

Article

# The Monumental Olive Trees as Biocultural Heritage of Mediterranean Landscapes: The Case Study of Sicily

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**Abstract:** Monumental olive trees, with their longevity and their remarkable size, represent an important information source for the comprehension of the territory where they grow and the human societies that have kept them through time. Across the centuries, olive trees are the only cultivated plants that tell the story of Mediterranean landscapes. The same as stone monuments, these green monuments represent a real Mediterranean natural and cultural heritage. The aim of this paper is to discuss the value of monumental trees as “biocultural heritage” elements and the role they play in the interpretation of the historical stratification of the landscape. We present the results of a survey of the most significant olive trees growing in Sicily. The selection was based on the “monumentality” aspects of trees, taking into account dendrometric parameters and environmental contexts. The collected dataset constitutes a heterogeneous sample of 367 specimens of considerable size that, in some cases, reach a circumference of about 19 m. Starting from the data presented here, the whole Sicilian territory shows a historical relationship between human and olive. The presence of these plant monuments is, therefore, evidence of long-term, often centennial, landscapes as a result of sustainable use of the territory.

**Keywords:** agrobiodiversity; ancient trees; biocultural diversity; biodiversity; heritage trees; historical ecology; long-lived trees; *Olea europaea*; veteran trees

## 1. Introduction

The olive tree can be considered the most symbolic tree of civilization and a part of the anthropized Mediterranean landscape [1]. Exploited at least since the Mesolithic [2] and cultivated for the production of oil at least since the Bronze Age in Sicily [3,4], it has a wide distribution in all countries bordering the Mediterranean, with around 800 million individuals [5,6]. Evidence of mythology, history, and literature attest to the great importance of the olive tree and its oil in the trade, food, and customs of Mediterranean populations, starting with the olive tree as the protector tree of the city just founded by Athena and mentioned among the most precious trees by numerous Jewish, Greek, and Roman sources [6]. It is a very long-lived plant, with very slow growth, able to bear fruit for several hundreds of years, assuming extraordinary shapes and sizes over time and contributing to modern genetic diversity [7].

The use of the wild olive dates back to the Israeli region in the Epipaleolithic [4]. It is probably from primitive cultivation located in the west of Iran and the south of the

Caucasus that the irradiation to other geographical areas and the differentiation of the different cultivated varieties began [5]. It is believed that the cultivated olive tree (*Olea europaea* L. var. *europaea*) is derived from the refinement of the wild one (*Olea europaea* var. *sylvestris* (Mill.) Lehr), which is spontaneous throughout the Mediterranean basin [8] and with which it retains considerable genetic affinities [9], although its origin is still much debated [10]; however, it is no coincidence that the aspect of the abandoned olive tree tends to regress toward that of the wild olive tree [11]. The distribution of the olive tree, in fact, is almost superimposed on that of its wild ancestor, representing one of the characteristic elements of Mediterranean sclerophyllous vegetation [8]. According to Zohary and Hopf [9], within the Mediterranean countries, the olive tree was one of the first fruit plants to be domesticated, perhaps as early as the 5th millennium BC, as evidenced by the several structures for the pressing of olives found in the Chalcolithic age in the Jordanian area [12].

The olive varieties we know today would therefore be the result of an ancient selection process [13] by Syrian and Palestinian farmers and probably also those from the vast area extending from the Southern Caucasus to the Iranian highlands, starting from the wild olive tree, widespread in that time period but not very usable for food purposes due to the spinescence and small drupes and their being poor in oil, to cultivars rich in oil and without thorns [14–16].

The relation between humans and olive trees in Sicily has a long story. Beyond the previously cited remains from Grotta dell'Uzzo, olive tree wood has been exploited in Eastern Sicily since the end of the Paleolithic [16]. According to the natural sequence of Pergusa lake, *Olea* sp. experienced an expansion starting from 7200 BP (Middle Neolithic) [17], but it is unlikely that it was due to its early cultivation. Archaeobotanical data confirm that olive tree wood and probably its fruits were used during the Bronze Age, 2nd millennium BC, despite missing carpological data [18–20]. For the Greek colonies such as Selinunte (7th century BC), the olive tree was considered a symbol of peace, wisdom, and prosperity for the various uses to which the oil was intended. Carpological data are scarce, probably due to the extremely low record of archaeobotanical remains for these phases; the only exception is the city of Camarina [21]. According to literary sources, the farmers of Selinunte became a point of reference in the oil trade in the Mediterranean. They cultivated and propagated the olive tree in the valleys and in the fertile lands of the hinterland, producing oil, as evidenced by the findings of rudimentary mills dating back to the fifth century BC [22] and exporting it, as the city of Akragas, to the Phoenicians colonies of Northern Africa [23].

It is evident that this tree constituted a preponderant and highly characterizing element of the ancient Sicilian agricultural landscape, also according to the literary sources. Thucydides (Book VII, 81, 4), speaking of a village south of Syracuse, called the Polizelo enclosure, where the Athenians stopped briefly in retreat, gives us the opportunity to imagine the olive fields delimited in "enclosures" by low walls of dry stones, as they are still today for the needs of sheep farming. One significant document with some valuable information on the olive tree in antiquity is the Tabulae Halaesinae, a Hellenistic description carved on two stone tablets of the land of Halaesa, an ancient city near the modern village of Tusa (Messina). Ancient olive trees are raised to the role of natural monuments through the marking of the Halaesian monogram engraved on the bark as a marking boundary sign [24]. In the Tabulae, the importance and predominance of olive cultivation for the economy of that territory come out, also supported by the presence of special "nurseries" (*elaiokomion*) [25]. During the Roman Empire, the exploitation of Sicilian oil together with other food resources was slowly replaced with the use of the island as a bridge for the import of Northern African products [26]. Finally, during the Middle Ages, its presence in the hilly Sicilian landscape seems quite spread, with some exceptions, especially in the Islamic areas [27–29].

Today the olive tree, together with wheat and vines, represent the "Mediterranean triad" of traditional agriculture [30]. In the Sicilian agricultural landscape, dry (non-

irrigated) olive groves are widespread in pure plantations, with more or less irregular spacing, or in “mixed cultivation” systems, together with carob and almond trees.

The centuries-old olive trees and, more generally, all monumental trees, with their longevity and considerable size, certainly represent a sign that is not negligible for the purposes of a better understanding of the territory that hosts them and of the society that wanted them to be preserved. The attention to monumental olive trees is linked to the most up-to-date concepts of “historical ecology” for the interpretation of the traditional rural landscape, in which the historical-anthropological components are intimately connected to the natural ones. As a matter of fact, as cultivated plants, olive trees are anthropogenic elements of the landscape, and, thanks to their longevity, they have become a source of historical information on the use of the territory. They are the only cultivated plants that tell the story of the Mediterranean landscapes through the Anthropocene and represent a “cultural heritage”, like some stone monuments. Having evolved over the centuries, the olive tree landscapes represent a tangible example of sustainable land use [31]. The recognition of ancient and notable trees and historic orchards as elements of cultural heritage is widely accepted (see, e.g., [www.english-heritage.org.uk](http://www.english-heritage.org.uk)), although, as they are living monuments, we believe it is more appropriate to consider trees as elements of the “biocultural heritage” [32].

While some research has focused on the role of olive groves in the Mediterranean landscape e.g., [33–35], less emphasis has been placed on the cultural/biocultural value of single monumental olive trees that dot the landscape.

Considering the importance of secular olive trees not only from a cultural, environmental, and scientific point of view, as well as for the precious genetic heritage of which they are depositories, in 2003, a survey project was started in Sicily in order to acquire significant elements for the documentation, protection, and enhancement of this plant heritage [36,37].

This work reports the results of the survey of monumental olive trees conducted in Sicily and discusses their value in terms of “biocultural heritage” and the importance they play in the interpretation of the historical stratifications of the landscape.

## 2. Materials and Methods

### 2.1. Study Area

Sicily is the largest Mediterranean island, with an area of approximately 25,500 km<sup>2</sup> and about 1000 km of coastline. The island has different geological characteristics, which have shaped different landforms with an elevation ranging from sea level to 3340 m (Mount Etna). The territory is hilly in the central and southwestern parts (approximately 61.4%), mountainous, especially in the northern and eastern parts (24.5%), and 14.1% consists of alluvial plains [38].

According to Bazan et al. [39], Sicily is divided into 25 bioclimatic belts (thermotypes and ombrotypes) from thermomediterranean semiarid to cryo-mediterranean hyperhumid. This great variety of environmental conditions and its complex paleo-geographic and human history make the island one of the Mediterranean biodiversity hotspots.

Agricultural systems are widespread and are structured as highly diversified landscape mosaics (arable lands and extensive herbaceous crops, vineyards, olive groves and dry cultivation mosaics, orchards, built-up areas, etc.), which are significant containers of agrobiodiversity.

Olive groves create diffused semi-open landscapes compared to other tree crops, especially along the marginal hilly areas and at the base of the mountainous areas [40]. The cultivation of the olive tree currently has about 18 million plants in Sicily and contributes considerably to the characterization of the physiognomy of the region's agroecosystems, with particular reference to the hilly ones, where 65% of the olive groves exist, and to the mountain ones, where the traditional olive groves represent 17% of all

groves [41]. With an area of 157,891 ha [42], equal to 6.1% of the regional territory, this cultivation plays an important role.

## 2.2. Data Collection

The survey covered the entire Sicilian regional territory and the selection of the most significant specimens, chosen for their "monumentality" aspect, mainly took into account the parameters inherent to the measurement of maximum circumference, measured at 1.30 m from the ground (for appropriate comparisons with other individuals), height, development, crown width, and presumed age. This information was also integrated by considerations relating to the historical, naturalistic, and landscape value of the individual plants.

For the survey, the research group also made use of the collaboration of the technicians of the Operational Sections of Technical Assistance (SOAT) of the Regional Department of Agriculture, Rural Development, and Mediterranean Fisheries, located in the territory, which helped to report to the authors the presence of individuals with the characteristics of monumentality.

The research methodology was chosen in order to maintain the methodological continuity with previous surveys on monumental trees carried out in Sicily [25,36,42,43]. For the survey of monumental individuals, the survey form proposed by Schicchi and Raimondo [25] was used; it is made up of various items, listed below and contextually explained to summarize the methodology used for the acquisition of the information data:

1. Identification refers to the scientific binomial (or trinomial) of the taxon to which it belongs, to the vulgar name, to the local name, and to the family of reference;
2. Location, with reference to the surveyed sample, indicates the municipal area, the province, the IGM Italian Map Sheet, at scale 1:50,000, and the section of the Regional Technical Map at scale 1:10,000. This item also shows the geographical coordinates in UTM WGS84 format, information about the ownership of the area in which the monumental tree stands as well as the path to access it. The geographic coordinates, latitude and longitude, were identified by GPS (global positioning system). Mapping and spatial analysis were carried out using ESRI ArcGIS 10.2;
3. Stational parameters show the altitude expressed in meters above sea level (m asl), the exposure, the position, the nature of the substrate, the vegetation context of which the surveyed tree is a part, and any existing protection measures, with particular reference to the Regional Parks and Regional reserves;
4. Main morphological features concern the structure and habit of growth, the circumference of the stem measured at 1.30 m from the ground, the maximum circumference of the trunk, the width (length and width) of the foliage, the height of the plant, and the presumed age. The circumference was measured, using a measuring wheel, at the point of maximum development, generally coinciding with the basal part of the stem or with the part below the insertion of the branches, and at a predetermined height (1.30 m from the ground) for appropriate comparisons between individuals belonging to the same species. In the case of plants located in areas subject to steep slopes, the measurement at 1.30 m from the ground was carried out in an intermediate position, between the upper and the lower part of the trunk, following not the line parallel to the ground but the one perpendicular to the trunk.

The width of the canopy was measured differently: in the case of foliage with a basically circular base, the diameter of the projection on the ground was measured; in the case of irregular foliage, the greater length and width of their projection on the ground was measured.

The height was measured using a hypsometer, a laser distance meter, metric rods, etc. The age estimation represents the closest approximation, as it is very difficult to determine. In fact, in centuries-old olive trees, the trunks are hollow and do not allow

the use of classical methods of dendrochronology. Therefore, an age range was derived from an "expert-based" estimation [25] based on the growth rate of 1.5 mm/year by Michelakis [45]. This methodology, compared to the growth rates proposed by Arnan et al. [46] and Camarero et al. [47], is more suitable for the comparison with the growth measure carried out 25 years after some sampled trees. Age estimation was made at the root collar because many trees are branched at a height of less than 1.30 m. In the attribution of age, both the growth features of the species and the fertility conditions of the site where the monumental olive trees were found were considered.

5. The condition of the specimen concerns the vegetative and health state (pathologies in progress, organs affected, the type of damage, the extent of damage, etc.), threats to its conservation, and any proposed conservation interventions. The vegetative and phytosanitary state is synthetically expressed on the basis of evaluations referring to a qualitative scale of the appreciated condition (excellent, good, fair, mediocre, and poor);
6. Notes and distinctive traits are reserved for all other possible information regarding the tree and/or the station in which it stands, including historical references, legends, etc.

### 3. Results

The collected dataset represents a heterogeneous sample for dendrometric parameters and environmental contexts. There are 367 specimens, 364 of which are *Olea europaea* var. *europaea* and 3 of which are *Olea europaea* var. *sylvestris*, of considerable size found in different Sicilian provinces (Figure 1). Of these, a significant part is located in the provinces of Agrigento, Messina, Palermo, and Syracuse. The collected data were computerized to facilitate its management, consultation, and implementation over time. A significant example of the surveyed specimens, divided by regional province and referring to 50 individuals, is reported in Table 1. Of 367 specimens, 74 are part of the province of Agrigento, 73 are of Messina, 64 are of Palermo, 56 are of Syracuse, 30 are of Trapani, 21 are of Ragusa, 20 are of Catania, 16 are of Enna, and 13 are of Caltanissetta (Figure 2).

With reference to the maximum circumference value of the stem (measured at the collar), 11.4% of them have circumference values equal to or less than 4 m; 30.5% have values between 4 and 6 m; 31.3% have values between 6 and 8 m; 14.2% have values between 8 and 10 m; 7.1% have values between 10 and 12 m; 2.7% have values between 12 and 15 m; 2.7% have values greater than 15 m.

Considering the age of the surveyed plants, 7.1% of them are between 200 and 400 years old, 26.4% are between 400 and 600 years, 33.5% are between 600 and 800 years, 15.3% are between 800 and 1000 years, and 17.7% over 1000 years.

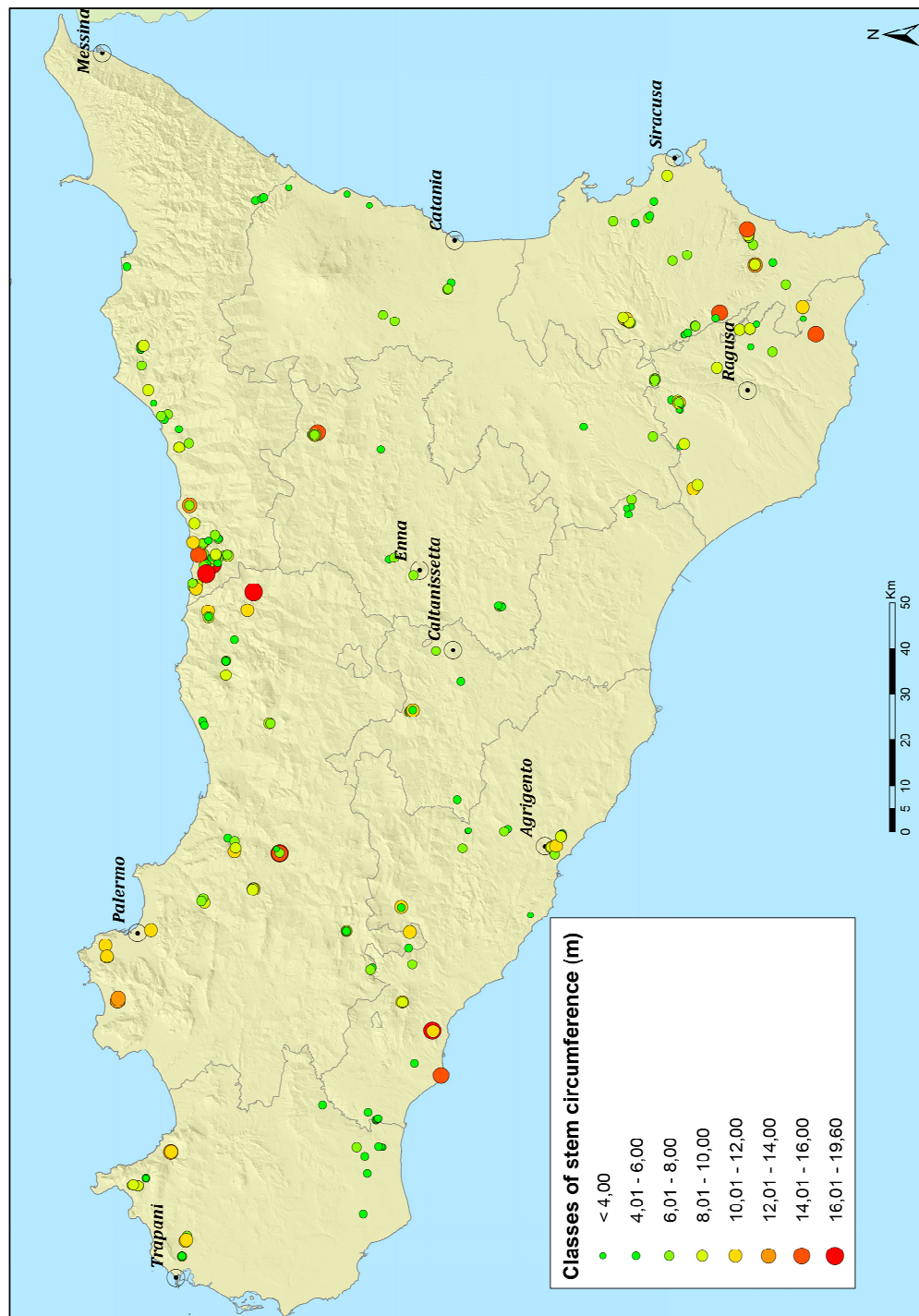
In particular, examining the data relating to the aforementioned sample, it is possible to argue that, in the province of Agrigento, there are several extraordinary olive trees among which, in addition to the very suggestive ones of the Greek Valley of the Temples, there are some plants of about 800–1100 years present in the municipalities of Agrigento (Figure 3a), Caltabellotta (Figure 3b), and Sciacca, with circumference values ranging from 6 to 17 m. Additionally noteworthy is the Olivastro di Inveges, located in the Sciacca area, full of history and legends, with a stem of about 5 m in circumference.

In the province of Caltanissetta, the largest olive trees are found mainly in the territory of the chief town, in the Canalotto-Mimiani, Vituso, and Bugini districts. These are ancient specimens with maximum circumference values between 5 and 11.40.

In the province of Catania, among the most beautiful monumental olive trees, there are specimens along the millenary olive tree road, in the municipal area of Motta S. Anastasia, with specimens up to 8 m, while in the province of Enna, there are ancient specimens with a maximum circumference between 3.40 and 14.1 m.

**Table 1.** Sample of the 50 most significant monumental olive trees. The complete list of specimens is given in the supplementary materials.

Name	Municipality	Province	Circ.	Age
Olivo di Innari 1	Pettineo	Messina	19.60	2081
Olivo di Vallefonda 4	Vicari	Palermo	19.00	2017
Olivo di Calabrò	San Mauro Castelverde	Palermo	18.00	1911
Olivo di Fontana Calda 1	Sciacca	Agrigento	17.00	1805
Olivo di contrada La Gebbia	Avola	Siracusa	15.50	1645
Olivo di Feudo Vassallo	Sciacca	Agrigento	15.20	1613
Olivo di Palazzelli	Modica	Ragusa	15.10	1603
Olivo di Fraginesi 1	Castellammare del Golfo	Trapani	13.00	1380
Olivo di Predica 1	Caronia	Messina	12.90	1369
Olivo della Contemplazione	Carini	Palermo	12.70	1348
Olivo di Busulmone	Noto	Siracusa	12.60	1337
Olivo secolare di Troina1	Troina	Enna	12.10	1284
Olivo di Cattiva 4	Alessandria della Rocca	Agrigento	11.40	1210
Olivo secolare di Mokarta 2	Erice	Trapani	11.30	1199
Il Patriarca della Favorita	Palermo	Palermo	11.10	1178
Olivo del Cinghiale	Agrigento	Agrigento	11.00	1168
Olivo di Maviti	Pettineo	Messina	10.80	1146
Olivo di Fontana calda 2	Sciacca	Agrigento	10.50	1115
Olivo di Muti 4	Chiaramonte Gulfi	Ragusa	10.50	1115
Olivo di Scorsone 3	Ispica	Ragusa	10.50	1115
Olivo di Lippia	Acate	Ragusa	10.30	1093
Olivo di Pullicia di Sopra	Palazzo Adriano	Palermo	10.10	1072
Olivo di Verdesca 1	San Vito Lo Capo	Trapani	10.00	1062
Olivo di Zocco-Venera 4	Buccheri	Siracusa	9.70	1030
Olivo di Castelluzzo 2	San Vito Lo Capo	Trapani	9.50	1008
Olivo di Misilmeri	Misilmeri	Palermo	9.50	1008
Olivo di Centunzi	Caltavuturo	Palermo	9.10	966
Olivo Grande di Bonamorone	Agrigento	Agrigento	9.10	966
Olivi di Acquedolci	Acquedolci	Messina	9.00	955
Olivo di Sacramento 3	Buccheri	Siracusa	8.50	902
Olivo di Santa Tecla	Capri Leone	Messina	8.20	870
Olivo di via dell'olivo Millenario 1	Motta Sant'Anastasia	Catania	8.00	849
Olivo di Nicoletta	Enna	Enna	7.80	828
Olivo di via dell'olivo Millenario 5	Motta Sant'Anastasia	Catania	7.60	807
Olivo di Milo 2	Trapani	Trapani	7.50	796
Olivo di Piraino	Licodia Eubea	Catania	7.50	796
Olivo di S. Maria di Licodia	Santa Maria di Licodia	Catania	7.50	796
Olivo di Fontecà	Pettineo	Messina	7.40	786
Olivo di Sugherazzo	San Fratello	Messina	7.40	786
Olivo di Tardara	Tusa	Messina	7.40	786
Olivo di Contonaro-Lavanche 1	Caltabellotta	Agrigento	7.20	764
Olivo di Vituso 2	Niscemi	Caltanissetta	7.20	764
Olivo di Falabia 3	Palazzolo Acreide	Siracusa	6.90	732
Olivo di Contonaro-Lavanche 2	Caltabellotta	Agrigento	6.80	722
Olivo di Rastello	Pietraperzia	Enna	6.70	711
Olivo di Monaci	Caccamo	Palermo	6.50	690
Olivo di Seggio	Castelvetrano	Trapani	6.40	679
Olivo di Garofalo	Canicattini Bagni	Siracusa	6.30	669
Olivo della Madonna del Piano	Grammichele	Catania	6.00	637
Oleastro di Inveges	Sciacca	Agrigento	5.20	552



**Figure 1.** Distribution of 367 monumental olive trees of Sicily represented by classes of stem circumference (at root collar).

Among the most noteworthy olive trees in the province of Messina, aged between 414 and 2081 years, we can mention those present in the Nebrodi mountains territory, with particular reference to the area between Tusa, Pettineo, Acquedolci, and Caronia. In particular, the Predica area of the latter municipality contains one of the most relevant examples (Figure 3d). It has a maximum circumference of 12.9 m at the stump and a mon-cormic stem of 9.30 m at breast height, with various ribs with rounded edges, cavities, and grooves that, from the insertion of the crown, reach the ground. This specimen, over

1360 years old, can most likely be considered one of the largest olive trees in Sicily and Italy.

Among the numerous other notable specimens for age, shape, and size, we remember those of the Maviti and Innari areas in the territory of Pettineo (Messina): the first (Figure 3c) consists of a large stump of about 10.8 m in circumference, surmounted by two trunks of particular beauty, for shape and bearing, of 6.30 and 4.50 m in circumference to breast height; the second has a large stump of 19.60 m in circumference surmounted by three trunks with a breast height circumference of 4.60, 2.90, and 2.40 m, respectively.

Several olive trees in the province of Ragusa, distributed in the municipalities of Chiramonte Gulfi, Acate, Modica, and Ispica, are striking for their bizarre shapes and sizes. In the territory of the latter municipality, there is an extraordinary olive tree of Scorsone of about 1115 years, with a maximum circumference of 10.5 m at the collar.

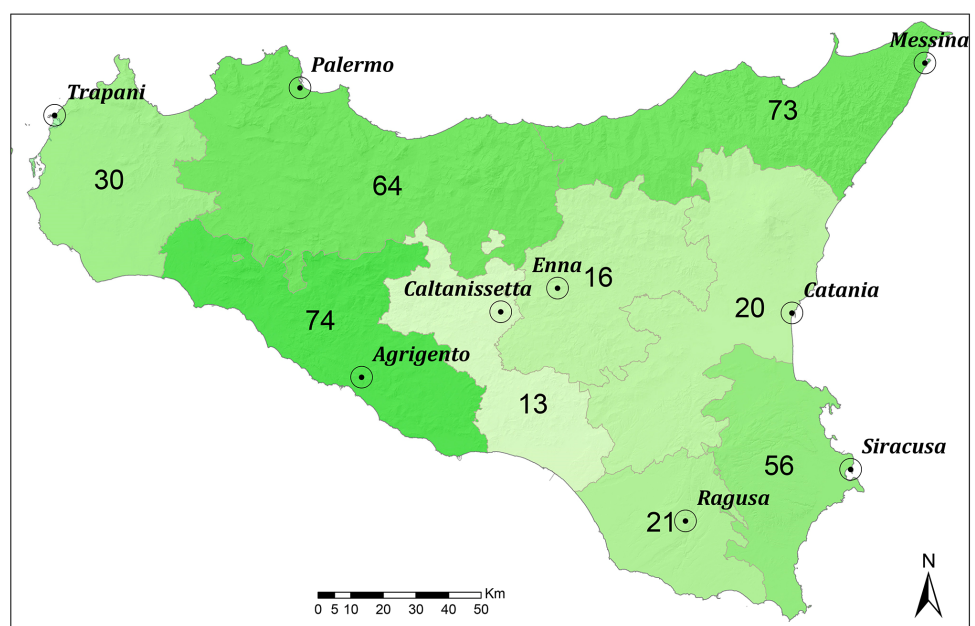
In the territory of Siracusa, extraordinary olive trees can be found in Buccheri, Noto, and Avola. The most representative are certainly those of the Busulmone district (Noto), which, with a circumference of 12.60 m at the level of the stump and 7.20 m at breast height, are probably 1338 years old (Figures 3f), and those of the area La Gebbia (Avola) with a circumference of 15.50 m at the collar and 10.10 m at breast height.

In the territory of the province of Palermo, considerable olive trees are found in the municipalities of Caltavuturo, Carini, Misilmeri, Palermo, Pollina, San Mauro Castelverde (Figure 3e), and Vicari, where several individuals with very large stumps show maximum circumference values of up to 19 m.

In the province of Trapani, worthy of consideration are several ancient olive trees present in the municipalities of San Vito Lo Capo, Castellammare del Golfo, Castelvetrano, and Trapani, which have maximum circumference values between 3.5 and 12 m.

The secular olives are located at an altitude ranging from 24 to 841 m asl, showing a distribution with an average value of 304 m and a standard deviation of 175 m. The distribution of olive trees across soil types shows no significant effect of substrata, indicating the plasticity of the species. A total of 267 specimens grow on basic lithotypes (limestone, dolomite, marl, gypsum, and calcarenite), and 94 grow on acid lithotypes (vulcanite, flysch, and quartzite).

Only four trees fall within the regional natural reserves, eight are located in Madonie Natural Park, and five are in Nebrodi Natural Park.



**Figure 2.** Distribution of monumental olive trees in the Sicilian provinces.





**Figure 3.** Some of the monumental olive trees of Sicily: **a)** Olivo grande di Bonamorone (Agrigento); **b)** Olivi di Caltabellotta; **c)** Olivo di Contrada Maviti (Pettineo); **d)** Olivo di Predica (Caronia); **e)** Olivo di Calabrò (San Mauro Castelverde); and **f)** Olivo di Busulmone (Noto).

Concerning the structure and habit of growth, the tree crown diameter varies from 7 to 15 m and, in the case of irregular shape, ranges from 5 to 13 m in the N–S direction and from 4 to 15 m in the E–W direction. The height of the surveyed plants changes between 5 and 15 m, in relation to the different techniques of pruning or in relation to the state of cultural abandonment or in order to maintain the foliage at a level that allows the grazing of livestock without damaging plant production.

Vegetative and health conditions are excellent in 4.9% of specimens, good in 24.8%, fair in 53.7%, mediocre in 14.4%, and poor in 2.2%.

#### 4. Discussion

The olive tree is a rustic species able to live on different types of soil. Over the centuries, it has been widely spread in all of the provinces of Sicily, from sea level to wherever the climatic conditions have allowed it (about 900 m asl). It has become, over time, the tree that dominates and is one of the most expressive, if not the most expressive, tree of the Sicilian agricultural landscapes, together with the marginally determined manna ash (*Fraxinus angustifolia* Vahl), another species of the same family [48,49].

Traditional olive groves with monumental specimens host a high number of varieties. The importance of this latter genetic resource and the potential it holds for agriculture is also a common element in other European and Mediterranean contexts, as shown by the recent studies on centenary olive trees conducted in several Mediterranean countries [50–55]. The cataloging, characterization, and in situ conservation of secular olive trees is, in fact, a priority to safeguard their genetic, natural, and agricultural value and to protect ancient genotypes threatened with extinction [56,57].

The varietal diversity of olive germplasm in Sicily is represented by 25 cultivars with different features in terms of the morphology, production, and quality of the oil [58].

The surveyed monumental olive trees belong to 11 different cultivars, including the cv. Fastucara, Biancolilla, and Cerasuola in the province of Agrigento, the cv. Ogliarola Messinese in Caltanissetta, the cv. Santagatese and Nocellara Etnea in Catania, and mainly the cv. Moresca in Enna.

In the province of Messina, the monumental specimens mainly belong to the Santagatese cultivar and, to a lesser extent, to the Ogliarola Messinese. In the province of Palermo, in addition to cv. Ogliarola Messinese and Santagatese, there are also some individuals belonging to the cv. Nerba. In Southern Sicily, monumental olive trees are of cv. Tonda Iblea and Moresca in the province of Ragusa and cv. Virdisa or Pizzuta in the Syracuse area. In the western sector of the island, in the province of Trapani, in addition to the Nocellara del Belice, there are olive trees of cv. Cerasuola, Santagatese, and Tonda Iblea.

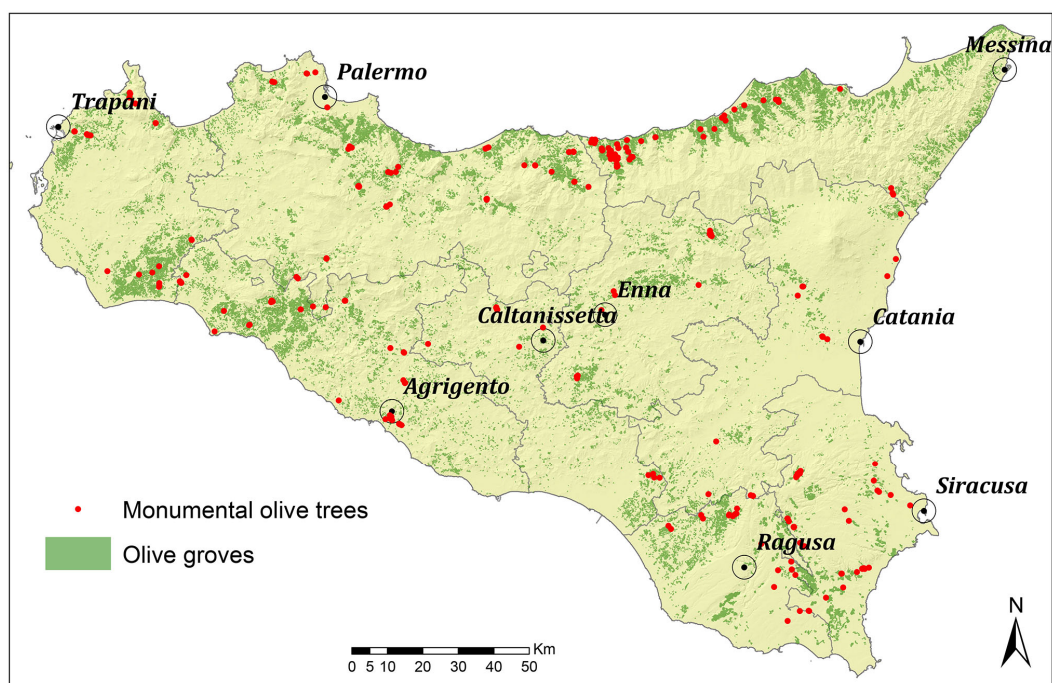
These are ancient cultivars grafted onto the wild olive trees that have given rise to irregularly planted olive groves, favoring the natural lay of the soil; several centuries-old plants still survive, cultivated extensively, with generally hollow trunks or with numerous cavities, which constitute microhabitats for vertebrate and invertebrate fauna. To preserve these trees in the best vegetative condition, as far as possible, it is necessary to ensure adequate crop care, including rational pruning, aimed at removing dying branches and aerating the foliage, monitoring and fighting against the agents of wood decay, and contrast, in some cases, to attacks by harmful insects and fungi. For some specimens, located in the Nebrodi mountains, it is also necessary to proceed with the removal of *Viscum album* L. and *Loranthus europaeus* Jacq., two semi-parasitic species that often develop abundantly on the canopy of centuries-old olive trees causing a vegetative decay and subsequently a worsening of the phytosanitary conditions

However, *Olea europaea* is a species characterized by remarkable longevity and by an extraordinary resistance to drought, due to different forms of anatomical and physiological adaptation, so much that it can survive and provide a certain fruit production even in conditions of low rainfall. It also resists fires very well due to its remarkable ability to emit vigorous suckers from the buds present on the stump after the passage of the fire. Therefore, the olive tree can be defined, with good reason, as "a plant that never dies". In this regard, Morettini [59] assigns the qualification of perennial species to the olive tree, observing that "the aerial portion is not perennial [, but] the underground portion it is; it is the base which, expanding into the bases formed by the new trunks that have succeeded over the centuries, replacing [...] the oldest ones, retains the vitality and a set of generations of other younger olive trees."

The antiquity of olive growing in the Sicilian territory is testified by several archaeological and historical finds, artifacts, laws, deeds, and inventories, as well as by the numerous toponyms of various places that recall the olive tree (Ogliastro, Marcatagliastro, Alivazza, Ogliastrillo, Madonna dell'Olio, etc.) and, above all, from the discovery of ancient plants and/or stumps. The oldest olive trees found in the Sicilian territory are spread within the areas where the wild variety of the olive tree lives or can potentially live. The latter is an important element of the Mediterranean scrub of which it constitutes particularly expressive formations, settled on the semi-rupestrian stations, both on calcareous and quartzarenitic soils, along the coasts and in the hinterland where the temperature almost never drops below 0 °C [11].

In Sicily, as it is in the rest of the Mediterranean, olive trees are relevant landscape elements because of their considerable economic, cultural, and environmental roles. According to Cancila [60], in the fourteenth century, the olive trees, with the exception of the provinces of Palermo and Catania, did not constitute wide groves; they were spread elements of a mixed agricultural system, very common in the island country. At the end of the fifteenth century, olive growing was also quite widespread in the province of Messina, and considerable development began in other areas of Sicily in the sixteenth century.

Currently, the island's olive trees are mainly grown in semi-intensive or traditional dry systems, both in specialized and mixed cultivation. The landscapes characterized by the olive tree are widespread and diversified in the regional territory in relation to the history of the places and the pedological and microclimatic characteristics and, above all, to the position, which also influenced the cultivation methods (Figure 4).



**Figure 4.** Distribution of the monumental olive trees in the olive Sicilian landscapes.

In hilly and coastal areas of Western and Southern Sicily, in favorable geopedological conditions, specialized olive groves are widespread and, until the mid-twentieth century, constituted a real cornerstone of the rural economy of the island. In addition to having considerable importance for production and a strong identity value for the landscape, the olive grove plays a fundamental role in protecting the soil, especially in areas with higher slopes where older plants are present. It is in these areas that most of the monumental olive trees surveyed in this work have been preserved.

In coastal areas, especially in Southern and Eastern Sicily, the olive tree represents a characteristic element of mixed agricultural systems together with the carob, almond, and pistachio trees. These systems have been maintained in marginal areas, with often uneven morphologies, where the olive trees are unevenly distributed in the plots. In the traditional groves of the foothills, the individual trees are sometimes protected from erosion thanks to drystone lunettes. In other areas (e.g., in the Etna area), the olive tree can also be found within terraced polycultural systems.

Many olive groves in Northern Sicily, located in the province of Messina and Palermo, within the ancient marquisate of Geraci, date back to the early sixteenth century when the Marquis Ventimiglia allowed the farmers to graft the wild oleasters that grew spontaneously in his fields, letting them become owners of the single trees: this gave origin to a promiscuous property, as the land, where the inhabitants could exercise civic uses, remained in the hands of the feudal lord [60].

Cases of mixed ownership, although less frequent than in the past, are still known both on the Madonie mountains, especially in the territory of Castelbuono, and on the Nebrodi mountains, in the municipality of Tusa. A tangible sign of this anachronistic form of ownership is the engraving on the stem of the initial letter of the tree owner's surname (Figure 5), often highlighted in recent decades with a red painting [43]. The promiscuous property in Sicily concerns only the olive tree and no other cultivated tree species; as a matter of fact, because of its longevity, the olive tree is considered as real estate and therefore transmissible by inheritance.

Furthermore, on the northern side of the Madonie mountains, there is an extraordinary landscape created by the promiscuity of ancient olive trees within the relict manna ash tree grove. In this context, there is no lack of fruit species, such as pear, almond, fig, rowan, apricot, and plum.

In Eastern Sicily, on the slopes and on the Iblean plateau, olive trees spot the fields of wheat or pastures. The landscape of this arborescent land is marked by an extensive system of fences built with dry stone walls. Inside these, there are ancient and isolated olive, almond, and carob trees, many of which are of extraordinary size and with limited productivity. In this context, the presence of several monumental olive trees is very frequent.

The traditional olive agroecosystems with monumental olive trees constitute peculiar tiles of the expressive Sicilian landscape consisting of a heterogeneous mosaic of agricultural systems and semi-natural systems, more or less fragmented and interspersed with hedges, dry stone walls, and narrow bands of forest species, which result in a high taxonomic and landscape diversity. The presence of monumental olive trees can be considered an indicator of the high biocultural diversity in the landscape and its agroecosystems. These last ones, given their diffusion in Sicily, define territorial mosaics with a high "widespread naturalness" [61], in which extensive agricultural practices are applied with a low environmental impact, compatible with the sustainable management of natural resources. They host rather diversified residual habitats, characterized by species of high conservation interest (e.g., [62–67]) and by a rich flora of ethnobotanical interest that is used for food purposes by local populations [68,69] or for its dyeing properties [70]. Along the margins, there are frequent residues of the ancient *Rhus coriaria* L. cultivation, recently re-evaluated for the antioxidant properties of the fruits [71]. According to Blasi et al. [72], the olive grove is a cultivation that maintains a dynamic link with potential natural vegetation.



**Figure 5.** The Olivo di Zimmari (Tusa) engraved on the stem of the initial letter of the tree owner's surname is different from the landowner.

The recognition of the value of these landscapes in terms of biodiversity conservation has led Biondi et al. [73] to suggest their inclusion in Annex I of the EEC Directive 92/43, called "Centuries-old olive groves with evergreen *Quercus* spp. and arborescent matorral" (code 6320), as a priority habitat, considering them peculiar to the Mediterranean region.

The olive tree, with its unmistakable persistent foliage, glaucous green on the upper page and silvery-gray on the lower page, gives itself and its landscape a particular and unusual beauty. In this context, numerous monumental specimens, with their particular shapes and extraordinary dimensions, testify to the slow passing of the centuries and the succession of human generations. For this reason, monumental olive trees can represent the destination or one of the major attractions of naturalistic itineraries within agroecosystems and the "oil routes." These green patriarchs, in fact, can alone constitute the reason for a trip, since they always have something special to offer: their shape, their size, and their age make each of them unique, and visitation of them is a memorable event [44]

From the data reported in this work, it emerges that, throughout the Sicilian territory, the relationship between man and the olive tree is historicized, as can be inferred both from the different signs of material culture, of which centuries-old olive trees constitute an extraordinary testimony and from the historical sources. Their longevity, the longest among cultivated plants, allows for a stratified reading of the contemporary landscape in which these "plant monuments" are the silent witnesses of the transformations of the environment that characterized the Anthropocene.

The monumental olive trees represent the bulwarks of a Mediterranean agricultural landscape that, over the last millennium, in many parts, has undergone limited alterations, at least up to about 60 years ago. In recent decades, this precious heritage, of incomparable historical, landscape, and scientific value, is seriously in danger of disappearing due to the abandonment of cultivation, especially in the hilly and foothills areas on sloping soils and by fires. Therefore, a renewed attention and protection toward these monuments of nature is crucial.

## 5. Conclusions

The Mediterranean agricultural landscape expressed by the olive tree has unique features, and it is still possible to find numerous monumental individuals in it, extraordinary for their age, shape, and size. They constitute authentic milestones both for the expressiveness they impress on the agricultural landscape, of which they are the significant elements and for the conservation of the precious germplasm of which they are custodians. The monumental olive trees represent, in fact, a reservoir of genetic diversity, which includes characteristics associated with resilience and adaptation to specific environmental conditions and which has allowed for resistance for several centuries, some for over a millennium, to the action of climatic agents, parasitic and anthropogenic activities, and the passage of fire. Therefore, they constitute the best guarantee for the future of olive growing, a sector of agricultural production that is fundamental for maintaining the Mediterranean identity, from an environmental, food, and social point of view.

The survey of secular olive trees, in addition to the considerable interest it holds in the context of the characterization and typification works of the olive-growing heritage, is also important from an eco-touristic point of view, being able to represent the destination or one of the major attractions of naturalistic itineraries within agroecosystems.

On the basis of the results of this paper, the following general recommendations should be taken into account for the conservation of monumental olive trees:

- Start long-term conservation projects beyond the horizon of European Community Policy, aimed at tangible results and more efficient use of financial resources. Monumental olive trees are biological entities depending on human care, and post-project abandonment would undermine the conservation effort;
- Establish a field collection of the germplasm of the Mediterranean monumental olive trees both for conservation purposes and with the aim of coping with climate change due to their extraordinary resilience;
- Promote on-farm germplasm conservation of monumental olive trees, which is an appropriate conservation strategy for this type of biodiversity that is strictly linked to the environmental and cultural contexts of origin;
- Recover and enhance traditional agricultural systems of olives. This approach preserves both agrodiversity and landscape, enhancing rural contexts' tourism attractiveness;
- Recover traditional agricultural knowledge (TAK) in management of secular olive trees, so preserving the associated biocultural heritage;
- Acknowledge monumental olive trees as cultural heritage under UNESCO's normative framework.

**Supplementary Materials:** The following are available online at [www.mdpi.com/article/10.3390/su13126767/s1](http://www.mdpi.com/article/10.3390/su13126767/s1). Table S1: List of the 367 monumental olive trees sampled in Sicily.

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