forests

MDPI

Review

Agroforestry and the Climate Crisis: Prioritizing Biodiversity Restoration for Resilient and Productive Mediterranean Landscapes

Rigas Tsiakiris [1], Kalliopi Stara [2,*], Yannis Kazoglou [3], Petros Kakouros [4], Dimitris Bousbouras [5], Anastasios Dimalexis [6], Panayotis Dimopoulos [7], Georgios Fotiadis [8], Ilias Gianniris [1], Ioannis P. Kokkoris [9], Konstantinos Mantzanas [10], Maria Panagiotopoulou [11], Olga Tzortzakaki [12], Vassiliki Vlami [13] and Michael Vrahnakis [3]

1 Green Institute Greece, (Prasino Institouto), 7 Stadiou Str., (Attention Thalia Roussou), 10562 Athens, Greece; rigastsiakiris@gmail.com (R.T.); igiann3@gmail.com (I.G.)
2 Laboratory of Ecology, Department of Biological Applications and Technology, University of Ioannina, 45110 Ioannina, Greece
3 Laboratory of Rangeland Science and Management of Protected Areas, Department of Forestry, Wood Sciences and Design, University of Thessaly, 43131 Karditsa, Greece; ykazoglou@uth.gr (Y.K.); mvrahnak@uth.gr (M.V.)
4 Greek Biotope/Wetland Centre, 57001 Thessaloniki, Greece; petros@ekby.gr
5 Independent Researcher, Palamidou 25, 54633 Thessaloniki, Greece; bousbourasd@gmail.com
6 NCC—Nature Conservation Consultants Ltd., 15235 Vrilissia, Greece; adimalexis@n2c.gr
7 Laboratory of Botany, Section of Plant Biology, Department of Biology, University of Patras, 26504 Patras, Greece; pdimopoulos@upatras.gr
8 Laboratory of Forest Botany-Geobotany, Department of Forestry and Natural Environment Management, Agricultural University of Athens, 11855 Athens, Greece; gefotiadis@aua.gr
9 Department of Sustainable Agriculture, University of Patras, 30100 Agrinio, Greece; ipkokkoris@upatras.gr
10 Laboratory of Rangeland Ecology, School of Forestry and Natural Environment, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece; konman@for.auth.gr
11 Independent Researcher, Frangini Str. 9, 54624 Thessaloniki, Greece; buru97@gmail.com
12 Biodiversity Conservation Lab, Department of Biological Applications and Technology, University of Ioannina, 45110 Ioannina, Greece; olgatzortz@gmail.com
13 College Year in Athens (CYA), 11635 Athens, Greece; vassiliki.vlami@cyathens.org
* Correspondence: kstara@uoi.gr or kallio21@hotmail.com; Tel.: +30-2651009057

Abstract: This study deals with the future of the traditional agroforestry systems (TAFSs) in the northern Mediterranean Basin. Important productive systems, such as ancient non-irrigated olive groves and extensive silvopastoral systems, from subalpine grasslands to coastal landscapes, are being irreversibly degraded, threatening the bio-cultural heritage of the Mediterranean region, an area recognized as a global biodiversity hotspot. In the midst of the global biodiversity and climate crisis, immediate actions are proposed for the protection and conservation management of TAFSs, within a new EU policy framework. Having the TAFSs of Greece in the spotlight of this analysis, a four-step approach was used in order to review the value of agroforestry in terms of (a) biodiversity (birds, mammals, invertebrates and soil biota), (b) agroforestry landscapes, such as traditional olive groves on terraces and valonia silvopastoral systems, (c) ecosystem services, especially concerning cultural values, and (d) the modern threats to traditional agroforestry. Through this research, problems are highlighted and European policy priorities are defined. Our conclusion is that there is an immediate need to revise the European Union rural, forestry, and environmental policies in the Mediterranean region, following the provisions of the new EU Nature Restoration Law, in order to revive agroforestry landscapes and make them productive and sustainable again for the benefit of rural economies, local communities, and biodiversity, especially in marginal Mediterranean mountainous and island areas, where depopulation and susceptibility to wildfires are major threats.

Keywords: traditional agroforestry systems; climate change mitigation; ecosystem services; European Green Deal; CAP; EU Nature Restoration Law

Citation: Tsiakiris, R.; Stara, K.; Kazoglou, Y.; Kakouros, P.; Bousbouras, D.; Dimalexis, A.; Dimopoulos, P.; Fotiadis, G.; Gianniris, I.; Kokkoris, I.P.; et al. Agroforestry and the Climate Crisis: Prioritizing Biodiversity Restoration for Resilient and Productive Mediterranean Landscapes. *Forests* **2024**, *15*, 1648. https://doi.org/10.3390/f15091648

Academic Editor: Xibao Xu

Received: 5 August 2024
Revised: 30 August 2024
Accepted: 15 September 2024
Published: 18 September 2024

1. Introduction

Agroforestry sustains resilient landscapes throughout the world and successfully mitigates climate change impacts on rural areas and communities [1]. These landscapes are also very efficient in sequestrating carbon [2] and in tackling poverty [3]. Preserving, enriching, and restoring traditional agroforestry systems (TAFSs) combats desertification [4], increases surface water runoff, improves soil productivity [5], and preserves arks of global biodiversity, including rare species [6,7].

TAF landscapes in Europe (mainly Portugal, Spain, France, and Italy) have been preserved for centuries in areas with limited land use intensification [8], as evidenced by the numerous centuries-old trees found at most of them, many of which are now threatened. The cultural characteristics of these landscapes have been formed through the long-term coexistence of humans with nature and present a model of sustainable land use at the local scale. For these countries TAFSs are a significant land use. For example, in Spain and Portugal they cover 11.2% and 13.1% of each country, respectively, while in Greece they cover 12.2% of the country. Their share is even higher in relation to the utilized agricultural area (UAA), where agroforestry is estimated at 23.5% for Spain, 31.8% for Portugal, and 31.2% for Greece [9]. According to the European Environment Agency, approximately one-third of European farmland consists of significant areas of semi-natural vegetation managed at low intensity by agriculture and forestry; even if not clearly named, this farmland constitutes TAFSs [10]. Mediterranean agroforestry landscapes contain a large part of Europe's biodiversity, while some of the most iconic and internationally well-known local agricultural products come from such systems [11]. In recent years, TAFSs are threatened simultaneously by two opposite trends, abandonment and intensification. Abandonment allows for rapid, natural regrowth of mainly highly flammable young scrub and forest, such as Aleppo pine (*Pinus halepensis*) and prickly oak (*Quercus coccifera*) [12] leading to the increase in wildfire risk [13] and biodiversity decline. At the time, in other areas, overgrazing results in desertification underpinned by the destruction of centuries-old cultural landscapes, such as the collapse of silvoarable terraces in Mediterranean islands, while in other cases TAFSs are sacrificed in the course of land reclamation projects.

TAFSs are adapted to local ecological conditions with few inputs, thus their existence has been solely dependent on local labor and their economic viability depends on agricultural market rules and policies on the local and global scale [14]. Without economic competitiveness to maintain them, their abandonment or transformation seems inevitable [15]. Moreover, EU policies and mainly the Common Agricultural Policy (CAP), aiming at the growth of agricultural production for many decades, as well as the recent "greening" of the CAP, have not favored agroforestry, especially in the case of conserving existing TAFSs. At the same time, the lack of coherent rural policies led to rural depopulation and to a drop of almost 50% of the agriculture population over the last five decades, especially across the Mediterranean countries and in mountainous areas where such landscapes are more common [16]. Because of this, several local communities collapsed, altering rural landscapes and causing biodiversity loss. Although there are no special economic tools aiming to maintain and sustainably manage agroforestry landscapes, modeling scenarios of rapid economic development seem to favor agroforestry [17].

To sum up, the lack of coherent EU and national policies based on scientific knowledge about the value of maintaining agroforestry resulted in the loss of thousands of hectares of climate-resilient agroforestry systems [18] that held an important part of the region's biodiversity, bonded with centuries-old TAFSs. Agroforestry landscapes are still in peril due to the fact that they have not been subject to mainstream forestry, rural and biodiversity conservation policies; land abandonment is altering their structure and large-scale forest fires are irreversibly destroying their most valuable elements, such as old-growth trees, while in other cases the land mosaic continues to degrade due to agriculture intensification, land reclamation and ecological succession.

The aim of this study is to propose direct actions for the preservation and restoration of agroforestry systems in Mediterranean Europe, for the restoration of its declining biodi-

versity, within a new or updated policy framework. Our hypothesis is that agroforestry landscapes could hold higher biodiversity value, and therefore a four-step, bottom-up approach is used, taking Greece as a characteristic example where agroforestry systems still cover most of its mountainous and island territory. We therefore review the value of agroforestry systems in terms of biodiversity and habitats, cultural landscape characteristics and ecosystem services, categorization of threats to which they are exposed, and outline the policy priorities needed for their long-term existence.

2. Material and Methods

In order to pass from large-scale initiatives, like those stemming from EU strategies, to the regional or even the local scale supporting policies, there is an imperative need to apply a bottom-up approach to delineate the value system of agroforestry, especially in Mediterranean Europe, where these systems are mostly still alive. On the contrary, European policies are implemented mostly "from top to bottom" and reflect the "compromise" of political, financial and national interests, an approach that shows several inadequacies, especially for capturing the diversity of problems that need to be solved at the local scale.

Therefore, a novel, four-step, bottom-up approach is presented that starts from (a) species and (b) landscape diversity, then (c) emphasizes TAFSs' ecosystem functions and services, and (d) presents threats that need to be tackled within an integrated policy framework. In more details, the importance of agroforestry systems for biodiversity is reviewed for several groups of organisms, comparing their occurrence in agroforestry habitats, the unique agroforestry cultural landscapes are described and classified, wider ecosystem functions and services supported by agroforestry systems are defined, threats to agroforestry systems are detected, and, finally, policy measures and immediate actions for agroforestry are proposed.

Greece has been chosen as a typical example for Mediterranean Europe because: (a) almost a quarter of its area is still covered by agroforestry systems, especially in mountain areas and islands, (b) it is one of the most mountainous countries in Europe and has hundreds of inhabited islands, and (c) is characterized as a biodiversity hotspot with most of its endemic species located on mountains and islands.

To implement this four-step evaluation (Figure 1), experts from all over the country summarized all available data and presented their most prominent findings on the subject in short notes [19]. For each step of the evaluation procedure, the following focus groups were assessed:

1. For species diversity in agroforestry landscapes, available data on the most characteristic and best studied groups of species were assessed. Birds were given special attention, focusing on raptors and passerine species, as they have been used as "umbrella species" to define key biodiversity areas for nature conservation and to assess the biodiversity status of agricultural ecosystems in Europe (e.g., common farmland bird index) [20]. Moreover, reptiles and amphibians were included, as well as mammals with special attention to bats, many species of which are considered threatened in Europe. On the contrary, the populations and distribution of small mammals (rodents and insectivores) are not well known in Greece. Conservation-important invertebrates such as butterflies were also evaluated, followed by data on pollinators and soil-dwelling species diversity [21].
2. For landscape diversity, the classification developed under the European Commission's Habitats Directive (92/43/EEC) is followed, especially the habitat types included in Annex I, representing the diversity of habitats found within the Natura 2000 network of protected areas as well as outside them included in the Annex I of the EU 2024/1991 Regulation. Special notes on the most prominent agroforestry ecosystems of the country are given, including notes on their history, land uses, and important plant species that they host, as plant endemism is exceptionally high in the country. The European Red List of Habitats [22] and their threat status was also

considered for their evaluation through the lens of agroforestry practices that are critical for their maintenance.

3. Agroforestry landscapes are typical cultural landscapes that include semi-natural and natural habitat types that have evolved and been maintained by pre-industrial land uses over long periods of time. Therefore, areas where TAFSs still exist are examined, focusing on prominent examples with notes on their identification, classification, indicator metrics, and functions.
4. Threats are classified and categorized according to main driving forces and importance for the categories mentioned above (e.g., TAF cultural landscapes and current land uses, habitat, and species diversity and conservation importance).

Figure 1. Schematic diagram showing the four-step procedure and the focus groups of the evaluation of agroforestry systems.

Finally, the EU policies for agriculture and forestry are assessed for each threat and level of the present four-step assessment. A new policy framework for all agroforestry systems is proposed according to a priority classification system, resulting in six broad policy principles and baselines that could easily be implemented to adapt the broad network of European policies for the needs to conserve, revitalize, and make traditional and modern agroforestry systems economically sustainable and viable.

3. Results

3.1. Species Diversity Value System in EU Mediterranean Agroforestry Landscapes

3.1.1. Birds

According to an extensive literature review by Tucker and Evans (1997), the Mediterranean landscapes host a large percentage of bird species of high conservation concern in Europe [23,24] linked to historical land uses and existing old agroforestry systems favoring sparse woody vegetation with scattered solitary trees. In Greece, 147 bird species are categorized as "Species of Agropasture Lands", 21 of which are globally threatened, and 60 are threatened or protected by a network of nature protection laws. Most of the above commonly occur in areas with agroforestry land uses that maintain specific favorable habitat structural characteristics, such as centuries-old solitary trees frequently preserved as shade trees for livestock, and scattered bushes sometimes intersected by small burnt areas, mixed with farmland and hedges, while in steep rocky areas they include dry-stone walls and creeks, a mosaic typical in several islands of Greece [25]. A characteristic bird of these areas, with 40% of its global distribution occurring in Europe, that is now threatened with extinction is the roller (*Coracias garrulus*), decreasing as much as 20% annually in some areas over the last 30 years due to the elimination of single, old-growth hollow trees in farmlands, where it nests [26]. Other species that nest in such landscapes have a limited global distribution, like the sombre tit (*Poecile lugubris*) and the levant sparrowhawk (*Accipiter brevipes*), while others face rapid decline in Europe, like the turtle dove (*Streptopelia turtur*). To add to the above, favorable game species that used to be very abundant in Mediterranean agroforestry landscapes, such as the rock partridge (*Alectoris graeca*), are also in decline. However, the group of birds that are all declining at the European agroforestry areas are the shrikes (family Laniidae), the red-backed shrike (*Lanius collurio*) being the most characteristic example. This species, extinct in many European countries, is threatened either by agriculture intensification or by abandonment, especially concerning the decline

of extensive livestock raising on a small scale, which leads to the rapid natural regrowth of woody vegetation and loss of open habitats with sparse small trees and thorny bushes used as nesting sites and hunting spots [27].

Agroforestry ecosystems are extremely valuable, especially for raptors, as they form extensive ecotone habitats, which constitute the main foraging grounds for most diurnal and nocturnal raptor species. The connection of landscape mosaics to raptors' prey availability has been explicitly demonstrated in Dadia National Park [28,29], although direct estimation of prey availability (i.e., rodents) has not been investigated so far. In Europe, 33 out of 36 diurnal birds of prey species occur in agroforestry landscapes, of which 26 are under threat and 9 are included in the global IUCN Red List. Immediate actions for the conservation of threatened and declining raptor species frequently involve the revival of agroforestry land uses. Characteristic examples of birds strongly linked to agroforestry mosaics are the imperial eagle in eastern Europe (*Aquila heliaca*) and the Iberian Peninsula (*Aquila adalbertii*), and both European scavengers, the black kite (*Milvus migrans*) and the red kite (*Milvus milvus*). The common buzzard (*Buteo buteo*), the booted eagle (*Hieraaetus pennatus*), the Bonelli's eagle (*Aquila fasciata*), the short-toed eagle (*Circaetus gallicus*) and the lesser spotted eagle (*Clanga pomarina*) also occur more frequently in such landscapes [30]. All of them nest in trees and hunt reptiles, small mammals, and birds in open areas with short grass, while some also prefer amphibians that are found in small agricultural ponds used mainly to provide water to livestock. Moreover, all four European vultures are associated with extensive livestock farming that is a keystone land use in agroforestry landscapes, the best example being the griffon vulture (*Gyps fulvus*), the black vulture (*Aegypius monachus*), and the Egyptian vulture (*Neophron percnopterus*), while the bearded vulture (*Gypaetus barbatus*) follows all other species to feed mostly on bones of dead livestock [31].

Mediterranean agroforestry landscapes are also valuable for the conservation of the most threatened group of birds in Europe, the farmland birds [32]. Intensification of farming activities coupled with land abandonment in less economically favorable areas and especially in mountain areas and islands, mainly during the second half of the 20th century, had a detrimental effect on the most abundant farmland species. Depending on local conditions, agroforestry landscapes may include small wetlands, such as artificial or natural ponds maintained by farmers and used by stockbreeders, increasing the agroforestry landscapes' diversity, which is also important for migrating and wintering species favored by such a mosaic. Lastly, agroforestry landscapes often include old-growth groves frequently related to sacred natural sites, which preserve aged veteran trees (e.g., "habitat trees") that offer nesting spots to many conservation-important species [33].

3.1.2. Amphibians and Reptiles

Many organisms strongly linked with agroforestry landscapes, especially in dry areas in Mediterranean Europe, have been neglected by nature conservation and agro-environmental policies [34]. One such group is the amphibians, many species of which are now listed among the globe's most threatened vertebrates since the IUCN first assessed their status [35]. Of the 23 species of amphibians and 73 species of reptiles in Greece, 16 species of amphibians and 61 species of reptiles live in agroforestry systems using especially drystones, hedgerows, ponds, and openings and edges of forests and shrubland [36]. Habitat loss, in both their aquatic and terrestrial life phases, is their main threat, as small ponds maintained by farmers and breeders and narrow ditches and streams next to fields are disappearing in the lowlands where intensive agriculture is homogenizing the landscape. These critical artificial wetlands favor various amphibians, including common pond frogs (*Pelophylax* spp.) and rare crested newts (*Triturus macedonicus* and *T. ivanbureschi*).

Several structural elements of agroforestry landscapes like the above also favor reptiles and small mammals. A characteristic example is the terraces made by drystone walls that resemble natural rock and cobble habitats in dry landscapes. Terraces also support populations of insect and rodent predators, thus being beneficial to crops. In addition,

scattered trees and scrub are also critical elements for several species of reptiles and small mammals as they cover the ground with branches and provide shelter to them.

3.1.3. Mammals

Correspondingly, open canopy mosaics, including grazed forests and agricultural land, have greater diversity for insects and consequently reptiles and mammals than homogeneous dense forests managed exclusively for timber production. Small clearings that are created through logging and grazing are similar to natural forest gaps. In addition, agroforestry systems host many fruit trees and scrub that attract mammals such as bears (*Ursus arctos*) in the Pindos mountains (NW Greece) that surprisingly show clear preference for mixed agroforestry systems as well as forests with mixed broadleaved species, including planted chestnuts (*Castanea sativa*) and hazelnuts (*Corylus avellana*) [37]. The critical importance of corridors in the agricultural landscapes, such as linear forest habitats, small woodlands, and hedgerows, especially for the conservation of mammals, such as bears and roe-deer (*Capreolus capreolus*) is well established in the bibliography, as several species move in open environments at night, ensuring their movement between mountain ranges and forests under partial woody cover with basic food sources [38]. In contrast, in open, non-covered areas with food sources based only on agricultural production, large populations of rodents dominate and damage crops, as hedgerows, which favor the rodent predators, are absent.

The importance of agroforestry landscapes to bats (Chiroptera) has not yet been studied in detail, although one-third of the indigenous terrestrial mammal species in Europe are bats, most of which are insectivores and play a key role in plant pollination, forest regeneration, and agricultural production. All 46 bat species are protected by the Habitats Directive (92/43/EEC), namely Annex IV and Annex II, which includes 13 strictly protected species. Two bat species, *Barbastella barbastellus* and *Myotis bechsteinii*, are also species whose conservation requires the Natura 2000 network designation of Special Areas of Conservation, due to their strong reliance on mature and dead trees, the loss of which threatens their populations. Bats use typical agroforestry areas, and pastures may play a key role as foraging habitats for several species (*Eptesicus serotinus*, *Rhinolophus ferrum-equinum*, *R. hipposideros*, *Myotis myotis*, *M. blythii*, *M. nattereri*, *Plecotus austriacus*). Removal of hedgerows, loss of foraging areas (meadows, ponds) and the increased use of pesticides impact bat populations [39]. Agricultural intensification seems to be the main threat to most bat species, as evidenced by the decline of many European bat populations [40].

In Greece, a hotspot for bat conservation hosting 36 out of a total of 46 European bat species, agroforestry systems are an essential bat habitat for foraging and commuting (due to landscape connectivity) and possibly also for roosting and reproduction, especially when old and dead trees and other types of roosts (e.g., rock crevices, mines, caves,) are present. When water bodies, such as creeks and permanent or temporary ponds are part of agroforestry systems, their value increases as bats use them to drink water and prey on insects favored by the presence of water and the riparian vegetation [41]. In the same way, water troughs maintained by farmers in TAFSs with limited water are especially valuable for bats. Agroforestry systems in Mediterranean islands sustain relatively high bat species diversity as they are preferred by species that depend on other habitats on the mainland, such as wetlands. On islands like Crete, where undisturbed, wooded surfaces are rare, agroforestry systems become even more significant for bats, as evidenced by the 14 of the 17 Cretan bat species that occur in agroforestry systems [42].

3.1.4. Invertebrates and Soil Biota

Similarly, agroforestry systems are very important for invertebrates. Old-growth silvopastoral woodlands are vital for several beetle species [43], as has been evidenced from central Europe [44]. Representatives of Carabidae and other taxa are benefited by the traditional management of old-growth woodlands that retain their structural diversity [45]. In addition, old-growth "heritage trees", such as massive solitary oaks, mostly found

in agroforestry landscapes, have been found to be important sanctuaries for saproxylic beetles [46].

Agroforestry landscapes are important habitats for butterflies, whose occurrence largely depends on traditional management practices [47,48]. Forest clearings, maintained by extensive stockbreeding and selective logging, are essential for the survival of many butterfly species and populations. Both intensive grazing and abandonment of agricultural land are destructive, as herbaceous plants valuable for butterflies may disappear due to intense grazing and trampling and woodland succession, respectively [49]. The protected marsh fritillary (*Euphydryas aurinia*, 92/43/EEC Annex II) is largely dependant on suitable grazing [50]. Similarly, the Apollo (*Parnassius apollo*, 92/43/EEC Annex IV, and CITES) became extinct in several parts of central Europe due to the modification of its natural habitats to cropland and artificial land uses or to wooded and forested areas due to changes in woodland management and to the abandonment of traditional livestock farming [51].

Traditional tree and crop management sustain pollinator resources through a diversity of wild annual plants favored by such management that benefits both cultivated trees and annual crops; a typical example is offered by traditionally cultivated olive groves in the northeastern Aegean islands, which were richer in annual plants and wild bee species [52] compared to abandoned olive groves. In these islands, considered as a global hotspot for bees [53], traditionally managed agroforestry systems dominated by oak and chestnut held maximum bee diversity [54]. On the other hand, cultivated fruit trees in agroforestry systems, such as almond trees (*Amygdalus communis)* in southern Sinai, Egypt, benefited from wild bee diversity and might not need honeybee pollination at all [55]. Another characteristic example is the carob (*Ceratonia siliqua*) groves, densely or sparsely planted, that constitute silvopastoral systems very common across the Mediterranean and of great pollinator diversity by both nocturnal (mainly settling moths) and diurnal insects (mainly bees, flies, and wasps) [56]. Additionally, in the new National Red List, more than 250 species of invertebrates, several of which are found in agroforestry landscapes, have been classified as high threat status, which should lead to increased focus on them [21]. Lastly, many soil chemical and biological properties are enhanced in agroforestry systems as incorporated trees offer several advantages to soil biodiversity. Increased soil biodiversity is achieved due to the contribution of trees, in the form of increased dead plant (organic) material, to the soil ecosystem, increased nutrient availability, improved soil structure through increased porosity, protection of soil from erosion, removal of excessive nitrates in over-fertilized land, and promotion of organic carbon fixation in the soil. In addition, various organisms grow under favorable conditions in the soil, thus forming the biotic community of the soil system, which is characterized by the interaction of these organisms with each other as well as with the plants [57].

The effects of land use on soil fauna abundance and diversity show a mainly positive effect of agroforestry when it is compared to cropland and a neutral or negative effect when compared to forests [58]. The diversity of soil organisms, which is much higher in agroforestry systems plays a key role in decomposing the organic matter and recycling nutrients. One gram of soil can host up to 10 billion microorganisms of thousands of different species, and agroforestry systems are considered to increase the abundance of soil biota [59].

3.2. Habitats and Plant Diversity in EU-Mediterranean Woodlands and Wood Pastures

Agroforestry systems and, in particular, silvopastoral systems are crucial for the conservation of Europe's floristic and habitat diversity. Grazers, such as goats, substitute the wild ungulates of prehistorical times [60] in controlling the aggressive Mediterranean woody vegetation. For example, in rough arid areas, centuries-old prickly oaks in tree form dominate in pastures grazed mainly by goats (Figure 2a,b) and keep the characteristic mosaic of open woody landscapes (Figure 2c: typical areas in plains contain a variety of mixed land uses intersected with hedgerows, pastures, and orchards).

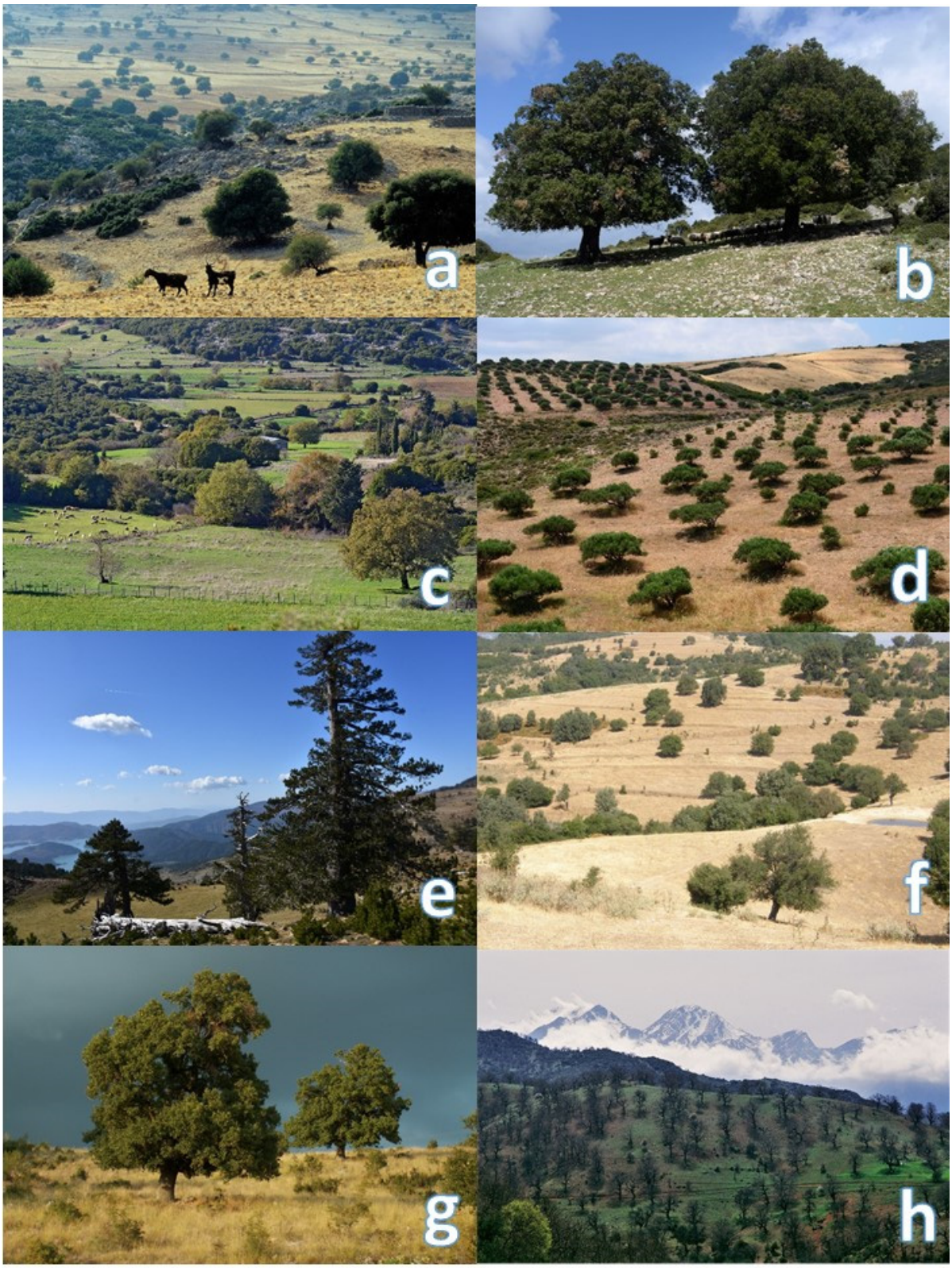

Figure 2. Typical Agroforestry Landscapes of Greece. Photographs: G. Roussopoulos (**a**–**d**,**f**,**h**), K. Stara (**e**,**g**).

The Mediterranean basin has a very rich flora while Greece hosts more than 6600 taxa, many of which are Mediterranean endemics and hemicryptophytes. Plant species have adapted to many different microenvironments, forming several plant communities, with

most taxa found in typical components of agroforestry systems, such as agricultural and ruderal habitats and temperate and sub-Mediterranean grasslands [61]. The olive (*Olea europaea*) is the most widespread cultivated tree in Greece, covering an area of 700.000 ha [62], 20% of which forms agroforestry systems (some of the oldest olive trees on the planet still survive and are still productive in steppe-like habitats on the island of Crete, Figure 2d) with various crops (cereals, corn, alfalfa, grapevines, vegetable crops, or edible wild herbaceous vegetation) or pasture (sheep, cattle, goats, pigs, or chicken). The intercropping of olives with cereal crops (barley and mixtures of barley and legumes, such as the common vetch) is a very promising practice for Mediterranean areas with traditional olive agroforestry systems. Another typical example of a tree species well-adapted to xerothermic conditions and suitable for agroforestry in Greece, as previously mentioned, is the carob tree, mainly in the Southern Peloponnese and Crete. In the past, carob fruits were largely used as fodder for livestock, while recently, a strong interest in carob flour and honey has occurred. Walnuts (*Juglans regia*) and almonds also form extensive silvoarable systems. Walnuts occur in semi-mountainous or mountainous areas throughout the country, and they are cultivated for their fruits and high-quality timber. In their understory, cereals, alfalfa, vine, cotton, tobacco, and other crops may be present. Almonds are traditionally grown with various crops (e.g., cereals, tomatoes, legumes, and hay), while chestnuts, mulberries (*Morus alba*), figs (*Ficus carica*), pseudoacacias (*Robinia pseudoacacia*), cherries (*Prunus avium*), apples (*Malus domestica*), and pears (*Pyrus communis*) also form silvoarable systems on a smaller scale. Silvopastoral woodlands with prickly oak are found in mountainous and semi-mountainous areas covering extensive parts of the Eastern Mediterranean. They retain exceptional floristic diversity, especially when they are located at the edges of agricultural land, where they act as conservation zones for flora and fauna. Due to their extensive human use, they are commonly found in shrub form, forming extensive communities, pure or mixed with other evergreen or deciduous shrubs, which are known as '*prinones*' (prickly oak shrub lands) and are mainly used for grazing by goats [63], while they can also be found in tree form in protected areas (e.g., urban and sub-urban forests, churches, cemeteries, private farms) either isolated or in small groves.

Agroforestry systems dominated by Aleppo pine, Calabrian pine (*P. brutia*), and stone pine (*P. pinea*) spread mainly along coastlines. They are seated on stable soils (Aleppo and Calabrian pines) or sand dunes (stone pine), the latter forming an EU priority habitat (92/43/EEC, habitat type 2270*). Under intensive use, the understory consists of phrygana, such as *Sarcopoterium spinosum*, while in resin-extracted and heavily grazed woodlands it consists of resistant herbaceous species, such as *Allium chamaemoly*, and in stands with mild use, the understory is dense, with many evergreen shrubs (e.g., *Pistacia lentiscus*, *Erica arborea*). Livestock grazing, especially by goats, can control the understory vegetation to the benefit of the trees. Scots pine (*P. sylvestris*) woodlands in mountainous areas and Bosnian pines (*P. heldreichii*) near the tree line in the Pindos mountain massif, where some of the oldest—more than 1000 years old—pines in Europe survive (Figure 2e), offer valuable timber and summer forage as well as places to construct sheds, and host interesting plant elements of central and northern European origin, such as *Avenella flexuosa* [64]. Pine forests, which contain the most ancient trees of Europe [65], are found in agroforestry landscapes, which are maintained by the periodical use of fire [66], with fire playing a key role in their current structure [67].

The mountain cypress (*Cupressus sempervirens*) woodlands on the islands of Crete and Symi form a very special agroforestry system. In ancient times, they produced valuable timber, especially for shipbuilding, and formed important pastures for sheep and goats. Their understory hosts rare endemic plant species, such as *Asperula pubescens* and *Silene sieberi* [9]. Nowadays, the most common use of cypress trees is for ornamental purposes along national roads and in urban parks, churches, and cemeteries. In addition, they are also planted in arable lands to mark boundaries or for protection of crops from strong winds. These latter uses result in silvoarable or agrosilvopastoral systems [68].

Juniper woodlands of *Juniperus oxycedrus*, *J. phoenicea*, *J. macrocarpa*, *J. foetidissima*, *J. drupacea*, and *J. excelsa* occur at a wide altitude range, i.e., from coastal sand dunes up to very high woodlands and forests in the Mediterranean basin. Many of them belong to EU priority habitat types, namely under the codes 2250 and 9560. These photophilous junipers, enduring dry conditions and intense grazing, are ideal for agroforestry purposes. They hold many important and rare plant species with distribution limited only to the Balkan Peninsula, including species with a very narrow distribution, such as *Iris attica*, and endemics, such as *Cerastium candidissimum* and *Marrubium velutinum*.

Oak (*Quercus*) silvopastoral woodlands, such as those made by centuries-old Macedonian oak (*Q. trojana*) and valonia oak (*Q. ithaburensis* subsp. *macrolepis*), prevail in dry hilly areas, forming open oak wood pastures, constituting the '*meeting point*' of timber, firewood, and livestock productions lines (Figure 2f,g).

The trees usually occur on the borders of cereal fields and offer forage during the summer or after the grain harvest and are usually pruned in late autumn to provide animal fodder and firewood in winter. These special management practices have resulted in the presence of plant species that are usually recorded in forests, such as *Lathyrus laxiflorus*, as well as species well-adapted to grazing, such as *Phlomis fruticosa*. Among the various oak species, the valonia oak, found on mainland Greece as well as in many Aegean islands with typical Mediterranean or sub-Mediterranean climate, stands out. Other oak species, such as *Quercus pubescens*, *Q. frainetto*, and *Q. petraea*, form agrosilvopastoral and silvoarable systems in extensive mainland areas in the semi-mountainous and mountainous zones (Figure 2h: Extensive wood pastures on Mt. Erimanthos (2224 m) in Peloponnese, S. Greece, dotted with shredded oaks). These agroforestry systems are the Eastern Mediterranean counterparts of the Spanish *dehesas* or Portuguese *montados*, well-documented for their value and long historical presence, that occur extensively in the Iberian Peninsula.

3.3. Cultural Value System in EU Mediterranean Agroforestry Landscapes

Cultural landscapes are defined as semi-natural or natural configurations that have been gradually molded by human land utilization over extended durations, frequently encompassing conventional agroforestry practices. Agroforestry forms a transitional and complex landscape configuration between natural ecosystems and farmland, including ecotones. Significant presence of ecotones determines the abundance of species and microhabitats in pastoral woodlands [69]. The multifunctionality of these systems has attracted growing interest from researchers and decision-makers in the fields of agriculture, forestry, rural development, tourism, and nature conservation. Cultural landscapes shaped by agroforestry systems frequently include:

- Implementation of agricultural techniques that promote elevated levels of biodiversity, including high nature value farming, in close proximity to natural land formations.
- Livestock grazing that creates landscape patterns of natural/semi-natural vegetation.
- Mature stands of trees, natural vegetation patches located near small agricultural communities, and pastures and cultivated lands.
- Small rural settlements or villages with a multifunctional agroforestry character.

Examples of such systems in Greece include various types of intercropping of cereals and legumes in combination with grapevines and olive trees, as well as vines growing on trees. Similarly, small plots with shredded or pollarded trees that provided leaf and twig fodder were important for the survival of stalled livestock, mainly goats, and for supporting everyday necessities in fuel wood [70]. These features were characteristic of several landscapes, especially in mountain areas. Other typical elements of agroforestry landscapes are the centuries-old trees, that used to serve as shade trees for livestock during summers' hottest hours and the "sacred trees" of maiden form growing next to small chapels and serving as festive places, well-preserved due to their association with taboos against cutting in the fear of supernatural punishment [71]. Such trees are often neglected and frequently cut down; however, there are exceptions, such as the modern use of the massive valonia oaks for acorn flour and other activities related to oaks on the island of

Kea in the Aegean. Valonia oaks, typical in the eastern edge of the EU Mediterranean, apart from sustaining local economies in fodder, fuelwood, and acorns, harbor exceptional biodiversity elements [72].

Other important silvoarable and silvopastoral systems of high cultural value are the drystone terraces and associated infrastructures, the predominant large-scale anthropogenic impact on the island ecosystems of the Mediterranean region, that are considered to be of utmost significance. Influenced by successive generations of inhabitants, these crucial infrastructure components facilitated farming on hilly terrains, in poor and notably dry soils, enabling the practice of agriculture, livestock rearing, apiculture, and ultimately the enduring human settlement and self-reliance. Today they constitute important habitats for many species and provide a critical "green infrastructure" for islands, important for their adaptation to climate change [73].

3.4. Threats to Mediterranean Agroforestry Systems

Traditional agroforestry systems face many threats driven by the rapid development in globalization and liberalization of international trade. There are two opposing trends threatening agroforestry systems and their associated cultural landscapes: abandonment, on one side, and intensification of their use, on the other side, both of which result in reduced ecosystem services, habitat degradation, and eventual loss of TAFSs. The main changes in former agroforestry landscapes are shown in Figure 3 and include: (a) land abandonment consequences that are more evident in landscapes with ancient terraces where traditional small-scale land uses are fading; (b) natural vegetation recovery that rapidly invades agricultural landscapes in steep slopes, homogenizing mountain mosaics; (c) overgrazing in Mediterranean islands that leads to non-reversible desertification; (d) improved breeds of beef cattle that replace small-bodied local breeds of grazers, resulting in similar effects in mountain areas; (e) absence of solitary trees and hedges in mass-scale agriculture in lowlands, where their preservation is still considered an obstacle to agriculture mechanization; (f) modern big machinery that is seriously exposing homogenized agricultural land to the consequences of climate change; (g) increase in flammable material due to land abandonment of agroforestry landscapes, especially in pine forests intersected with ancient olive groves, that lead to their destruction (however, if their understory is grazed they can serve as barriers to wildfires); and (h) abandonment of resin collection and grazing of flammable pastoral pine woodlands that make them fire-resistant, because they are not economically viable anymore.

Agroforestry systems and landscapes are abandoned due to the cessation of crop farming, grazing, and systematic tree management, especially of cultivated trees and their understory vegetation, a trend expected to seriously impact biodiversity conservation in Europe. After abandonment, the regeneration of dense "blanket" woody vegetation most of the time results in degradation of local biodiversity that, especially in Mediterranean landscapes, thrives in landscape mosaics. Habitats characterized by low open scrub and grassland, which play a significant role in supporting biodiversity, account for approximately 17.5% of the total cultural formations present within the Greek Natura 2000 network [74]. Abandonment has reduced bird biodiversity, either Species of European Conservation Concern (SPEC) or common farmland species, also within protected areas. Interpreting transformations within cultural landscapes can be intricate at times; the extended period of abandonment has provided an advantage to numerous biodiversity elements resembling a "forest", yet the diverse blend of biological and cultural aspects in many landscapes has frequently experienced irreversible deterioration as a result of the swift and extensive phenomenon of rural abandonment prevalent across a large portion of the Mediterranean region.

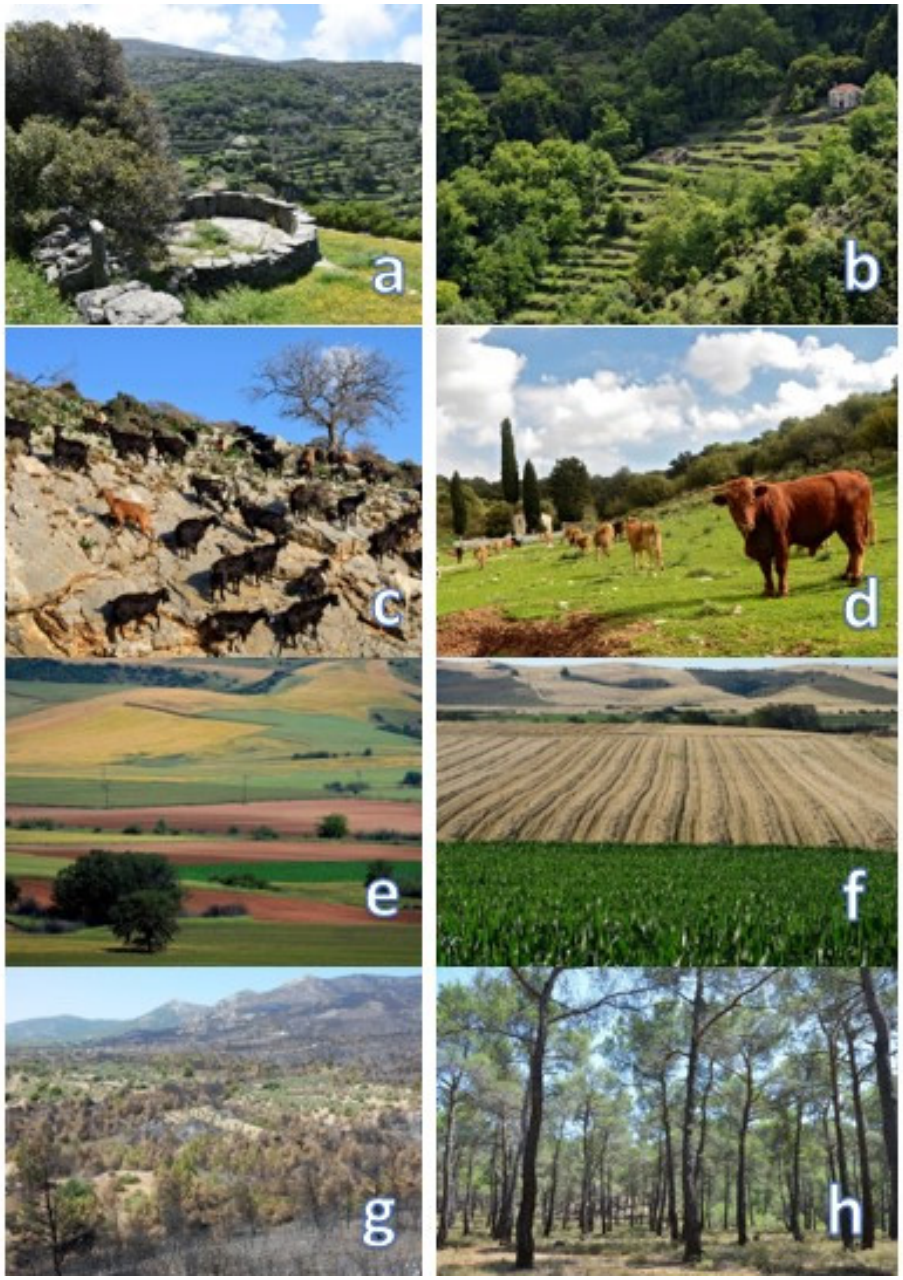

Figure 3. Main changes in former agroforestry landscapes. Photographs: G. Roussopoulos (**b**–**g**), K. Stara (**a**,**h**).

Intensification includes: (a) urbanization expressed mainly by expansion of settlements and appearance of new buildings dispersed across the countryside (e.g., for tourism) in the absence of coherent spatial planning, (b) installation of new land uses on agricultural land mainly through the establishment of renewable energy power plants, as well as industrial plants, quarries and transport projects, and (c) agricultural intensification. These changes are taking place even within the Natura 2000 network. Agricultural intensification includes the removal of trees and hedgerows, the cessation of extensive grazing and the conversion to monoculture, which is most often connected to excessive use of agrochemicals that lead to the loss of biodiversity (especially pollinators), ecosystem services degradation, and soil erosion. Agricultural intensification, urbanization, and road construction, along with several new infrastructure projects (especially concerning the rapid expansion of photovoltaic panels), contribute to the fragmentation of silvopastoral habitats that have not

been heavily used up to now. Two typical examples of agricultural intensification and their impacts include:

(a) Overgrazing after the absence of regeneration and the aging of woodlands, which is a significant issue in silvopastoral systems in Greece and Spain, as pointed out by Plieninger et al. (2023) [75]. It remains unclear whether this problem is specific to long-standing, century-old wood-pastures or if it has arisen only in recent decades due to overgrazing. The scarcity of seedlings and young trees is primarily observed in silvopastoral systems where sheep and goats graze. Overgrazing also diminishes the area of herbaceous vegetation beneath the bushes, which otherwise could provide shelter for shade-dependent tree seedlings. In addition, shifts to more "productive" and less demanding animals, in terms of labor, such as from sheep and goats to large beef cattle in Greece, has recently been of great concern, particularly about soil erosion in regions with fragile soils and steep slopes.

(b) Replacement of traditional, old olive groves with intensive irrigated cultivars. The elimination of ancient olive groves is a prominent characteristic of the cultural landscapes found in Mediterranean regions. These groves often serve multiple purposes such as grazing, and contain a diverse array of plant species, particularly orchids and other bulbous plants. However, over the past twenty years, there has been a significant increase in the removal of these historic groves, making way for high-yielding olive plantations.

To sum up, the two contrasting but simultaneous trends of intensification and abandonment in the management of agroforestry ecosystems similarly impact habitats of endangered agricultural species, especially birds, and TAF landscapes (Table 1).

Table 1. Ways, drivers, and results of intensification in land uses and land abandonment in agroforestry systems.

Ways and drivers of land use intensification in agroforestry systems	Ways and drivers of land abandonment in agroforestry systems
• Land re-arrangement • Increased area of monoculture • Replacement of native trees • High stocking levels (heads per hectare) • Non-periodic crop rotation • Increase of mechanization—CO_2 emissions • Cessation of periodic grazing • Removal of old growth trees and hedges • Use of modified seeds and varieties • Use of non-local/improved breeds of farm animals • Drainage of small wetlands • Land concentration • Reforestation/exotic tree species plantations • Demolition of agro-infrastructure (e.g., barns)	• General cessation of farming activities • Cessation of (periodic) extensive grazing • Infrastructure development (e.g., highways, renewable energy power plans) • Land use change—urbanization • No product competitiveness and global economy • No economic incentives • Absence of climate change adaptation policy • Absence of spatial planning • Collapse of traditional agro-infrastructure (e.g., terraces etc.) • Reforestation • Cessation of tree management • Plant diseases (e.g., chestnut blight)
Results of land use intensification	**Results of land abandonment**
• Decrease of land mosaic and spatial diversity • High water and irrigation demand • Landscapes non-resilient to climate change • Increased presence of pests • Increased use of pesticides and agrochemicals • Decrease of biodiversity • Soil degradation, erosion, nutrient losses • Alien trees/species invasion • Rural exodus—social inequality • Gradual financialization—savage competition	• Landscape homogenization, absence of ecotones • Forest and scrub encroachment • Increase of wild and/or mega-fires • Decrease of biodiversity (genetics, species, etc.) • Loss of local varieties of crops and animals • Soil fertility degradation • Habitat fragmentation • Loss of traditional ecological knowledge • Loss of cultural heritage • Rural abandonment

A prominent factor for the shaping of the current status of agroforestry in the European Union is the Common Agricultural Policy (CAP) and, in particular, the separation between agriculture and forestry. What constitutes a "forest" and what constitutes "agricultural land" determines the eligibility of the land to be supported by the CAP. There is no mutual agreement on the relationship between forestry and agricultural production between scientists and practitioners that work on forests in Central and Northern Europe and in the Mediterranean and their colleagues working on agricultural production and development. The issue of livestock grazing in forests is at the center of these differences in Southern Europe, in relation to the need to determine which plant species should be considered as "forest" and which as "agricultural" species (and therefore can be grazed by livestock or not). All these disagreements cause problems for agroforestry practices, for which such differences between forest and agriculture do not exist [76]. The separation between forestry and agriculture and the subsequent ignorance of agroforestry as a practice combining the two is evident in the existence of two separate policies: (a) the forest policy, which is a responsibility of the member states and, in some cases, part of environmental policies, and (b) the agricultural policies that are shaped by the CAP. Besides this conceptual ambiguity, due to which agroforestry cannot easily be identified as a separate land use combining farming with forestry, the spatial and functional separation between agriculture and forestry is further hindered by the intensification of agriculture and the cessation or decrease in practices combining agriculture with livestock management.

4. Discussion

Abandonment of traditional land uses in the Mediterranean Basin over the last 50 years, coupled with rural exodus, boosted the expansion of built-up land use for housing, infrastructure, industry, and tourism. In addition, due to agricultural intensification in the most accessible areas, the quality and resilience of farmland and forest landscapes often degrade. A homogenization of landscapes has been observed, where modern intensive farming replaces traditional forms; an example being the spread of irrigated olive plantation monocultures in Southern Spain, Crete, and the Peloponnese were these systems cover a great percentage of the rural landscapes [77]. TAFSs, which play a significant role in the formation of Mediterranean cultural landscapes, frequently undergo transformations leading to the erosion of their initial authenticity. Abandonment is followed by natural vegetation succession, finally transforming them into dense scrubland and, eventually, forest. Based on climate models, it is observed that these landscapes exhibit a significant susceptibility to large-scale forest fires, particularly in xerothermic conditions. The exceptional biodiversity supported by TAFSs is exposed, therefore, to several threats and policy inadequacies emerging from the paradox of abandonment or intensification of their use.

From the data provided by the European Commission (2016), it is estimated that over 35% of threatened habitats are maintained by agroforestry practices [69]; the most striking examples are the habitats of oak wood-pastures (code G1.7b). Moreover, BirdLife International categorizes the "Mediterranean forest scrubland and rocky habitats" as well as the "Agriculture and grassland" broad habitat categories that dominate the European continent, as key for the conservation of birds if maintained via traditional non-intensive agroforestry practices, as they contain the largest percentage of threatened bird species in Europe (100 and 173 priority species, respectively) [21].

Intensification of agricultural activity in TAFSs was particularly evident in cases when the demand for large agriculture space of high productivity was favored by major policy instruments of the previous EU CAP programs. Agroforestry systems and practices have historically been neglected by policies pertaining to agricultural and rural development. Without neglecting the impact of private interest that controls agricultural market forces, these policies were detrimental for TAFSs. Extensive conversions of agroforestry by removal of trees (i.e., its identity element) to pure and intensive monocultures resulted in large biodiversity loss.

Recently, a shift to pro-agroforestry measures emerged after a wave of research findings on the benefits acquired by agroforestry. Old systems like these possess the capacity to be effectively employed in contemporary management practices, enabling the adaptation and alteration of rural terrains. Additionally, they play a crucial role in bolstering the provision of ecosystem services within conventional agroforestry frameworks. Agroforestry is gradually gaining its place in the heart of the EU CAP in both pillars. For example, the 2023–2027 CAP clearly recognizes that the so-called "forest species" can be actively managed by means of agricultural practices and this is desirable from an environmental and ecosystem services perspective. Several provisions of the 2023–2027 CAP can be used in favor of TAFSs, provided that the member states recognize their values and are willing to act accordingly. The new EU Nature Restoration Law (NRL) includes also several provisions (see Article 11: Restoration of agricultural ecosystems) that can support the conservation and restoration of TAFSs based on adequate scientific reasoning and documentation. In that particular direction, the identification, mapping, and assessment of agroforestry systems serve as fundamental pillars for effective biodiversity management and the preservation of diverse landscape values, particularly in regions with Mediterranean-type climates characterized by traditional cultural landscapes.

In addition, according to the European Commission's publication on 14 January 2021 of Agricultural Practices that Eco-schemes could Support, Agroforestry is one of the ten high-level practices listed. Eco-schemes are key to the "green architecture" of the current CAP, and agroforestry is specifically listed in the "Farm to Fork Strategy" as a good candidate. There is a new Pillar I approach, which should "stimulate good farming practices and go beyond enhanced conditionality".

A main obstacle regarding agroforestry systems and cultural landscape conservation and restoration is the lack of a classification framework. The utilization of instruments pertaining to cultural ecosystem services (CESs) is frequently observed. Numerous cultural ecosystem benefits provided by landscapes necessitate the incorporation of the perceptual aspect of the landscape. Since the NRL was only adopted in June 2024 and a cross-sectoral review of the CAP and other EU policies is pending, a holistic agroforestry policy, which will give impetus to the necessary inter-sectoral arrangements, is needed. This could stand on the following suggestions:

(a) Mapping of agroforestry as a distinct land use. Agroforestry should be treated as a distinct land use, where mainly trees and other woody plants are grown intentionally together with grasslands to be used for domesticated and wild animals and agricultural crops. So far, in the typology of the Corine Land Cover, agroforestry systems are termed "agro-forest areas", classified as "heterogeneous agricultural areas"—a subcategory of "agricultural areas"—, and are not included the "forests and semi-natural areas" category. The term "agro-forest" is not a sufficient one because it excludes areas where domesticated animals graze. In addition, according to the 5-yearly FAO Forest Resource Assessment (2020), the EU Member States report "Forest Land", "Other Wooded Land", and "Other Land with Tree Cover". The sum of the last two categories constitutes the so-called "trees outside the forests" that include not only trees in agroforestry systems but also in urban areas and that vary across the Mediterranean countries; e.g., for Greece, this is 48.2% of the total tree cover; for Spain, 41.7%; for Portugal, 31.8%; for Italy, 32.4%; for Croatia, 25.6%; for Slovenia, 20.3%; and for Cyprus, 55.3% [78]. The definition of agroforestry, its scale, the spatial resolution of the available data, and the method of analysis all have a significant impact on estimates of the field's extent. According to Zomer et al. (2014), there were at least 10% of trees covering 48% (or 113.5 million ha) of all agricultural land in Europe [79]. On the other hand, Den Herder et al. (2017) calculated the overall agroforestry area in Europe's 27 to be 15.4 million hectares by utilizing the LUCAS database [62]. Distinct mapping is essential in order to better support new national policies and increase funding of agroforestry, whereas it will help to distinguish them from other land uses and facilitate the adoption of agroforestry by farmers and land managers, as well as to monitor future changes in terms of area extent and condition.

(b) Categorization, diversity, and cultural value. A wide range of agroforestry systems exist based on their structure and function, particularly in terms of the dominant tree types (forest or cultivated) in the canopy. These systems are present from coastal areas to the upper treeline in mountainous regions. The coexistence of these diverse systems, along with natural, geomorphological, and cultural aspects, results in the development of varied agroforestry landscapes that characterize each region. Agroforestry systems are examples of traditional ways of living and practices with a rich cultural past. They stand for management techniques that are grounded in a corpus of indigenous or local technical knowledge that has developed over time in response to shifting political, economic, and ecological conditions. They are the people's ecological, social, cultural, and financial legacy. Regarding the relationship between agroforestry and livestock husbandry, Ispikoudis et al. (2004) have emphasized the significance of transhumance, a pastoral practice that has historically been practiced in mountainous areas [80]. These areas are typified by silvopastoral systems that are based on deciduous oaks and pines, and transhumance has created unique landscapes within these areas. Even though transhumance is still being carried out, significantly fewer animals are used in the process nowadays. Hence, there is an urgent need for a classification of all agroforestry systems in each country, using a suitable typology that acknowledges and fully incorporates their bio-cultural essence. This mapping process is crucial both for implementing the International Convention on Landscape and for the potential inclusion of some systems in the FAO's World Important Agricultural Heritage Systems.

(c) Surveying biodiversity—Specific strategic objectives. Agroforestry landscapes, especially at the Mediterranean Basin, are characterized by a variety of structural features and great spatial heterogeneity, making them very important for biodiversity at a global scale. The species richness in agroforestry landscapes has not been surveyed in detail yet, but it is well-documented that these areas are of great importance for several endangered species in Europe. At the same time, the populations of many such species are rapidly declining due to threats to agroforestry landscapes, so it becomes increasingly necessary to thoroughly inventory their species richness and the threats they face, a task to be completed within this decade. This is in line with the 20% of habitats and species targeted for restoration by 2030 set by the NRL.

(d) Valorization of ecosystem services. With the exception of human labor, agroforestry systems are low-input and provide numerous ecosystem services such as provisioning (e.g., biomass for grazing, agricultural, and forest products), regulating and maintenance (e.g., habitat for wild species conservation, soil protection, nutrient cycle, flood mitigation, protection from desertification), and cultural services (e.g., local cultural identity, traditional practices, aesthetic value), which may be threatened by many landscape-scale changes. Among these, above- and below-ground carbon storage is a priority ecosystem service, contributing to the mitigation of the effects of climate change. A land parcel under agroforestry with 50–100 trees per hectare captures and stores from 1.4 to 4 tons of carbon per hectare per year. This is a score 5 to 10 times higher than a land parcel with herbaceous crops [81]. Assessment and valuation of agroforestry systems' significance in social and economic terms should also be a priority as a contribution of agroforestry's importance for the rural economy at local and national levels, and thus to become a priority of agricultural policy at the national and broader level (e.g., EU CAP).

(e) Agroforestry systems and local communities. Agroforestry is particularly important for the well-being of small- and medium-sized local communities for its contribution to climate change adaptation and mitigation. Historical data and recent research confirm the ability of agroforestry to maintain a regional circular economy and a high level of autonomy of rural communities. Co-production of a variety of products, either "modern", like non-timber forest products or "traditional", like animal husbandry or wood-based products, along with "innovative" ones, makes agroforestry systems attractive for both older residents and young farmers seeking a high quality of life by providing employment and job security in areas where isolation is no longer an issue due to the options of the

digital era. These benefits consolidate social cohesion—a challenge in our times—making agroforestry a priority of every relevant policy paper.

5. Conclusions and Priority Policy Recommendations

Agroforestry landscapes are the best examples of long-lived resilient multifunctional bio-cultural landscapes that could help to mitigate the climate change challenges worldwide, offering an economically viable and sustainable solution to rural communities that are mostly affected. The comprehensive approach to highlight their values applied in this study, with Greek agroforestry landscapes as an example of a characteristic Mediterranean sub-region (with marginal Mediterranean mountainous and island areas, where depopulation and susceptibility to wildfires are major threats), has never been presented before and could be used as a paradigm in several other areas of the world where agroforestry systems could be maintained, restored or created as a means for the implementation of "smart, nature-based", climate change adaptation solutions and policies. The revival of traditional agroforestry systems in such a modern frame are in line with at least 12 of the 17 Sustainable Development Goals (SDGs) set by the UN. Therefore, agroforestry, including both TAFSs and new systems, should be considered as a "climate-smart land use" and incorporated to the CAP Strategic Plans (where the "dual" nature of these systems as both "farmland" and "forest" should be identified and accepted by the respective agricultural and forest policies), and to the European Platform for Ecological Orientation, funded by the European Regional Development Fund (ERDF), the Cohesion Fund, the Public Investment Programs and other funding sources. Agroforestry is also fully in accordance with several new European strategies, such as the EU "Climate Change Strategy", the new EU Forest Strategy 2013–2030, the EU "Biodiversity Strategy for 2030", the "Farm to Fork Strategy" and the EU's zero land degradation commitment known as "Land Degradation Neutrality" by 2030. Funds for the implementation of conservation or research projects are or should be made available through several sources such as INTERREG, LIFE, and the Horizon Europe Program that could be implemented with priority on agroforestry landscapes. Research should focus on solutions to revive agroforestry by means of easily adaptable farming practices for both private and public land owners, as well as on subjects that have not been thoroughly covered so far including specific flora and fauna groups or species, such as rodents and other small mammals, soil and other invertebrates, as well as wildlife in specific habitats, such as terraces and stone walls separating properties with silvoarable or silvopastoral systems. At the same time, new funding opportunities under the umbrella of the EU Green Deal, as well as the "Recovery and Resilience Plan and Mechanism", and the "Just Transition Fund", could be generated in the frame of the new EU Nature Restoration Law. The latter is of ultimate importance, as, among other measures expected to be designed (in the anticipated national action plans) and implemented by mMember states in favor of biodiversity, it clearly states that measures and indices (associated with agroforestry systems and practices) on farmland butterflies and birds, organic carbon stock in inorganic soils of arable land, and agricultural land with highly diverse landscape features must be adopted. What those plans should necessarily include for agroforestry especially in Mediterranean countries is that funds for restoration should be directed to both maintaining existing agroforestry systems (TASFs) and to the creation of new ones.

Restoring agroforestry practices in the EU and worldwide could therefore provide viable solutions based on "retro-innovation", while all those ancient cultural landscapes coming to us from humanity's earliest days that are steadily degraded, could offer a resilient and productive alternative in the era of climate change mitigation policy priorities according to the UN decade of global ecosystem restoration.

Author Contributions: Conceptualization, R.T. and M.V.; methodology, M.V. and R.T.; investigation, all authors; resources, R.T. and K.S.; data curation, M.V., R.T. and K.S.; writing—original draft preparation, R.T., M.V., Y.K., K.S., P.K., I.P.K. and V.V.; writing—review and editing, all authors; writing—review coordination, K.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Acknowledgments: The authors would like to thank the European Network of Political Foundations that in cooperation with Green Institute Greece financially supported the publication *Reviving Agroforestry Landscapes in the Era of Climate Change: for People, Nature and Local Economy* (2023) that has been the base of this review.

Conflicts of Interest: Author Anastasios Dimalexis was employed by the Nature Conservation Consultants Ltd. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Quandt, A.; Neufeldt, H.; Gorman, K. Climate change adaptation through agroforestry: Opportunities and gaps. *Cur. Opin. Environ. Sustain.* **2023**, *60*, 101244. [CrossRef]
2. Kay, S.; Crous-Duran, J.; Ferreiro-Domínguez, N.; García de Jalón, S.; Graves, A.; Moreno, G.; Mosquera-Losada, M.-R.; Palma, J.H.N.; Roces-Díaz, J.V.; Santiago-Freijanes, J.J.; et al. Spatial similarities between European agroforestry systems and ecosystem services at the landscape scale. *Agrof. Syst.* **2018**, *92*, 1075–1089. [CrossRef]
3. Dou, Y.; Li, Y.; Li, M.; Chen, X.; Zhao, X. The role of agroforestry in poverty alleviation: A case study from Nujiang Prefecture, Southwestern China. *Sustainability* **2023**, *15*, 12090. [CrossRef]
4. Xiao, J.; Xiong, K. A review of agroforestry ecosystem services and its enlightenment on the ecosystem improvement of rocky desertification control. *Sci. Total Environ.* **2022**, *852*, 158538. [CrossRef]
5. Kokkora, M.; Vrahnakis, M.; Kleftoyanni, V. Soil quality characteristics of traditional agroforestry systems in Mouzaki area, central Greece. *Agrof. Syst.* **2022**, *96*, 857–871. [CrossRef]
6. Greenler, S.M.; Ebersole, J. Bird communities in tropical agroforestry ecosystems: An underappreciated conservation resource. *Agrof. Syst.* **2015**, *89*, 691–704. [CrossRef]
7. Andreychev, A.; Kuznetsov, V.; Lapshin, A. Distribution and population density of the Russian desman (*Desmana moschata* L., Talpidae, Insectivora) in the Middle Volga of Russia. *For. Stud.* **2019**, *71*, 48–68. [CrossRef]
8. Nerlich, K.; Graeff-Hönninger, S.; Claupein, W. Agroforestry in Europe: A review of the disappearance of traditional systems and development of modern agroforestry practices, with emphasis on experiences in Germany. *Agrof. Syst.* **2013**, *87*, 475–492. [CrossRef]
9. Dafis, S.; Papastergiadou, E.; Lazaridou, E.; Tsiafouli, M. *Technical Guide of Identification, Description and Mapping of Habitat Types of Greece*; Greek Biotope/Wetland Centre: Thermi, Greece, 2001. (In Greek)
10. EEA. *High Nature Value Farmland: Characteristics, Trends and Policy Challenges*; EEA Report No 1; European Environmental Agency: Copenhagen, Denmark, 2004; Available online: https://www.eea.europa.eu/publications/report_2004_1 (accessed on 29 July 2024).
11. Pinto-Correia, T.; Ribeiro, N.; Sá-Sousa, P. Introducing the *montado*, the cork and holm oak agroforestry system of Southern Portugal. *Agrof. Syst.* **2011**, *82*, 99–104. [CrossRef]
12. Udawatta, R.P.; Rankoth, L.M.; Jose, S. Agroforestry and biodiversity. *Sustainability* **2019**, *11*, 2879. [CrossRef]
13. European Commission, Directorate-General for Research and Innovation; Vallejo Calzada, V.; Faivre, N.; Cardoso Castro Rego, F.; Moreno Rodríguez, J.; Xanthopoulos, G. *Forest Fires: Sparking Firesmart Policies in the EU*; Publications Office: Luxembourg, 2018. [CrossRef]
14. Mastroianni, K.; Adser, L.S.; Loibl, S. *Agroforestry Value Chains and Market Systems*; Agroforestry Network; Vi-skogen: Stockholm, Switzerland, 2020.
15. Ollinaho, O.I.; Kröger, M. Agroforestry transitions: The good, the bad and the ugly. *J. Rural Stud.* **2021**, *82*, 210–221. [CrossRef]
16. Bruno, D.; Sorando, R.; Álvarez-Farizo, B.; Castellano, C.; Céspedes, V.; Gallardo, B.; Jiménez, J.J.; López, M.V.; López-Flores, R.; Moret-Fernández, D.; et al. Depopulation impacts on ecosystem services in Mediterranean rural areas. *Ecosyst. Serv.* **2021**, *52*, 101369. [CrossRef]
17. Mamanis, G.; Vrahnakis, M.; Chouvardas, D.; Nasiakou, S.; Kleftoyanni, V. Land use demands for the CLUE-S spatiotemporal model in an agroforestry perspective. *Land* **2021**, *10*, 1097. [CrossRef]
18. Kizos, T.; Koulouri, M. Agricultural landscape dynamics in the Mediterranean: Lesvos (Greece) case study using evidence from the last three centuries. *Environ. Sci. Policy* **2006**, *9*, 330–342. [CrossRef]
19. Tsiakiris, R.; Mantzanas, K.; Kazoglou, Y.; Kakouros, P.; Papanastasis, P. (Eds.) *Reviving Agroforestry Landscapes in the Era of Climate Change: For People, Nature and Local Economy*; EnoP—Green Institute Greece: Athens, Greece, 2023.
20. BirdLife International. *Important Bird and Biodiversity Areas: A Global Network for Conserving Nature and Benefiting People*; BirdLife International: Cambridge, UK, 2014; Available online: https://www.birdlife.org/wp-content/uploads/2021/04/SOWIBAs2014.pdf (accessed on 17 May 2024).
21. Natural Environment and Climate Change Agency (NECCA). *The Greek Red List of Threatened Species*; NECCA: Athens, Greece, 2024. Available online: https://redlist.necca.gov.gr/ (accessed on 28 July 2024).

22. EEA. European Red List of Habitats—Enhanced by EEA, May 2022/2022 Last Modified 14 February 2024. Available online: https://www.eea.europa.eu/en/datahub/datahubitem-view/de2276d8-e295-4cd7-89c9-88812065db87 (accessed on 28 July 2024).
23. Tucker, G.M.; Evans, M.I. *Habitats for Birds in Europe: A Conservation Strategy for the Wider Environment*; BirdLife International: Cambridge, UK, 1997.
24. EEA. *State of Nature in the EU: Results from Reporting under the Nature Directives 2013–2018*; EEA Report No 10; European Environmental Agency: Copenhagen, Denmark, 2020.
25. Cheke, A.; Tsiakiris, R.; Christopoulos, A.; Ashcroft, R.E. The breeding birds of a small Aegean island (Amorgos, Cyclades, Greece) with details of changes over 25 years. *Parnass. Arch.* **2020**, *8*, 5–47.
26. BirdLife International. Species Factsheet: European Roller Coracias garrulus. Available online: https://datazone.birdlife.org/species/factsheet/european-roller-coracias-garrulus (accessed on 30 July 2024).
27. Tsiakiris, R.; Stara, K.; Pantis, J.; Sgardelis, S. Microhabitat selection by three common bird species of montane farmlands in Northern Greece. *Environ. Manag.* **2009**, *44*, 874–887. [CrossRef]
28. Xofis, P.; Poirazidis, K. Combining different spatio-temporal resolution images to depict landscape dynamics and guide wildlife management. *Biol. Conserv.* **2018**, *218*, 10–17. [CrossRef]
29. Poirazidis, K.; Papageorgiou, A.C.; Kasimiadis, D. Mapping the animal biodiversity in the Dadia National Park using multi-criteria evaluation tools and GIS. In Proceedings of the 2006 Naxos International Conference on Sustainable Management and Development of Mountainous and Island Areas, Island of Naxos, Greece, 29 September–1 October 2006; Manolas, E., Ed.; Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace: Komotini, Greece, 2006; pp. 299–304.
30. Sánchez-Zapata, A.J.; Calvo, J.F. Raptor distribution in relation to landscape composition insemi-arid Mediterranean habitats. *J. Appl. Ecol.* **2001**, *25*, 143–151.
31. Voříšek, P.; Jiguet, F.; van Strien, A.; Škorpilová, J.; Klvaňová, A.; Gregory, R.D. Trends in abundance and biomass of widespread European farmland birds: How much have we lost? In Proceedings of the BOU Proceedings—Lowland Farmland Birds III: Delivering Solutions in an Uncertain World, Leicester, UK, 6–8 April 2010.
32. Zakkak, S.; Radovic, A.; Nikolov, S.C.; Shumka, S.; Kakalis, L.; Kati, V. Assessing the effect of agricultural land abandonment on bird communities in southern-eastern Europe. *J. Environ. Manag.* **2015**, *164*, 171–179. [CrossRef]
33. Avtzis, D.; Stara, K.; Sgardeli, V.; Betsis, A.; Diamandis, S.; Healey, J.; Kapsalis, E.; Kati, V.; Korakis, G.; Marini Govigli, V.; et al. Quantifying the conservation value of sacred natural sites. *Biol. Conserv.* **2018**, *222*, 95–103. [CrossRef]
34. Batáry, P.; Dicks, L.V.; Kleijn, D.; Sutherland, W.J. The role of agri-environment schemes in conservation and environmental management. *Biol. Conserv.* **2015**, *29*, 1006–1016. [CrossRef] [PubMed]
35. Stuart, S.; Chanson, J.; Cox, N.; Young, B.; Rodrigues, A.; Fischman, D.; Waller, R. Status and trends of amphibian declines and extinctions worldwide. *Science* **2004**, *306*, 783–1786. [CrossRef]
36. Pafilis, P.; Maragkou, P.; Deimezis-Tsikoutas, A.; Dimaki, M.; Ioannidis, I.; Karameta, E.; Spaneli, V.; Strachinis, I.; Toli, E.-A.; Christopoulos, A.; et al. *Atlas of Amphibians and Reptiles of Greece*; Broken Hill Publishers LTD: Nicosia, Cyprus, 2010. (In Greek)
37. Kanellopoulos, N.; Mertzanis, G.; Korakis, G.; Panagiotopoulou, M. Selective habitat use by brown bear (*Ursus arctos* L.) in northern Pindos, Greece. *J. Biol. Res.* **2006**, *5*, 23–33.
38. Chouvardas, D.; Vrahnakis, M.S.; Bousbouras, D.; Evangelou, C.; Lampou, E.; Georgiadis, L. Modelling habitat suitability of agrosilvopastoral landscapes for brown bear (*Ursus arctos*). *J. Environ. Prot. Ecol.* **2013**, *14*, 162–171.
39. Barova, S.; Streit, A. *Action Plan for the Conservation of All Bat Species in the European Union 2019–2024*; EC: Brussels, Belgium, 2018; Available online: https://iene.se/wp-content/uploads/EU-Bats-Action-Plan-Final.pdf (accessed on 18 May 2024).
40. Wickramasinghe, L.P.; Harris, S.; Jones, G.; Vaughan, N. Bat activity and species richness on organic and conventional farms: Impact of agricultural intensification. *J. Appl. Ecol.* **2003**, *40*, 984–993. [CrossRef]
41. Salvarina, I.; Georgiakakis, P. Bats in agroforestry systems. In *Reviving Agroforestry Landscapes in the Era of Climate Change: For People, Nature, and Local Economy*; Tsiakiris, R., Mantzanas, K., Kazoglou, Y., Kakouros, P., Papanastasis, V., Eds.; EnoP-Green Institute: Athens, Greece, 2023; pp. 106–113.
42. Benda, P.; Georgiakakis, P.; Dietz, C.; Hanák, V.; Galanaki, K.; Markantonatou, V.; Chudárková, A.; Hulva, P.; Horáčcek, I. Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 7. The bat fauna of Crete, Greece. *Acta Soc. Zool. Bohem.* **2009**, *72*, 105–190.
43. Bergmeier, E.; Petermann, J.; Schröder, E. Geobotanical survey of wood-pasture habitats in Europe: Diversity, threats and conservation. *Biol. Conserv.* **2010**, *19*, 2995–3014. [CrossRef]
44. Müller, J.; Bußler, H.; Bense, U.; Brustel, H.; Flechtner, G.; Fowles, A.; Kahlen, M.; Möller, G.; Mühle, H.; Schmidl, J.; et al. Urwald relict species. Saproxylic beetles indicating structural qualities and habitat tradition = Urwaldrelikt-arten-xylobionte käfer als Indikatoren für strukturqualität und habitattradition. *Wald. Online* **2005**, *2*, 106–113.
45. Desender, K.; Ervynck, A.; Tack, G. Beetle diversity and historical ecology of woodlands in Flanders. *Belg. J. Zool.* **1999**, *129*, 139–156.
46. Nakládal, O.; Zumr, V.; Remeš, J.; Macháčová, M.; Pešková, V. Heritage Trees as an Important Sanctuary for Saproxylic Beetles in the Central European Landscape: A Case Study from Litovelské Pomoraví, Czech Republic. *Forests* **2022**, *13*, 1128. [CrossRef]

47. Villemey, A.; van Halder, I.; Ouin, A.; Barbaro, L.; Chenot, J.; Tessier, P.; Calatayud, F.; Martin, H.; Roche, P.; Archaux, F. Mosaic of grasslands and woodlands is more effective than habitat connectivity to conserve butterflies in French farmland. *Biol. Conserv.* **2015**, *191*, 206–215. [CrossRef]
48. Ernst, L.M.; Tscharntke, T.; Batáry, P. Grassland management in agricultural vs. forested landscapes drives butterfly and bird diversity. *Biol. Conserv.* **2017**, *216*, 51–59. [CrossRef]
49. Sunde, J.; Askling, J.; Kindvall, O.; Johansson, V.; Franzén, M. Negative impacts of future forest succession on three threatened butterfly species. *Biodivers. Conserv.* **2024**, *33*, 2885–2910. [CrossRef]
50. Ellis, S.; Bourn, N.A.D.; Bulman, C.R. *Landscape-Scale Conservation for Butterflies and Moths: Lessons from the UK*; Butterfly Conservation: Wareham, Dorset, 2012.
51. Nakonieczny, M.; Kędziorski, A.; Michalczyk, K. Apollo butterfly (*Parnassius apollo* L.) in Europe: Its history, decline and perspectives of conservation. *Funct. Ecosyst. Communities Glob. Sci. Books Takamatsu* **2007**, *1*, 56–79.
52. Potts, S.G.; Petanidou, T.; Roberts, S.; O'Toole, C.; Hulbert, A.; Willmer, P. Plant-pollinator biodiversity and pollination services in a complex Mediterranean landscape. *Biol. Conserv.* **2006**, *129*, 519–529. [CrossRef]
53. Nielsen, A.; Steffan-Dewenter, I.; Westphal, C.; Messinger, O.; Potts, S.G.; Roberts, S.P.M.; Settele, J.; Szentgyörgyi, H.; Vaissière, B.E.; Vaitis, M.; et al. Assessing bee species richness in two Mediterranean communities: Importance of habitat type and sampling techniques. *Ecol. Res.* **2011**, *26*, 969–983. [CrossRef]
54. Petanidou, T. 2023 Agroforestry systems and pollinators. In *Reviving Agroforestry Landscapes in the Era of Climate Change: For People, Nature, and Local Economy*; Tsiakiris, R., Mantzanas, K., Kazoglou, Y., Kakouros, P., Papanastasis, V., Eds.; EnoP—Green Institute: Athens, Greece, 2023; pp. 120–127.
55. Norfolk, O.; Eichhorn, M.P.; Gilbert, F. Flowering ground vegetation benefits wild pollinators and fruit set of almond within arid smallholder orchards. *Insect Conserv. Divers.* **2016**, *9*, 236–243. [CrossRef]
56. Dafni, A.; Marom-Levy, T.; Jürgens, A.; Dötterl, S.; Shimrat, Y.; Dorchin, A.; Kirkpatrick, H.E.; Witt, T. Ambophily and "super generalism" in *Ceratonia siliqua* (Fabaceae) pollination. In *Evolution of Plant-Pollinator Relationships*; Patiny, S., Ed.; Systematics Association Special Volume Series; Cambridge University Press: Cambridge, UK, 2012; pp. 344–373.
57. Mola, M.; Kougias, P.G.; Statiris, E.; Papadopoulou, P.; Malamis, S.; Monokrousos, N. Short-term effect of reclaimed water irrigation on soil health, plant growth and the composition of soil microbial communities. *Sci. Total Environ.* **2024**, *949*, 175107. [CrossRef]
58. Marsden, C.; Martin-Chave, A.; Cortet, J.; Hedde, M.; Capowiez, Y. How agroforestry systems influence soil fauna and their functions—A review. *Plant Soil* **2020**, *453*, 29–44. [CrossRef]
59. Barrios, E.; Sileshi, G.W.; Shepherd, K.; Sinclair, F. Agroforestry and soil health: Linking trees, soil biota, and ecosystem services. In *Soil Ecology and Ecosystem Services*; Wall, D.H., Bardgett, R.D., Behan-Pelletier, V., Herrick, J.E., Hefin Jones, T., Ritz, K., Six, J., Strong, D.R., van der Putten, W.H., Eds.; Oxford University Press: Oxford, UK, 2012; pp. 315–330.
60. Rackham, O.; Moody, J. *The Making of the Cretan Landscape*; Manchester University Press: Manchester, UK, 1996.
61. Dimopoulos, P.; Raus, T.; Bergmeier, E.; Constantinidis, T.; Iatrou, G.; Kokkini, S.; Strid, A.; Tzanoudakis, D. *Vascular Plants of Greece. An Annotated Checklist*; Botanic Garden and Botanical Museum Berlin-Dahlem & Hellenic Botanical Society: Berlin, Germany; Athens, Greece, 2013.
62. Den Herder, M.; Moreno, G.; Mosquera-Losada, R.M.; Palma, J.H.N.; Sidiropoulou, A.; Santiago Freijanes, J.J.; Crous-Duran, J.; Paulo, J.A.; Tomé, M.; Pantera, A.; et al. Current extent and stratification of agroforestry in the European Union. *Agric. Ecosyst. Environ.* **2017**, *241*, 121–132. [CrossRef]
63. Papanastasis, V.P.; Mantzanas, K.; Dini-Papanastasi, O.; Ispikoudis, I. Traditional agroforestry systems and their evolution in Greece. In *Agroforestry in Europe: Current Status and Future Prospects*; Rigueiro-Rodríguez, A., McAdam, J., Mosquera-Losada, M.R., Eds.; Springer Science + Business Media B.V.: Dordrecht, Germany, 2009; Volume 6, pp. 89–109.
64. Caballero, R.; Fernández-González, F.; Pérez Badia, R.; Molle, G.; Roggero, P.P.; Bagella, S.; D'Ottavio, P.; Papanastasis, V.P.; Fotiadis, G.; Sidiropoulou, A.; et al. Grazing systems and biodiversity in Mediterranean areas: Spain, Italy and Greece. *Pastos* **2009**, *39*, 9–154.
65. Konter, O.; Krusic, P.J.; Trouet, V.; Esper, J. Meet Adonis, Europe's oldest dendrochronologically dated tree. *Dendrochronologia* **2017**, *42*, 12. [CrossRef]
66. Christopoulou, A.; Fulé, Z.P.; Andriopoulos, P.Z.; Sarris, D.; Arianoutsou, M. 2013 Dendrochronology-based fire history of *Pinus nigra* forests in Mount Taygetos, Southern Greece. *For. Ecol. Manag.* **2013**, *293*, 132–139. [CrossRef]
67. Touchan, R.; Baisan, C.; Mitsopoulos, I.D.; Dimitrakopoulos, A.P. Fire history in European black pine (*Pinus nigra* Arn.) Forests of the Valia Kalda, Pindus Mountains, Greece. *Tree-Ring Res.* **2012**, *68*, 45–50. [CrossRef]
68. Rigueiro-Rodríguez, A.; McAdam, J.; Mosquera-Losada, M.R. (Eds.) *Agroforestry in Europe: Current Status and Future Prospects*; Springer Science + Business Media B.V.: Dordrecht, Germany, 2009; Volume 6.
69. European Commission: Directorate-General for Environment; Tsiripidis, I.; Piernik, A.; Janssen, J.; Tahvanainen, T.; Molina, J.; Giusso del Galdo, G.; Gardfjell, H.; Dimopoulos, P.; Šumberová, K.; et al. *European Red List of Habitats. Part 2, Terrestrial and Freshwater Habitats*; Publications Office: Luxembourg, 2016.
70. Halstead, P. Ask the fellows who lop the hay: Leaf-fodder in the mountains of Northwest Greece. *Rural Hist.* **1998**, *9*, 211–234. [CrossRef]

71. Stara, K.; Tsiakiris, R.; Wong, J.L.G. The trees of the sacred natural sites of Zagori, NW Greece. *Landsc. Res.* **2015**, *40*, 884–904. [CrossRef]
72. Vrahnakis, M.S.; Fotiadis, G.; Pantera, A.; Goudelis, G.; Papadopoulos, A.; Papanastasis, V.P. Floristic diversity of valonia oak silvopastoral woodlands in Greece. *Agrofor. Syst.* **2014**, *88*, 877–893. [CrossRef]
73. Petanidou, T. *Terraces of the Aegean Sea. The Example of the Dodecanese*; Parisianou Scientific Publications: Athens, Greece, 2015. (In Greek)
74. Vlami, V.; Kokkoris, I.P.; Zogaris, S.; Cartalis, C.; Kehayias, G.; Dimopoulos, P. Cultural landscapes and attributes of "culturalness" in protected areas: An exploratory assessment in Greece. *Sci. Total Environ.* **2017**, *595*, 229–243. [CrossRef]
75. Plieninger, T.; Abunnasr, Y.; D'Ambrosio, U.; Guo, T.; Kizos, T.; Kmoch, L.; Topp, E.; Varela, E. Biocultural conservation systems in the Mediterranean region: The role of values, rules, and knowledge. *Sustain. Sci.* **2023**, *18*, 823–838. [CrossRef]
76. Pantera, A.; Burgess, P.J.; Mosquera Losada, R.; Moreno, G.; Lopez-Dıaz, M.L.; Corroyer, N.; McAdam, J.; Rosati, A.; Papadopoulos, A.M.; Graves, A.; et al. Agroforestry for high value tree systems in Europe. *Agrofor. Syst.* **2018**, *92*, 945–959. [CrossRef]
77. Vlami, V.; Kokkoris, I.P.; Charalampopoulos, I.; Doxiadis, T.; Giannakopoulos, C.; Lazoglou, M. A transect method for promoting landscape conservation in the climate change context: A Case study in Greece. *Sustainability* **2023**, *15*, 13266. [CrossRef]
78. FAO. *Global Forest Resources Assessment 2020*; Main Report; FAO: Rome, Italy, 2020.
79. Zomer, R.J.; Trabucco, A.; Coe, R.; Place, F.; van Noordwijk, M.; Xu, J.C. Trees on farms: An update and reanalysis of agroforestry's global extent and socio-ecological characteristics. In *Working Paper 179*; World Agroforestry Centre (ICRAF) Southeast Asia Regional Program: Bogor, Indonesia, 2014.
80. Ispikoudis, I.; Sioliou, M.K.; Papanastasis, V.P. *Transhumance in GREECE: Past, Present and Future Prospects*; Bunce, R.G.H., Pérez-Soba, M., Jongman, R.H.G., Gómez Sal, A., Herzog, F., Austad, I., Eds.; Transhumance and Biodiversity in European Mountains; ALTERA: Wageningen, The Netherlands, 2004; pp. 211–229.
81. Dupraz, C.; Liagre, F. Agroforesterie. In *Des Arbres et des Cultures*; Editions France Agricole: Paris, France, 2008.