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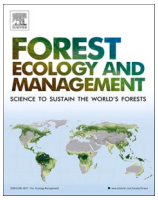

Cultural values and forest dynamics: The Italian forests in the last 150 years

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ABSTRACT

In the context of the worldwide increasing interest on the role of forests for global warming and biodiversity targets, there is a growing tendency to consider the need to increase not only the extension of forests, but also their degree of naturalness. These indications have been recently included also in important political documents such as the European Green Deal enacted by the European Union, affecting 28 member states of the European continent, also with the aim of fighting deforestation and desertification. In Italy national and regional forest inventories, as well as planning documents, classify more and more forests as natural or seminatural. These indications often result in the limitation of traditional silvicultural methods, by environmental and landscape restrictions, orienting forest management towards favoring more natural forests structures. These policies are often threatening the conservation of the cultural features of the Italian forests. The paper provides an analysis of the evolution of forests in Italy during the last 150 years through official forest inventories and various investigations. This study shows that from 4.215.000 ha of forest in 1888 we have today about 11.778.000 ha, with an increase of 7.563.000 ha and an annual growth rate of 59.551 ha. The present Italian forests can be described partly as derived from those already mapped in 1936 and entirely managed, although not regularly, and secondary forests developed on abandoned land, extending for 5.279.895 ha.

The results show that human influence has affected extension, density, structure and species composition of Italian forests in all the geographical areas of the country, independently from altitude, latitude or climate conditions. There are no dangers of deforestation, but rather an uncontrolled increase of forests and there is no need of further afforestation but rather to better manage the existing ones. Moreover, "cultural forests", meaning forest shaped and managed by human activities through times, are more and more reducing their extensions together with the material and immaterial heritage associated to them. Considering the third pillar of Sustainable Forest Management in Europe, the one on "social and cultural values", defined by MCPFE in 2003, the paper proposes the definition of "cultural forests" as a new category in forest conservation and an important part of the biocultural heritage associated to the rural territory. Furthermore, the paper stresses the need of historical investigations, for the better understanding of the features of the forest ecosystems and for the identification of the values to be considered in forest restoration.

1. Introduction

Despite some attempts, the topic of cultural forests has not yet been formally included in the assessment, planning and management of forest ecosystems, although many forests in the world are the result of the integration of human and natural processes in time and space and clearly present cultural features (Agnoletti and Santoro, 2015). During the fourth Ministerial Conference on the Protection of Forests (MCPFE) held in Vienna in 2003, an important step towards the inclusion of social and cultural values in Sustainable Forest Management (SFM) was taken, leading to the adoption of the Vienna Resolution 3. This resolution introduced the social and cultural values as the third pillar of SFM inviting the countries to protect and manage cultural values associated to forests. After the Vienna Conference scientific work on this matter was carried out by specific scientific meetings promoted by MCFPE together with several national and international institutions, as the international seminar on "Forestry and our cultural heritage" held in Sunne (Sweden) in June 2005 (MCPFE, 2006), or the meeting on "Cultural heritage and sustainable forest management: the role of traditional knowledge" held in Florence (Italy) in 2006 (Parrotta et al., 2006). The following year guidelines for the implementation of socio-cultural values in SFM were produced upon request of the MCPFE by the International Union of Forest Research Organizations in 2007 (IUFRO, 2007). In the same and subsequent years, several investigations on the cultural features of

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European forests have been carried out (Johann et al., 2004; Agnoletti and Santoro, 2015; Tieskens et al., 2017 Eriksson, 2018; Tabbush, 2010), whose findings are also in line with genetic studies demonstrating a close correspondence between genetic and landscape diversity, as a geographical map of Europe arises as an efficient summary of genetic variation in the continent (Novembre et al., 2008). These studies indicate a different degree of naturalness in the forests according to environmental, social and economic factors, but also suggest a different degree of cultural features characterizing the forests in different continents and countries in the world. These cultural features of forests are usually related to Traditional Forest Knowledge (TFK). In countries like Italy, a long history of integration between forests and agricultural activities has also created land use forms and biological diversity that is closely connected to landscape patterns (Agnoletti, 2018). Forest landscapes often show a high level of habitat diversity tighten into a complex mosaic produced by the application of different management forms, and the introduction of a great variety of species over the years, that came to meet specific economic, social and environmental functions (Trosper et al., 2011).

Cultural landscapes are increasingly threatened by intensification and abandonment, in addition to the lack of specific protection and management tools as well as appropriate policies. At European level, the European Commission recently produced the "green deal" strategy, contemplating to promote the expansion of forest surfaces not only for increasing carbon sink, but also to fight deforestation. At the same time there is the will to expand natural habitats to preserve and improve biodiversity. The European Union has also defined a forest strategy, that expresses concern for the fact that management practices are not always in line with the need to ensure biodiversity in woodland ecosystems and to preserve the existing carbon stock. According to the European Commission, in addition to an increased demand for timber, forests continue to face, among others, urban sprawl, landscape fragmentation and habitat and biodiversity loss. The forest strategy also states that unsustainable forestry practices should be prevented or corrected. In consideration of the above the EU Commission (2021) committed to:

- Strictly protect all EU primary and old-growth forests - which are large carbon sinks and are home to many of our animal and plant species.
- Develop guidelines for closer-to-nature forest management - which will lead to a more sustainable use of forest resources, and to healthier, more resilient, and more diverse forests.
- Develop guidelines for biodiversity-friendly afforestation, reforestation and tree-planting - which will ensure that the right tree is planted in the right place at the right time, creating mixed forests adapted to current and future challenges.
- Plant 3 billion additional trees by 2030 - to substantially increase the EU's forest area, store CO2, and provide more living space for animal and plant species.

The Biodiversity Strategy also put forward ambitious objectives for nature protection, including by enlarging the EU's network of protected areas and through strict protection of one third of protected areas.

At the same time, according to the EU, the forests sector should also:

1. *contribute to a modern, climate neutral, resource-efficient and competitive economy*
2. *preserve lively rural areas and help maintain wealthy rural populations*
3. *and preserve landscapes, culture and heritage*

The above indications reflect similar strategies today shared also at UN level and, in the intentions of the Commission are directed and applicable to all the countries of the EU and reflect a large part of the scientific literature on forests of the past decades. This imply that all the countries might be submitted to these political indications, according to the structure and functioning of the European Union. However, these strategies should take into consideration the different social, economic, and environmental conditions of each country, in order to evaluate if they all show the same criticalities and the need of developing such policies independently from local conditions. Furthermore, more attention should be paid to the classification of forests, as well as the scientific approaches and the methods used to understand their features and management. The risk of not properly considering these factors may lead to a waste of economic resources and also to the impossibility of applying the proposed strategies. As stated in the third objective of the forest sector of the EU reported above, there is also the need to preserve landscape, culture and heritage, associated to forests.

Italy has developed approaches in forest planning and management following the indications proposed by the EU Commission and a "nature based" approach. The data related to the last national forest inventory (Rete Rurale Nazionale, 2017), classify as having "natural features" more than half of the Italian forests as well as indicating "old growth", included among them, not mentioned in previous inventories. Furthermore, some restrictions to the applications of traditional silvicultural methods, such as simple coppice, are often applied by the authorities in charge of environmental and landscape protection. These activities are accompanied by recent important national projects suggesting expanding forest areas and planting several millions of trees. These tendencies result from the consideration of the threats represented by deforestation, desertification and forest fires, announced by international organization (e.g. IPCC) and various national authorities.

Considering the above, this paper aims to go over the transformations of the forest ecosystems occurred in Italy in the last 150 years, taking into consideration the results of new research carried out on this topic and several investigations produced in the past years. The core of the study is to understand the origin and the features of the current Italian forests, as well as their evolution, in relation to social and economic changes. The study aims also at identifying the cultural features of the Italian forests, the threats, and the vulnerabilities connected to their conservation and restoration, as also to explore the potential of historical investigation for a better understanding of the dynamics of forest ecosystems, also suggesting the use of an historical approach in the management, restoration and assessment of forest ecosystems.

Although forest history as a research topic exists since 18th century and was also an official teaching in several schools of forestry (Agnoletti and Anderson, 2000) and the more recent development of historical ecology and environmental history, little has been done for an effective use of an historical approach for the understanding and the classification of forest ecosystems (Szabó, 2010a). The definition of vegetation types currently adopted, as well as terms as *natural*, *seminatural* and *old growth* forests, often assign little attention to historical factors affecting the features of the forest vegetation. Usually, a plant community is defined as a set of species that occupies a defined space and to which Clements' theories then applied a theoretical evolutionary model aimed at achieving the maximum naturalness stage called "climax". The system determined by the interaction between plant species in an area corresponds to the plant association, which is the subject of phytosociology, developed following the studies of the Swiss Braun-Blanquet (1884–1980) and are today of general use for interpreting vegetation communities at any scale. This vision assumes that a certain environment, for example, a mountain slope in a certain climatic zone, corresponds to a certain community of plant species and, conversely, a certain type of plant species corresponds to a given environment.

The result is that the plant community present at the time of observation becomes a "biological evidence" of the natural characteristics of that environment. According to this approach, among the various factors that influence vegetation are also included the "anthropic" ones, understood however as factors that "degrade" the vegetation, interrupting the natural evolution, or bringing it back to primitive stages (for example from forest to shrublands using fire). Each individual vegetation survey is then brought back to a theoretical natural reference model, identified as potential vegetation, that is, a higher-order plant

population to which the vegetation should tend, according to repeatable models on a geographical scale, wherever equivalent environmental conditions occur. Unfortunately, this vision does not consider the historical processes that took place locally, which are instead studied by forest history and historical ecology and which influence the local environmental conditions, for example by modifying the structure of the soil and therefore the development of some species instead of others (Agnoletti, 2020).

The difference between the two approaches consists in the fact that the phytosociological approach tends to abstract the place studied from the historical-topographical context to bring it back to a model of theoretical plant association towards which management is aimed. Unfortunately, the models created by phytosociology, hardly ever manage to consider the complexity of the historical dynamics that have affected current ecosystems. These are historical dynamics that do not necessarily coincide with the theoretical natural dynamic series. In other words, the concepts of "potential vegetation", "climax", "evolutionary/regressive series" and "degree of naturalness" often obscure the reality of historical processes behind theoretical schemes, which are yet to be demonstrated, but above all deny historical-cultural values combined with vegetation structures. This scientific approach, therefore, often develops ineffective interpretative models to describe landscapes influenced by man's work, also influencing the media and several institutions. The importance of this reflection is evident considering the global context where almost 77% of the planet's land surface is occupied by the production and consumption landscapes of contemporary economies, over half of this surface today is abandoned, although still shaped by previous activities. Furthermore, it is often not clear the advantage to bring back forest ecosystems to a theoretical "natural state" (Nature, 2009).

Historical investigations also offer a better interpretation of the concept of biodiversity. While in most of the case biodiversity is considered as a set of species to be protected with little consideration of the role of "time", the study of biodiversification processes, especially when focusing on the links between cultural and biological diversity at the individual landscape level, is of fundamental importance (Cevasco et al., 2015). When observed at a local, topographical site-scale, or on an individual landscape-scale (gamma diversity), the links between biological and cultural diversity appear more clearly as historical products (Cevasco and Moreno, 2012). Rapid evolutions in environmental conservation studies have recently led to the radical notion that the 'ecosystem is dominated by history' (Editorial Nature, 2008). In this respect the CBD UNESCO declaration on biocultural diversity has formally clarified not only the origin of the rural landscape of Europe, including forests, but also the type of biodiversity characterizing both forest and farmed land (CBD-UNESCO, 2014). These are the premises allowing to interpret the investigation on the dynamic of Italian forests presented in this paper.

2. Materials and methods

2.1. Preliminary analysis

An understanding of the features of the Italian forests requires at least a brief synthesis of the historical factors affecting them, although the lack of quantitative information proposes strong limitations to the understanding of the changes occurred before the Unity of Italy (1861). An analysis of the official statistics has been carried out starting from that period, as after this year it is possible to collect data on the extension and composition of the Italian woodlands at national level and to follow their changes until today. However, these statistical data do not provide maps or any information about the spatial distribution of forest surfaces.

2.2. Forest changes from 1936 to 2018 according to spatial data

The main analysis presented in this paper focused on the historical and current forest spatial distribution, in order to measure the transformation at territorial level. This part of the research started with the analysis of the oldest national forest map, dating back to 1936 that has been recently digitized by the Italian Forest Service (CFS) and made available in a GIS format. In fact, despite some partial representations of forest coverage in Italy which date back to the medieval period and that the first forest documents based on cartographic projections date back to the beginning of the 19th century, all these documents refer only to limited areas and are characterized by heterogeneous information, so it is not possible to use them to obtain reliable data at national level (Ferretti et al., 2018). The layers used for this second phase are the following:

- The Forest Map of the Kingdom of Italy of 1936: this map is the first forest map at national level made after the Unity of Italy (1861). It has been recently digitalized and made available by the Italian Forest Service, thanks to the scanning and geo-referencing of the original sheets, both in raster and in vector format. The original document is made of 276 sheets with a scale equal to 1:100,000, even if the original field sampling was conducted and reported on 1:25,000 official topographic maps (Ferretti et al., 2018). The map covers the former national boundaries, including small portions of land now part of Slovenia and Croatia, thus it has been cut to focus only the surfaces included in the current Italian borders.
- CORINE Land Cover 2018: downloaded from the ISPRA (The Institute for Environmental Protection and Research) portal SINANET. Land use map for all Europe, with a shared methodology and legend.
- Digital Terrain Model (DTM): downloaded from the National Geoportal site. This raster layer is offered with different resolution, with pixels from 20 m to 75 m. Since the area analysed, the entire national territory is very large, we considered the 75 m resolution the best option.
- Natura2000 sites map and the Official List of Protected Natural Areas (EUAP): both maps have been downloaded from the National Geoportal site. The first map includes the Special Area of Conservation (SAC), the Special Protection Areas (SPA) and the Sites of Community Importance (SCI). The second layer includes all the national protected areas - National Parks, Marine Protected Areas, State Nature Reserves, other national protected areas – and all the regional protected areas – Regional Parks, Regional Nature Reserves, other regional protected areas.
- Italian official administrative border: downloaded from the website of the Italian National Institute of Statistics (ISTAT), the administrative borders of the Italian regions have been used to classify the territory according to the official geographical partition that divides the national territory in five macro-areas: north-western, north-eastern, central, south, islands.

All the following elaborations have been carried out with the aid of the software QGIS, with the GRASS plug-in for the most complex ones.

The first preliminary step was carried out on the Forest Map of the Kingdom of Italy. This map describes the forests of 1936 according to different classes mainly based on a wood production perspective. Forests are firstly classified according to the physiognomic category, and secondly according to the management form or in the case of resinous trees, related to the presence of the different species (Ferretti et al., 2018). In the 1936 categories, the one called "degraded woods" does not have a clear definition and it was probably used to describe different forest types, as Mediterranean maquis, areas degraded by fires or by overgrazing, or shrublands normally managed as short rotation coppice used for a variety of purposes. The original legend entries have been split to obtain two different attributes, one containing the species and the other the management form (tall tree, coppice or coppice with standards).

Since there are not coppices for coniferous forests, in the last attribute column the "Coniferous" entry has been used for this species, and since we have very little information about the definition of "degraded woods" the management form has been classified as "Unknown". The final classification resulting from this preliminary elaboration is showed in Table 1.

The second preliminary elaboration involved the combination of two different layers of protected areas (Natura2000 and Italian Protected Areas) in a single vector file containing only the boundaries of all these areas, without internal partitions. Since most of the protected areas overlap, it was used the dissolve function from the geoprocessing tools to delete these overlaps and to obtain a map with the surface of all the protected areas regardless of their type. In addition, since many protected areas cover sea surfaces, the final layer has been clipped with the coast border to obtain only the terrestrial protected areas.

The third preliminary step involved the reclassification of the 75 m resolution DTM into elevation classes, to obtain a raster map with the elevation included in altitude classes of 100 m each. This classification allows a better and easier analysis of the results, to show certain dynamics.

Finally, the fourth preliminary step involved the Corine Land Cover 2018 map. Since this map shows all the possible land cover, only the forest-related land uses have been extracted. In addition to the class 3.1 - forests, we have also considered as forest areas the category 3.2.2 - Moors and heathland, 3.2.3 - Sclerophyllous vegetation and 3.2.3 - Transitional woodland/shrub. All these classes, once extracted, have been merged and the boundaries have been dissolved to obtain a vector map with only the surface covered by forests and related land uses.

2.3. Analysis of forest changes 1936–2018

The first elaboration involved the analysis of the distribution and management type of the forest of 1936. After a summary of the different species according to the management type, the map has been overlayed with the boundaries of the current protected areas to measure what types of historical forests are actually included into the system of protected areas.

The second elaboration involved the overlaying of the two forest maps, 1936 and 2018, to measure and analyze the forest surface expansion or contraction. Since the 2018 map does not include any information about the forest type or about the management form, this elaboration only considered the presence or absence of forest areas. Thus, after merging all the category of the 1936 map, the two layers have been overlapped, to obtain a new layer showing the evolution of the forest surfaces according to the following different categories:

- Pre-existent forest: i.e., woods present in 1936 and still presents in 2018.
- New forest: i.e., forest growth on surfaces that in 1936 were not classified as forests.
- Lost forest: i.e., surface that was forest in 1936, but are not wooded in 2018.

Since one of the aims of this research is to study and to contribute to understanding the origin and the evolution of the current Italian forests, most of the following elaboration focused on the pre-existent forests and on the new forests, namely the two categories that represent the woods of 2018. In fact, lost forests, by definition, are surfaces that are not currently forested.

The forest surface changes layer has then been analysed according to three issues (Fig. 1): the presence of protected areas, the geographical partition of Italy, the altitude class. These further analyses contribute to find possible correlations between the expansion of the forest surfaces and the geographical or the altitude distribution, as well as in highlighting the origin and the historical management applied to the forests actually included into protected areas to evaluate the human impact on these forests.

Table 1
Reclassification of the forest map of 1936 original legend, with the species classification and the management system.

Species	Management form
Degraded woods	Unknown
Cestnut (*Castanea sativa*)	Tall tree
	Coppice
	Coppice mixed with tall trees
European beech (*Fagus sylvatica*)	Tall tree
	Coppice
	Coppice mixed with tall trees
Turkey oak (*Quercus cerris*)	Tall tree
	Coppice
	Coppice mixed with tall trees
Irish oak (*Quercus petrea*) and European oak (*Quercus robur*)	Tall tree
	Coppice
	Coppice mixed with tall trees
Cork oak (*Quercus subera*)	Tall tree
	Coppice
	Coppice mixed with tall trees
Silver fir (*Abies alba*)	Coniferous
Spruce (*Picea abies*)	Coniferous
European larch (*Larix decidua*)	Coniferous
Stone pine (*Pinus pinea*)	Coniferous
Other pines	Coniferous
Other species or mixed woods	Tall tree
	Coppice
	Coppice mixed with tall trees
	coniferous

3. Results

3.1. Italian forests in ancient times

In the Italian language *bosco* (wood) is a term derived from the Greek language with the meaning of pasture, while *foresta* (forest) has probably a German origin and was brought to Italy after the fall of the western Roman Empire probably by the Longobards invading Italy (Agnoletti, 2018). The term *bosco*, largely used today, is quite illustrative of the past situation of the Italian woodlands characterized mostly by grazing, both in the form of wooded pasture (*saltus* in Latin language) and pastured woods. The first information on the Italian forests come from Roman times, and in particularly from Plinius the Elder, who in the first century after the death of Jesus Christ wrote a monumental work on natural history analyzing 2000 manuscripts and 500 authors while traveling across the Roman empire (Pliny the Elder 1938-1962). A large part of the forest landscape was managed as wooded pastures and pastured woods, named "*saltus*". Coppices and high stands were well known management forms and the rotations of cuts was widely applied, simple coppicing was applied on a 5 to 6 year basis, while pollarding was carried out every 2–3 years. Still in the second half of the 18th century pollarded woods were the third type of coppice woods exiting in Tuscany, and they were particularly suited to combine grazing with wood production. Coppice with standards was also quite widespread. A crucial importance was assigned to forests producing acorns for the pigs freely grazing in almost all the oak forests of Italy and in many other parts of the empire. High stands of beech were cut at an age ranging between 60 and 80 years, fir and spruce at about 60. Due to the intensive utilization of forests, not only for grazing, timber or fuelwood, but also for many other products (e.g. care) and considering the widespread application of the fire in the form of "slash and burn", there were very few forests considered as "virgin or pristine". Latin authors describe about ten of

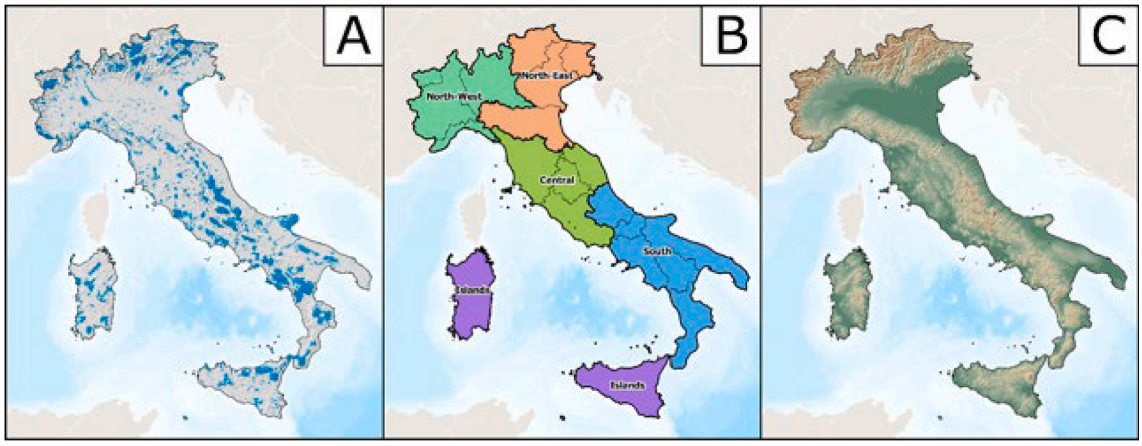

Fig. 1. The forest surface changes in Italy have been analysed according to the presence of protected areas (a), the official geographical partition (b), the altitude class (c).

them distributed from the north to the south of the country, some considered sacred and dedicated to various Gods. With the exception of early medieval times (5^{th}-9^{th} centuries) characterized by several invasions from the north of Europe, when forest surface extended again due to the demographic fall (about −50%) and the reduction of agriculture, all the forests were exploited for various purposes until the 20^{th} century (Agnoletti, 2018).

3.2. The forest statistics from 1861 to 2015

Some of the kingdoms existing before the Unity of Italy developed surveys and even forest inventories (Agnoletti, 2018), but they used very different methods and it is very difficult to collect precise information. The first statistic at national level (except for Veneto region and Rome, which were not already included in the Italian Kingdom) is the one carried out in 1862 (Valenti, 1911). It is important to highlight that, as happens in other more recent statistics, the chestnut orchards were not considered in forest inventories, due to the fact that were mainly used to produced nuts to feed the population and therefore were considered as an agricultural crop. This first dataset was later criticized by the Italian National Institute of Statistics (ISTAT) because of the uncertain data sources and the lack of an accurate definition of wood.

The next Forest Statistic of the Italian Kingdom of 1870, committed by Stefano Castagnola, the agricultural, industry, commerce and marina minister (MAIC, 1870), did not include the Rome province and was made through the analysis of cadasters and archives maps, collecting the results according to municipalities and provinces, so that it includes more accurate information about the forest types and properties. The following work dates to 1874 and it was a portion of a wider document about the kingdom agriculture (MAIC, 1876). This document criticized the Castagnola's statistic data because it did not consider chestnut surfaces while it had taken into account shrublands and other surfaces like uncultivated ones. The 1874 statistic lacked data on Tuscany region except for the Lucca province. The missing data can be obtained by a later document: the Annuario Statistico Italiano of 1886 in which a table reporting data about the forest annual average extension between 1876 and 1881 can be found. In addition, there are further data available in Bollettino di Notizie Agrarie, although the method of data collection is not clear (Agnoletti, 2005).

From 1913 to 1926, different statistics including the forested surfaces were published, but none of them was complete or produced maps. It was necessary to wait until 1936 to have a complete document at national level based on field surveys and maps, the Italian Forest Map of 1936, developed by the National Forest Service. In this work, for the first time we find all the forests of Italy mapped with the same methodology, including information about the forest types and the management forms (Agnoletti, 2005).

The lack of an accurate and coherent methodology in data collection and statistics analysis on forest surfaces in Italy was compensated by ISTAT after the second world war. In collaboration with the Agricultural and Forestry Minister, ISTAT started to produce statistics through the application of the same standards from 1948 to 2005. This makes the analysis of this period easier and partially solves one of the major problems we have to deal with: the different methods used in data collection and the different way the wood is considered. The ISTAT series, even if they are based on reliable data, cannot be compared to the most recent forest inventories made by remote sensing, especially due to the different forest definitions (ISTAT, 1998).

The most recent and reliable data derives from the National Forestry Inventories. The first one was carried out in 1985 followed by the one of 2005 and the last one of 2015 (Rete Nazionale Rurale 2017). These inventories answer to the need of increasing the forest conditions awareness, so that the last one focuses not only on wood distribution, composition and dynamics, but also on other ecosystem services provided by forest, in particular on its role in carbon sequestration.

Despite the limitations due to the different methodologies applied from 1861 to 1915, the data collected allowed an evaluation of the changes affecting the overall forest surface (Fig. 2). This graph may present some limitations but surely shows a reliable trend of the forest surfaces. In the same graph, the data on the forest extension have been compared with the population growth and the variation of agricultural land. These two data were less influenced by the different methodologies adopted, especially for what concern agriculture.

In conclusion the data collected shows that between 1888 and 2015, the forests extension passed from almost 4.215.000 to almost 11.778.000 ha, with an increase of 7.563.000 ha and an annual growth rate of about 59.551 ha. Considering only the official three forest inventories carried out in 1985, 2005 and 2015, the forest surfaces increased by 3.103.000 ha at a rate of 103.000 ha per year. There are obviously some differences due to the different methods used in the various surveys carried out by the different authorities, as also in the definition of what is considered "forest", but the general trends are clear. From this data we can conclude that about 7.563.000 ha of the contemporary forests surfaces do not have a natural origin, but are the result of secondary successions occurred on abandoned farmed land since 1888, except for about 1.000.000 ha due to afforestation made by the state. This afforestation can be divided into a first period between 1883 and 1939, when 197.000 ha were reforested and a second period 1952–1972, when about 800.000 ha were reforested according to new laws. About 80% of these plantations was done with conifers, mostly Austrian pine, sometime replacing previous broadleaved woods (Agnoletti, 2010).

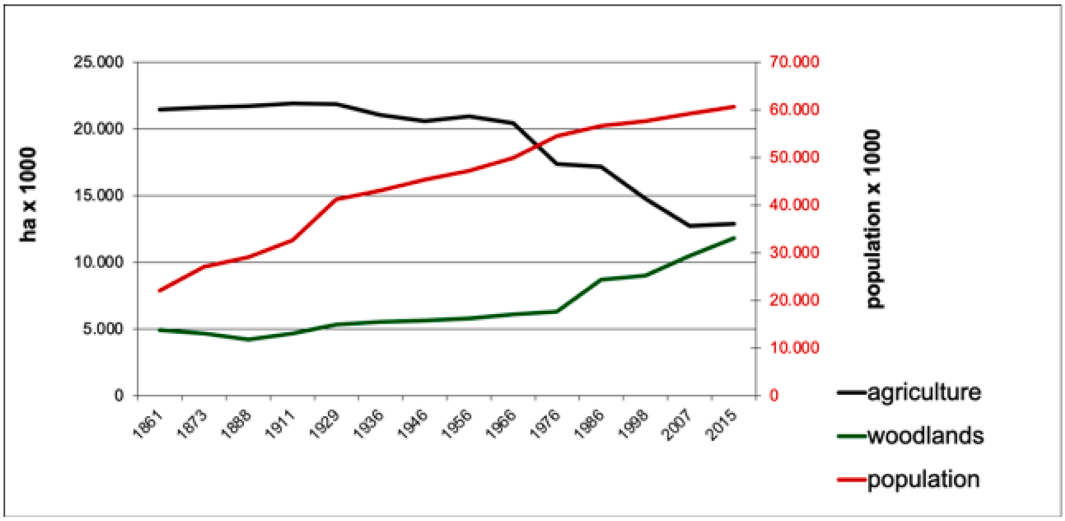

Fig. 2. Dynamics of forests, population and farmed land in Italy from 1861 to 2015.

Another important information that was collected analysing the different statistical information concerns the dynamic of the forest surfaces managed according to the two main management forms: coppice and high stand (Fig. 3). The data confirms the importance of coppice as the most important management form in Italy since the last century.

3.3. Forest dynamics from 1936 to 2018

Table 2 shows the distribution of the species according to the different management systems. The table summarise the species by type (conifer/broadleaved). Of the total forest surface in 1936 (including broadleaf, conifer, and degraded wood) 57% was managed as coppice (simple or with standards). This information is important because it demonstrates that those surfaces were actively managed. Concerning high stands, the information about the most important Italian conifer forests, mainly located in the north-east of Italy, as well as the ones in Central Italy (Tuscany) and in the south of Italy (Calabria), show that they were intensively managed for a variety of purposes (Agnoletti, 2018). In addition, oak forests were usually managed for grazing, as demonstrated by many documents coming from all Italian regions (Agnoletti, 2010).

To better understand the importance of coppice in 1936, Table 3 summarizes the previous data but only for the broadleaf species (including the fraction of "other species" class that have been classified as broadleaf). The Forest Map of the Kingdom of Italy also distinguish between two kinds of coppice: the simple coppice and the coppice with standards. The data shows that 75% of all the broadleaf forest in 1936 was managed as coppice. Chestnut forests were mostly managed as tall trees, because while there was a significative part dedicated to pole and coal production (from coppices), they were a crucial food resource for people living in the mountains, especially in the Apennines. Nearly 70% of the beech forests were instead managed as coppice, mainly to provide wood for charcoal production. Concerning turkey oak's forests, only 27% of them was managed as coppice, all of it as coppice with standards. Cork oak's main destination was (and still is) the production of cork, therefore the main management form applied to this species was the tall trees (86%). Irish and European oak and the other species count a high percentage of coppice.

The overlap of the 1936 forests with the borders of the current protected areas, highlighted that at the time only one third of the actual

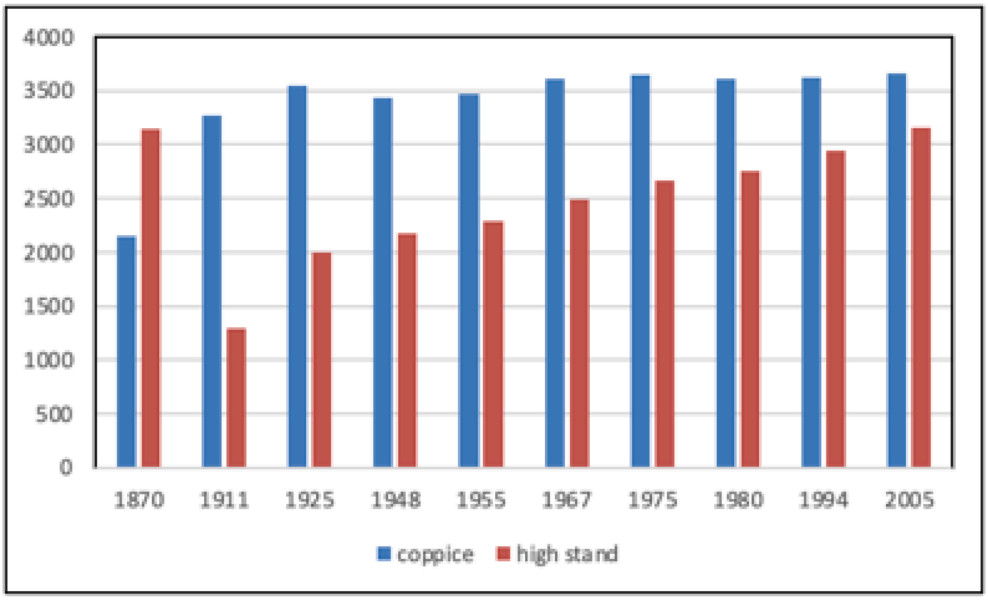

Fig. 3. Proportion between high stand and coppice forests between 1870 and 2005.

Table 2
Forest species and management systems in Italy in 1936. Each row indicates the distribution (in hectares and percentage) for each management systems.

Species	Broadleaf				Conifer		Unknown		Total
	Tall trees		Coppice						
	ha	%	ha	%	ha	%	ha	%	ha
Chestnut	463,092	58%	337,081	42%	–	–	–	–	***800,173***
Cork oak	64,075	86%	10,749	14%	–	–	–	–	***74,824***
European beech	259,644	31%	584,987	69%	–	–	–	–	***844,631***
Irish Oak or European Oak	133,909	15%	755,864	85%	–	–	–	–	***889,774***
Turkey oak	57,612	73%	21,636	27%	–	–	–	–	***79,248***
Silver Fir	–	–	–	–	19,328	100%	–	–	***19,328***
Spruce	–	–	–	–	135,458	100%	–	–	***135,458***
European larch	–	–	–	–	82,012	100%	–	–	***82,012***
Stone Pine	–	–	–	–	10,507	100%	–	–	***10,507***
Other Pines	–	–	–	–	195,572	100%	–	–	***195,572***
Degraded woods	–	–	–	–	–	–	334,665	100%	***334,665***
Other species or mixed woods	145,826	6%	1,722,000	68%	663,093	26%	–	–	***2,530,919***
Italy total	***1,124,159***	***19%***	***3,432,317***	***57%***	***1,105,971***	***18%***	***334,665***	***6%***	***5,997,112***

Table 3
Focus on the broadleaf and the distribution between management systems. Percentages of the two coppice subcategories (simple or with standards) refer to the coppice total, not the row total.

Species	Tall trees		Coppice						Total
			Total		*Simple*		*With standards*		
	ha	*%*	*ha*	*%*	*ha*	*%*	*ha*	*%*	*ha*
Chestnut	463,092	58%	337,081	42%	*323,359*	*96%*	*13,722*	*4%*	***800,173***
Cork oak	64,075	86%	10,749	14%	*10,356*	*96%*	*393*	*4%*	***74,824***
European beech	259,644	31%	584,987	69%	*549,902*	*94%*	*35,085*	*6%*	***844,631***
Irish Oak or European Oak	133,909	15%	755,864	85%	*679,632*	*90%*	*76,233*	*10%*	***889,774***
Turkey oak	57,612	73%	21,636	27%	–	–	*21,636*	*100%*	***79,248***
Other species or mixed woods	145,826	8%	1,722,000	92%	*1,585,353*	*92%*	*136,646*	*8%*	***1,867,826***
Italy total broadleaf	**1,124,159**	**25%**	**3,432,317**	**75%**	***3,148,602***	***92%***	***283,716***	***8%***	4,556,476

protected areas was covered by forests, and more than half of forest surface (57%) was definitely not natural, since it was managed as coppice.

The overlay of the maps of 1936 and of 2018 (Fig. 4) shows that new forest covers a total of 5.279.895 ha, the pre-existent forests cover a total of 4.801.906 ha and that 1.191.793 ha of forests have been lost.

The first graph in Fig. 5 shows the 2018 national forest distribution. The data relative to the national territory shows that one third of the land is occupied by forest; this forest is composed more than half by woods generated after 1936, and half were already forests in 1936. However, 55.8% of these pre-existent woods derived from forests that in 1936 were managed as coppice. This means that of the 10 million hectares of woods in Italy, 78,9% derives from lands managed and altered by human activities, and are the consequence of secondary successions on former agricultural surfaces or forests that were regularly managed.

The second graph in Fig. 5 shows the same analysis but only for the protected areas. It is possible to find the same increasing trend of the national level: more than 54% of the protected areas of Italy are covered by woods (3.2 million hectares), while, in 1936, the woods only covered 32% of the same area. Again, about 48,1% of the forests currently included in protected areas originated after 1936. Following the national trend, 56,3% of the pre-existent woods derives from forests managed with coppice system; thus, while the total percentage of forest is higher than the national average, the percentage of forest grown on surfaces altered by anthropic activities remain pretty similar (77.3%).

Fig. 6 shows the forest coverage in percentage on the total surface according to the altitude class, dividing from the forests already present in 1936 (dark green) and forests grown between 1936 and 2018 (light green). The results show a couple of peaks in forest coverage, at 800–900 m and at 1700–1800 m, reaching values of about near 90%, with a sensible increase of new forests.

Fig. 4. map of Italy showing the forests present in 1936 and still presents in 2018 (in green), the forest surfaces developed after 1936 (in yellow), and the surfaces that were classified as forests in 1936 and that in 2018 are occupied by non-forested land uses (in red). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

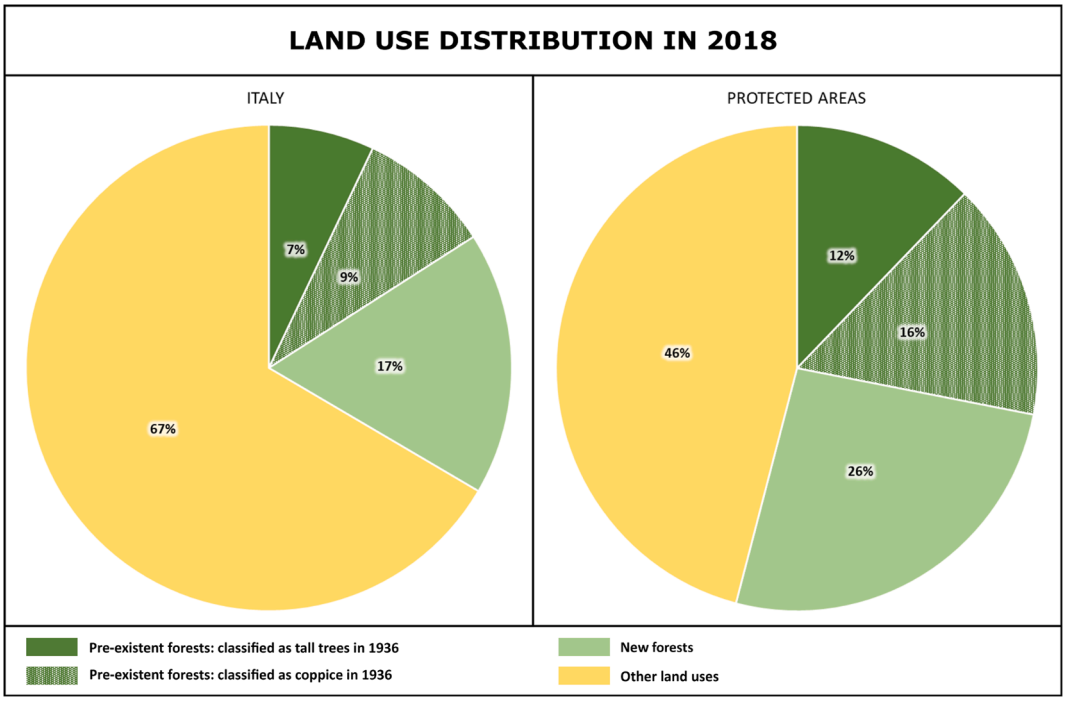

Fig. 5. The charts show the forest land use percentage, subdivided by the classification in 1936. On the left, the chart shows the data on national level; on the right, the chart shows the data for protected areas only.

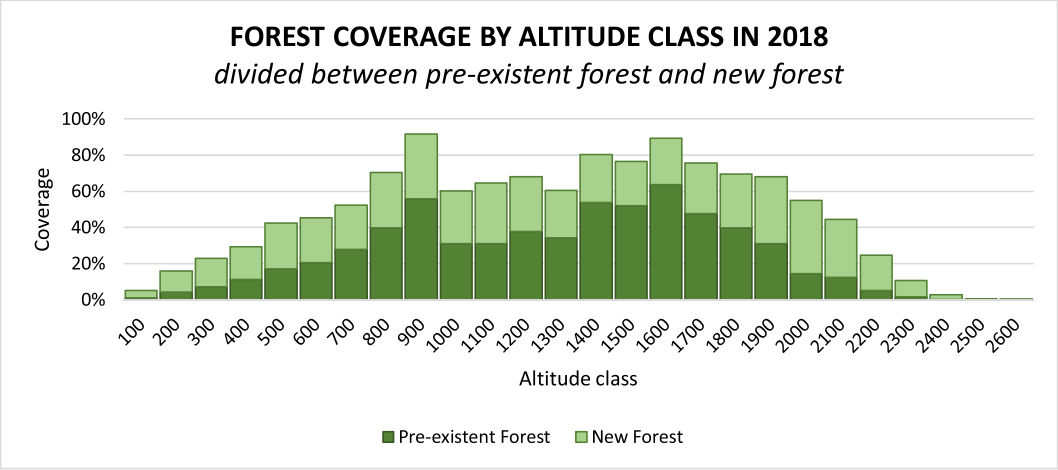

Fig. 6. Forest coverage in percentage for 2018 according to the different altitude classes, dividing the forests already present in 1936 from the new forest surfaces grown after 1936.

It is interesting to notice that the south and the islands are the Italian areas most involved by the growth of new forests (Fig. 7). On the islands the increase of forests is pretty impressive, from 8% of forest coverage in 1936 (404.249 ha) to 31% in 2018 (1.528.557 ha). The southern part of Italy was the penultimate geographic partition for forest coverage in 1936 (17%), and the last one in 2018 (19%), because this part of the country has the higher value of lost woods (283.000 ha – 23% of the 1936 forest areas) that brought the net surfaces dynamics to a reduced value. The central part of Italy already hosted the highest forest coverage in 1936 (29% – 1.673.266 ha), and it maintains this first place in 2018, with 38% (2.214.671 ha) of surfaces covered by woods. The two northern parts of Italy had a very similar coverage in 1936 (22–23%), but the north-eastern part has undergone a slightly reduced expansion compared to the north-western one.

4. Discussion

4.1. Forest dynamics in Italy

The initial decrease of forest surfaces 1861–1888 shown in Fig. 2, was due to the growing population and the need to cultivate more land and the migration of the population from the hills and plains to the mountain areas, creating new pastures and farmed land (Agnoletti, 2010). Deforestation was also accelerated by the discussion on the first forest law of 1877 suggesting owners to remove forests before the restrictions to cuttings came through. The law on forest restoration of 1888 contributed to reduce deforestation but only 194.000 ha were reforested from that time until the second world war. During this period, we also witness the growth of coppicing, becoming the most widespread form of forest management applied in the country. This was due to the

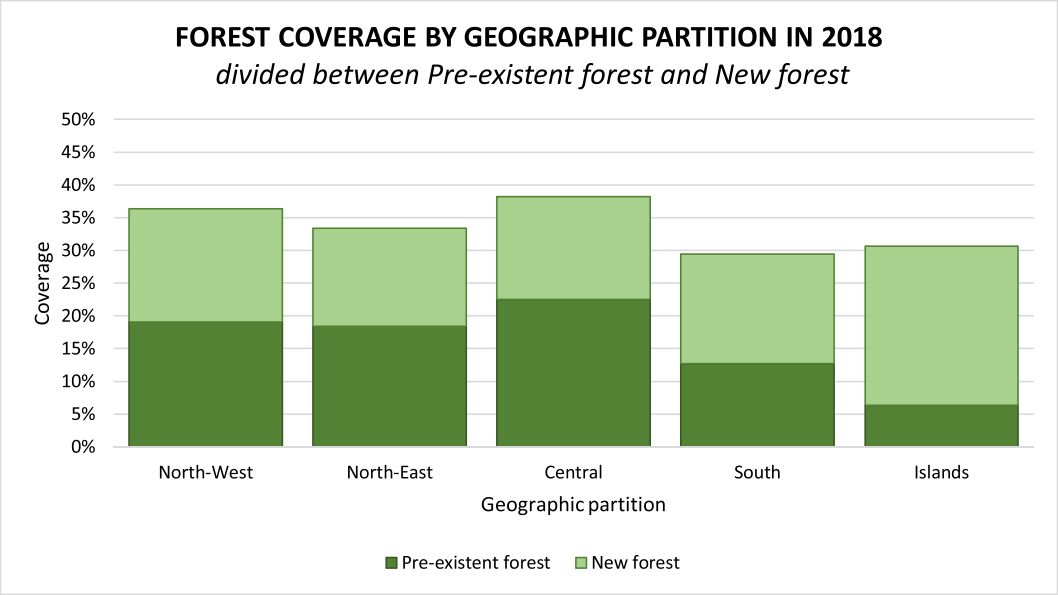

Fig. 7. Forest coverage in percentage for 2018 according to the different geographic partitions, dividing the forests already present in 1936 from the new forest surfaces grown after 1936.

fact that the product of coppicing was better suited to farming activities and to charcoal production compared to high stands, moreover the latter immobilize capitals for about 60–80 years, compared to coppicing producing every 5 up to 25 years according to the rotation of cuts applied.

The continuous increase of forest surfaces from 1888 to nowadays is entirely due to the important socioeconomic changes occurred after the second world war. The abandonment of the countryside with the growth of the urban population from 1955 to 60 on, and the process of migration from the mountains to the plains, as well as the migration from the south to the north, not only reduced cultivated land allowing secondary forests to colonize abandoned land, but also affected forest management. This has brought to a situation where 57% of the population lives in 23% of the territory, mainly urban areas and plains, while almost all the Italian forests are concentrated in the rest of the territory, made of mountains and hills (77%). This unbalanced distribution of the population has also contributed to the diffusion of the infections due to Covid-19 (Agnoletti et al., 2020). An important amount of the new forests was due to afforestation made by the state, especially after the second world war, about 800.000 ha of conifers planted in mountain areas after 1952. The reduction of famers and shepherds on the mountains eliminated the main "enemies" of afforestation and finally a "state landscape" replaced the "social landscape" existing in these areas. The law of 1952 financing afforestation was clearly enhanced to create jobs in mountain areas that were slowly falling into an economic depression, still ongoing today. All the afforestation occurred in Italy since 1888 mostly used *Pinus nigra*, a species not native of Italy and having no cultural roots in the landscape. They generated new woods that are similar to other afforestation promoted in different parts the world, most often not related to the local cultures. In Italy this afforestation with black pine led to little economic result, it created poor forest ecosystems although succeeded in colonizing poor soils (Agnoletti, 2018).

The increase of forests on abandoned land is a widespread phenomenon especially in Europe (Fuchs et al., 2014). Between 1920 and 2005, Sweden and Norway witnessed a steady decline of agriculture (Hamre et al., 2007). Between 1830 and 1995, Austrian agriculture declined by 35% (Krausmann, 2001). Also in Spain dry farmed land decreased by 25% between 1989 and 1999 (Serra et al., 2008) as well as in Poland (Hernik et al., 2015). In Europe we are witnessing a steady increase of land classified as forest, from north to south and from east to west, but similar processes occur in Japan, Korea and North America. According to the FAO (FAO, 2010), in the past 20 years forests in Pan-European countries have increased by 850,000 ha per year.

Considering Italy, the reforestation process occurred since 1888, together with the change of land use due to the abandonment of farmed land and pastures, represent an environmental change probably stronger than the ones proposed by the scenarios of climate change produced by IPCC since 1990. In fact, not only there are no significant deforestation or desertification processes affecting the expansion of forests surfaces, but all these processes are entirely driven by direct human factors, not by the changing climatic conditions. The deforestation processes occurred around urban areas, mainly after the second world war for the constructions of new urban areas and due to forest fires, did not affect the general growth of forest surfaces (Agnoletti, 2010).

Considering the changes in the structure of the Italian forests, especially the proportion between high and low forests, this was also influenced by socioeconomic changes. The prevalence of low forests due to coppicing occurred between 19th and 20th century, was due to the need of wood charcoal as a source of energy, but also to the fact that coppices were the most suitable management form for the famers, producing different kind of products, with an interval between cuts varying from 5 to 25 years. After the second world war charcoal was substituted by fossil fuels and many coppice woods were slowly abandoned, as well as grazing activities inside forests, an activity occurring from the Alps to Sicily (Agnoletti, 2018). Since the 1980 many beech coppices on the Apennine Mountains were converted into high stands with the idea of renaturalizing these forests. Nevertheless, although the abandonment of this silvicultural method is today also supported by environmental and landscape restrictions, coppice woods are still characterizing the structure of most of the Italian forests (Fig. 8).

Together with changes in the forest extension and structure we can also witness changes in the species composition. As already reported, the afforestation done by the state contributed to about 1.000.000 ha of new conifer forests, about 20% more, in the whole country (Agnoletti, 2010). In the Trento province, a small area of the north-east of Italy considered the best for timber production, the percentage of conifers in the forests grew from 54% to 74% between 1892 and 1977, thanks to the continuous substitution of broadleaved trees. This expansion occurred even in areas not suited for the ecological needs of fir and spruce, the species mostly used for this purpose (Agnoletti, 2010). The expansion of conifers

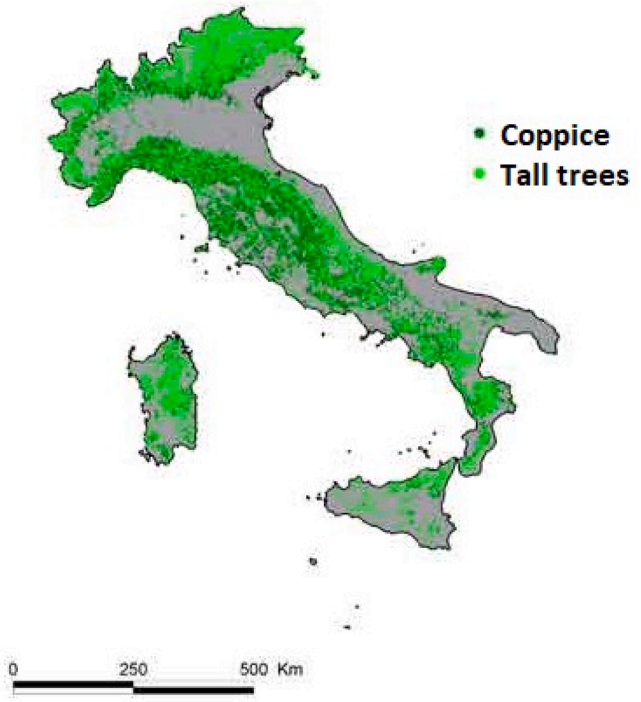

Fig. 8. The map produced for the National Forest Inventory of 2005 shows the distribution of coppice woods in Italy (dark green). These woodlands can be considered as a cultural product, since they have been extensively shaped by human influence. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

is a process reported for many other countries of Europe, since the 18th century (Johann et al., 2004), often replacing oak forests used for grazing and ship building (Agnoletti, 2018). In Italy, the slow growth of broadleaved reported between the seventies and the eighties of the last century, was instead due to the abandonment. For the Apennines, Malandra et al. (2019) demonstrated that the increase of broadleaf forests registered after the Second World War mainly derived from secondary successions occurring on grasslands (61.5%), croplands (20.5%), and shrublands (9.2%). The growth of a dense homogeneous forest cover indicated in Fig. 2 contributed to the reduction of the biodiversity, especially at landscape scale (gamma diversity) (Whittaker, 1972), reducing many different types of open spaces due to grazing and agriculture, as also to an excessive increase of wildlife compared to the habitats available. In some study areas in Tuscany the reduction of the diversity of the landscape mosaic measured between 1832 and 2020, was higher than 45%, with cases where land use diversity passed from 65 to 18 land use types (Agnoletti, 2007).

In the Apuane Alps, in Tuscany, between 1832 and 2002, forests not only expanded towards the top of the mountain as a consequence of the abandonment of the pastures at higher altitudes, but also the type of forest deeply changed. In particular, chestnut orchards became mixed broadleaved woods with prevalence of chestnuts due to the cessation of a regular management. The interesting thing is that the nature protection authorities established protected areas according to the EU NATURE 2000 network, protecting the natural habitat named "woodland with dominance of chestnut'' (Agnoletti, 2007). Clearly this woodland type represents only an ecological transition phase from a totally man-made forests, chestnut orchards, to a mixed forest, that is not surely a natural habitat. Chestnut orchards can also be considered perhaps the most typical cultural forests of Italy, presenting a high multifunctionality due to the production of timber, fuel wood, nuts, leaves and grazing. In the past centuries almost all the chestnuts orchards were managed for the production of nuts to feed the mountain population, since these forests were planted for this reason, while some of them were turned into coppice woods for the production of poles (Agnoletti, 2018). The ecology of this species growing from 20 to 1500 m above sea level, allowed a wide distribution often presenting an alternation with olive orchards in the same plot of land, not because of different ecological conditions, but for the simple decisions of the farmers. The abandonment of chestnut forests and their transformation into mixed forest it is a good example of the slow disappearance of cultural forests in Italy, but there are other cases like this. Other important examples can be found also along the western Italian sea coast where forests of stone pine (*Pinus pinea*), were planted since in 18th century after land reclamation. These woods are slowly turning into mixed forests due to the natural regeneration of oak species, but even in this case protected areas were established considering them as "natural habitats" (Agnoletti, 2010).

The growth of the forests on abandoned surfaces affected different environments, from the Alps to the Apennines, to the islands (Camarretta et al., 2018; Mancino et al., 2014). This expansion affected also areas with difficult climatic, morphological, and pedological conditions, as in 11.4% of the cases forest expansion occurred in areas with annual mean temperature between 16 and 18 °C, and in 28.3% in areas with average annual rainfall of 500–700 mm (Mancino et al., 2014). The expansion of forest surfaces occurred with a relatively homogeneous trend according to the different altitude class, as there are no classes with low increase, except for the highest ones. This trend is also confirmed by Malandra et al. (2019) for the Apennines, highlighting that lower-elevation landscapes showed more dynamic forest expansion than the ones at higher elevation. In addition, they found that the grassland-to-forest transition is more common at higher altitude than the cropland-to-forest transition. This testifies that anthropic activities were once well spread in every altitude class, from the coast to the highest mountain pastures, and that the abandonment of these activities have led to significant landscape changes at every altitude.

The fact that the bigger islands, especially Sardinia, registered the higher forests surface increase in the period 1936–2016, is not surprising. In fact, Sardinia underwent important changes of the forest structure in the previous centuries, mainly due to grazing and partly to the need of producing railroad ties and firewood for charcoal in the 19th century (Beccu, 2000). On one side, overgrazing led to the decrease of forest surfaces, while on the other side, the ancient dense forests existing in the island were turned into wood pastures, making Sardinia one of the most important historical wood pastures of Europe, traditionally used for both cheeses and meat production. On the other hand, extended afforestation carried out with *Pinus radiata* in the island introduced a species that has nothing to do with the Sardinian landscape and also with no economic importance, showing the limits and the little attention to the cultural landscape while carrying out afforestation.

Concerning secondary succession, Santoro et al. (2021), in Cinque Terre National Park (Liguria Region), for the period 1936–2018, showed that only 54% of 1936 *Pinus pinaster* forests are today classified in the same way, while the rest undergone significant changes in specie composition, due to ecological successions with the progressive entry of local broadleaved species; at the same time, about the half of 2018 pine forests are found on terrains that in 1936 were not occupied by forests, meaning that pines are "moving" towards non-forested terrains colonizing them thanks to their pioneer attitude. Several studies demonstrated, in fact, that the past land use or the past management forms deeply affect species composition both of the herbaceous and of the upper layer, vertical and horizontal structure, or soil characteristics. The imprints of past land-use changes in forest composition, structure, and carbon stocks have been studied for several European forest types (Plieninger and Schaich, 2014; Eriksson et al., 2010; Gimmi et al., 2009; Kopecky and Vojta, 2009; Szabó, 2010b). According to Dupouey et al., 2002, the effects of past agricultural land use on current forest biodiversity are strong even after centuries, due to the long-term changes of chemical and structural soil properties, while Compton and Boone (2000) demonstrated that XIX century agricultural practices impacted

the nutrient content and ratios with consequences on the actual forest soil composition. Other studies focused on analyzing the species composition and the forest structure of woods developed on terrains previously used for agriculture or as pastures, finding that the past human activities still influence the current forests characteristics, even in forests unmanaged by several decades (Holmes and Matlack, 2018; Verheyen et al., 2003; Hermy and Verheyen, 2007; Koerner et al., 1997; Peña-Claros, 2003).

4.2. Natural and cultural forests

The Italian case presents strong evidence of the cultural origin of the Italian forests, that are an important component of the Italian landscape, basically a cultural landscape according to the definition given by Sauer (Sauer, 1925). Different populations living in different environment and climates, in order to respond to their need for surviving, developed distinct relationships with their forests through history, affecting them in different ways. Forest landscapes evolve slowly compared to other land uses and may take centuries to form a characteristic structure although strictly related to traditional practices (Antrop, 1997). Taking into consideration the current trends showing the gradual abandonment of forest activities, especially the traditional ones, and the majority of unmanaged forests today dominating the Italian forest landscape, about 70% of the total, we can clearly see the danger of rapidly losing the cultural features of Italian forests, as well as the cultural heritage associated to them. Not only the abandonment of traditional practices associated to forest, but also protection tools, like landscape and environmental restrictions, are today deciding their dynamics, replacing socioeconomic factors. Recently the Ministry of Culture, the institution in charge of landscape protection, has forbidden simple coppice, a historical management form existing since Roman times, in some areas under landscape protection, despite the fact that cultural values are the foundations of the landscape protection in Italy.

Despite historical evidences on the cultural origin of many forests, there are continuing efforts to apply concepts such as “natural” and “seminatural” to assess and manage them. Basically, for the attempt to define “models” suited to rewild large portion of forest land across the world, considering this as the best strategy to achieve the highest level of biodiversity and the other ecosystem services. Semi-natural forest is a term often used in Europe, about forests that are more or less natural or resemble such forests enough to make it difficult to tell the difference. Inventory and statistical purposes have been the main reasons for this rather unprecise term, e.g. for sites where it is difficult or impossible to find out if the stand was planted or not - maybe 200 years ago (Buchwald, 2005). These definitions of natural or seminatural seem not coherent with the origin and features of many forests, especially the ones in Italy. It is also worth remembering that the use of the semi-natural cover type term, arose initially from a binary habitat/matrix landscape representation, which often dominates in the literature. In this framework, semi-natural covers (suitable habitat) are expected to support biodiversity while farmlands (matrix) are seen as a hostile environment because of the intensity and frequencies of anthropogenic disturbances (Fahrig et al., 2011).

Recently, FAO introduced new definitions regarding the characteristics of forests based on their origin (FAO, 2020):

- Primary forest - Naturally regenerated forest of native tree species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.
- Naturally regenerating forest – forest predominantly composed of trees established through natural regeneration (now a main category including stands of mixed or unknown origin, and naturally regenerating introduced species).
- Planted forest – forest predominantly composed of trees established through planting and/or deliberate seeding.

All these definitions clearly neglect the cultural origin of many forests and the term is not even used in the national forest inventories showing the failure of many researchers and institutions, to recognize the duality of the forest landscape they seek to influence (Agnoletti and Rotherham, 2015). In this sense, the human perception and psychological construct of what are ‘natural’ forests, as well as the research findings, are often misleading and are largely influenced by the deliberated will to ignore the cultural features as part of sustainable forest management. This issue becomes more than an intellectual exercise because it then influences, if not determines, the human response to landscape management. Misunderstanding of ecosystem processes and of related biodiversity in terms of the reality of the cultural aspect of ‘forest landscape’ becomes especially troublesome. There is a desire for wilder future landscapes (Adams, 2003; Rotherham, 2014). The issue is particularly relevant in Italy, where many contradictory conservation strategies have been developed for forests. On the other hand, it is worth noting that the description of the protected areas created through the European Habitat Directive seems to offer a “reading’’ of the territory that denies, or at least ignores, its cultural origin, which is the case not only for Mediterranean woodlands but also some boreal forests (Axelsson and Ostlund, 2000). This has brought also to well-known controversies like the recent one about the Bialowieza forest in Poland, considered one of the last pristine forest of Europe, home of the last group of European bison, included in the UNESCO natural heritage. Despite the idea of naturalness proposed to the public and scientists, historical investigations demonstrated a long history of human intervention affecting all the features of this forests (Samojlik et al., 2020).

The debate is not new (Balée, 1998), but surely it did not bring to any consideration about the need to identify and protect cultural forests, intended not as forest including “some cultural elements”, or as natural values becoming part of the culture, as it appears also in some SFM criteria and indicators. According to the theories on ecosystem services (Costanza et al., 1997) cultural values have been associated to immaterial values, such as “aesthetic, artistic, educational, spiritual and/or scientific values of ecosystems” and are included among the ecosystem services. However, cultural forests, meaning forests presenting density, structure, extension and species composition, entirely or partially determined by human action, cannot be technically considered as a service provided by ecosystems. The services that an ecosystem may offer often depend on the type of human influence that affected a natural environment in history. There are no services related to forests in a landscape where all the trees have been removed, as there are no services related to the diversity of tree species in a forest made of a single species. These are both cultural landscapes where the main driver of the change is human influence.

Both for the understanding of ecological processes, as well as for the correct classification and elaboration of planning and management guidelines, the use of terms as *semi-cultural* or *cultural forests* seems more representative of most of the forests of Italy as well as for other forest in the world. The use of these definitions could help the assessment of cultural values for sustainable forest management, but also promote special conservation programs considering cultural forests. The proposed definitions are the following:

Cultural forests are forests that mostly retain characteristics which come from a traditional management form, affecting their extension, density and spatial structure, species composition, typology, vertical and horizontal structure.

Semi-cultural forests are not currently under a traditional and/or regular management, but whose characteristics (extension, density spatial structure, and species composition, vertical and horizontal structure) have been influenced by traditional management practices. The term should also be applied to secondary forests developed after the abandonment of farmed land or pastures, particularly when agricultural or grazing activities occurred for a long time affected the features of the soil.

5. Conclusions

This study shows that in Italy from 4.215.000 ha of forest in 1888 we have today about 11.778.000 ha, with an increase of 7.563.000 ha and an annual growth rate of 59.551 ha, no deforestation processes occurred in the past decade affects this trend. Considering the map of 1936, the present Italian forests can be described partly as derived from those already mapped in that time, entirely managed although not regularly, and secondary forests developed on abandoned land, extending for 5.279.895 ha. Therefore, there is a large majority of forests resulting from secondary successions on abandoned farmed land or pastures, that, independently from any management form currently applied do not have a natural origin, nor can be considered natural. These forests include also new categories created in the last forest inventories such as "old growth", that most often relates simply to forests where management practices have been interrupted. The new forests spread because of the abandonment of the countryside started after the second world war, especially on the mountains, but their ecological features are largely influenced by current and past human influence. It is worth noting that, despite this significant increase, Italy is still importing about 85% of timber from abroad as it did in the 19th century and only one third of the Italian forests are regularly managed. The abandonment has contributed not only to economic depression and to concentrate high level of pollutant in limited areas of the countries around urban centers, but also to the interruption of traditional forest knowledge and the related management forms. This study shows that there are almost no forests in Italy that can be considered as having natural features, despite the data of national inventories, the high percentage of forest land classified under the NATURE 2000 networks and studies claiming the existence of such forests (Sabatini et al., 2018). It is also questionable whether there is the real need to locate or restore "pristine nature" in Italy or elsewhere as also cultural forests can offer ecosystem services (Nature, 2009) and if a natural environment could represent the best option for the country.

The combination of the abandonment of forest management, policies favoring renaturalization and the increasing landscape restrictions limiting traditional forest management forms, has contributed to reduce the extension of forest shaped by cultural factors. These cultural forests developed through the centuries, contributed to the growth of society and to build the cultural heritage of the nation. Given the fact that today cultural forests seem to be the most endangered forest type, a trend occurring also in other countries, and considering the existing indication of SFM to preserve cultural values associated to forests, it seems useful to introduce the category of *cultural forests*, in addition to the categories of *natural* and *seminatural forests*, for conservation, planning and management purposes. The objective of this categorization is to promote the recognition of the existence of cultural forests that deserve to be protected for future generations. Despite several recent political indications, in Italy there is no need to have new forests on mountains or hills, but rather to manage the existing ones, or even to decrease some of them, to reduce the homogenization and simplification of the landscape favoring its diversification and remedying the shortage of food locally produced. Concerning afforestation, historical investigations conducted at local level are necessary to identify the type of forests that should be planted, if and where necessary, in order to avoid the creation of new woods that have nothing to do with the local cultural context.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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