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Research Article

The Origin of the 'Wild Orchards' of Central Anatolia

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Abstract : Palynological investigations have revealed that the deforestation of Central Anatolia started c. 4000 BP. At present, most of the land is cultivated and only small patches of woodland occur in remote mountain areas. These woodlands are dominated by deciduous oaks (*Quercus* L. spp.) or locally by junipers (*Juniperus* L. spp.). A pattern of scattered fruit trees, the so-called 'wild orchards', characterizes the cultivated fields. Another type of arboreal vegetation is found on isolated rock outcrops in the fields.

Surveys of the vegetation types show that oaks are uncommon among the fields and on the rock outcrops. By contrast, wild fruit trees are virtually absent in the oak woodlands. The results of this investigation contrast with the opinion that the present 'wild orchard' stands are the remnants of former oak woodland or forest. Moreover, archaeobotanical records demonstrate that certain wild fruit trees (e.g., *Celtis tournefortii* Lam. and *Amygdalus* L. spp.) were present before the maximum expansion of oak woodland, c. 8000 BP.

Key Words: Anatolia, orchard, fruit tree, oak woodland

Orta Anadolu'da 'Yabani Meyva Bahçeleri'nin Kökeni

Özet : Palinolojik araştırmalar Orta Anadolu'da orman tahribinin günümüzden yaklaşık 4000 yıl önce başladığına işaret etmektedir. Günümüzde arazinin çoğu tarıma ayrıldığından doğal koruluklar sadece uzak dağlık bölgelerde küçük alanlar halinde kalmıştır. Bu korularda rastlanan başlıca ağaç türleri herdem yeşil meşeler (*Quercus* L. türleri) ya da belirli alanlarda rastlanan ardıç (*Juniperus* L. türleri) ağaçlarıdır. Yabani meyva ağaçları, ya da 'yabani meyva bahçeleri' tarlalar arasında dağınık olarak yer alır. Bir diğer tür ağaçsı vejetasyon ise ekime uygun olmayan kayalık alanlarda görülür.

Vejetasyon envanterleri, ovalardaki tarım alanlarında ya da kayalık arazilerde meşelere ender olarak rastlandığına işaret eder. Buna karşın yabani meyva ağaçları da meşe korularında hiç görülmez. Bu araştırmanın bulguları günümüzdeki 'yabani meyva bahçeleri'nin geçmiş dönemlere ait meşe ormanlarının kalıntıları olduğu yönündeki görüşle çelişmektedir. Arkeobotanik bulgular da belirli yabani meyva ağaçlarının (örneğin *Celtis tournefortii* Lam./'Çitlembik-Çıtlambık', *Amygdalus* L. türleri/'Badem') günümüzden yaklaşık 8000 yıl önce, yani henüz meşe ormanlarının yayılımı en üst sınırına ulaşmadan önce varolduğunu belgelemektedir.

Anahtar Sözcükler: Anadolu, meyva bahçesi, meyva ağacı, meşe korusu

Introduction

This paper discusses the origin of the so-called 'wild orchards', a widespread feature of the Anatolian plateau. The area of study encompasses the provinces of Aksaray, Nevşehir and Niğde and the northern borderlands, commonly known as Cappadocia. This volcanic area, together with the Konya Plain, the Tuz Gölü area and the area north of the Kızılırmak, is part of what is usually referred to as Central Anatolia (Figures 1 and 2). Although this is one of the most arid regions of Turkey, its mean annual rainfall of 400 mm is still sufficient for tree growth.

As a result of overgrazing, secondary *Artemisia* L. steppe characterizes the vegetation in most places and only in some mountainous areas can oak woodlands be found. There is evidence that such woodlands were more extensive in the past. A pollen diagram from a drained crater lake near the town of Acıgöl, northwestern Cappadocia, documents maximum oak expansion around 4000 BP, followed by its dramatic and almost complete, man-induced destruction (Woldring & Bottema, *pers. comm.*). Nowadays, most of Cappadocia is under cultivation or is used as pasture.

Apart from stands of oak woodland, a range of mostly wild fruit trees is found in the arable fields. Their distribution is marked by large intervals and irregular scatters, which is probably associated with edaphic conditions and selection by man. These wild fruit trees

are kept for the fruits and serve as shady resting-places in the hot summers of Central Anatolia. In addition, they are used as rootstock for cultivated fruit varieties, e.g., domestic pear varieties are grafted upon *Pyrus elaeagnifolia* Pallas, or *P. amygdaliformis* Vill.

Apart from these scattered trees and shrubs in the fields, remnants of woody vegetation are found on isolated rock outcrops, often located amidst farmed fields or grazed land. The arboreal vegetation on these outcrops is chiefly composed of wild fruit trees and shrubs, although with a somewhat different composition compared to the trees in the fields. Most trees have rooted in the deep crevices between the rocks, which prevents destruction by man. Their poor accessibility also hinders browsing by herbivores.

The vegetation of a number of these outcrop localities has been recorded during field studies in 1997 and 1998. The aim of this study is to discuss the origin of the wild orchards in relation to the woodlands, the vegetation of the outcrops and the scattered trees in the arable fields.

The Origin of the Outcrop Vegetation

The solitary wild fruit trees, which characterize much of the Anatolian landscape, are considered by Zohary (1973), and Mayer & Aksoy (1986) to be remnants of the woodlands that occupied most of inner Anatolia before the interference of man. In this view, population growth and the subsequent need for firewood and timber, as well as the increasing need for cultivated land, reduced the woodlands to their present state, leaving only isolated trees within the fields. This picture, however, is contradicted by the species composition of oak woodlands and outcrop stands.

As can be gathered from Table 1, the oak woodlands are overwhelmingly dominated by oak and are

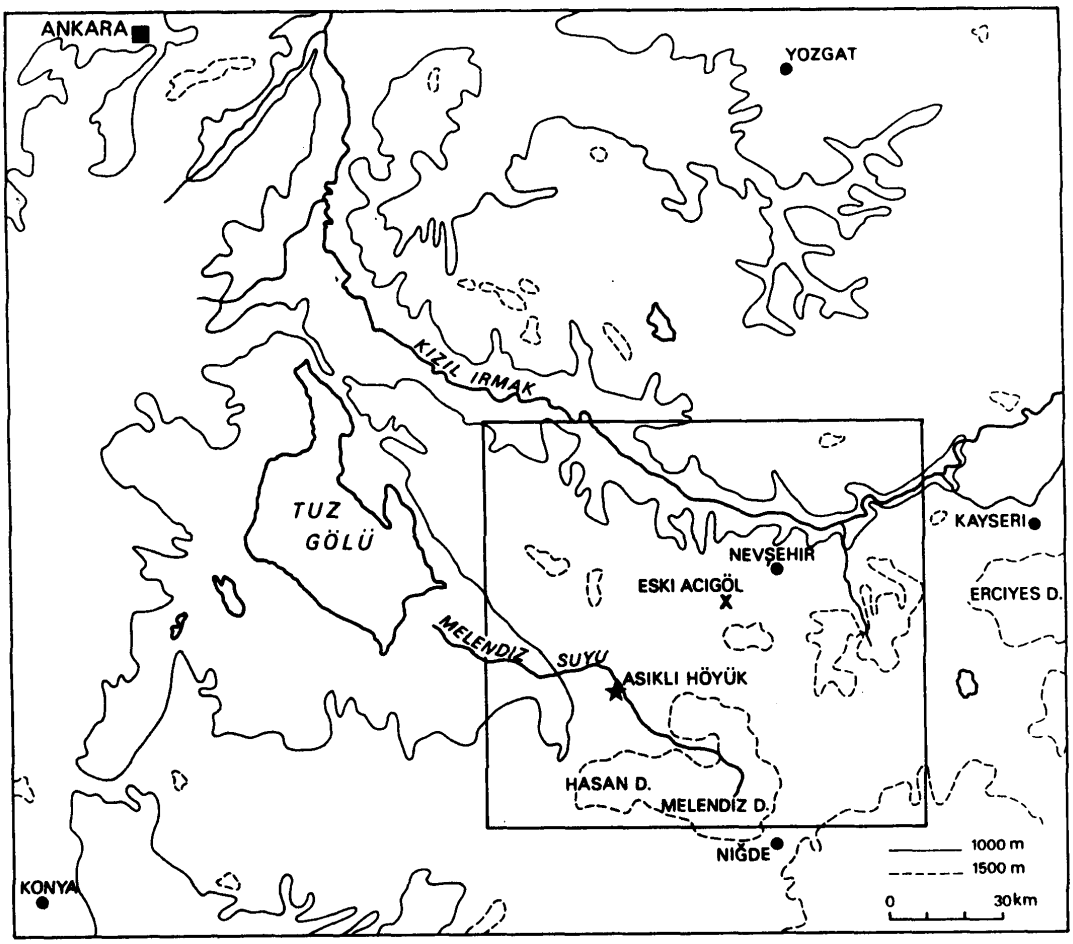

Figure 1. Map of central Anatolia. Inlay area, see figure 2.

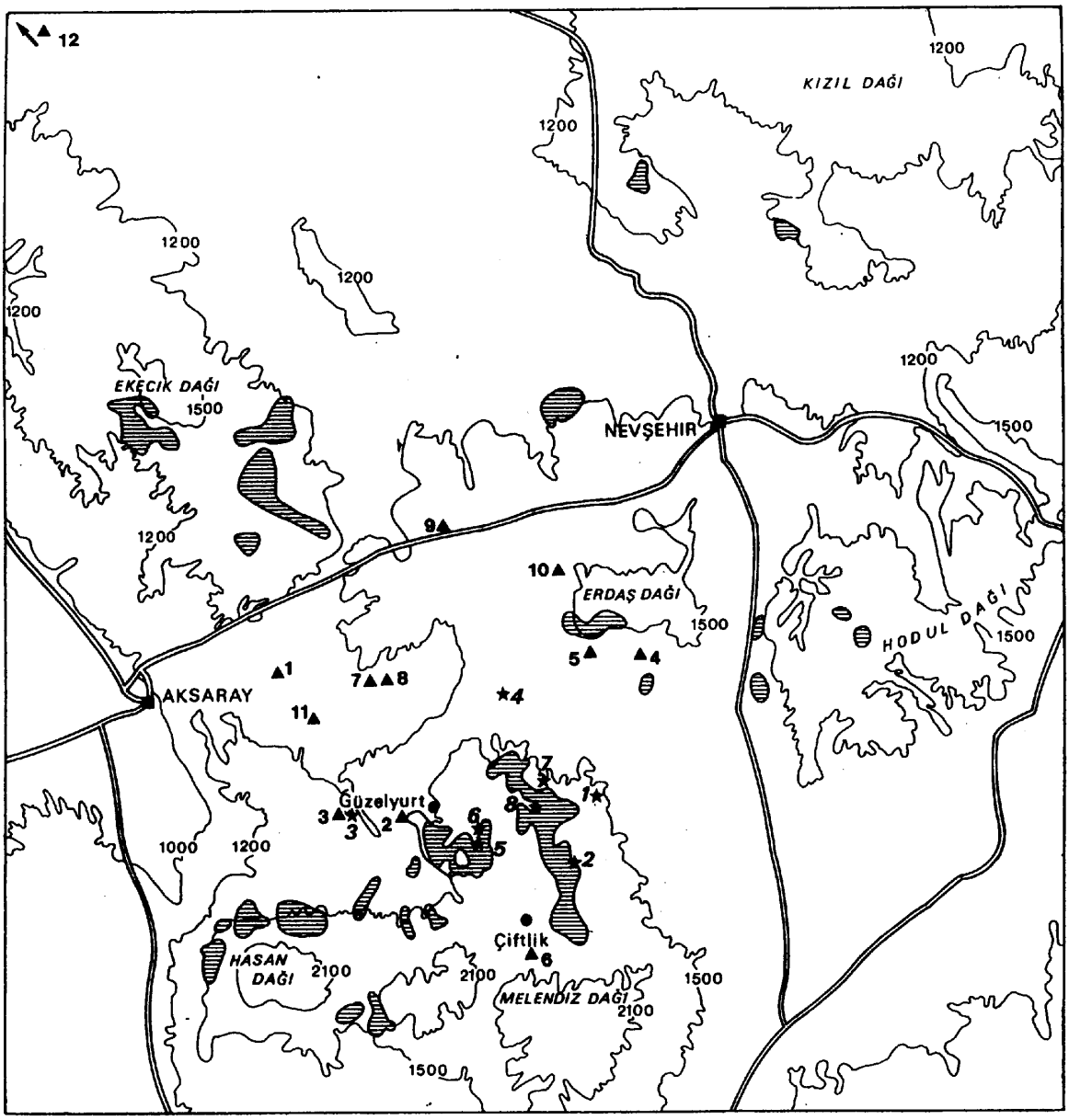

Figure 2. Legend: black star: locations of oak woodland recorded in Table 1; black triangle: location of rock outcrop recorded in Table 2; hatched: distribution of oak woodland.

remarkably poor in other woody species. The outcrops, on the other hand, are characterized by a different composition of tree species, including, among others, members of the rose family (Table 2).

The origin of the wild fruit trees will be discussed in more detail with reference to three different aspects: the clustering of wild fruit trees on the rock outcrops, the general absence of oak trees on the rock outcrops, and the general absence of fruit-bearing species within the oak woodlands.

The clustering of wild fruit trees on the rock outcrops

The specific composition of the outcrop vegetation may either be the result of reduced exploitation and browsing because of limited accessibility, or represent an ecologically unique habitat with special woody vegetation. The latter possibility seems to be the more likely, as characteristic outcrop species, such as *Prunus ursina* Kotschy (=*P. divaricata* Ledeb. ssp. *ursina* (Kotschy) Browicz) and *Celtis tournefortii* Lam. (Figure 3), rarely

Table 1. Inventory of oak woodlands. The locations are indicated on the map of Figure 2 with*.

1. Cömürçü, coordinates 38°16.69'N, 34°33.71'E; alt. c. 1500 m
Extensive, rather dense *Quercus pubescens* brush

2. Gölcük-Güzelyurt road and further west, coordinates 38°14.89'N, 34°35.04'E; alt. 1500/1600 m
Monotonous *Quercus pubescens* brush, occasionally *Colutea* L., *Berberis crataegina* DC, red-fruited *Crataegus*(*C. monogyna* Jacq.?) on the fringes of or slightly within the rather open oak woodland. Solitary *Pyrus elaeagnifolia* and *Crataegus* sp. predominate in the adjacent fields.

3. Forest near Kitreli, coordinates 38°16.68'N, 34°16.02'E; alt. 1400 m
Quercus ithaburensis ssp. *macrolepis* forest, some *Crataegus* shrubs with small red fruits on the fringes and in open locations. Beyond the forest, various wild and cultivated fruit trees.

4. Nenezi Dağı, coordinates 38°23.21'N, 34°26.97'E; alt. c. 1200 m
Monotonous open *Quercus pubescens* scrub, 2 to 3 m tall. At the field/woodland transition *Rhamnus oleoides, Pyrus elaeagnifolia* and *Amygdalus orientalis* Miller. The occurrence of *Phlomis* L., *Eryngium* L., *Verbascum* L., *Euphorbia* L. and *Centaurea* L. points to serious grazing.

5. South slope of Küçük Göllüdağ, coordinates 38°13.88'N, 34°31.64'E; alt. 1600 m
Quercus pubescens, at higher elevation increasing numbers of *Quercus ithaburensis* ssp. *macrolepis* and *Juniperus oxycedrus.* Vegetation cover near top 30-50%. At top almost closed forest, including *Quercus infectoria* Olivier. *Rhamnus* L. rare, no other fruit trees.

6. Sivrihisar to Çiftlik road, coordinates 38°14.48'N, 34°25.61'E; alt 1500 m
Quercus pubescens/ithaburensis forest, cover 40-60%. *Pyrus elaeagnifolia* and *Prunus cerasus* L. near the road. Within woodland, occasional *Crataegus* and *Cotoneaster nummularia* Fisch. et Mey.

7. Kayırlı-Bozköy road, coordinates 38°17.14'N, 34°30.18'E; alt. 1500 m
Volcanic soils. Very open *Quercus pubescens* scrub. Locally denser oak vegetation. Also *Juniperus oxycedrus* and occasional *Berberis crataegina.* In the arable fields *Pyrus elaeagnifolia, Crataegus* and *Rosa* L.

8. Kayırlı-Bozköy road, coordinates 38°16.79'N, 34°30.27'E; alt. 1500-1700 m
Volcanic soils. Trees and shrubs of *Quercus pubescens,* occasional *Quercus ithaburensis* ssp. *macrolepis,* 6-8 m tall. Some tall *Juniperus excelsa; J. oxycedrus* rare. In the arable fields: *Pyrus elaeagnifolia, Rosa, Cotoneaster nummularia,* and *Crataegus aronia.* Further south, towards Bozköy, increasing numbers of *Juniperus excelsa,* dense near gullies.

occur as solitary shrubs or trees in the arable fields and are even completely absent in the 'closed' oak woodlands. By contrast, *Crataegus aronia* (L.) Bosc. ex DC.) occurs frequently in the fields, but was encountered on the outcrops only once.

This suggests that the rock formation can be regarded as a special habitat for a number of wild fruit tree species. Accumulation of organic material and surface runoff from the rocks into the deep, shady crevices provides a comparatively high moisture content, which could compensate for the water loss by evaporation during the hot summer period. Most if not all of the trees and shrubs in these locations are light-demanding species. Thanks to the wide spacing caused by the boulders, often measuring several meters across, each tree or shrub receives sufficient light.

The absence of oaks on the rock outcrops

The virtual absence of oaks on the rock formations indicates that this kind of habitat is either unsuitable for oak growth, or that oaks at such sites are granted only a short life, which could be caused by browsing animals or exploitation by man.

Oak wood is in demand for timber and firewood. According to Ertuğ-Yaraş (*pers. comm.*), wood from the poplar (*Populus* L.) and willow (*Salix* L.), together with animal dung, nowadays are the basic fuels in Central Anatolia. Ertuğ-Yaras also mentions that oak wood was preferred as a fuel before it became scarce. These factors would in part explain the reduction of the woodlands to their present extent, including the absence of oaks in the fields.

The outcrops are often the only locations with scattered tree growth in areas otherwise completely devoid of woody vegetation. This is especially obvious where they are situated amidst large stretches of arable land, e.g., on the Aksaray-Nevşehir road. The nature of the outcrops prevented the total conversion of the area into arable land. In spite of their use, such as for firewood, various woody species were able to maintain themselves on the outcrops. Apparently these species are

Table 2. Inventory of the rock outcrops indicated on the map of Figure 2 with ▲.

	1. Güvercinkayası	2. Güzelyurt	3. Kitreli	4. Küyüklıtatlar	5. Soğatlar	6. Çiftlik	7. Demirci[1]	8. Demirci[2]	9. Acıgöl town	10. Eski Acıgöl	11. Kutluaya	12. Köprüköy
Berberis crataegina DC	+	.	.	.	.	.	+	.	.	.	+	.
Amygdalus orientalis Miller	.	+	+	+	+	.	.	+	.	.	+	.
Cotoneaster nummularia Fisch. et Mey.	.	.	.	.	.	+	.	.	+	+	.	.
Crataegus L.	+	+	+	.	+	+	+	.	+	.	.	.
Crataegus aronia (L.) Bosc. ex DC	.	.	+	.	.	.	.	.	.	.	.	.
Prunus armeniaca L. ◆	.	.	.	.	+	.	.	.	.	.	.	+
Prunus spinosa L.	+	.	.	.	+	+	+	+	.	.	+	.
Prunus ursina Kotschy	.	+	+	.	.	.	.	.	+	+	.	+
Rosa (*canina* L. group)	.	.	.	.	+	+	+	.	+	+	+	+
Pyrus amygdaliformis Vill.	.	.	.	.	.	.	.	.	+	+	.	.
Pyrus elaeagnifolia Pallas	.	.	+	.	+	.	.	.	.	+	.	.
Rhamnus L.	.	.	.	+	.	.	.	.	.	.	.	.
Rhamnus oleoides L.	+	.	+	.	+	.	+	+	.	+	+	+
Celtis tournefortii Lam.	+	+	+	.	+	.	+	.	.	.	+	+
Ulmus minor Miller	.	.	.	.	.	.	+	+	.	.	+	.
Quercus pubescens Willd.	.	.	.	.	.	+	.	.	.	.	.	.
Quercus ithaburensis var. *macrolepis* (Kotschyi) Hedge et Yalt.	.	.	.	.	.	+	.	.	.	.	.	.

1. Güvercinkayası	38°23.99'N, 34°11.44'E
2. Güzelyurt	38°16.25'N, 34°20.83'E
3. Kitreli	38°16.68'N, 34°16.02'E
4. Küyüklıtatlar (Erdaş Dağı)	38°24.83'N, 34°37.50'E
5. Soğatlar (Erdaş Dağı)	38°25.84'N, 34°33.71'E
6. Çiftlik	38°09.57'N, 34°31.82'E
7. Demirci-1	38°23.51'N, 34°18.00'E
8. Demirci-2	38°23.42'N, 34°17.64'E
9. Acıgöl town	38°32.75'N, 34°27.62'E
10. 6 km south of Eski Acıgöl	38°29.66'N, 34°31.74'E
11. Kutluaya	38°21.19'N, 34°14.04'E
12. c. 6 km southeast of Köprüköy	39°32.16'N, 33°28.29'E

able to regenerate from the stools after cutting, or alternatively, from seedlings. Both properties are also well documented for oaks. Young oak specimens readily regenerate from the stubs. Older oak trees, e.g., those that were left for timber, stand for scores of years and, once felled, may not regenerate from the stools. However, by virtue of their age such trees usually reach the fruit-producing stage. Both forms of regeneration would be most effective on the rock outcrops with their many fissures, since new growth would mostly be beyond the reach of browsers. Therefore it seems that exploitation or browsing cannot explain the absence of

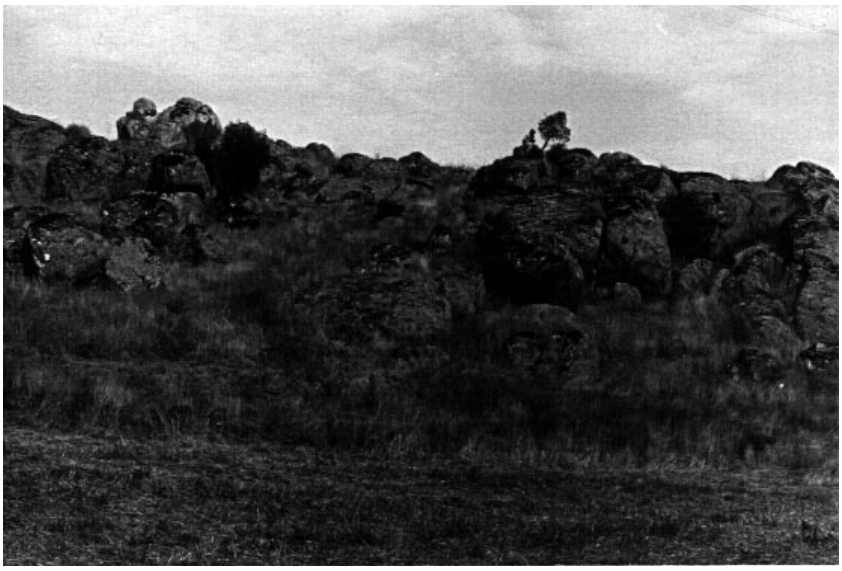

Figure 3. Rock outcrop near Köprüköy with *Prunus ursina* (above left) and *Celtis tournefortii* (above right)

oaks. This outcome suggests special ecological conditions on the outcrops that do not match the ecological demands of oak, but might explain the occurrence of the present peculiar vegetation.

The absence of fruit-bearing species in the oak woodland

Almost all the oak woodland in Central Anatolia is found over 1200 m above sea level. Relatively high rainfall, low population densities and the remoteness of such mountain areas can explain the survival of these woodlands to the present day.

Fairly large expanses of woodland dominated by white oak (*Quercus pubescens* Willd.) are found in the Göllüdağ Mountains, a northern extension of the Melendiz Mountains (Figure 4). East of Çiftlik, mixed woodlands of white oak and vallonea oak (*Q. ithaburensis* Decne ssp. *macrolepis* (Kotschy) Hedge & Yalt.) predominate. Turkey oak (*Q. cerris* L.) is the predominant species on the northern slopes of the Hasan Dağı volcano, but also vallonea oak and white oak are locally present. White oak was the only oak species encountered on the south slopes of the Erdaş Dağı. The Ekecik Dağı woodlands, north of Aksaray, could not be visited and were only seen from a

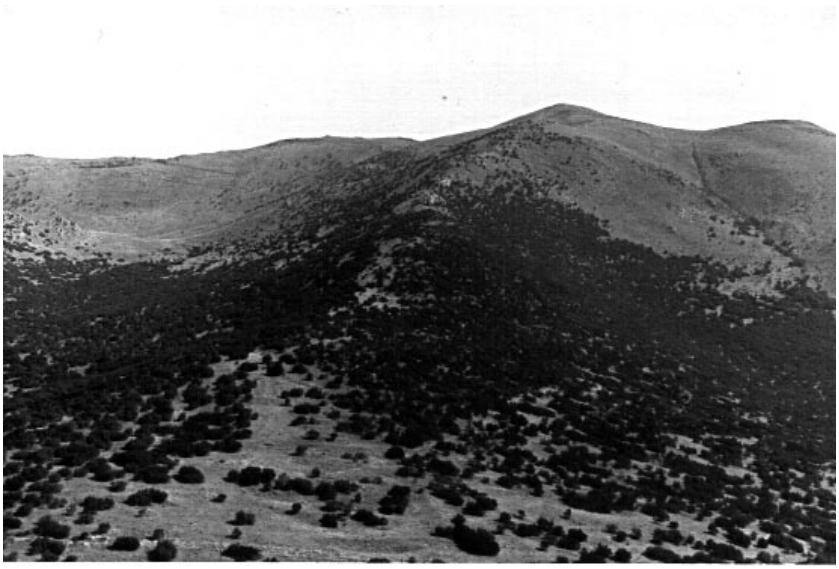

Figure 4. Remnants of deciduous oak woodland in the Küçük Göllüdağ on the road Güzelyurt-Çiftlik.

great distance. The low, scrubby patches of woodland hint at white oak as the most frequent species.

Beside oaks, some juniper species also play a modest role as woodland components. Prickly juniper (*Juniperus oxycedrus* L.) occurs scattered throughout Cappadocia, whereas Grecian juniper (*J. excelsa* M. Bieb.) is mainly distributed in the Göllüdağ mountains (Table 1, nrs 7 and 8).

The present state of the oak woodlands indicates that most of these woodlands have been felled on one or more occasions. A white-oak woodland in the Küçük Göllüdağ area (38°13.88'N; 34°31.64'E) that was recently felled against the will of the local farmers and villagers (personal communication by Dr. Catherine Kuzucuoğlu) is now a kind of coppice consisting of 2- to 4-m-tall shrubs. Most woodlands are in this state of regeneration, a phase readily recognizable by the numerous basic sprouts.

The woodlands are also heavily grazed. This regime will primarily affect the herb vegetation, but undoubtedly also cause changes in the species composition of the arborescent vegetation. It might be expected that selection by grazers would leave impalatable species, such as spiny members of the Rose family, but the opposite seems to be the case. This group is conspicuously absent, not only in the relatively dense white-oak woodlands, but also in the more open vallonea woodlands, e.g., near Kitreli, where only a few hawthorns (*Crataegus* L. sp.) have been recorded.

In contrast to the almost monospecific vegetation of the woodlands, a range of rosaceous and other spiny shrubs can be found in the bordering fields (Figure 5), which in terms of species composition is fairly similar to that of the outcrops. This scattered woody vegetation can hardly be considered a remnant of former woodland, given the absence of these species in the nearby woodlands. This suggests that mere felling does not create suitable habitats for this group, despite the fact that several species are distinct pioneer species. Apparently, further devastation, such as the removal of the stubs and disturbance by working of the topsoil, activated the germination of seeds that gave rise to this type of vegetation.

Palaeobotanical Evidence of 'Wild Orchard' Trees

Palynological research of a sediment core from a volcanic lake near Acıgöl, northwestern Cappadocia (Figure 1), demonstrates a steady advance of oak woodland from 10000-8000 BP onwards and a maximum expansion between 8000 and 4000 BP (Woldring & Bottema, *pers. comm.*). An abrupt decline of oaks starts around 4000 BP. In response to this large-scale deforestation, it is very likely that wild fruit trees took advantage of this new situation. Unfortunately, such a shift in the composition of woody species is not visible in the pollen diagram. This can be explained by differences in pollen dispersal. A fairly large number of woody species have extremely poor pollen dispersal due to their entomophilous nature, i.e., requiring pollination by insects. This type of pollination seriously reduces the atmospheric release of pollen and pollen counts contrast strongly with the number of pollen released by wind-

Figure 5. Wild orchard trees (foreground) and oak remnants (background) in Hasan Dağı.

pollinating (anemophilous) taxa, such as oak (*Quercus* L.) and hazel (*Corylus* L.).

Nearly all the wild-orchard species belong to the insect-pollinators, which explains their general absence in pollen diagrams. Even pears (*Pyrus* L. spp.) and hawthorns (*Crataegus* spp.), which nowadays are widely distributed in Central Anatolia, are scarcely if at all represented palynologically in subfossil or modern pollen records. Therefore, the absence of 'wild orchard' species in pollen diagrams cannot be interpreted as though these trees were almost or even completely absent in the former vegetation.

Fortunately, the analysis of macroscopic subfossil plant remains can complement the palynological findings in this matter. There is archaeobotanical evidence that certain 'wild orchard' species were present before the general spread of woodland in Central Anatolia. Judging from the archaeobotanical records, at least hackberry (*Celtis tournefortii*) must have been very common. In addition to nutshell fragments of pistachio and almond, large amounts of hackberry fruit remains have been found at the Early Neolithic (c. 8950-8400 BP) site of Aşıklı Höyük, 20 km east of Aksaray (Figure 1). This evidences the substantial collection of these fruits (van Zeist & de Roller, 1995). In addition, of the sixteen samples from this site, which have been examined for carbonized wood remains, fourteen contained only wood of *Pistacia* L. Oak and poplar (*Populus* sp.) predominated in the two remaining samples. In the Early Neolithic settlement of Can Hasan III (8600-7750 BP), c. 13 km northeast of Karaman, a fair amount of *Celtis* seeds (probably also *C. tournefortii*) has been demonstrated together with fruits of walnut (*Juglans regia* L.), *Prunus* L. and hawthorn (*Crataegus*) (French *et al.,* 1972). In Çatal Höyük (7800-7500 BP), about 100 km west of Karaman, Helbaek (1964) found fruit stones of *Celtis australis* L. in many samples. Also acorns and nutshell fragments of almond and pistachio have been recorded at this site. Obviously, vitamin - and nutrient-rich fruits formed an essential complement to the diet of early-Holocene farming communities.

Pistacia is also evidenced palynologically. The Acıgöl diagram indicates that pistachio was quite common during the first millennia of the Holocene. Around 7000 BP the pollen values of pistachio decline to reach negligible values towards modern times. Apparently, the rock outcrops and farmed plains do not meet the ecological requirements of the members of this taxon. The only location where we recorded *Pistacia atlantica* Desf. is the Ihlara Gorge, west of Güzelyurt, where it grows together with *Celtis tournefortii* and *Rhamnus oleoides* L.

Archaeobotanical research confirms the presence of various fruit-bearing species of *Celtis, Amygdalus, Crataegus, Prunus, Pistacia* and others before the oak-woodland expansion in Central Anatolia. During the mid-Holocene woodland optimum, the outcrops were among the locations where wild fruit trees could maintain themselves in the absence of oaks. In response to the devastating action of man, this vegetation spread and replaced the oak woodland in deforested areas.

Maquis-Vegetation Type?

A comparison with the Mediterranean maquis springs to mind. At present, this type of vegetation almost completely dominates the Mediterranean climate zone. Typical maquis components include *Quercus coccifera* L., *Q. calliprinos* Webb., *Phillyrea* L. spp., *Arbutus* L. spp., *Spartium junceum* L., *Erica arborea* L., and *Pinus halepensis* Miller. Pollen diagrams of the Mediterranean climate zone indicate that in the past maquis was much more restricted and deciduous-oak forest dominated this zone up until approximately 3000 BP. It has been suggested that maquis vegetation was restricted to specific open locations, such as rocky sites, screes and steep slopes. Destruction of the primary forest subsequently initiated the spread of maquis vegetation.

Climatically, the Mediterranean area and Central Anatolia show many parallels. According to Nahal (1981), the Central Anatolian climate is merely a colder variant, notably expressed in more continental winters and smaller amounts of summer rainfall. This may be illustrated by the fact that several important components of the Mediterranean woodland vegetation and other Mediterranean plant communities, such as *Quercus cerris., Q. pubescens, Pistacia palaestina* Boiss., *Prunus ursina, Crataegus aronia* and *Capparis spinosa* L., are also present in Central Anatolia.

It seems that in Central Anatolia, and particularly in Cappadocia, the competitive capacity of woodland trees restricted the wild fruit trees to suitable isolated locations, such as the rock outcrops. These barren sites

prevented the development of dense tree stands and, therefore, remained a suitable niche for the light-demanding fruit trees in the course of time. Like the widespread maquis vegetation of today, the arborescent rock outcrop vegetation took advantage of the deforestation and part of the species rapidly spread into the newly created habitats. Restricted on this level, the scattered pattern of fruit trees in Central Anatolia represents a typical 'wild orchard landscape' with a long history.

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