Harmonized forest categories in central Italy

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SCIENCE

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Ugo Chiavetta[a] (iD), Nicolò Camarretta[a] (iD), Vittorio Garfì[b], Marco Ottaviano[b], Gherardo Chirici[c], Matteo Vizzarri[b] (iD) and Marco Marchetti[b] (iD)

[a]Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria – Forestry Research Centre, Arezzo, Italy; [b]Dipartimento di Bioscienze e Territorio (DiBT), Università degli Studi del Molise, Pesche, Isernia, Italy; [c]Dipartimento di Gestione dei Sistemi Agrari, Alimentari e Forestali (GESAAF), Università degli Studi di Firenze, Firenze, Italy

ABSTRACT

To support sustainable forest management, planning policies and environmental actions, it is essential to have available common and standardized geospatial information on forest structure, composition and distribution. In this paper we present a harmonized forest categories (HFCs) map of four administrative Regions located in central Italy (i.e. Marche, Abruzzo, Lazio and Molise) at a scale of 1:400,000. The study area extends over 42,246 km^2, 14,878 km^2 of which are covered by forests. Four regional forest maps were harmonized in order to produce common standardized information on composition, structure and the distribution of forests in central Italy. A forest category is a forest vegetation unit defined by the main tree species composition. In this study we adopted a nomenclature scheme composed of 16 forest and shrubland categories. This work represents the first HFCs map in Italy over a large area. The legend is also harmonized with the European Environment Agency forest types nomenclature.

1. Introduction

Forest maps are fundamental for sustainable forestry and land management. The information about forest types (FTs) and their distribution are helpful for forest managers and other stakeholders. Moreover, this has important repercussions on public and private interests. On the one hand, forest maps support local, regional and national policies to properly allocate economic resources. On the other hand, a comprehensive knowledge of the forest distribution can help to classify fragile or undisturbed forest landscapes requiring special conservation actions.

All these aspects entail an accurate, detailed and harmonized geographic description of forests, organized in an appropriate nomenclature system.

The FT nomenclature system is used as a standard scheme in Europe (Barbati, Corona, & Marchetti, 2007). FTs can be described as forest classes identified by their vegetational composition, and/or site factors (locality), as defined by each country in a system suitable to its situation (Canadian Forest Service, 1995). They are usually organized in hierarchical structures, in which the main level is based on FTs grouped together usually on the basis of the main dominant tree species, and further divided in to variants or subtypes. The higher hierarchical level of the FT system is the forest category (FC) obtained through grouping FTs with similar main tree species (i.e. Beech forests, Chestnut forests) or ecological role (Riparian forests).

In Italy, there are currently several independent sources of information available. They are based on different systems of classification and can therefore prove to be an inefficient tool for forest managers and stakeholders, hence the need to harmonize these systems to better serve the community. In the last few years three geographic forest data sets have been developed. The first data set was developed at national level based on the Corine Land Cover (CLC) 2006, the second was developed at a pan-European level for low resolution forest/non-forest classification. The third data set was developed for central Italy. In this area FT maps are available for many administrative Regions: Marche (IPLA, 2001; Pesaresi, Biondi, Casavecchia, Catorci, & Foglia, 2007), Toscana (Hofman et al., 1998), Lazio (Chirici et al., 2014), Abruzzo (Corona, Marchetti, Morgante, & Di Pietro, 2001) and Molise (Garfì & Marchetti, 2011) separately. Regional FTs and FCs are organized in local nomenclature systems. Only the maps from Marche, Lazio, Abruzzo and Molise were produced using the same methodology, adopting the same forest definition from FAO (2000), at the same scale (1:10,000), and with the same Minimum Mapping Unit (MMU) of 0.5 ha, despite they were associated with different nomenclatures systems based on FCs sub-divided in FTs.

The study area covers a total of 42,246 km^2 and includes four administrative Regions of central Italy: Marche, Abruzzo, Lazio and Molise. Elevation ranges from sea level to 2914 m a.s.l on top of Mount Gran

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CONTACT Nicolò Camarretta ✉ nicolo.camarretta@gmail.com

Sasso (the highest peak of the Apennines). The climate is mainly Mediterranean, with a concentration of precipitations in spring and autumn.

2. Methods

The 4 original maps were structured as follows: in Abruzzo 32 FTs grouped in to 12 FCs (Corona et al., 2001); in Marche 42 FTs grouped into 11 FCs (IPLA, 2001); in Lazio 36 FTs grouped into 16 FCs (Chirici et al., 2014); in Molise 40 FTs grouped into 14 FCs (Garfì & Marchetti, 2011).

The four layers were stored as a vector data set using the shapefile format with two fields: FT and FC.

Harmonization of nomenclature systems between the four regional data sets was available from Vizzarri et al. (2015). The methodology used to harmonize the four different FT nomenclature systems available for the data sets followed a bottom-up approach, from local to European level, and from FTs to FCs. The first step concerned a comparison between the four FT nomenclature systems, and subsequently the creation of a new reference system, namely Harmonized Forest Types Nomenclature System (HFTNS). This new reference system was organized in to Harmonized Forest Types (HFTs), which were then grouped in to HFCs. This aggregation resulted in a total of 42 HFTs grouped in to 16 HFCs. The 16 HFCs (Table 1) were finally used to produce the HFCs map of central Italy.

From a logical perspective, different nomenclature systems were aggregated with a merge operation then simplified by aggregating the local FTs that had the same diagnostic characters. The production of the harmonized map followed the same workflow. First, the four FTs maps were re-projected to the same projection and reference system (UTM WGS84 zone 33 North). Second, they were merged together and two fields were created: HFT and HFC. At this time the corresponding class value was assigned to each record. Finally, the resulting polygons were dissolved according to the HFC field.

A Digital Elevation Model was used to create the hillshade surface, bathymetry, main cities, administrative regional borderlines and hydrography datasets were available from the Italian National Geographic Portal (http://www.pcn.minambiente.it/GN).

3. Conclusions

The Main Map presented was produced by merging high resolution FC maps available for four administrative Regions of central Italy. These maps were developed independently for the period 2001–2007 adopting the FAO forest definition and the same methodology. The aim of this paper was to solve difficulties in exchanging forest data and information between land planners, forest managers and decision-makers across different local administrations and at multiple scales. The Harmonized nomenclature systems could be effectively used for multi-scale forest resource monitoring to limit a lack of information and reduce implementation delay of common rules, laws and guidelines at different administrative levels. Moreover, harmonized FTs nomenclature systems, as well as associated maps, are expected to bridge the current gap between forest monitoring and biodiversity conservation purposes within policy and governance processes from local to European scale (e.g. Barbati, Marchetti, Chirici, & Corona, 2014).

Table 1. Brief description of the 16 HFCs.

HFCs	Description
Holm oak forests	Typical evergreen forests of the mediterranean biogeographical region, dominated by *Quercus ilex*
Cork oak forests	Typical evergreen forests of the mediterranean biogeographical region, dominated by *Quercus suber*
Downy oak forests	Supra-mediterranean forests of *Quercus pubescens* usually associated with thermophilous deciduous species (*Quercus cerris, Acer campestre, Ostrya carpinifolia, Fraxinus ornus*)
Turkey oak forests	Supra-mediterranean oakwoods characterized by different mixtures of *Quercus* species, mainly *Q. cerris, Q. frainetto, Q. petraea*
Sessile oak forests	Lowland-hill submountainous oak forests (*Carpinus betulus, Q. petraea, Tilia cordata*) growing on soils without groundwater or draught extremes
Lowlands oak forests	Lowland-hill (to sub-mountainous) penduculate oak (*Quercus robur*) forests growing on groundwater-influenced or hydromorphic soils
Riparian forests	Forests dominated by a single species or mixtures of species including *Fraxinus angustifolia, Platanus orientalis, Nerium oleander, Liquidambar, Tamarix* spp.
Hop-hornbeam forests	Typical mixed forests of the higher supra-Mediterranean region dominated by site-native broadleaves (*F. ornus, O. carpinifolia*)
Chestnut forests	Forests dominated by sweet chestnut (*Castanea sativa*).
Other broadleaved forests	Mixed forests dominated by other site-native broadleaves (mesophilous and meso-thermophilous broadleaves as *Acer negundo, O. carpinifolia* and *F. ornus*).
Site-native coniferous forests (including coniferous plantations)	Forests dominated by Mediterranean pines and cypresses; by silver fir and/or spruce; by oro-Mediterranean and mountainous pines.
Beech forests	Forests characterized by the dominance of European beech (*Fagus sylvatica*)
Plantations of broadleaved species	Forests and/or ex-plantations dominated by self-sown exotic broadleaved species (*Eucalyptus, Robinia pseudoacacia, Ailanthus altissima*).
Hilly and coastal shrublands (including mediterranean maquis and garigue)	Low and dense vegetation, dominated by bushes and herbaceous plants (*Erica* spp., *Rubus* spp., *Spartium* spp., *Prunus* spp., *Juniperus* spp., *Laburnum anagyroides*, etc.).
Mountainous shrublands	Sclerophyllous species areas (Areas characterized by evolving woody and/or shrubby vegetation) below the timberline.
High-mountainous shrublands	Shrubs and herbaceous plants with rare trees over the timberline.

This map is the first harmonized representation of the Italian FTs at a supra-regional scale with a very small MMU (0.5 ha), and a detailed and accurate thematic resolution.

Software

The four vector layers were imported and processed (merged and dissolved) using GRASS GIS 6.4.3. The map design was performed using Quantum GIS (QGIS) Wien 2.8.1.

ORCID

Ugo Chiavetta 🞮 http://orcid.org/0000-0002-8404-7927
Nicolò Camarretta 🞮 http://orcid.org/0000-0001-7520-126X
Matteo Vizzarri 🞮 http://orcid.org/0000-0002-9505-783X
Marco Marchetti 🞮 http://orcid.org/0000-0002-5275-5769

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Barbati, A., Corona, P., & Marchetti, M. (2007). A forest typology for monitoring sustainable forest management: The case of European forest types. *Plant Biosystems – An International Journal Dealing with All Aspects of Plant Biology*, *141*(1), 93–103. doi:10.1080/11263500601153842

Barbati, A., Marchetti, M., Chirici, G., & Corona, P. (2014). European forest types and forest Europe SFM indicators: Tools for monitoring progress on forest biodiversity conservation. *Forest Ecology and Management*, *321*, 145–157. doi:10.1016/j.foreco.2013.07.004

Canadian Forest Service. (1995). *Criteria and indicators for the conservation and sustainable management of temperate and boreal forests: The Montreal Process*. Hull: Author, 13p.

Chirici, G., Fattori, C., Cutolo, N., Tufano, M., Corona, P., Barbati, A., … Marchetti, M. (2014). Map of the natural and semi-natural environments and forest types map for the Latium region (Italy). *Forest@ – Rivista di Selvicoltura ed Ecologia Forestale*, *11*(2), 65–71. doi:10.3832/efor1204-011

Corona, P., Marchetti, M., Morgante, L., & Di Pietro, R. (2001). Cartografia sperimentale e prodromi di una tipologia dei boschi dell'Appennino Abruzzese [Experimental mapping and signs of a typology of the Apennine forests in Abruzzo region]. *Annali dell'Accademia Italiana Di Scienze Forestali*, *XLIX-L*, 174–241.

FAO (2000). *Global forest resource assessment 2000*. Forestry Paper 140, FAO, Rome, Italy, pp. 479.

Garfì, V., & Marchetti, M. (2011). *Tipi forestali e preforestali della regione Molise [Forest types of Molise region]*. Alessandria: Edizioni Dell'Orso s.r.l [in Italian].

Hofman, A., Goretti, D., Merendi, G. A., Tabacchi, G., Vignoli, M., & Bernetti, G. (1998). *L'inventario forestale. Boschi e macchie di Toscana [Forest inventory. Woodlands and shrublands of Tuscany region]*. Firenze: Giunta Regionale.

IPLA. (2001). *I tipi forestali delle Marche: inventario e carta forestale della regione Marche [Forest types of Marche region: Forest inventory and map of Marche region]*.

Pesaresi, S., Biondi, E., Casavecchia, S., Catorci, A., & Foglia, M. (2007). Il geodatabase del sistema informativo vegetazionale delle marche. *Fitosociologia*, *44*(2), 95–101.

Vizzarri, M., Chiavetta, U., Chirici, G., Garfì, V., Bastrup-Birk, A., & Marchetti, M. (2015). Comparing multisource harmonized forest types mapping: a case study from central Italy. *iForest – Biogeosciences and Forestry*, *8*(1), 59–66. doi:10.3832/ifor1133-007