic and glareicolous vegetation of the Apennines and Italian peninsula coastal mountains	High
High altitude grasslands of the Apennines with *Sesleria juncifolia, S. nitida, Festuca macrathera, Nardus stricta, Carex kitaibeliana*, etc.	High
Fagus sylvatica woodland of the Apennines with *Abies alba, Taxus baccata, Ilex aquifolium, Acer cappadocicum* subsp. *lobelii*, ecc.	High
Ostrya carpinifolia, Fraxinus ornus, Carpinus betulus, C. orientalis, Ulmus minor, etc. mixed woodland of the Italian peninsula	High
Mediterranean and subMediterranean woodland of the Italian peninsula with *Quercus ilex* and/or *Q. suber* (*Q. calliprinos* in Salento)	High
Decidous oak woodland of the Italian peninsula with *Quercus cerris, Q. robur, Q. petraea, Q. pubescens, Q. virgiliana, Q. frainetto, ecc.*	Medium
High-altitude shrub vegetation with *Juniperus communis* subsp. *alpina*, *Pinus mugo*, *Vaccinium myrtillus*, *Rhamnus alpina* subsp. *fallax* of the Apennines	Low
Shrublands of low mountain areas, hills and inland plains of the Italian peninsula with *Spartium junceum, Rosa* sp.pl., *Crataegus monogyna, Juniperus oxycedrus, Prunus spinosa, Rubus ulmifolius*, etc.	Low
Mediterranean and subMediterranean evergreen shrublands of the Italian peninsula with *Quercus ilex*, *Phillyrea latifolia, Arbutus unedo, Erica arborea, Pistacia lentiscus, Myrtus communis, Rosa sempervirens*, ecc.	Low
Low hill and plain grasslands of the Italian peninsula with *Dasypirum villosum, Avena* sp.pl., *Trifolium* sp.pl., *Dactylis glomerata*, etc.	Low
Mountain, submountain and hill grasslands of the Apennines with *Brachypodium genuense, B. rupestre, Bromus erectus, Cynosurus cristatu*s, ecc.	Low
Herbaceous formations of the subMediterranean hills and Mediterranean coasts with *Ampelodesmos mauritanicus, Hyparrhenia hirta, Lygeum spartum, Brachypodium retusum*, etc.	Low
Hygrophilous woodland with *Salix, Populus, Alnus, Platanus*, etc. of the Italian peninsula	Low
Mediterranean and subMediterranean pine woodland of the Italian peninsula with *Pinus pinaster, P. pinea* and/or *P. halepensis*	Low
Submontane and hilly *Castanea sativa* woods of the Italian peninsula	Low
Mountain and oroMediterranean pine woodland of the Italian peninsula with *Pinus nigra, P. leucodermis* and/or *P. laricio*	Low
Hygrophilous vegetation of the Italian peninsula (river banks and wet areas with varying vegetation cover)	Low
Psammophilous vegetation of the Italian peninsula with *Cakile maritima, Elymus farctus, Ammophila arenaria, Crucianella maritima*, etc.	Low

Table 2. List of ecosystems and their conservation status in the Metropolitan City of Rome

5. Mapping urban ecosystem services

Biophysical assessment of selected ecosystem services for 5 pilot case studies.

The 5 pilots include (ecosystem type: ecosystem service types, indicators):

1. beech forests: provisioning service, above-ground woody biomass; regulating services, carbon sequestration and air pollution removal; cultural service, old-growth forests;
2. **urban green**: regulating service, air pollution removal;
3. olive groves: provisioning service, food production; regulating service, carbon sequestration; cultural service, extent of protected olive groves;
4. lakes: maintenance service, nursery and feeding habitats; regulating service, ecological state; cultural services, intensity of scientific monitoring and level of representation in protected areas;
5. Posidonia beds: provisioning service, biomass; maintenance service, species distribution.

Experimental approach for the estimation of Particulate (PM_{10}) removal by urban and peri-urban forests in the Metropolitan city of Rome, by using data derived from Landsat images.

The Ecosystem Map of Italy has been used to derive the map of the ecosystems of the territory comprised in the Metropolitan City of Rome (formerly Province of Rome, DL Delrio 2014 n° 56)

By applying a modelling approach, based on data acquired at different space-temporal scale (Manes et al., 2001; Anselmi et al., 2004; Allegrini et al., 2006; Manes et al., 2012; Manes *et al*., submitted), satellite data have been analyzed in order to estimate the Leaf Area Index (LAI) of the plant communities growing within the Metropolitan City of Rome. LAI is a morpho-functional parameter, which is necessary in order to estimate the amount of PM_{10} removed by vegetation. Different steps of data analysis allowed to obtaining the LAI map and, subsequently, the Map of the Regulating Ecosystem Services of PM_{10} removal, as reported below.

In the Villa Ada Urban Park in Rome, we have also simulated the air quality improvement due to vegetation sink capacity for PM_{10} (Figure 4). Four seasonal scenarios for the "real case" (actual vegetation cover for evergreen broadleaves, deciduous broadleaves and conifers), and "no vegetation" (bare soil replacing woody vegetation at all location), are reported. The ratio vegetation/bare soil deposition was calculated for each vegetation leaf-type. The results show a conspicuous contribution of all the three vegetation types in removing pollutants from the urban atmosphere (Silli et al., 2015).

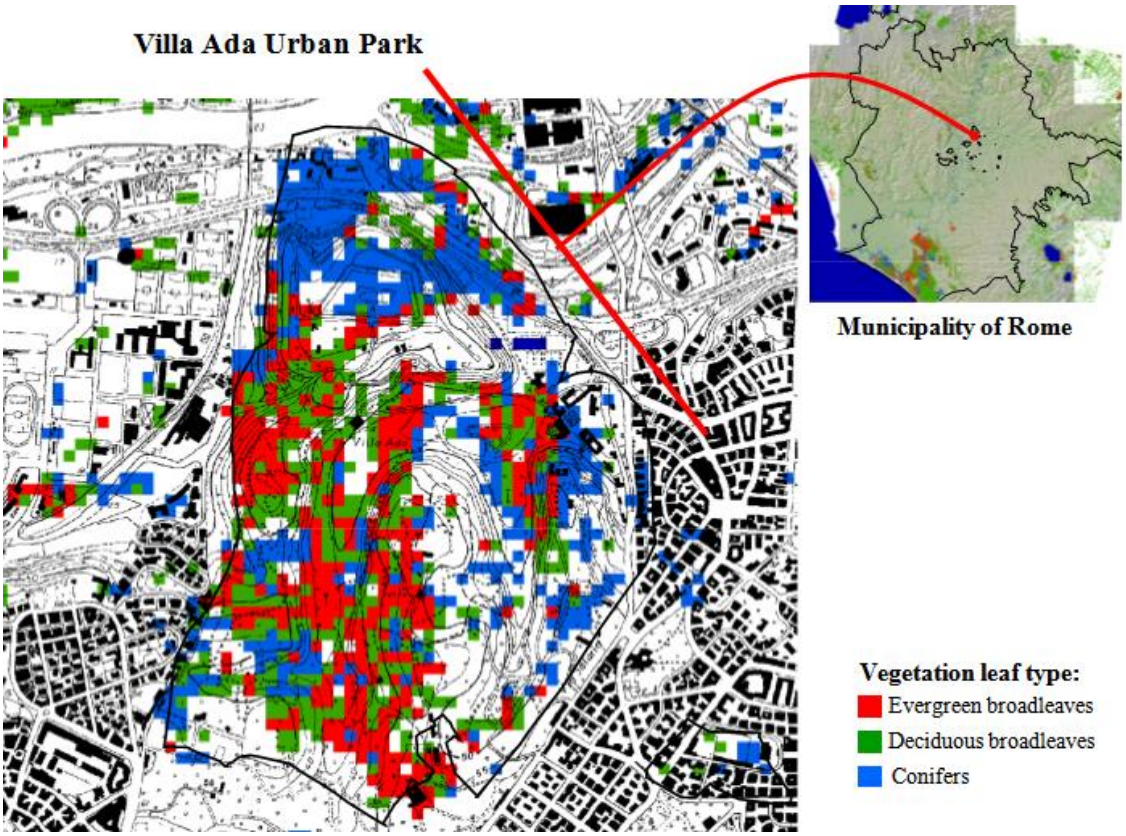


Figure 3. Vegetation map of the Villa Ada urban park, and its position inside the Municipality of Rome, derived from the Land Cover map.

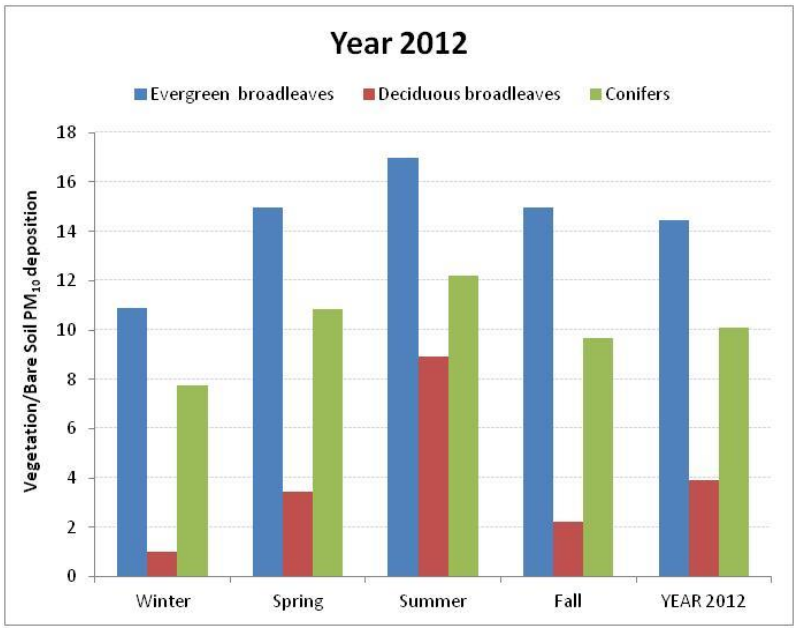


Figure 4. Mitigating role of urban vegetation. Ratio between PM_{10} deposition to each vegetation leaf type ("real case"), and PM_{10} deposition to bare soil ("bare soil scenario"), in the Villa Ada green area (116.40 ha of woody vegetation), during winter, spring, summer and fall 2012 (from Silli *et al.*, 2015).

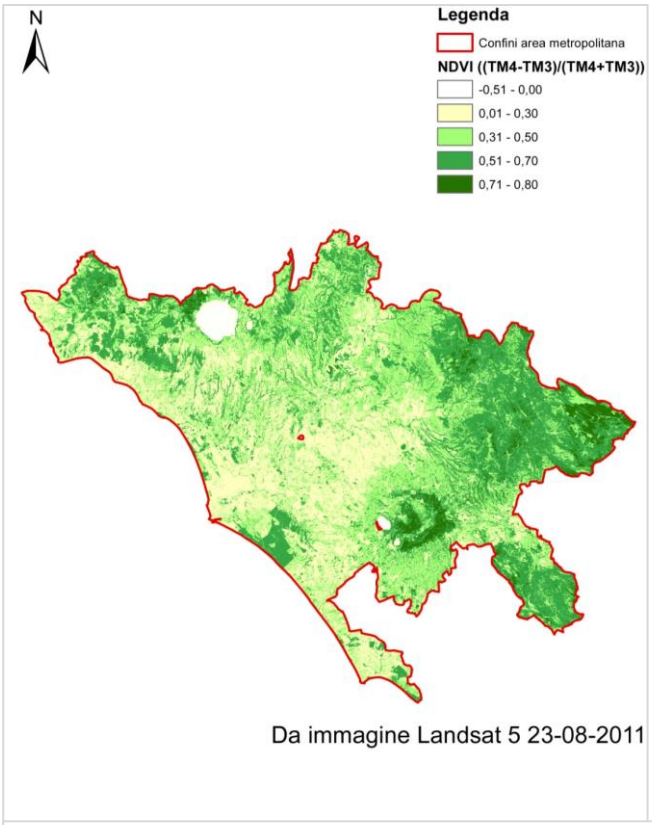


Figure 5. Map of the Normalized Difference
Vegetation Index (NDVI),
calculated by using the TM3 and TM4 bands of the Landsat TM image acquired on August 23, 2011

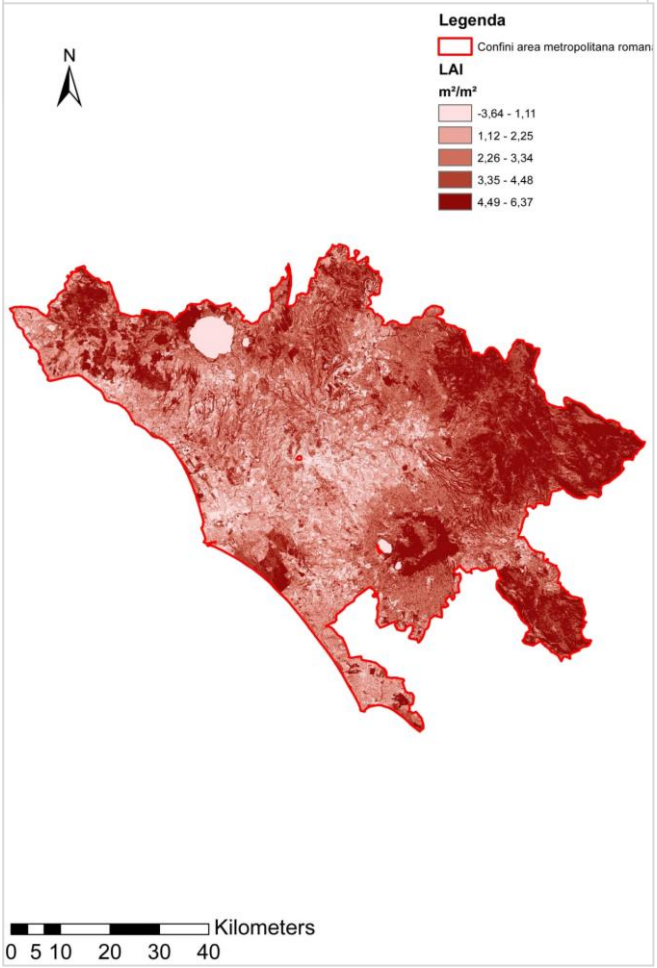


Figure 6. Map of the Leaf Area Index (LAI), derived from the NDVI map of Figure 5 by applying the equation described in Allegrini *et al.* (2006).

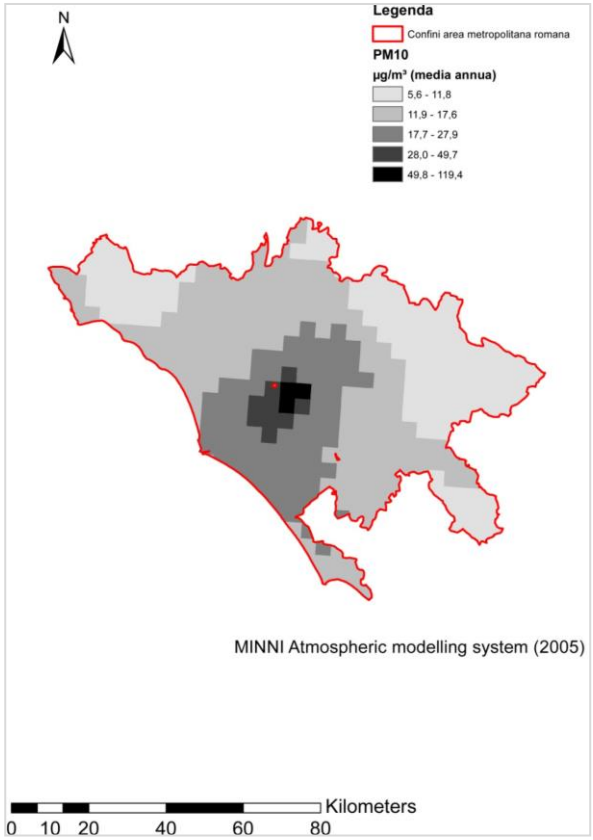
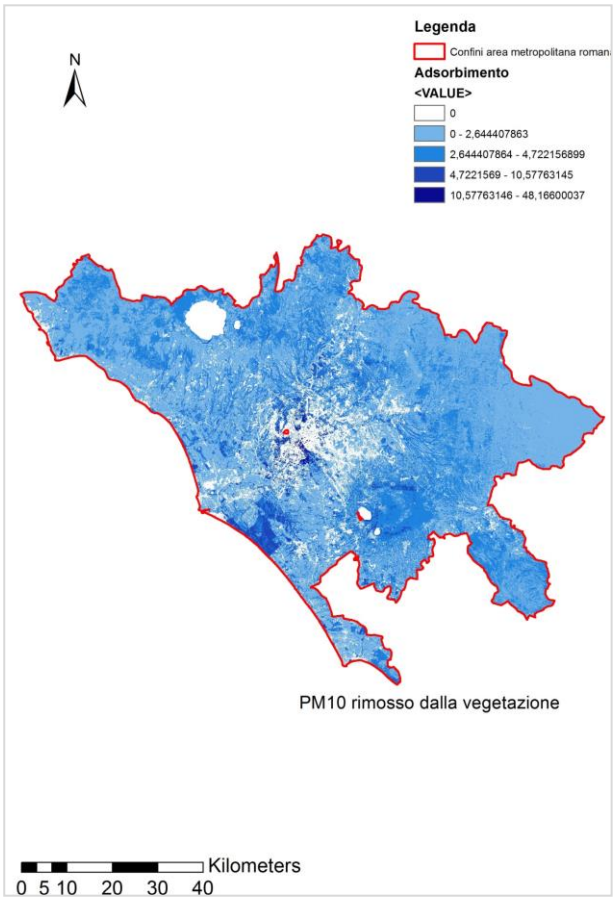


Figure 7. Map of the mean annual value (year 2005) of the PM_{10} concentrations for the Province of Rome, derived from the map produced, at national scale, by the model MINNI (Mircea et al., 2014). The concentration fields of atmospheric pollution have been produced in the project MINNI (Integrated National Model in support to the International Negotiation on Air Pollution), financed by the Italian Ministry for the Environment, Land and Sea Protection, coordinated by ENEA, and kindly supplied by Dr. L. Ciancarella (ENEA Technopole, Bologna).



Using the approach developed by Nowak (1994), and described in Manes et al. (2014), the amount of PM_{10} removed by the ecosystems of the Metropolitan City of Rome has been estimated (Figure 8).

Figure 8. Map of the annual values (year 2005) of the amount of PM_{10} (t/ha) removed by the different vegetation class of the Metropolitan City of Rome.

The pilot on urban green has been developed for all the ten metropolitan cities in Italy.

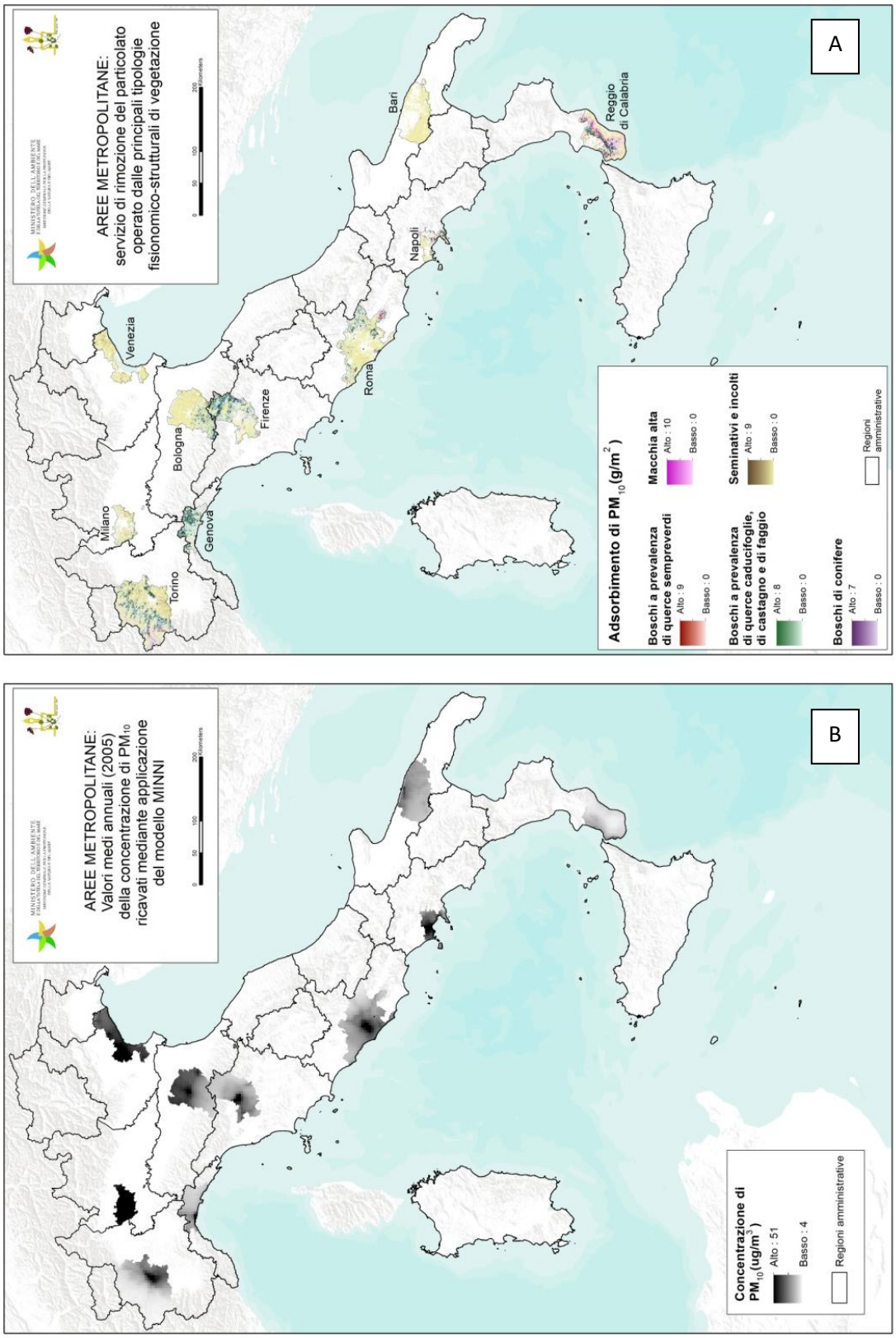


Figure 9. A Map of PM10 removal by natural ecosystems, B Map of PM10 concentration.

6. Identification of areas for ecosystems restoration

In order to identify areas for restoration projects (Green Infrastructure) we:

- select ecosystems with lower conservation status for each administrative Region;
- assess the conservation status of the selected ecosystems within their correspondent ecoregion;
- identify, within each selected ecoregion, the ecological areas coherent with the ecosystem to be restored (Potential Natural Vegetation).

This model has been applied to identify, for each of the 20 administrative Italian Region, not only the ecosystems requiring restoration, but also the areas where the restoration measures are needed. It is indeed interesting to note that, within the administrative Region Latium, the focus area for the needed restoration measures corresponds to the very metropolitan city.

Method adopted	**Main results**
In order to identify areas for ecosystem restoration purposes (Green Infrastructure), we have: - selected the ecosystems with lower state of conservation level at the regional (administrative) scale; - applied the national ecoregional classification that allows, within each region, to identify the most ecologically homogeneous areas; - re-assessed the state of conservation level for in the selected ecosystems; - selected the priority areas for restoration, after the above- mentioned re-assessment, including the macro-areas for the implementation of the restoration measures, using the Natural Potential Vegetation data. Basic data and mapping: • Map of Ecoregions of Italy (scale 1:100.000); • Map of Ecosystems of Italy; • Map of the Conservation State of Ecosystems; • Map of the Natural Potential Vegetation.	For each ecosystem with lower conservation status, the specific areas for the implementation of restoration measures have been identified. Such specific areas provide larger macro-areas where the ecosystems to be restored are found, or can be found for their ecological characteristics. Although the MAES process can deliver a good level of detail, the areas are derived from maps at the national scale. Each administrative Region can subsequently identify the areas based on studies and maps issued at the local scale (1:25.000; 1:10.000).

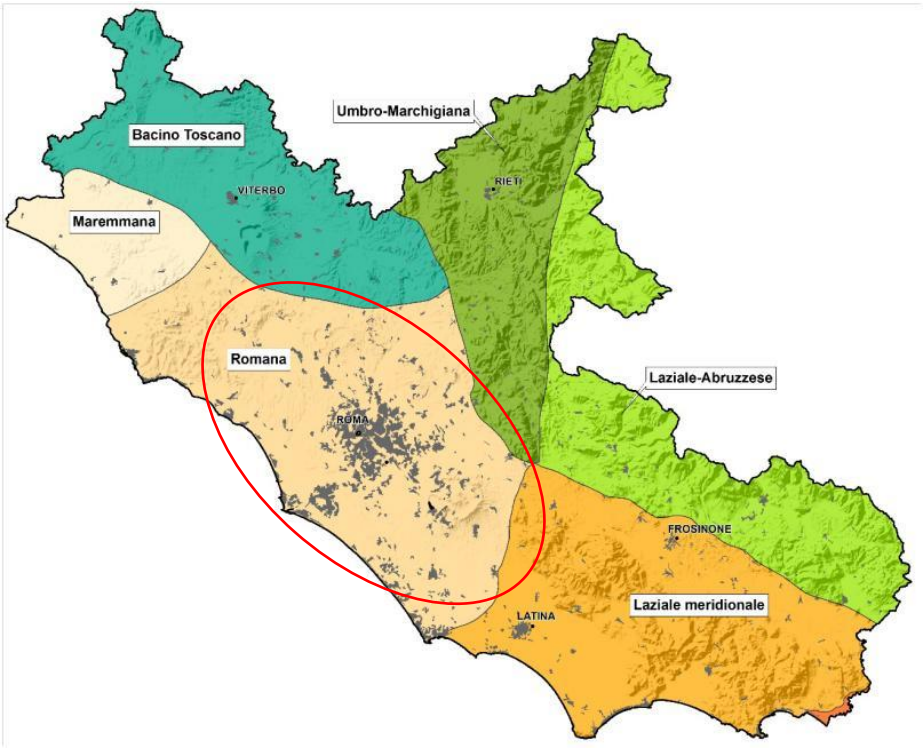


Figure 10. The low conservation status of the ecoregion of Rome is a priority area for the ecosystem restoration purposes

	ECOSYSTEMS	ECOREGIONS					
		Tuscany Basin	Southern Lazio	Lazio and Abruzzo	Maremma	Roman Area	Umbria and Marche
MATURE VEGETATION	Mediterranean and subMediterranean evergreen shrublands of the Italian peninsula with *Quercus ilex* , *Phillyrea latifolia* , *Arbutus unedo* , *Erica arborea* , *Pistacia lentiscus* , *Myrtus communis* , *Rosa sempervirens* , ecc.				X	X	
	Hygrophilous woodland with *Salix* , *Populus* , *Alnus* , *Platanus* , etc. of the Italian peninsula	X	X	X	X	X	
	Hygrophilous vegetation of the Italian peninsula (river banks and wet areas with varying vegetation cover)	X	X	X		X	X
	Psammophilous vegetation of the Italian peninsula with *Cakile maritima* , *Elymus farctus* , *Ammophila arenaria* , *Crucianella maritima* , etc.		X		X	X	
SUCCESSIONAL AND REPLACEMENT VEGETATION	Low hill and plain grasslands of the Italian peninsula with *Dasypirum villosum* , *Avena* sp.pl., *Trifolium* sp.pl., *Dactylis glomerata* , etc.	X	X	X	X	X	X
	Herbaceous formations of the subMediterranean hills and Mediterranean coasts with *Ampelodesmos mauritanicus* , *Hyparrhenia hirta* , *Lygeum spartum* , *Brachypodium retusum* , etc.				X	X	
	Mountain, submountain and hill grasslands of the Apennines with *Brachypodium genuense* , *B. rupestre* , *Bromus erectus* , *Cynosurus cristatus* , ecc.	X			X	X	X
	High-altitude shrub vegetation with Juniperus communis subsp. alpina, *Pinus mugo* , *Vaccinium myrtillus* , *Rhamnus alpina* subsp. *fallax* of the Apennines			X			X
	Shrublands of low mountain areas, hills and inland plains of the Italian peninsula with *Spartium junceum* , *Rosa* sp.pl., *Crataegus monogyna* , *Juniperus oxycedrus* , *Prunus spinosa* , *Rubus ulmifolius* , etc.	X			X	X	
	Mediterranean and subMediterranean evergreen shrublands of the Italian peninsula with *Quercus ilex* , *Phillyrea latifolia* , *Arbutus unedo* , *Erica arborea* , *Pistacia lentiscus* , *Myrtus communis* , *Rosa sempervirens* , ecc.						X
	Mediterranean and subMediterranean pine woodland of the Italian peninsula with *Pinus pinaster* , *P. pinea* and/or *P. halepensis*	X	X		X	X	
	Submontane and hilly *Castanea sativa* woods of the Italian peninsula	X	X			X	X

Figure 11. Distribution of ecosystems with lower conservation status in ecoregional sectors of the Lazio Region

7. Promoting Green Infrastructure

Definition of the ecological framework for the development of green infrastructure according to the land ecological network approach.

The Green Infrastructure topic was included by the Ministry of the Environment as part of its National conference "La Natura dell'Italia", which traditionally focuses on biodiversity and protected areas. The 2013 edition took place in Rome on the 11th and the 12th of December and highlighted the importance of green infrastructure in a green economy context for the National Biodiversity Strategy. In particular the conference focused on the discussion around policies for the enhancement of biodiversity and the implementation of European directives and best practices. The objective of the conference was to kick-start the economy focusing on the Italian natural capital, protected areas, on sustainable tourism, on agriculture and local products.

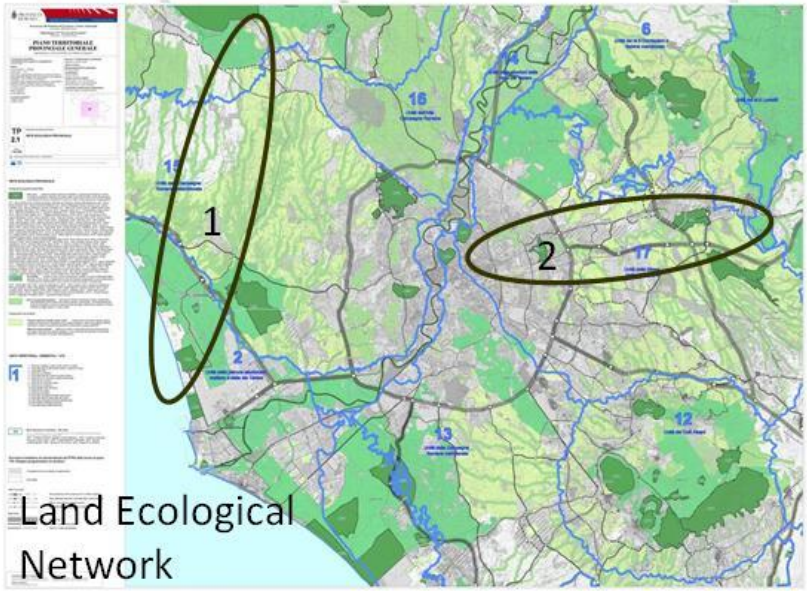
The deep connection between green infrastructure and land ecological networks has been explored in order to capitalise existing knowledge for the development of new green infrastructure projects. Various examples of Land Ecological Networks, as being designed by the department of Environmental Biology of Sapienza University of Rome at different scales, administrative levels, and contexts, have been therefore collected and properly joined to feasible development of green infrastructure:

Admin. level	Scale	Land planning tool	Case study	Links to Green Infrastructure development	web links and publications
Province	**1:50.000**	General Provincial Territorial Plan prescriptive document	Ecological Network of the Province of Rome	natural resources conservation, environmental restoration, conservation and restoration of natural and landscape values in the agricultural system	http://ptpg.provincia.roma.it Blasi, C. *et al. 2008* The concept of land ecological network and its design using a land unit approach. Plant Biosystems, 142, 540–549.
Municipality	**1:25.000**	Master Plan prescriptive document	Ecological Network of the Municipality of Rome	biodiversity conservation, reduction of landscape fragmentation, integrated management of the river systems, forest plantation, soil consumption control	http://www.urbanistica.comune.roma.it/prg-vigente-4.html http://www.comune.roma.it/PCR/resources/cms/documents/RSA2011_Presentazione.pdf
Municipality	**1:25.000**	Urban Forest Plan	Selected priorities for forest plantation in the Metropolitan Area of Rome (Italy)	The aim is to provide a methodological approach to identify priorities in urban forest planning with comprehensive responses to ecological and social needs in any metropolitan context. The first step defines an ecological framework for forestation plans by means of the ecological land classification and assessment of landscape conservation status. The second step sets afforestation priorities according to both ecological and social criteria	Capotorti G, et al. 2015. Setting priorities for urban forest planning. A comprehensive response to ecological and social needs for the metropolitan area of Rome (Italy). Sustainability 7: 3958–3976
Municipality	**1:50.000/ 1:10.000**	sustainable urban development	Biophysical assessment of ecosystems services provision and vulnerability in Rome	Assessment of habitat provision, conservation of species diversity, urban climate regulation, and educational values	Capotorti et al., 2011 The contribution of plant sociology to the ecosystem service approach in urban and peri-urban areas: evidences from a Mediterranean metropolis case study (Rome, Italy).Fitosociologia vol. 48 (2) suppl. 1: 127-135.
Municipality	**1:50.000**	UNESCO MAB	Proposal of the	conservation of biodiversity, sustainable	Blasi *et al.*, 2008 Interdisciplinary

		Urban Biosphere Reserve	Urban Biosphere Reserve of Rome Municipality	urban development, logistic support for research and monitoring	research for the proposal of the Urban BiosphereReserve of Rome Municipality. Plant Biosystems, Vol. 142, No. 2, pp. 305–31
Municipality	**1:10.000**	Master Plan supporting document	Ecological Network of the Municipality of Fiumicino	biodiversity conservation, landscape connectivity enhancement, phytoremediation, multifunctionality and greening of agricultural system, urban quality improvement	Unpublished data
Municipality	**1:10.000**	Planning and management of the tree lined-roads	4 censuses of the tree-lined roads made by Rome admin. 1898, 1955, 1971, 1998	preservation of cultural identity	Attorre, F., et al. 2000. Landscape changes of Rome through tree-lined roads. Landscape and urban planning, 49(3), 115-128.
Union of municipalities	**1:10.000**	Integrated Municipal Structural Plan	Ecological Network of the Union of Municipalities "Terra e Fiumi" (Ferrara)	Improvement of habitat functionality, promotion of recreation activities, sustainable economic development, natural vegetation restoration	http://www.unioneterrefiumi.fe.it/
Protected Area	**1:10.000**	National Park Plan	Ecological Network of the Circeo National Park	Restoration of dune structure and functionality, landscape connectivity enhancement, freshwater banks requalification, buffering of river network, urban green restoration	http://www.parcocirceo.it/public/documenti/Relazione%20Tomo%201%20Analisi%20ver%2028_11_2011.pdf
	1:10.000/ 1:5.000	Regional Park Plan	Preparatory studies for protected areas RomaNatura	Network of protected areas in metropolitan context	AA.VV: 2001: Informatore Botanico Italiano Vol. 33
Region	**1:100.000**	Management Plan for Natura2000 sites	Ecological Network of Molise Region	reinforcement of ecological connections, renaturation of river banks, improvement of coastal habitat conservation status	Unpublished data

Green Infrastructures in the Metropolitan City of Rome:

As required by the Action 6, the second phase of support to the Ministry of Environment consists in the identification of two Green Infrastructure pilot projects, Target 2 of the European Biodiversity Strategy, in an urban and peri-urban context of the metropolitan city of Rome. The preliminary step focuses on areas with a high level of impacts on natural systems (one mostly agricultural and the second residential) within parts of water basins. The first project area has been identified in the northwest part of the river Arrone sub-basin (GI 1) and the second in the centre-eastern urban area of the Aniene sub-basin (GI 2), both sub-basin of the Tiber main catchment. In the first area, the land patterns are related to the coastline and, towards the inland area the patterns are mainly well-differentiated agricultural systems: intensive farming in the costal alluvial lowland, croplands. In the second area the patterns are mainly those of a residential system, both continuous or discontinuous and integrated by more fragmented farming areas towards the complex litho-geomorphological of the ravines of San Vittorino. In particular the area of the first Green Infrastructure is covered for over 60% by farming systems (with crops in the alluvial lowland and meadows/pastures on the hillside) and by natural areas (30%), while the second Green Infrastructure by artificial areas (50%) and by agricultural land (40%). In the latter, the natural areas are mostly those included in the urban areas and on the riversides of the Aniene.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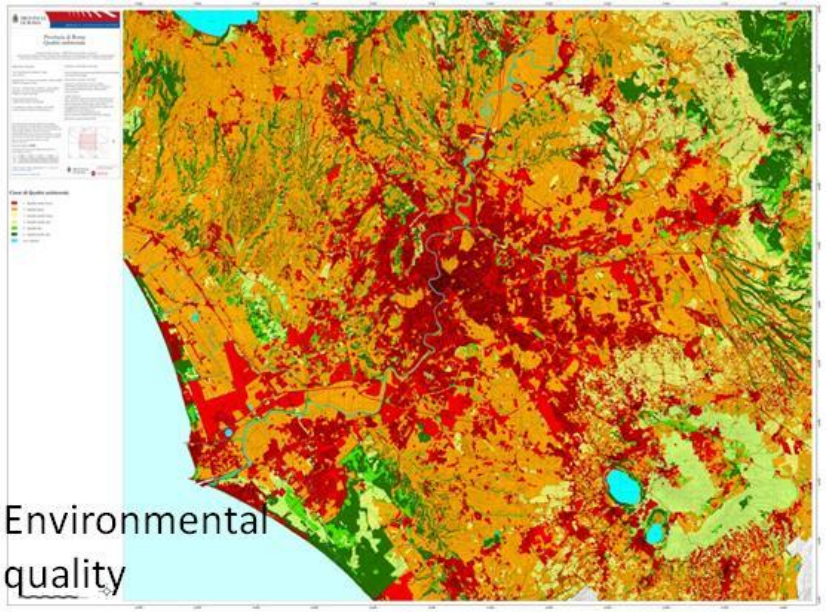
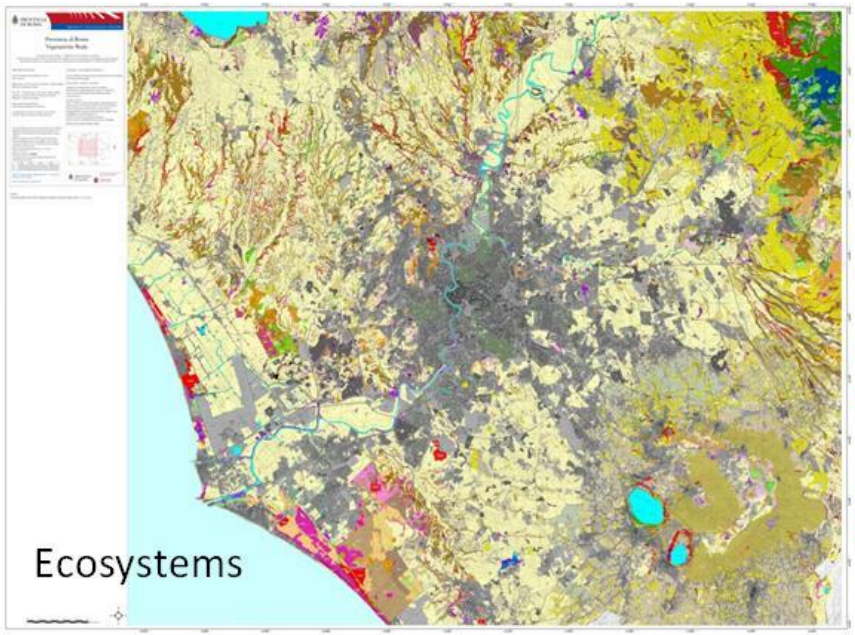
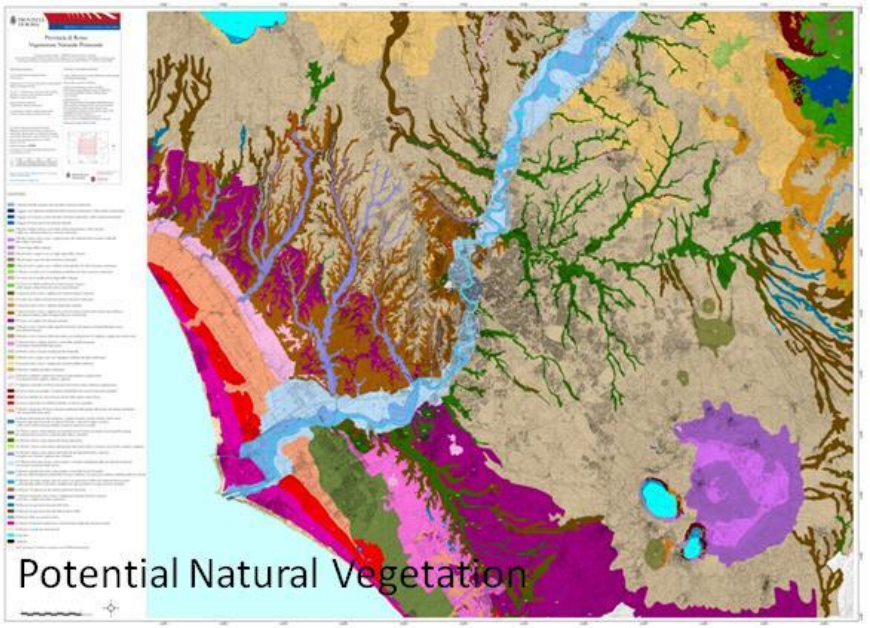
2
Land Ecological Network


Environmental quality


Ecosystems


Potential Natural Vegetation

9. Conclusion

The combination of the overall Italian MAES process with the new perspectives provided by the recently established Metropolitan Cities Law concur to build a solid basis for sustainability. In this sense urban sustainability is indeed a permanent provision of benefits from the ecosystems towards wellbeing and health of people, perfectly in line with the ten messages adopted by the CBD Decision X/22 on the links and opportunities between urbanization and biodiversity (www.cbd.int/decision/cop/?id=12288).

The methodology adopted provides an interesting step towards the promotion and improvement of the functionality of ecosystem services, of biodiversity and, in a broader sense, of the natural capital. Specifically, each metropolitan city will be able to identify the areas in which green infrastructure can be developed as an effective approach to restoration of ecosystems in bad conservation status. In particular this exercise will be useful for:

- Improving and promoting ecosystem services in order to meet the target of restore at least 15% of the degraded land by 2020, corresponding to the commitments of the European Biodiversity Strategy - Target 2. and to the Convention on Biological Diversity - Aichi Target 15;
- Enhance the connectivity among the different vegetation communities and ecosystems;
- Improve the functional and the socio-economic relations between protected areas, adjacent areas and rural or artificial systems;
- Combine the improvement of the ecological connectivity with the improvement of employment growth, with particular reference to small and medium enterprises and family enterprises that are still active green communities in the rural system of the hilly and mountainous areas.

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References

AA.VV. 2001. Informatore Botanico Italiano Vol. 33

Allegrini A., Anselmi S., Cavalli R.M., Manes F., Pignatti S. 2006. Multiscale integration of satellite, airborne and field data for Mediterranean vegetation studies in the natural area of the Castelporziano Estate (Rome). Annals of Geophysics 49, 167-175.

Anselmi S., Giannini M., Allegrini A., Manes F. 2004. Nine years monitoring of structural and functional vegetation indices in natural and urban areas. Analysis of multi-temporal remote sensing images. Proceedings of the Second International Workshop on the Analysis of Multi-Temporal Remote Sensing Images. Edited by: Smits, P and Bruzzone, L. pp.259–267. London: World Scientific.

Attorre, F. *et al.* 2000. Landscape changes of Rome through tree-lined roads. Landscape and urban planning, 49(3), 115-128

Blasi C., Zavattero 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

Blasi C. (editor) 2010 La Vegetazione d'Italia con Carta delle Serie di Vegetazione in scala 1: 500,000 (Rome: Palombi Editori) (in Italian)

Blasi C., Attorre F., Capotorti G., Zingari P.C., editors. 2014a. Natural and cultural capital. Contributions to the Conference held at the Botanical Garden of Rome, Italy 24 November 2014. Ograro srl. Rome.

Blasi C., Capotorti G., Copiz R., Guida D., Mollo B., Smiraglia D. and Zavattero L. 2014. Classification and mapping of the ecoregions of Italy Plant Biosystems 148 1255-345

Blasi *et al.*, 2008 Interdisciplinary research for the proposal of the Urban BiosphereReserve of Rome Municipality. Plant Biosystems, Vol. 142, No. 2, pp. 305–31

Capotorti G., Mollo B., Zavattero L., Anzellotti I., Celesti-Grapow L., 2015 Setting Priorities for Urban Forest Planning. A Comprehensive Response to Ecological and Social Needs for the Metropolitan Area of Rome (Italy), Sustainability, 7(4): 3958-3976

Capotorti G., Anzellotti I., Attorre F., Copiz R., Mollo B., Zavattero L. and Blasi C. 2014. Ecological classification of land and ecosystem mapping. Towards the implementation of Action 5 of the European Biodiversity Strategy to 2020 in Italy Annali di Botanica 4 9-17

Capotorti *et al*., 2011 The contribution of plant sociology to the ecosystem service approach in urban and peri-urban areas: evidences from a Mediterranean metropolis case study (Rome, Italy).Fitosociologia vol. 48 (2) suppl. 1: 127-135.

Capotorti G., Alós Ortí M. M., Anzellotti I., Azzella M.M., Copiz R., Mollo B., Zavattero L 2015 The MAES process in Italy: contribution of vegetation science to implementation of European Biodiversity Strategy to 2020. Plant biosystems Vol. 149, No. 6, 949–953.

Manes F., Incerti G., Salvatori E., Vitale M., Ricotta C. and Costanza R. 2012. Urban ecosystem services: tree diversity and stability of tropospheric ozone removal Ecol Appl 22 349–360

Manes F., Blasi C., Salvatori E., Capotorti G., Galante G., Feoli E. and Incerti G. 2012. Natural vegetation and ecosystem services related to air quality improvement: tropospheric ozone removal by evergreen and deciduous forests in Latium (Italy) Annali di Botanica 2 79-86

Manes F., Silli V., Salvatori E., Incerti G., Galante G., Fusaro L. and Perrino C. 2014. Urban ecosystem services: tree diversity and stability of PM10 removal in the metropolitan area of Rome Annali di Botanica 4 19-26

Manes F., Marando F., Capotorti G., Blasi C., Salvatori E., Fusaro L., Ciancarella L., Mircea M., Marchetti M., Chirici G. and Munafò M. Regulating. Ecosystem Services of urban and periurban forests in the ten Italian Metropolitan Cities: air quality improvement from PM10 and O3 pollution. Submitted to Ecological Indicators.

Manes F., Anselmi S., Giannini S., Melini S., 2001. Relationships between Leaf Area Index (LAI) and Vegetation Indices to analyse and monitor Mediterranean ecosystems. In: Remote Sensing for Agriculture, Ecosystems and Hydrology II, September 25-29 2000, Barcelona, SPIE Proc., EUROPTO Ser., 4171, 328-335

Mircea, M., Ciancarella, L. , Briganti, G., Calori, G., Cappelletti, A., Cionni, I. et al., 2014. Assessment of the AMS-MINNI system capabilities to predict air quality over Italy for the calendar year 2005. Atmos. Environ., 84, 178-188.

Nowak D.J., 1994. Air pollution removal by Chicago's urban forest. In: McPherson, E.G., Nowak, D.J., Rowntree, R.A. (Eds.), Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project. USDA Forest Service General Technical Report NE-186, Radnor, PA, pp. 63-81.

Silli V., Salvatori E., Manes F. 2015. Removal of airborne particulate matter by vegetation in an urban park in the city of Rome (Italy): an ecosystem services perspective. Annali di Botanica, 5, 53-62.