

## Article

# Analysis of the Forest Landscape and Its Transformations through Phytotoponyms: A Case Study in Calabria (Southern Italy)

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**Abstract:** Place names, or toponyms, provide a useful geographical reference system; they can help analyse past landscapes, recover history and understand changes. Among place names, plant place names (phytotoponyms) can be used to analyse the current and past distribution of plants and plant communities and to highlight changes in land use due to human impacts and climate change. We assessed the feasibility of using place names related to species and forest ecosystems to evaluate changes that have affected the forest landscape. As a case study, we considered Calabria, a region in southern Italy rich in toponymic studies. We used the official topographic maps of Calabria, at scales of 1:25,000 and 1: 10,000, and literature data on Calabrian toponymy. To interpret toponyms related to plants and avoid errors, we performed a joint linguistic and naturalistic analysis. A total of 1609 phytotoponyms were identified relating to 45 forest species (28 trees and 17 shrubs) and 399 place names generically related to woods and forests. The most frequent plants associated with place names were *Castanea sativa* (8.3% of all plant place names), *Quercus pubescens* s.l. (7.2%), *Salix* sp. pl. (6.9%) and *Quercus frainetto* (5.6%). All the phytotoponyms were georeferenced and mapped in a GIS. Phytotonym distribution maps were compared with current Calabrian forest vegetation, using digital orthophotos, land use maps and literature data. A close correspondence between phytotoponyms and forest vegetation for the mountain belt was identified. In contrast, in the basal belt, we found poor correspondence between phytotoponyms and current forest vegetation, especially for wet forests, that can be accounted for by the severe changes in the landscape due to the agricultural and urban transformations that have occurred. The spread of phytotoponyms concerning species linked to forest degradation, such as *Spartium junceum*, emphasises the ancient anthropic impacts on forests. Our study shows that phytotoponyms are an important tool for analysing changes in vegetation over time. They make it possible to reconstruct changes in the landscape and the intended use of the territory and provide useful information on the restoration of forest ecosystems.

**Keywords:** forest landscape change; plant place names; forest restoration; habitat



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## 1. Introduction

Place names respond to the need of local populations to represent and identify the geographical space through the elements that characterize it, by organizing a spatial reference system for the unambiguous identification of places [1,2]. They provide important information about history, language and human relationships with the land [3,4].

Toponyms are characterized by a high degree of conservation over time, and toponymy, the science that has as its subject the study of geographical names, often constitutes a

primary and irreplaceable source of knowledge for the recovery of the history and culture of a territory and of local communities [5–7].

Toponymy is of interest to researchers from a wide range of disciplines, since place names can represent a very important historical memory that assists in the understanding of landscape transformations [8,9].

Toponyms are also an important resource for studies and analysis in ecological and environmental fields and are an important element for the reconstruction of the historical landscape [10,11]. The origin of place names is very diverse, often highlighting structural or functional characteristics of the landscape and constituting an important tool for recognising certain natural properties of places [12,13]. In particular, toponyms referring to plants or vegetation (“plant place names” or “phytotoponyms”) can be used to analyse the current and past distribution of plants [14–17] and vegetation [18–22] and to highlight changes in land use due to human impacts and/or climate change, with the purpose of supporting forest restoration [23–26].

Several authors have pointed out that plant names belong to one of the most conservative conceptual categories. In this respect, it is obvious that elements of the two great Mediterranean languages, Latin and Greek [27], survive in the modern dialects of this basin, which is particularly rich in phytonyms [28–30]. Italian toponymy is also particularly rich in phytotoponyms [3]. However, available studies on this topic have mainly adopted a linguistic perspective and there are few studies examining the possibility of combining linguistic analysis with cartographic methodologies and botanical correlation to reconstruct past vegetation [31–34]. Calabria is a region where several cultures and languages have crossed over history [35–37]. The region is quite well known from floristic [38–41] and vegetational points of view [42–45], as well as from the ethnobotanical perspective, where knowledge of plants, languages, traditions and history are intertwined [37,46,47]. The toponymy of the region is quite well-known, primarily as a result of the studies of [48–51], distinguished linguists who have made a fundamental contribution to the knowledge of Calabrian dialect and toponymy, facilitating the complex work associated with the linguistic interpretation of phytotoponyms.

Although Calabria is geographically well defined, from a linguistic point of view it shows little unity [37,52]. The stratification of languages and cultures resulting from the different colonization of peoples, who throughout history have affected different parts of the region, has contributed to a rich and articulated toponymy. Rohlf [53] points out that in Calabria, over the centuries, the replacement of the original Greek language with Latin has generated a considerable density of place names derived from both Greek and Latin, while those originating from other languages, such as Arabic, are very rare.

The interpretation of toponyms is therefore not always easy, since they are the result of a complex stratification over time of multiple events, caused by socio-economic developments, processes of population and repopulation by human communities, changes in the environment, and linguistic ‘wear and tear’ over the centuries [54,55].

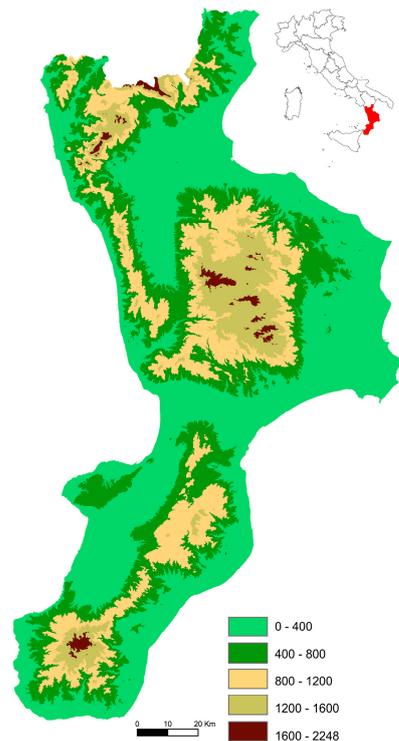
Linguistic analysis is therefore fundamental for understanding the meaning of place names and avoiding misinterpretations. Place names that have different origins in terms of cultural belonging and chronology must therefore be interpreted according to a stratified reading that identifies the historical period and the society that established them [56]. In a previous study, Spampinato et al. [25] carried out an analysis of plant place names linking them to the linguistic origin and the dialectal name of the species, highlighting that they are an important tool in the reading of a territory and its dynamics.

In this study, we evaluated the possible use of phytotoponyms in analysing the current and past distribution of plants and vegetation and to highlight changes in land use due to human impacts and/or climate change for the purpose of supporting forest restoration. Reconstruction of the past forest landscape can support forest restoration consistent with potential vegetation. To investigate the possible use of toponyms as landmarks in the reconstruction of past forest vegetation at regional scale, we used the Calabria region as a case study.

## 2. Materials and Methods

### 2.1. Study Area

Calabria, an extreme offshoot of the Italian peninsula in the Mediterranean basin, covers an area of 15,082 km<sup>2</sup> and is surrounded on three sides by the sea (Figure 1). The territory is predominantly hilly (49.2%) and mountainous (41.8%), with very limited areas of plain. The entire length of the region is crisscrossed by the Calabrian Apennines, with their highest peak at Mount Pollino (2248 m a.s.l.) on the northern border with Basilicata, while the rest of the region's reliefs do not exceed 2000 m a.s.l.



**Figure 1.** Calabria with altitude belts highlighted in m a.s.l.

The geology of the region is dominated by crystalline substrates of the Calabrian-Peloritanian arc, with the exception of the northern part of the region and the hilly areas which are characterized by sedimentary rocks of various types [57].

Data from the latest national forest inventory show that the forest area of Calabria covers 612,932 hectares, with a forestry index of 40.6%, which places the region among those with the highest forest cover in Italy [58].

The bioclimate is of Mediterranean type with seasonal oceanic rainfall up to about 1000 mm and of temperate sub-Mediterranean type in the mountainous area [59].

The geological and bioclimatic diversity of the region generates a considerable diversity in vegetation [60,61]. The forest vegetation consists of evergreen sclerophyllous formations of *Quercetea ilcis* up to 600–800 m a.s.l. and deciduous winter formations of *Querceto-Fagetea* up to 2000 m a.s.l. [62].

### 2.2. Data Collection and Elaboration

To evaluate the forest landscape and its transformations, all toponyms present in the Calabria region referring to forest or pre-forest communities or to single species of the regional dendroflora were considered. In addition, toponyms concerning forests without indication of the species were considered, such as Longari, Forestola, Foresta Iemallo, Mt. Novellito, Foresta, Bosco di Rudina, etc. Studies on the Calabrian language carried out by distinguished linguists [29,53], as well as our previous study on the phytotoponyms of southern Calabria, were indispensable to our analysis [25].

As data sources, we used the official Calabrian topographic maps of “Istituto Geografico Militare Italiano” IGMI at scales 1:25,000 and 1:10,000, and literature data on the Italian [63,64] and Calabrian [48,53,65] toponymy.

All the phytotoponyms identified were georeferenced using WGS 84/UTM zone 33N projected coordinate system into a GIS corresponding to the inscription shown on the topographic maps, taking into account the extension and the shape of the usually elongated surface. To verify the relationship between plant place names and current forest vegetation, a comparison was made with GIS updating topographic maps, 2021 georeferenced orthophotos and a land use map. For this purpose, we used the “Carta dei Luoghi della Regione Calabria”, a land use map produced in 2018 at a scale of 1:5000 by the Calabria Region using the Corine Land Cover system. Using the GIS, each phytotonym was correlated with altitude, aspect, land use and potential natural vegetation.

The GIS-assisted comparison of toponyms for plants of forest interest and forest with the current distribution of forest vegetation made it possible to process a great deal of data in a very short time and to investigate toponyms over large areas.

A previous study [25] dealt with the semantic analysis of phytotoponyms in southern Calabria related to species and plant formations. To interpret the place names related to plants and avoid mistakes, we carried out a joint linguistic and naturalistic analysis.

Available bibliographic data were also used due to the availability of numerous geobotanical studies that have been carried out on the vegetation of the region [45,66,67].

For each species, distribution maps were generated to highlight the current presence or absence of the forest vegetation referred to by the phytotonym.

The representation of the altitudinal distribution dataset of toponyms related to forest species was performed as 2D box-plot graphs.

### 3. Results

#### 3.1. Frequency, Distribution and Typologies of the Toponym

A linguistic and phytogeographical analysis of the toponyms of 30,727 Calabrian place names reported on the topographical maps of the study area made it possible to identify 1210 phytotoponyms referring to 45 woody taxa (species or groups of taxa) of forest interest (28 tree, 17 scrub). In addition, 399 toponyms of different semantic origin, referring generically to the forest without specifying the species, were identified, such as Longari, Forestola, Foresta Iemallo, Novellito, Foresta, Bosco di Rudina, etc. In total, we identified 1609 toponyms. Table S1 shows the database generated.

The phytotoponyms were distributed throughout the region (Table 1), although not uniformly. There were more phytotoponyms at lower altitudes, probably due to the greater anthropic presence over the centuries in the coastal and hill areas and the consequent need to name places. The higher number of phytotoponyms in some provinces was not related to density, but rather to the greater surface area occupied.

**Table 1.** Number of phytotoponyms by province and altitude zone.

Province	Catanzaro	Cosenza	Crotone	Reggio Calabria	Vibo Valentia	Total
Surface (km <sup>2</sup> )	2391	6710	1717	3183	1139	15,140
Population density (N inhabitants/km <sup>2</sup> )	10.3	12.1	11.5	7.3	10.9	10.2
Altitude zone (m asl)						
0–400	99	147	95	150	41	532
400–800	66	135	10	117	23	351
800–1200	29	107	6	78	16	236
1200–1600	9	60		14	1	84
1600–2000	2		1	4		7
<b>Total</b>	<b>205</b>	<b>449</b>	<b>112</b>	<b>363</b>	<b>81</b>	<b>1210</b>

The most frequently mentioned taxa in phytotoponyms (Figure 2) were *Castanea sativa* Mill. (8.7%), *Quercus pubescens* s.l. (8.1%), *Salix* sp.pl. (7.2%), *Quercus frainetto* Ten. (4.9%), *Quercus suber* L. (4.8%), *Fraxinus angustifolia* Vahl subsp. *oxycarpa* (M. Bieb. ex Willd.) Franco & Rocha Afonso (4.4%), and *Fagus sylvatica* L. (4.2%).

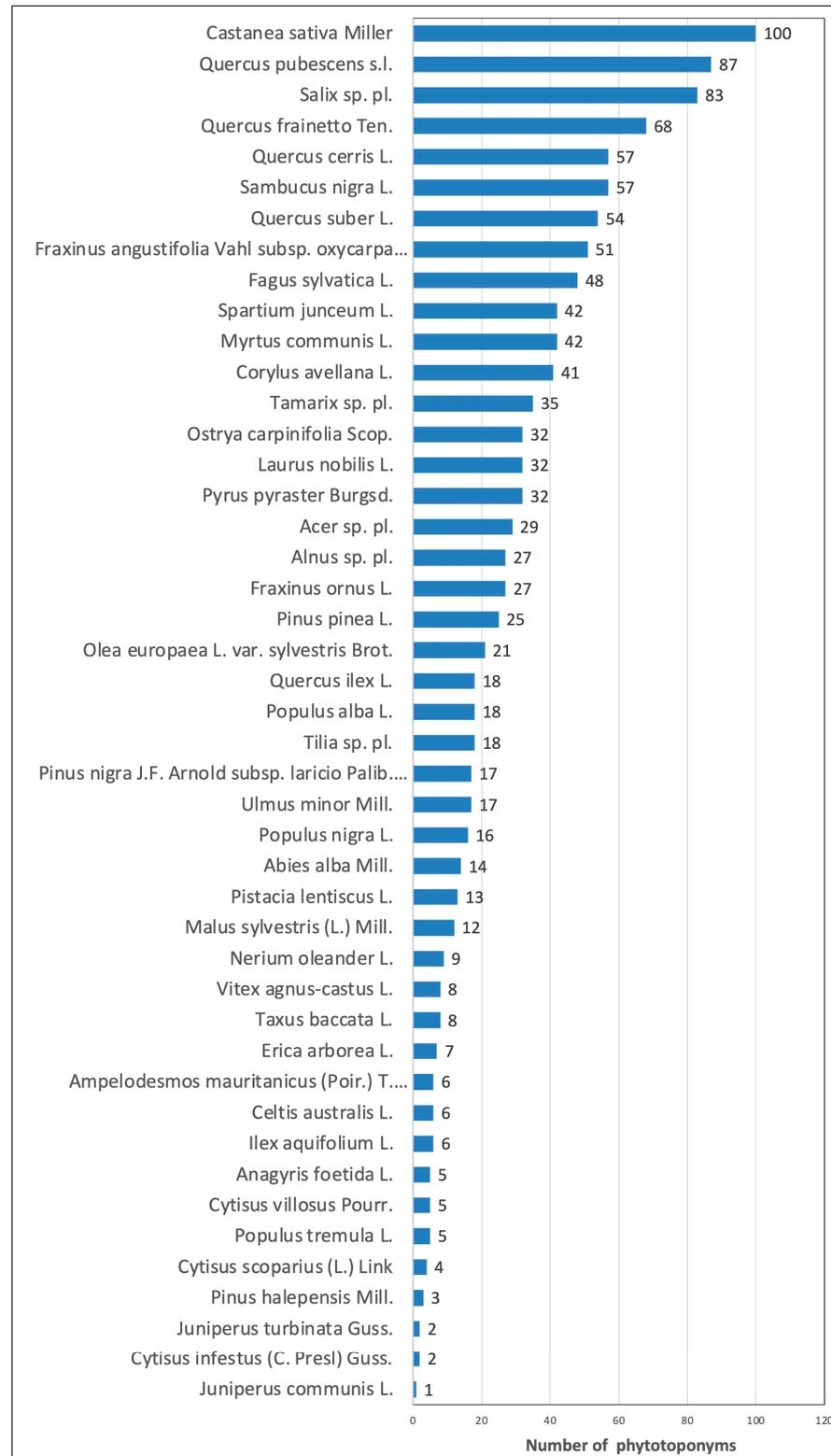
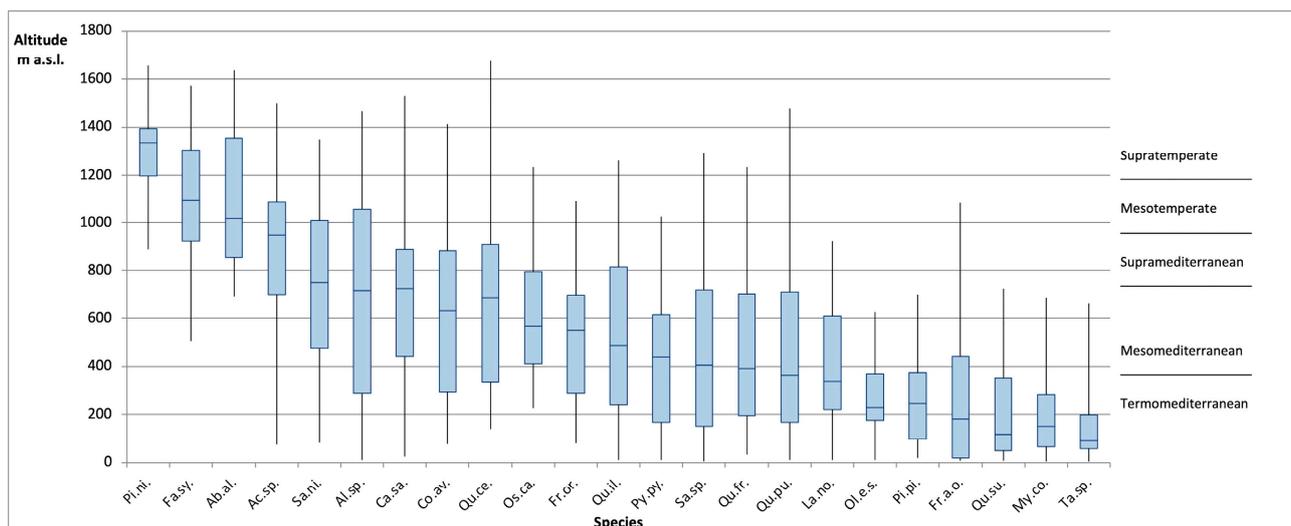


Figure 2. Number of phytotoponyms per taxon.

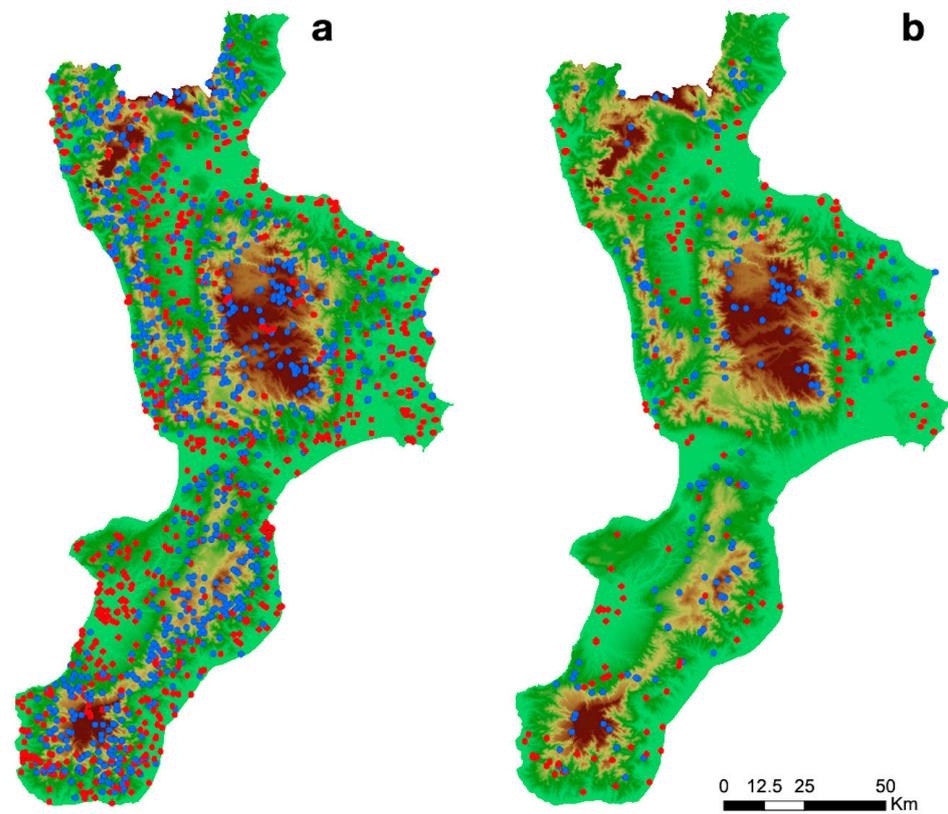
The altimetric distribution (Figure 3) of the phytotoponyms showed good correspondence between the identified species and the bioclimatic vegetation belts. In particular, phytotoponyms related to temperate forest species, such as *Pinus nigra* J.F. Arnold subsp. *laricio* Palib. ex Maire, *Fagus sylvatica* L., and *Abies alba* Mill., were distributed in the mountain zone in the supramediterranean, mesotemperate and supratemperate bioclimatic belts. On the other hand, the typical species of the Mediterranean maquis, such as *Olea europaea* var. *oleaster*, *Quercus suber* L. and *Myrtus communis* L. were distributed in the coastal zone, in the thermo-Mediterranean bioclimatic belt.



**Figure 3.** Altitude distribution of phytotoponyms related to principal species. The black horizontal line in each box plot indicates the median. The lower and upper edges of the box, respectively, indicate the 25% and 75% distribution percentiles. The line outside the box indicates the elevation of bioclimatic belts according to [66]. Pn = *Pinus nigra* subsp. *laricio*; Fs = *Fagus sylvatica* L.; Aa = *Abies alba* Mill.; Ac = *Acer* sp. pl.; Sn = *Sambucus nigra* L.; Al = *Alnus* sp. pl.; Cs = *Castanea sativa* Mill.; Co = *Corylus avellana* L.; Qc = *Quercus cerris* L.; Oc = *Ostrya carpinifolia* Scop.; Fo = *Fraxinus ornus* L.; Qi = *Quercus ilex* L.; Pp = *Pyrus pyrastrer* (L.) Baumg; Sa = *Salix* sp. pl.; Qf = *Quercus frainetto* Ten.; Qp = *Quercus pubescens* s.l.; Ln = *Laurus nobilis* L.; Oeo = *Olea europaea* var. *oleaster*; Fa = *Fraxinus angustifolia* subsp. *oxycarpa*; Qs = *Quercus suber* L.; Mc = *Myrtus communis* L.; Ta = *Tamarix* sp.pl.

### 3.2. Agreement between Plant Names and Present-Day Vegetation

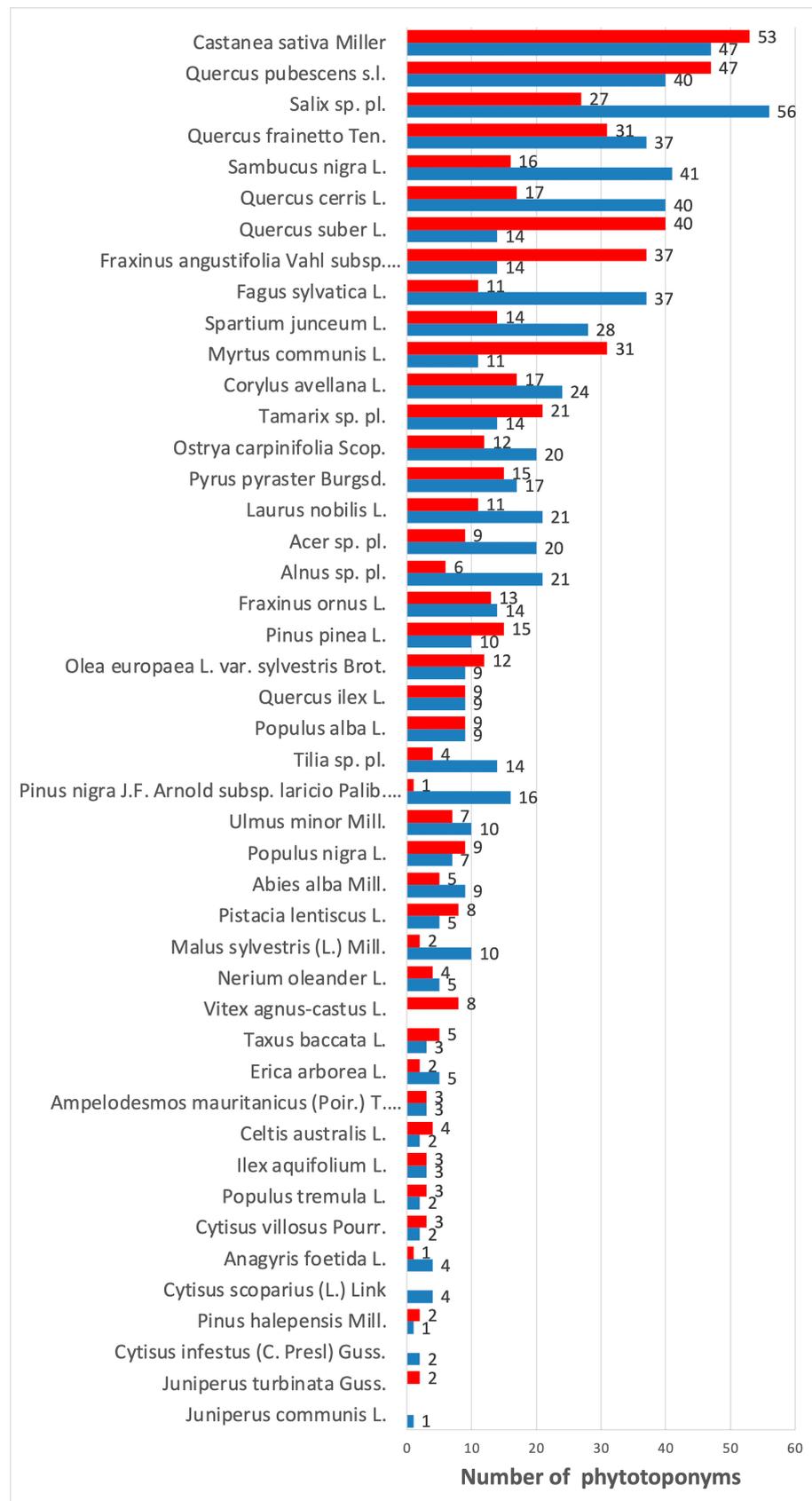
The georeferenced map of all the phytotoponyms relating to forest species in Calabria (Figure 4) shows that the distribution was not homogeneous but reflected the ecological characteristics of the territory. In the map, we highlight in blue those which corresponded to the current forest vegetation and in red those that fell in areas currently not occupied by forest plant communities. The comparison between phytotoponyms and current vegetation, carried out with the GIS and field surveys, showed that about half of the phytotoponyms referring to forest species fell in areas currently occupied by agricultural activities, pastures or, more rarely, urbanised areas.



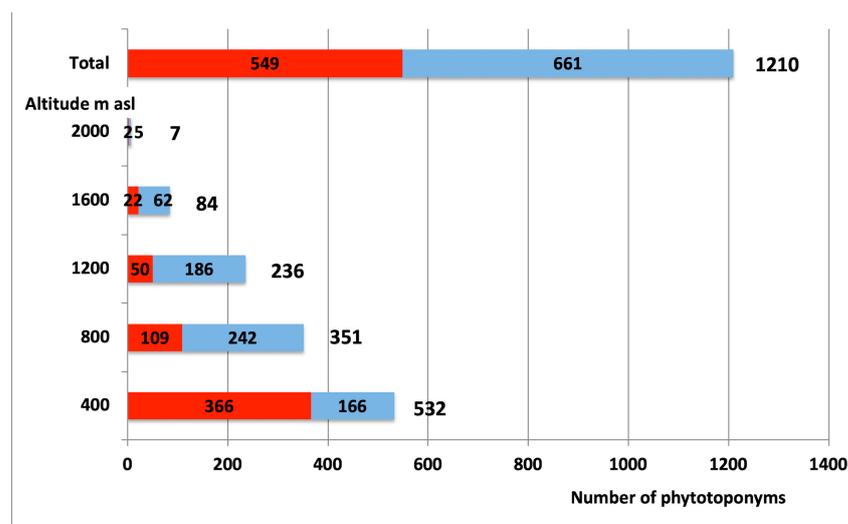
**Figure 4.** Georeferenced distribution: (a) phytotoponyms relating to forest species, (b) toponyms referring generically to the forest without specifying the species, and agreement with current forest vegetation. Blue, agreement with current forest vegetation, red, no agreement.

Figure 5 shows the concordance between the phytotoponyms and the current forest vegetation. The correspondence differed from species to species—on the whole, the phytotoponyms that coincided with the current landscape structure of the area predominated, even if slightly.

The distribution of phytotoponyms by altitudinal belt (Figure 6) showed that between 0 and 400 m only 29.2% of the phytotoponyms corresponded to current forest formations. In the higher altitudinal belts, the correspondence was greater—more than 70% of phytotoponyms corresponded to current forest formations.



**Figure 5.** Number of phytotoponyms per species and agreement with current forest vegetation. Blue, agreement with current forest vegetation; red, no agreement.



**Figure 6.** Distribution of phytotoponyms by altitudinal belt and agreement with current forest vegetation. In blue, correspondence between phytotoponyms and forest vegetation, in red no correspondence.

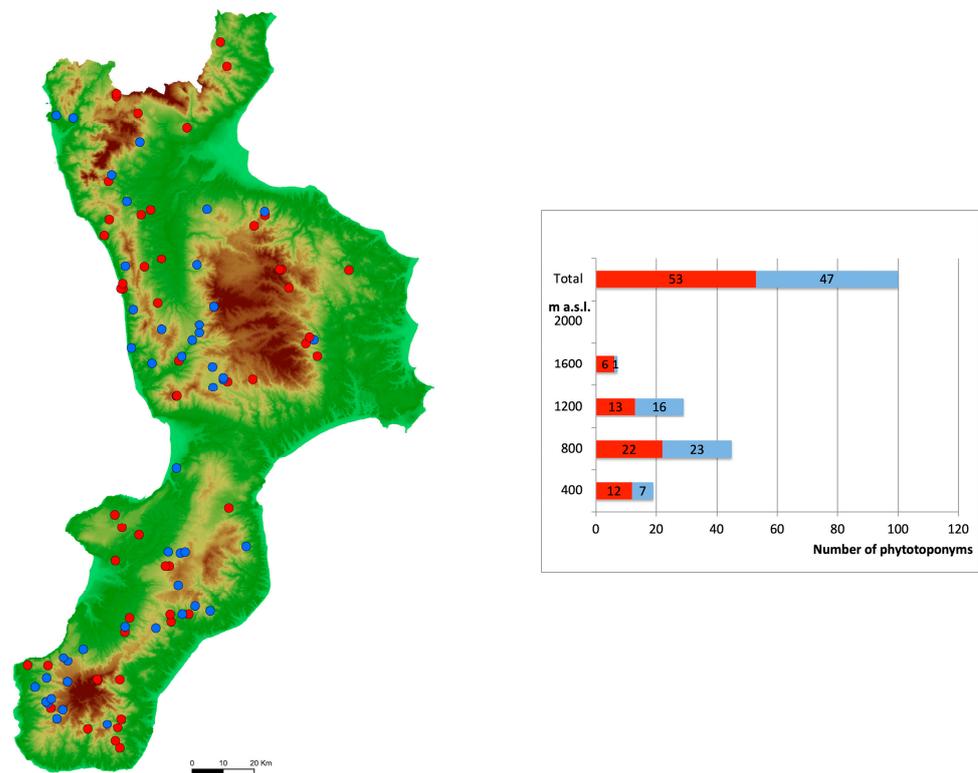
#### 4. Discussion

Plant place names are a rich source of ecological and environmental information and are very useful for interpreting the landscape and its transformations over time. Linguistic and etymological analysis is fundamental for the correct interpretation of the plants to which the place names refer, especially in a region like Calabria where the stratification of the Greek and Latin languages with that of the successive peoples who colonised the region has produced language that is quite differentiated in the various areas that make up the regional territory. The linguistic analysis highlighted that phytotoponyms can derive directly from phytonyms, but more frequently suffixes or prefixes are added to the phytonym, highlighting the importance of the plant in characterising the landscape by defining certain plant communities. For example, the phytotonyms, Carria and Farneto, which correspond to the dialectal name of *Q. frainetto*, were found only four times, while the phytotonyms, Carrà, Carruso and Farnoso, which refer to *Quercus frainetto* woods, were reported for 53 different localities.

In most cases, phytotoponyms are related to well-defined species (e.g., Savuto—*Sambucus nigra* L.), but in other cases are related to groups of species belonging to the same genus, that in the spoken language are not normally distinguished up to the level of species, as in the case of species of the genera *Salix*, *Tamarix*, *Acer*, etc. (e.g., Fellaro-*Tilia* sp. pl.).

Sometimes phytotoponyms are associated with other landscape elements, such as mountain, river, plain, etc., which contribute to defining the landscape structure. For example: Bosco Farnoso, Piano del Carrà, and Serra del Carro are all toponyms related to the *Quercus frainetto* woods, which better signify the landscape form where the forest is located (“Piano” flat area, “Serro” steep slope).

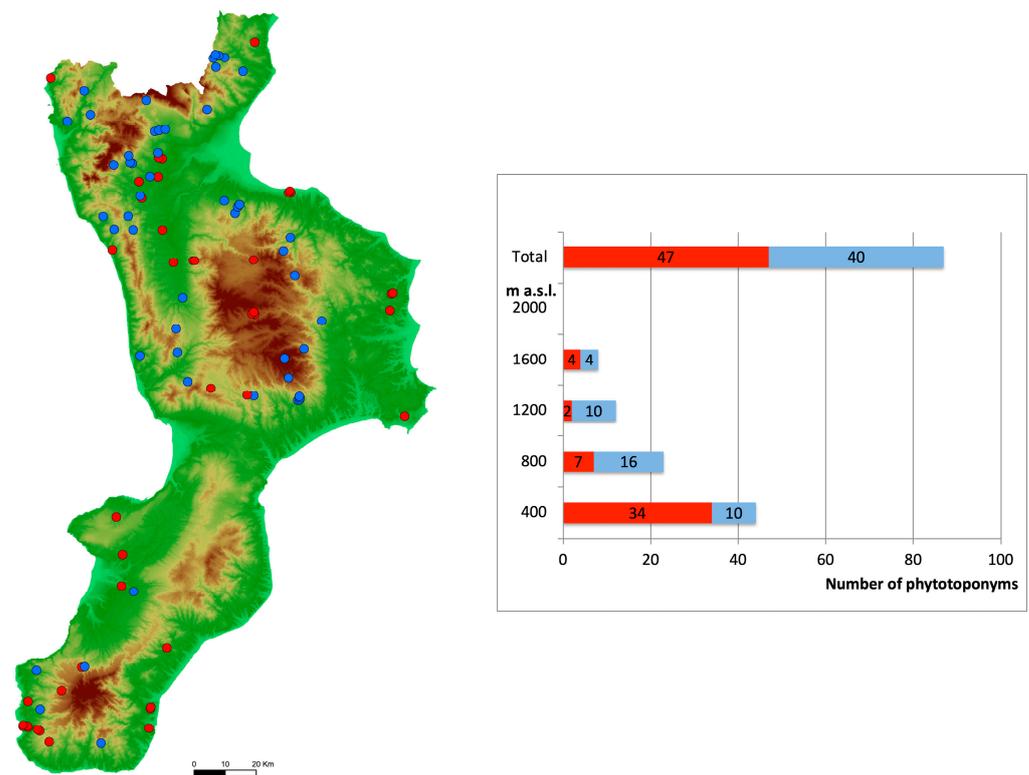
The forest species that most frequently occurred in the phytotoponyms was *Castanea sativa* (100 phytotoponyms), which testifies to the importance that chestnut trees and chestnut woods have had, and still have today, for the economy and landscape of the mountainous areas of Calabria, where it is widespread (Figure 7), above all in plantations destined for the production of wood, governed by coppice or coppice with standards, and more rarely in forests for the production of fruit [67].



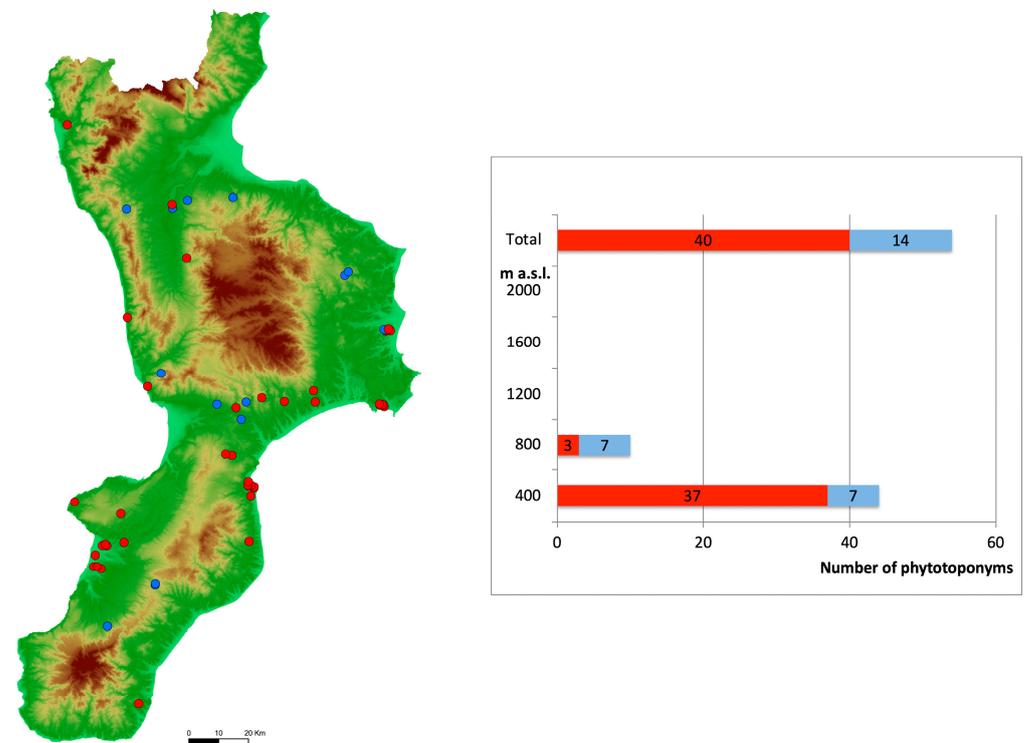
**Figure 7.** Distribution of phytotoponyms related to *Castanea sativa* Mill. on map and by altitudinal belt. Blue, agreement with current forest vegetation; red, no agreement.

After the chestnut tree, the most widespread phytotoponym was that linked to the deciduous oaks of the *Quercus pubescens* group, with 87 phytotoponyms found, or 8.1% of the total. This diffusion highlights the forestry importance that this group of species (Figure 7) has in the study area where they characterise different forest phytocoenoses distributed from sea level up to 1500 m a.s.l. [68]. *Quercus pubescens* is present in Calabria, with some taxonomically critical entities (*Quercus virgiliana* (Ten.) Ten., *Quercus congesta* C. Presl, *Quercus dalechampii* Ten. and *Quercus amplifolia* Guss.), differently represented in the taxonomic profile [68–71]. However, taking into account the distribution of the phytotoponyms and that of the oaks and oak groves, it can be stated that they mainly refer to *Q. virgiliana*, a species that is quite common in the area [72], and is well known and appreciated locally for its acorns, which are not very tannic, and are collected and used in the feeding of domestic animals, particularly pigs, and as a disinfectant and antidiarrheal treatment [46,47]. Comparisons with the current vegetation showed that the phytotoponyms referring to *Quercus pubescens* s.l. (Figure 8) did not correspond to any forest formation in 44% of cases, but rather to cultivated or urbanised areas. This is explained by the fact that the hilly strip where thermophilous oak woods are located in Calabria has undergone profound transformation linked to agricultural and pastoral activities that have fragmented the forest vegetation into small nuclei of limited surface area [67].

In the coastal and hilly areas, we observed a drastic reduction in all forest formations, such as thermophilous oak, cork oak, holm oak and maquis. The toponyms related to *Quercus suber* were widespread mainly between 0 and 400 m asl (Figure 9), but in most cases, they did not correspond to current cork forests but rather to agricultural or urban areas, with toponyms such as ‘Soveteto, Suvarara’ preserving only the name of the original forest vegetation. In many cases, the phytotoponym is evidence of formations and environments that have now completely disappeared across the whole region, as in the case of phytotoponyms related to humid environments of the coastal strip, such as lowland woods with *Fraxinus angustifolia* subsp. *oxycarpa* or hygrophilous bushes with *Vitex agnus-castus*.



**Figure 8.** Distribution of phytotoponyms related to *Quercus pubescens* s.l. on map and by altitudinal belt. Blue, agreement with current forest vegetation; red, no agreement.



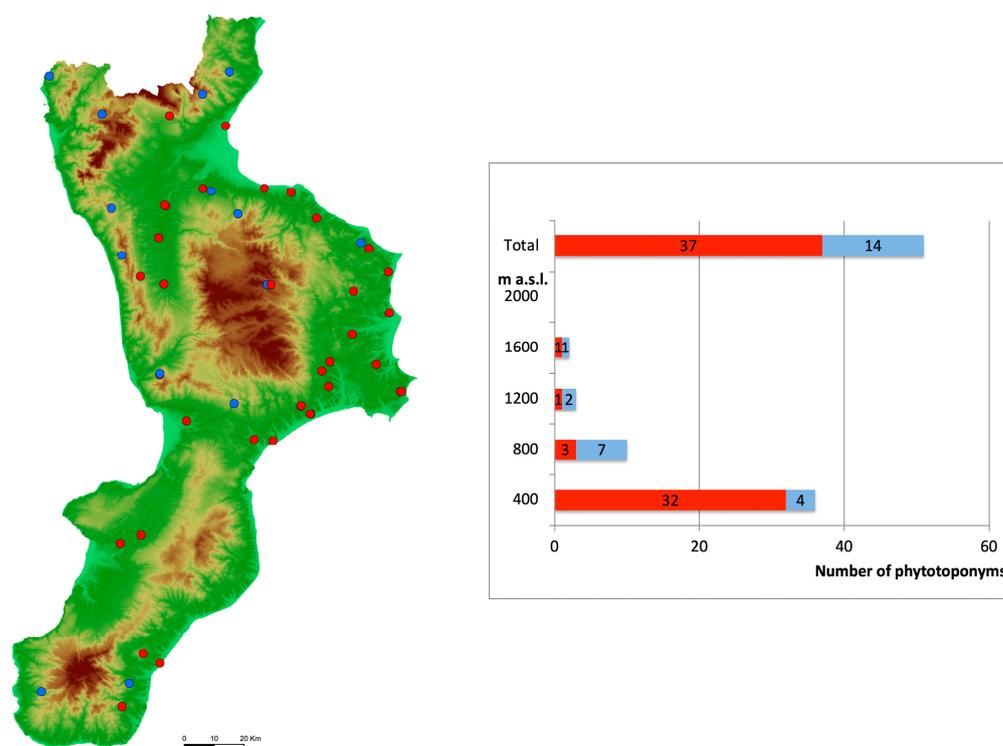
**Figure 9.** Distribution of phytotoponyms related to *Quercus suber* L. on map and by altitudinal belt. Blue, agreement with current forest vegetation; red, no agreement.

The comparison between the current structure of the coastal vegetation and the distribution of these phytotoponyms, therefore, showed a clear reduction, or more frequently

the disappearance, of hygrophilous and lowland woods in the whole coastal strip as a consequence of land reclamation, agricultural transformations, regulation of watercourses and urbanisation. These landscape transformations were in agreement with the study by [73] on the historical cartography of the Calabria region and the disappearance of vascular plants, and with the diachronic analysis carried out by [74] for a stretch of the coastal strip near the mouth of the Crati River.

Some species which are widespread in the forest vegetation of the region in terms of the areas occupied are poorly represented in the phytotoponymy, such as *Quercus ilex* L. (1.4%) and *Pinus nigra* subsp. *laricio* (0.6). This indicates a perceptive habit which, in the functional classification of a place, avoids the use of an element when it represents the structure of the place itself.

According to [75], place names normally highlight what is perceived by the local people in contrast to their surroundings, rather than describing what is usual, thus expressing a desire for contradiction. This explains why place names associated with widespread species of forest vegetation in the region, such as holm oak or beech, are not as frequent as localised species, such as *F. angustifolia* subsp. *oxycarpa*, which occupied modest areas even in the past. As shown in Figure 10, most of the places with toponyms referring to this species are not occupied by the humid woodlands that it characterises, but rather by agricultural areas or urbanisation. This is particularly relevant in the coastal and hillside areas (0–400 m asl) where, out of 36 phytotoponyms referring to this species, only four are currently covered by *F. angustifolia* subsp. *oxycarpa* woodlands. A similar situation was found for the species of the genus *Salix*, which recur often in the toponymy as attested by 83 phytotoponyms referring to species of willows (*Salix alba*, *S. purpurea*, *S. brutia*, etc.) located along watercourses. At present (Figure 5) only 27 phytotoponyms are characterised by willow forests, while for 57 of them there are no willow forests. The cause of this drastic reduction is mainly changes in the water regime following the subtraction of water flows for irrigation purposes and the hydraulic works on watercourses.



**Figure 10.** Distribution of phytotoponyms related to *Fraxinus angustifolia* Vahl subsp. *oxycarpa* (M.Bieb. ex Willd.) Franco & Rocha on map and by altitudinal belt. Blue, agreement with current forest vegetation; red, no agreement.

Other phytotoponyms are rare because the species and forest communities in which they occur are rare, such as *Taxus baccata* L. (0.7%), *Populus tremula* L. (0.3%), *Juniperus turbinata* Guss. (0.2%).

## 5. Conclusions

At regional scale, the study showed that phytotoponyms are an important tool for acquiring territorial knowledge. They are the memory of places and allow the reconstruction of past vegetation. The distribution of plant names is related to the distribution of potential natural vegetation. The correspondence between toponyms and forest vegetation highlights the transformations of the landscape due to agriculture and urbanisation.

The analysis of phytotoponyms referring to forest coenosis constitutes a useful support to the activities of restoration and rehabilitation of forest ecosystems.

Changes in the landscape have mainly affected the coastal and hillside areas as a result of the transformations induced by anthropic activities that have strongly modified the past landscape structure as a result of the expansion of agricultural and urban areas at the expense of forest areas. In particular, the Mediterranean vegetation of the *Querceteta ilicis* class, which in the region ranges between 0 and 800–1000 m a.s.l., being the most densely populated, has the greatest number of toponyms and highlights the biggest transformations of the forest landscape, with the loss of numerous types of forest habitats, such as coastal hygrophilous habitats. In contrast, the mountain belt (from 800–1000 to 2000 m a.s.l.) characterized by extensive deciduous winter forests of the *Quercu roboris-Fageteta sylvaicae* class, linked to a temperate macrobioclimate, has a lower population density and a smaller number of phytotoponyms which correspond, in most cases, to the current forest vegetation.

The toponymic analysis of place names linked to local phytonyms provides ecological information on the richness and diversity of forest cover in the area in the past. Thus, the toponomastic approach in scientific landscape research can inform the design of restoration activities for landscape, habitat and vegetation protection, including in other similar territories where they may be threatened [76,77].

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/land11040518/s1>, Table S1: Geodatabase of Calabrian phytotoponyms.

**Author Contributions:** Conceptualization, G.S. and C.M.M.; methodology, G.S., P.C. and C.M.M.; software, P.C.; validation, G.S. and R.C.; formal analysis, G.S., A.C.-O. and C.M.M.; investigation, G.S. and R.C.; writing—original draft preparation, G.S. and C.M.M.; writing—review and editing, G.S. and C.M.M.; supervision, G.S., P.C., R.C., A.C.-O. and C.M.M.; All authors have read and agreed to the published version of the manuscript.

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