DOI: 10.53478/TUBA.2018.014

Chapter 13
The ancient woodland concept as a practical conservation tool: the Turkish experience

Simay Kırca, Alper H. Çolak, Ian D. Rotherham

Abstract

Why ancient woodlands and wood species restoration and rehabilitation is necessary? In Turkey there are over 500 taxa of trees and shrubs, however only a few of them play a vital role both naturally and culturally. The technical term here is 'intergenerational equity', or in plainer language, not messing things up for our children and grandchildren. In ancient woodland restoration and rehabilitation approach in Turkey, there is no lack of knowledge to implement suitable strategies, however what is more often lacking is an understanding of the overall landscape and the factors that determine whether different land-uses are mutually reinforcing or in conflict. These applications need to accommodate new perspectives and ideas to put ancient woods back into the natural and cultural landscapes. The experience gained indicates that such implementations require supportive local and national policy frameworks and a strong constituency of local-level support. As a country with already significant areas of a highly degraded nature, but also containing diverse natural and cultural landscapes, Turkey should apply suitable techniques to bring these ancient woods back into their original landscapes in order to sustain its cultural and natural heritage. Ascertaining, and then maintaining, the condition of ancient woodland in Turkey like in UK will be a major challenge for the future.

Turkey contains ancient cultural landscapes with distinctive ancient wood and ancient woodlands. They are strongly influenced by human activity reaching back far into history. This is very obvious in Anatolia, a region where eastern and western civilizations meet. The region has also been recognized by eastern and western civilizations nearly as a 'tree paradise' with its diverse tree species adapted to different climatic and geomorphological conditions. In this context, it has been aimed to; (1) emphasize the interaction between cultural features and diverse forest landscapes with ancient woodlands, (2) introduce the understanding of ancient woodland concept in Turkey, (3) determine the typical prominent ancient woodland taxa, (4) represent some techniques in order to restore degraded ancient woodland ecosystems in Turkey and (5) seek opportunities for the planning of undisturbed ancient landscapes as a cultural heritage.

Additionally, the importance of developing strategies in order to prevent the loss of ancient woodlands was tried to be illustrated by two case studies on Common yew (*Taxus baccata* L.) and Common boxwood (*Buxus sempervirens* L.), which have been continuosly present in Anatolia since thousands of years, became an important component of cultural landscapes, however strongly influenced by human activity resulting with the degardation and loss of their habitats.

Landscape alteration in Anatolia and its reflections on ancient woodlands through history

Anatolia is a region where eastern and western civilizations meet and one of the oldest continually inhabited regions in the world. It has been repeatedly a battleground for foreign powers, being noted as a melting pot of cultures. From the first known urban city (Çatalhöyük c. 7500 BC) to the historically famous Troy, and from the Ionians to the great empires of the world (e.g. Roman, Byzantine, and Ottoman) many cultures (e.g. Sumers, Cimmerians, Cilicans, Phoenicians, Lydians, Carians, Persians, Hellenes, etc.) were established in this geography. Even the earliest major empire of the region (the Hittite Empire) derived its name from the dominant prehistoric culture of Anatolia (Hatti, Khetas or Hetas) (Çolak and Rotherham, 2006).

In accordance with its rich historic background, Turkey contains ancient cultural landscapes with distinctive ancient woods and woodlands. People have used these woodlands and to some extent have been shaped by

woodland environments for thousands of years. However, these areas have also been strongly influenced by human activity reaching back far into history. Over the last 2000 years, anthropogenic impacts have significantly reduced forest area containing distinctive ancient wood, most markedly in the last five centuries. All these civilizations and especially their cities required wood, timber, agricultural land and grazing land, while their armies played a particular role in the depletion of forests. Woodlands were the sources of wood for their fleets, weaponry and war machines, while they also provided cover for the armies. For example, the ancient Assyrians, like many more recent armies, deliberately burned the woodlands of their enemies (McNeill, 2004). Indeed the Roman poet and philosopher of the first century BC, Titus Lucretius Carus, listed armies and agricultural use among the four reasons behind the alteration and total destruction of woodlands because of forest fires (lightning and hunting parties were the others) (Carus, 1916):

'Now for the rest: copper and gold and iron
Discovered were, and with them silver's weight
And power of lead, when with prodigious heat
The conflagrations burned the forest trees
Among the mighty mountains, by a bolt
Of lightning from the sky, or else because
Men, warring in the woodlands, on their foes
Had hurled fire to frighten and dismay,
Or yet because, by goodness of the soil
Invited, men desired to clear rich fields
And turn the countryside to pasture-lands,
Or slay the wild and thrive upon the spoils.
(For hunting by pit-fall and by fire arose
Before the art of hedging the covert round
With net or stirring it with dogs of chase.)'

Major trends in the use wood and their effects on the ancient woodlands can be traced back to Neolithic Ages in Anatolia. Palynological and dendrochronological studies as well as pollen analyses demonstrate valuable information on the landscape alteration and dominant ancient wood or ancient tree species through history. For example, a sediment core from a volcanic lake near Acigöl, in Central Anatolia indicates a steady advance of oak woodland from 10000-8000 BC onwards and a maximum expansion between 8000 and 4000 BC, followed by its dramatic and almost complete, man-induced destruction (Woldring and Cappers, 2001). Additionally, the study of archeological wood-charcoal macro-remains has been viewed mainly as a tool for reconstructing past vegetation and climate patterns, as well as gaining some insights into the local strategies for woodland exploitation (Willcox, 1992, 1995; Vernet, 1997; Figueiral and Mosbrugger, 2000; Asouti and Austin, 2005; Dufraisse, 2006). The studies held in the Neolithic city of Çatalhöyük in Central Anaolia also indicated the expansion of oak woodlands followed by the use of oak wood particularly for fuel wood and construction purposes (Mellaart, 1967; Asouti, 2005). The surrounding landscape of the city

Photograph 1: Oak (*Quercus* sp.) (A. Ince; Archive of General Directorate of Forestry-Turkey).

was composed of three vegetation types as; (1) riparian and marsh vegetation, (2) woodland steppe and treeless steppe and (3) oak-park woodland (Asouti, 2005), while this landscape pattern has been transformed mostly into the Central Anatolia A*rtemisia fragrans* steppe and partly to salt steppe and *Quercus pubescens* (*Quercus pubescens* subsp. *anatolica*) forest steppe today (Noirfalise, 1987) as a result of felling and overgrazing, and only in some mountainous areas can ancient oak woodlands be found (Woldring and Cappers, 2001) (Photograph 1).

On the way to the east Strabo (1856) describes Mazaca (province in ancient Cappadocia) as entirely barren and uncultivated like almost all other provinces in Cappadocia with the exception of the woodlands surrounding Argaeus (Mount Erciyes). Ancient oak woodlands have also been started to decline moderately by the same period in Lake Van, in south-eastern Anatolia, with the effect of increasing human activity and summer drought and reached its highest point after the clearing about 600 years ago (Wick et al., 2003). Deforestation in the highlands of eastern Turkey during the Late Bronze Age is also apparent through increased sedimentation along the Euphrates River Valley, because of slope erosion due to human practises like land clearing, grazing and agriculture as well as precipitation depletion and irregularity

Photograph 2: Ancient Black pine (*Pinus nigra* subsp. *pallasiana* stands in Kartal Gölü Nature Protection Area (Beyagaç/Denizli) (R. Çetiner).

(Kuzucuoğlu, 2003; Longford et al., 2009). These findings have also been supported by pollen diagrams on the ancient woodland vegetation of Çatalhöyük (7500 BC to 5700 BC) in Central Anatolia, which indicate the presence of formerly extensive Xero-Euxinian open oak ancient woodlands (*Quercus macrolepis* Kotschy, *Q. trojana* Webb, *Quercus* sp.) with *Juniperus excelsa* M.Bieb., *J. oxycedrus* L. and *Pinus nigra* Arnold stands (Asouti and Hather, 2001) (Photograph 2). Furthermore, there should have been well-stocked forests within easy reach of Phyrigian capital-city of Gordium (southwest of Ankara) considering the unrestricted use of wood in the city (Young, 1974; Aytuğ, 1988). In 1402 Timburlaine was also able to conceal his herd of elephants in a wood outside the city of Ankara (Meiggs, 1982). Unfortunately this mosaic has left its place mostly to the present-day steppic elements formed as a result of high timber demand for firewood, fuel, building construction (esp. ancient woods like oak, black pine, cedar), forest fires as well as agriculture and over-grazing.

Further studies revealed that by the beginning of the Bronze Age societies were quite rural, probably impacting the vegetation only minimally in Anatolia, but shortly after (ca. mid-3rd millennium BC) became urbanized. It is also the period when plough use and fruit-tree cultivation became increasingly applied, and increased specialization within the agrarian and pastoral sector occurred (Figure 13.1). It is also of interest that one of the Middle Bronze Age rulers claimed to have intensively cut cedars and pines from the mountains, hence imported wood from remote areas (Deckers and Pessin, 2010), while Assyrian merchants imported wood from Anatolia between 1700-2100 BC (Dölarslan and Ok, 2006). Histories that relate to environmental change begin with Bronze Age (3500-1200 BC) cuneiform records, including mention of the Amanus Mountains as a source of cedar (*Cedrus libani*

Figure 13.1

Landscape alteration in the Bronze Age in Anatolia and some reflections on ancient woodlands (Kırca et al., 2015)

A.Rich), boxwood (*Buxus sempervirens* L.), and cypress (*Cupressus sempervirens* L.) (Rowton, 1967). Early timber was likely floated down rivers on the east side of the Amanus to the Aksu and the Euphrates. Some timber was also floated down western Amanus rivers and into the Mediterranean (Beach and Beach, 2008). Sumerians also associated some mountains with their dominant tree species by using tree-toponyms; i.e. allānu "oak", burāšu "a juniper tree", erēnu "cedar", meḫru and supālu (pine trees) and taskarinnu "boxwood". For example, they named the Eastern Taurus after "ḫašurru" or "šurmēnu", the earlier term used for *Cupressus sempervirens* L. var. *horizontalis* (Mill.) Cord., which no longer exists there today. Probably this species grew in sheltered parts of the Eastern Taurus, where there was sufficient precipitation and at lower attitudes where the winter was mild. However the exceptional fragrance of its wood should have made it used as timber for the construction of temples and palaces, and exploited in large quantities, while it was also confined to lower altitudes and therefore easily accessible (Rowton, 1967).

Mediterranean climate zone was also dominated by deciduous-oak forest up until 3000 BC, while the destruction of the primary forest (ancient woodland) subsequently initiated the spread of maquis vegetation (Woldring and Cappers, 2001). Here Taurus range and Amanus Mountains have suffered much more serious damage than other parts of this zone, since ancient woods (especially cedar and black pine) were exported to the great Mediterranean and near-east civilizations in order to provide timber for building and ship construction (Diodorus, 1946; Senitza, 1989). There was also great abundance of *Cupressus sempervirens* L. in Lycia (c. 1250-546 BC- western Mediterranean Region) (Theophrastus, 1999b), while this ancient tree shows relative rare distribution mostly forming mixed stands with *Pinus brutia* Tenore and *Quercus coccifera* L. (Mayer and Aksoy, 1998). However Kotschy (1858) reports about forests still well-stocked with oak, and pine on the lower slopes continuing with cedar, fir, pine and juniper towards the eastern end of Taurus in the middle of the 18th century, which severely declined particularly with the effect of increasing conversion of forest to agriculture and grazing. These forests were also called upon to meet the large demands of Egypt, especially when the Suez Canal was being built (Meiggs, 1982). It is also known that, there were still good reserves of cedar, juniper, pine and some amount of cypress in western Mediterranean Region by the beginning of 20th century (Philippson, 1910).

There is a striking contrast between the forests of northern Anatolia (i.e. southern parts of Sea of Marmara and Black Sea coast) and other parts of Asia Minor. These forests had a high reputation in ancient Greece and Rome, as well as Byzantium and Ottoman Empire and they have always had a rich range of trees including fir, pine, beech, chestnut, oak and maple (Meiggs, 1982) (Photograph 3). Towards the end of the 19th century Cuinet (2001) was also impressed by the dense forests present on east of

Photograph 3: Oriental beech (*Fagus orientalis*) (Kamilet Valley-Borçka-Artvin) (A. Ince; Archive of General Directorate of Forestry-Turkey).

Trabzon and the size of timbers being cut and exported from Sinop, Zonguldak and Izmit, which Xenophon so much admired and named as "sea of trees" (from which most of them classified as ancient tree species like oak, elm, beech, fir, yew, box tree, pine). According to Rowton (1967), this region represented the main source of timber for the whole Roman Empire, to the point that "timber to the Pontus" had much the same connotation as "coals to Newcastle" in the 19th century England. In spite of the historical evidence showing the great amount of wood these forests provided for building, fuel and ship construction (Theophrastus, 1999c; Meiggs, 1982; Olson, 1991; McNeill, 2004; Ágoston, 2005), there are still substantial forest reserves containing considerable amount of unfragmented ancient woodlands in this region. However this cannot be told for the remaining forest landscapes on the southern part of North Anatolian Mountains. The woodlands still dominated by *Pinus sylvestris* L. and oak species in Erzurum in the 4th century BC (Xenophon, 1976; Longford et al., 2009) were mainly transformed to 'naked landscapes' by the beginning of 17th century (Tournefort, 1636). Accordingly in the 17th century the forests from which the Ottoman Empire drew its naval timber stood as much as 50 kilometers inland, behind the coasts of the Black Sea, Sea of Marmara, and the northeastern Aegean (McNeill, 2004). As a result, the cumulative effects of timber use by a large number of civilations caused the total destruction, alteration of species composition or reduction of ancient woodlands.

Photograph 4: *Quercus hartwissiana* (K. Cengiz; Archive of Zonguldak Forest Enterprise)

An overview of the interaction between people and ancient wood in Anatolia

Fuel for heating and cooking was one of the most basic, irreducible needs of settled human existence in Anatolia, while every civilization had to develop its own fuel exploitation strategy which may differ mainly according to local wood resources. People relied on firewood and charcoal to satisfy their energy requirements for centuries, while in main urban centres this must have been a major (and potentially quite profitable) industry. According to Asouti (2005) people relied on dung fuel as well as firewood gathered mainly from the surrounding riverine vegetation in the early stages of the iconic Neolithic site of Çatalhoyuk, when the consumption of wood was relatively low. However firewood exploitation increased after 7000 BC and this was characterized by the predominance of oak, greater diversity of the riverine taxa, and the higher frequency of juniper, wild plum and wormwoods in the samples of wood macro-remains and charcoal. Asouti and Fairbairn (2002) also refers to the different types of fuel valued for different purposes in Çatalhoyuk (e.g. the slow burning and long-lasting dung fuel for cooking and firewood for heating, smoking and/or lighting), while oak became one of the dominant wood preferred as fuel material in this Neolithic settlement of Central Anatolia (Photograph 4). Use of oak as fuel was also common in the ancient Mediterranean civilizations. Even a simple peasant in the countryside could gather virtually all his fuel in the form of cuttings and prunings from his own land or nearby forests, as the ancient Greek dramatist Menander (ca. 341/42-ca. 290 BC) remarks: 'Everall after an oak falls, every man gets wood for himself' (Olson, 1991).

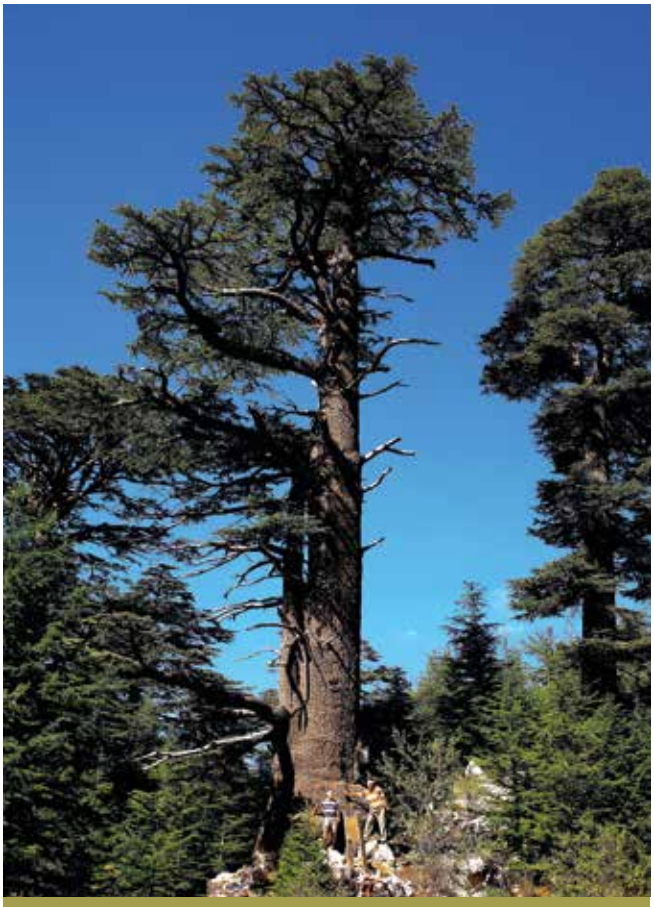
Theophrastus (c. 371-c. 287 BC) (1999c) indicated the necessity of fuelwood for different purposes in the Ancient Mediterranean World: 'Individual households needed heat and a way to cook their food; businesses such as bakeries and bathhouses required supplies of wood and charcoal on a daily basis; industries like metalworking and refining and pottery making were absolutely dependent on a steady supply of fuel to heat forges and fire kilns and often needed specialized types of charcoal made from particular woods. He also specified the varying uses of charcoal made of different woods. For example, people used charcoal made of *Quercus* sp., *Quercus ilex* L. and *Arbutus* sp. in silver mines for the first smelting of the ore, since these are the most solid woods and they last longest and strongest. However men required softer wood (*Castanea sativa* Mill.) for the charcoal used in iron mines, when the iron has been already smelted and they used charcoal of pine-wood in silver mines, while these kinds were also used by the crafts. Smiths of the Mediterranean required charcoal of fir rather than oak, although it is not so strong, but it blows up better into a flame and it's less apt to smoulder and its flames are fiercer. Theophrastus (1999c) also mentions the suitability of olive for kindling because of its close and oily texture, while he favoured *Rhamnus* sp., *Quercus coccifera* L. and *Tilia* sp. for firesticks. Homer (1990) also describes the traditional function of oak, 'the strongest burner among woods', in the Mediterranean culture which was collected from Mount Ida (Kaz Dağı) after a challenging journey for the cremation of Patroclus.

Wood was also the main material for building construction and furniture, while cedar, fir, oak species, cypress and juniper were the most preferred tree species because of their different features like resistance to climatic conditions and insects, aromatic scent, easiness to work and polish as well as aesthetic beauty. For example the royal tomb in the capital city of ancient Phrygia, in Gordium, is one of the great monumental examples for the use of ancient wood in construction, while *Cedrus libani* A.Rich, *Pinus sylvestris* L., *Pinus nigra* Arnold. subsp. *pallasiana* (Lamb.) Holmboe, *Juniperus excelsa* M.Bieb., *Buxus sempervirens* L. were the main tree species used (Meiggs, 1982). The most striking issue is the variety in the age of trees that were felled for the tomb, which were between 200 and 800 years old (Kuniholm, 1977). Similarly King Solomon is reputed to have sent 30.000 workers to the Taurus Mountains of southern Turkey in order to cut trees of about 30 m in height for the construction of his temple in Jerusalem and Hall of Judgement (Senitza, 1989), 'covering the interior from floor to rafters with wood…All was cedar, no stone was left visible' (Meiggs, 1982). Pliny the Elder (1855) also reports about the durability of cedar used by the roof-beams of temple of Artemis in Ephesus considering their good condition after 400 years of its construction. According to Meiggs (1982), the kings of Mesopotamia and Egypt chose cedar before fir for several reasons. As a tree it was a patrician, the fir plebeian. The wood of the cedar, unlike the fir, resisted rot and insects and was very durable. It also had an attractive aromatic scent, took a good polish, and was appreciated by carpenters and cabinet-makers because it had a close, straight grain and was easy to work (Photograph 5). The wood of cypress and juniper had very similar qualities. Like cedars their

wood was of a reddish brown colour; they too had an aromatic scent, and the juniper was stronger than the cedar (Photograph 6). But both cypress and juniper were less handsome and neither could compare with the cedar in height.

Analyses on marine pile examples from the ancient Byzantine port of Eleutherius/Theodosius in Istanbul (4th century BC) indicate the use of *Cupressus sempervirens* L., *Castanea sativa* Mill., *Quercus ithaburensis* Decne., *Q. pontica* C.Koch., *Quercus* sp. and *Fagus* sp. (Doğu et al., 2011), from which oak was also favoured by Theophrastus (1999c) for its usefulness in building and particularly in underwater work. *Buxus sempervirens* L. was another important ancient wood mostly used for furniture and musical instruments in the ancient Mediterranean world (for which the sources are far more eloquent than anywhere else in the world at that time) and the most famous boxwood was obtained from Amanus Mountains and Cytorus (Central Blacksea coast) (Theophrastus, 1999a).

In ancient world naval power was mainly based on the presence of high quality wood, which was mainly provided from ancient woodlands. Theophrastus (1999a) describes the use of tree species for different purposes. For example Triremes and other warships were made of mountain fir because it is lightweight, allowing ships to be fast and maneuverable. Merchantmen were made of pine, which was more durable, while on the Syrian and Lebanon coast, shipwrights used cedar because it was abundant. Keels required sturdy oak, because they had to withstand hauling over beaches or rocks. He also gives a list of areas that could supply good timber-ship for the ancient Mediterranean civilizations: in Europe Macedon, parts of Thrace and south Italy; in Asia the territories of Sinop and Amasya (Black Sea coast of northern Anatolia), Mt. Olympus (Uludağ in southern Marmara Sea) and Mt. Ida (Kaz Dağı in Biga Peninsula on the shore of Aegean Sea). Taurus and Amanus Mountains were also important sources for ship timber, while Antony gave Cleopatra –the queen of Egypt- a well forested area in Cilicia to provide timber for an Egyptian fleet (Meiggs, 1982). In Ottoman Empire wood continued to dominate as the main ship construction material until the second half of the 19th century, while oak (esp. *Quercus ilex* L.), pine, elm, fir, larch, chestnut, hornbeam, ash tree and lime tree were the most preferred tree species (Zorlu, 2008). However armies consumed more timber than fleets either by burning as the ancient Assyrians, like many more recent armies, who deliberately burned the woodlands of their enemies (McNeill, 2004), or by cutting to cook, provide warmth, open their way, deny cover to an enemy, construct bridges or roads and produce weapons (clubs, spears, slings, bows, and arrows) (Meiggs, 1982). In Anatolia production of gunpowder for the army also played an important role by the depletion of forest resources. The manufacture of gunpowder from saltpeter, for example, required fuelwood, about fifteen to twenty tons of wood for each ton of saltpeter. In the Ottoman Empire, annual saltpeter production in the mid-17th century used as much fuel as a city of 100.000 to 200.000 people (Ágoston, 2005).



Photograph 5: Lebanon cedar (*Cedrus libani*) /Çıglıkara-Elmalı-Antalya) (A. Ince; Archive of General Directorate of Forestry-Turkey).

Photograph 6: Juniper (*Juniperus* sp.) (R. Çetiner).

Mayer and Aksoy (1986), referring to Evliya Çelebi (a famous 17th century traveller and writer), note that thousands of timber (e.g. cedar, black pine, oak) producers lived in northwest Anatolia in 1648 AD. Thus, whilst the civilizations in Anatolia were destroying forests on the one hand, on the other they used the ancient wood for a variety of purposes.

Definition of the term "ancient woodland" in Turkey and UK

(Kırca et al., 2015; prepared after Peterken, 1983; Goldberg et al., 2007; Kırca et al., 2012)

Figure 13.2

The term '*ancient woodland*' in UK:

An area that appears to have been wooded continuously since at least 1600 (1750 in Scotland). This includes all primary woodland, the lineal descendants of UK's primeval woodland, whose wildlife communities, soils and sometimes structure have been least modified by human activities.

The term '*ancient woodland*' in Turkey:

A primary or natural / near natural forest area containing tree species, whose existence can be traced back from hundreds of years to neolithical ages. These are appreciated as icons of most important wooded landscapes in Turkey, as well as history of different civilizations in Anatolia.

What is meant by the term 'ancient woodland' in Turkey?

The concept of ancient woodland can be traced back to at least the 19th century (Watkins, 1988), but was actively promulgated in this form about 40 years ago by Peterken (1977) and Rackham (1976). Ancient woods were perceived to be particularly important for nature conservation, and were also under threat from agricultural clearance, development and modern forestry methods. Rackham (1976) pessimistically believed that there would be almost no ancient woodland left by the turn of the century (i.e. 2000) except in nature reserves (Goldberg et al., 2007). In United Kindom (UK), ancient woodland is widely understood to be an area that appears to have been wooded continuously since at least 1600 (1750 in Scotland). These areas have all been managed in some way, which sometimes involved temporary clearance of trees by felling. 'Ancient woodland' includes all primary woodland, the lineal descendants of UK's primeval woodland, whose wildlife communities, soils and sometimes structure have been least modified by human activities (Peterken, 1983; Goldberg et al., 2007). In Turkey, ancient woodland is defined as a primary or natural/near natural forest area containing tree species, whose existence can be traced back from hundreds of years to neolithical ages. These are appreciated as icons of most important wooded landscapes in Turkey, as well as history of different civilizations in Anatolia. This indicates an obvious difference in description of terms between UK and Turkey, as a result of geomorphological, climatic, ecological and historical backgrounds (Figure 13.2).

Photograph 7: Plane trees (*Platanus* sp.) scattered in individual groups. Sütçüler-Isparta (A. Ince; Archive of General Directorate of Forestry-Turkey).

Photograph 8: Old-growth black pine protection forest (R. Çetiner).

How small can an ancient woodland be?

The answer to the question 'how small can an ancient woodland be?' also differs between Europe and Turkey. According to many research Goldberg et al. (2007) notes the primeval wooded landscapes greater than 2 ha as ancient woodland. However in Turkey it wouldn't be suitable to define a minimum areal limit, since degraded ancient woodlands may cover hundreds of hectares as a whole, scattered in fragmented individual groups (Photograph 7 and 8).

By the determination of ancient woodlands and wood species origin plays an important role in order to qualify a

The minimum size of ancient woodlands and determination of ancient woodlands and wood species (prepared after Goldberg et al., 2007; Kırca et al., 2012)

Figure 13.3

How small can an ancient woodland be?

In Europe

According to many research the primeval wooded landscapes greater than 2 ha are noted as ancient woodland.

In Turkey

It wouldn't be suitable to define a minimum areal limit, since degraded ancient woodlands may cover hundreds of hectares as a whole or scattered in fragmented individual groups.

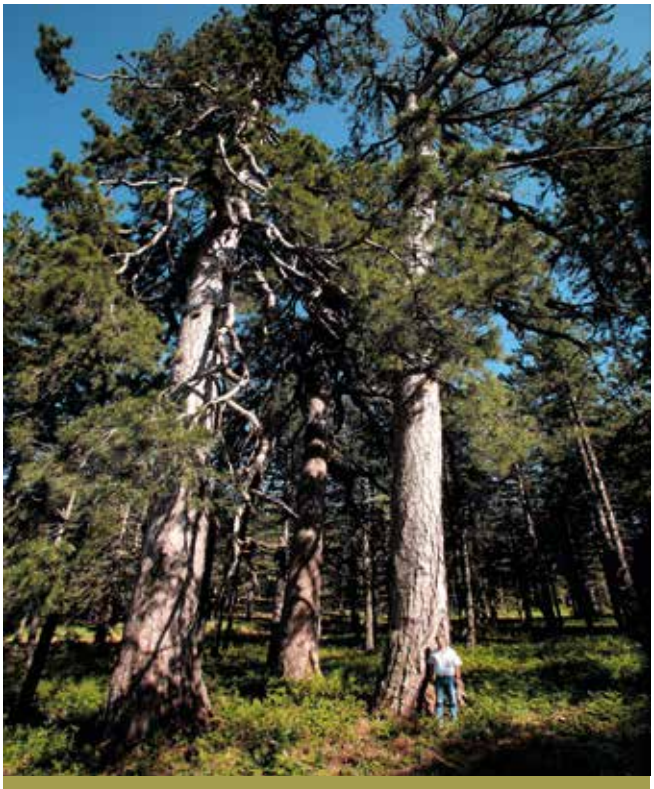
By the determination of ancient woodlands and wood species, origin plays an important role in order to qualify a wood to be ancinet in Turkey as well as in other countries.

- comparison of wood and polen records of particular species
- understanding the degree of continuity between ancient woods and the wildwood

wood to be ancient in Turkey as well as in other countries. Therefore comparison of wood and polen records of particular species is widely used as a technique in order to understand the degree of continuity between ancient woods and the wildwood (eg. Rackham, 2003). In Turkey the identification of woods that might be primary (land that has never been completely cleared of trees), or at least had probably arisen by natural regeneration in a relatively unimproved landscape plays a vital role by the inventory of ancient woodlands. However a generic system for the classification of different patches (plantations with non-native tree species, monocultures, degraded areas, etc.) is still lacking. For example in UK, the areas of ancient woodland with non-native trees planted on them, termed Plantations on Ancient Woodland Sites (PAWS), and those areas of ancient semi-natural woodland (ASNW) (Goldberg et al., 2007), (Figure 13.3).

Prominent ancient tree species of Turkey

Turkey, consists of European Turkey and Anatolia, is the meeting place of three phytogeographical regions: 'Euro-Siberian, Mediterranean and Irano-Turanian'. The vascular flora of Turkey contains over 9000 taxa and is the richest of the Near East and Middle East regions (Çolak, 2001). Its richness is of interest for both the total number of species and especially the number of endemics, of which there are c. 3000 (Ekim, 1995; Ekim et al., 2000). As a result of a variety of phyto-geographical regions Turkish landscape is divided into distinctive forest communities, which consist of more than 500 native species of trees and shrubs. Despite centuries of human activity, much of the forest in Anatolia is still relatively natural. There are still some residual virgin forest areas, but much has been degraded from near natural to semi-natural and altered (Çolak et al., 2010) (Photograph 9). The main forest regions found in these phyto-geographical regions partly contain same tree species, while they mainly differ from each other resulting with the rich diversity of species (Photograph 10, 11 and 12). However some species come into prominence with their typical characteristics and classified as ancient wood in Anatolia. In Figure 13.4 the distribution of main tree species to forest regions in Anatolia is summarized with the ancient wood distinction criteria.

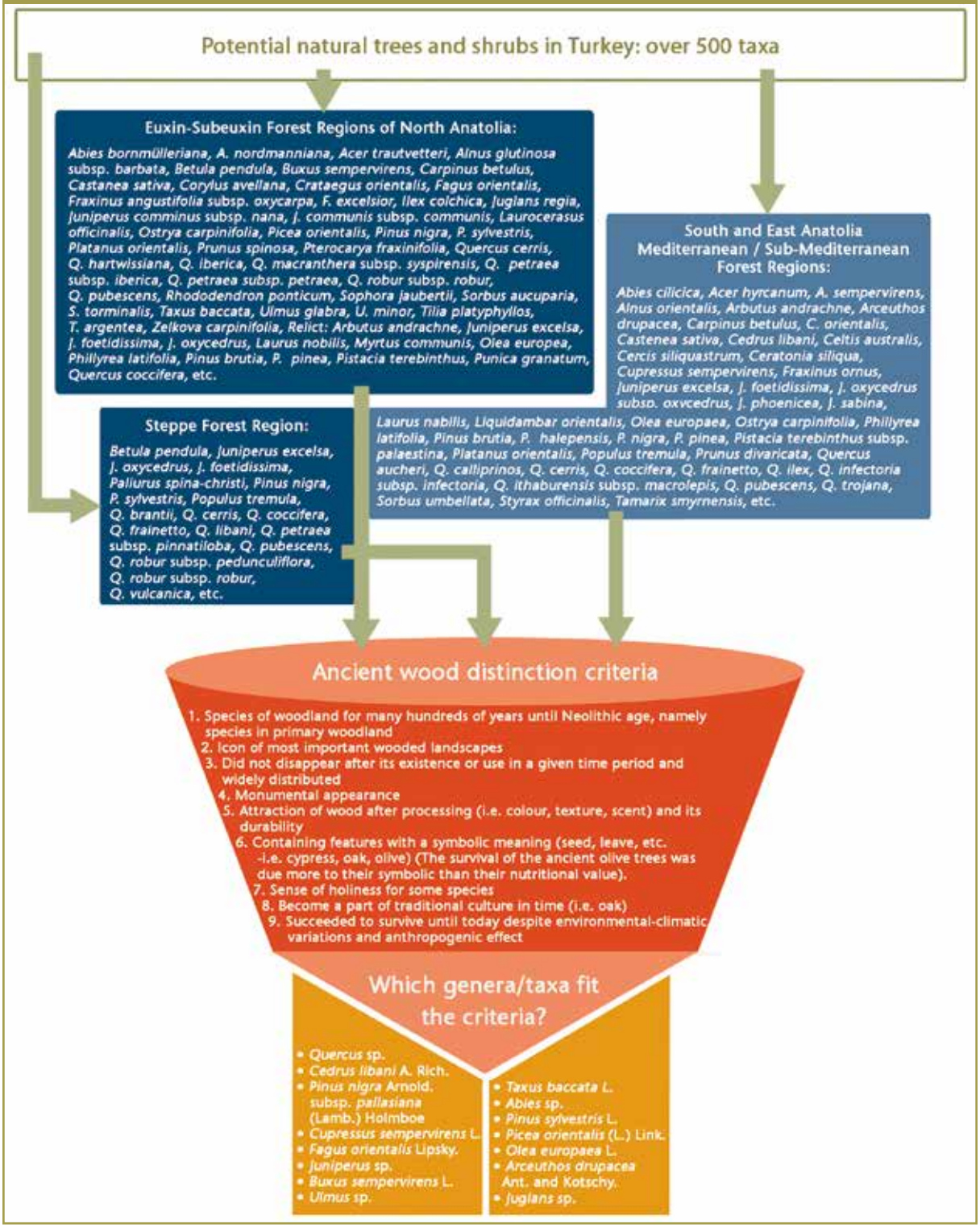


Photograph 9: Black pine (*Pinus nigra.* subsp. *pallasiana*) trees in a degraded forest (Dursunbey-Balıkesir) (A. Ince; Archive of General Directorate of Forestry-Turkey).

These criteria were generated due to the natural and cultural features of Turkish forest landscapes. For example, according to the results of pollen analyses made at lakes Abant and Yeniçağa (western Black Sea Region) (Bottema and Van Zeist, 1989), there have been no significant changes in vegetation (mainly in tree species) during the last 1000 years. The vegetation around Ilgarini cave (Kastamonu) in 1000 BC was composed of high mountain forests, containing mainly broad-leaved forest trees such as *Fagus orientalis* Lipsky., *Corylus colurna* L., *Carpinus betulus* L., *Carpinus orientalis* Miller, *Ostrya carpinifolia* Scop., *Castanea sativa* Miller, *Quercus* sp. and *Abies bornmülleriana* Mattf. (Akkemik et al., 2004). Such evidence is commonly used as a practical tool in

Prominent ancient tree species of Turkey and ancient wood distinction criteria
(Kırca et al., 2012)

Figure 13.4



Photograph 10: Kasnak Oak (*Quercus vulcanica*) typically found in Steppe forest region (Yukarıgökdere Village-Egirdir-Isparta) (A. Ince; Archive of General Directorate of Forestry-Turkey).

Photograph 11: Nordmann fir (*Abies nordmanniana*) typically found in Euxin-Subeuxin forest region of North Anatolia (Karaköy-Savsat-Artvin (A. Ince; Archive of General Directorate of Forestry-Turkey).

Photograph 12: Stinking juniper (*Juniperus foetidissima*) typically found in South and East Anatolia Mediterranean/Sub-Mediterranean forest region (Çıglıkara-Elmalı-Antalya) (A. Ince; Archive of General Directorate of Forestry-Turkey).

order to compare species composition of present forest cover with a specific time period. However it can't be the only criteria for the determination of ancient wood species as emphasized in Figure 13.4, since its intrinsic values (holiness, monumental appearance, etc.) as well as functional uses over time (characteristics of wood, purpose of use, etc.) play an important role. Pliny the Elder (1855) also indicates the intersection between spiritual meanings of ancient trees/woodlands and daily life in ancient world: '*Trees were once the temples of divine powers and, following traditional ritual, simple country people dedicate a tree that is particularly grand to a god. Nor do we honour with our worship wooden images gleaming with gold and ivory more than sacred groves and their silence*'. Ecological analyses and cultural survey show that oak species, Lebanon cedar, black pine, Mediterranean cypress, oriental beech, juniper species, as well as some other taxa given in Figure 13.4, come into prominence as ancient wood in Anatolia.

Restoring degraded ancient woodland landscapes to bring back ancient tree species into their native habitats

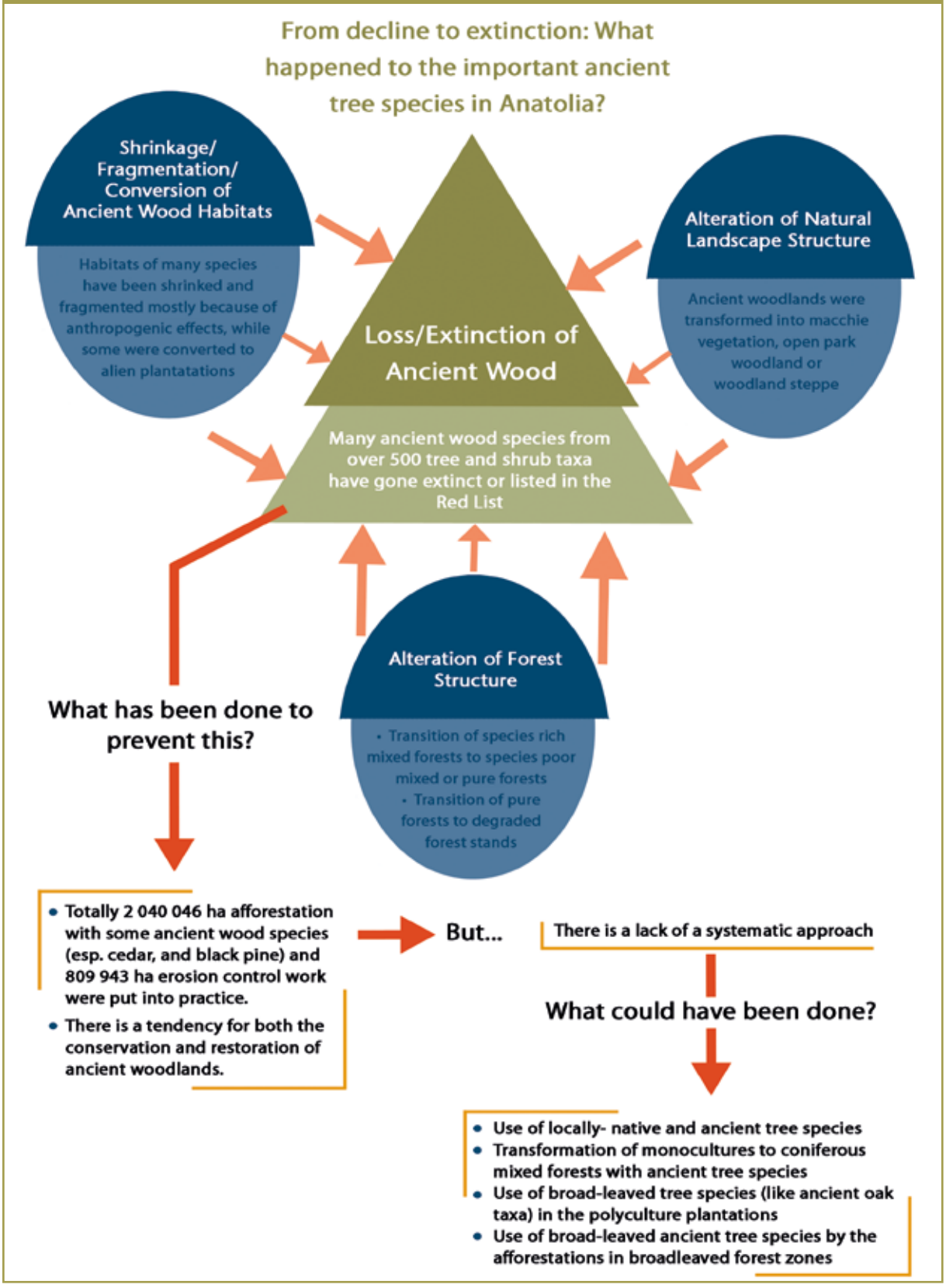
Historical records and contemporary research suggest Anatolia had 60-70% forest cover and 10-15% steppe around 2000 BC (Walter, 1956). The forest area has declined to 26% as a result of over-grazing, over-cutting, fires, spread of agricultural lands, wars etc., and steppe has increased to 24% in the intervening 4000 years (Louis, 1939; Walter, 1956). As mentioned before people played a particular role in this process resulting with the shrinkage/fragmentation and sometimes the conversion of ancient wood habitats. On the other hand natural landscape structure has been altered as in the case of Central Anatolia, which contained distinctive ancient woodlands but represented mainly with steppe vegetation today. Forestry implementations also played a particular role, while some species rich ancient forests were transformed into species poor mixed stands or

pure forests, or severely degraded (Çolak et al., 2010). This resulted with the loss or extinction of many ancient tree species, from which some of them have been listed in Red List of Threatened Species (Figure 13.5). These phenomena indicate the urgent need for the restoration of ancient woodlands in Turkey.

As the periods before the establishment of Turkish Republic are examined, not many implementations come

What happened to the important ancient tree species and what could have been done? (Kırca et al., 2016; transformed after Kırca et al., 2012).

Figure 13.5

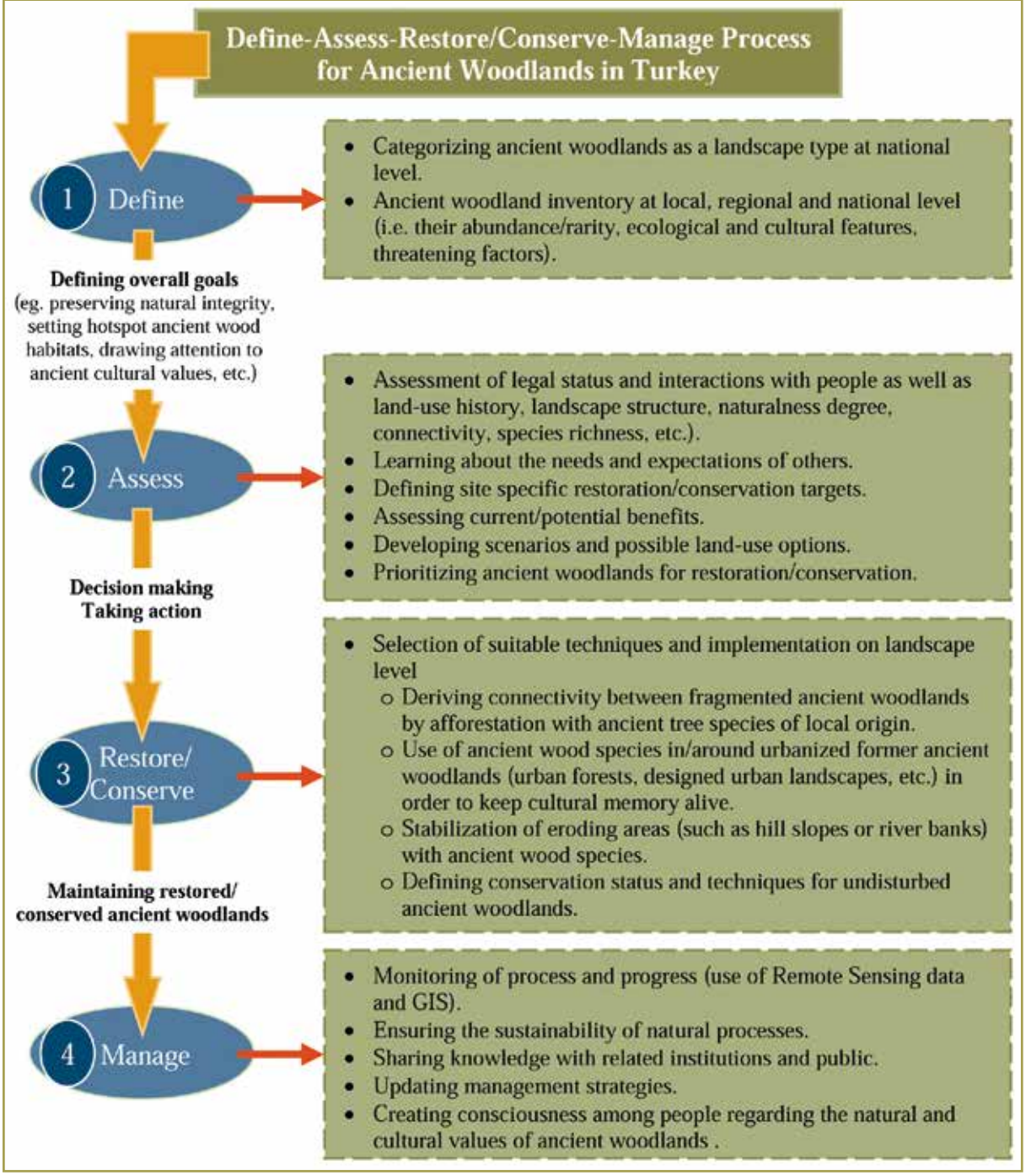


across on ancient woodland restoration issue. Therefore the afforestation work (including with some ancient tree species) done before the Republic Period should be accepted as discrete practices, while regular applications could only start after the period of World War II (Ürgenç, 1998). As a matter of fact, 'totally 2.040.046 ha afforestation with some ancient wood species (esp. cedar, and black pine) and 809.943 ha erosion control work' were put into practice (Çolak et al., 2010). However, it is considered that 10.2 million ha of forest (from which ancient woodlands constitute an important part of it) is still 'degraded' or 'highly degraded'. Therefore, a forest restoration concept considering ancient tree species/ woodlands and potential ancient woodlands play an important role in Turkey.

In Turkey the enthusiasm for prompt afforestation of the degraded areas led to some afforestation with monoculture coniferous and exotic tree species. However, in more recent works locally- native and ancient tree species have been used. Later on, monocultures were organized as coniferous mixed forests with ancient tree species, while broad-leaved tree species (like ancient

Actions to be taken for the restoration/conservation of ancient woodlands in Turkey: Define-Assess-Restore/Conserve-Manage Process (Kırca et al., 2012)

Figure 13.6



oak taxa) have begun to be included in the polyculture plantations afterwards. Today, in broadleaved forest zones afforestation work is implemented with broad-leaved ancient tree species. Such implementations indicate the tendency for both the conservation and restoration of ancient woodlands, but on the other hand a systematic approach is still lacking. The general framework for the conservation and restoration of ancient woodlands in Turkey has been summarized as 'Define-Assess-Restore/ Conserve-Manage Process' in Figure 13.6.

In this framework the assessment of landscape structure, naturalness degree and species richness plays a particular role for decision making and further steps. Rose (1999) emphasizes the use of vascular plants as an indicator for nature protection in ancient woodlands considering the general rule 'the older the habitat, the more species it will support'. Peterken (1983) also noted that the wildlife communities are generally (but not invariably) richer than those of more recent woods. They contain a very high proportion of the rare and vulnerable wildlife species. Many of these species require the stability afforded by the continuity of suitable woodland. Where large, old trees have been present for several centuries they provide refuges for characteristic inhabitants of primeval woodland such as lichens. They are reservoirs from which the wildlife of the countryside has been maintained (and could be restored). Ancient woodland often contains other natural features which rarely survive in an agricultural setting such as streams in their natural watercourses and microtopographical conditions formed under periglacial conditions (Goldberg et al., 2007). For instance oaks (also an important ancient wood in Turkey) are renowned for the diversity of species associated with them. There is no other species in Europe with so many species of insect associated with the foliage (Darlington, 1974). Oaks have 350 species of lichens associated with them and as they age they are host to a range of very rare and endangered species especially saproxylic and mycorrhizal and epiphytic ones. Many other trees too as they age become host to assemblages of species which are extremely rare in Europe (Butler et al., 2001).

Thus, such an approach summarized in Figure 13.6 would provide multiple benefits both for countless species and human beings considering enrichment of habitat quality as well as maintaining/building habitat connectivity, which would improve people's life quality in urban and rural landscapes. This issue is exemplified with the following case studies on two ancient woodland species as *Taxus baccata* L. and *Buxus sempervirens* L.

Case study 1

Wise residents of ancient woodlands: *Taxus baccata* L. in Anatolian forests (from Kırca et al., 2015)*

The companionship between trees and human beings can be traced back to the first existence of man on earth, but undoubtedly, yew has played a particular role in this long journey. In addition to being used because of its valuable wood for turnery, marquetry and wood carving, as well as for manufacturing weapons (i.e. bows, spears and knives) (Forestry Compendium, 2005), yew had various symbolic meanings in the spiritual world of people in many different cultures (DeLong and Prange, 2006; Hageneder, 2013). For example yew was held sacred by the early Indo-European people, while believed to be immortal and considered as a symbol of everlasting life probably because of remaining resolutely green like 'an island of life and colour' all through the year, having the ability to live for thousands of years and hosting numerous living organisms (Parker and Levington, 1999). Although it became known as the 'tree of death' in the 17th and 18th centuries in Europe, because of its toxicity and it was frequently seen in the graveyards and associated with the mass slaughters of the Middle Ages, this tree was well favoured by many artists and scientists like Charles Darwin, Felix Medelssohn-Bartholdy, T.S. Eliot, William Shakespeare, William Wordsworth, etc. (Hageneder, 2013). Yew has also been widely used in landscaping as an ornamental plant and in windbreaks, and considered as one of the most suitable plants for topiary with *Buxus* sp. (Hobhouse, 2002), while it is associated with sacred sites mostly in western countries (Forestry Compendium, 2005). Although yew has an ancient reputation as a toxic and magical plant (Itokawa, 2003), it has been traditionally used in the cure of various diseases such as headache, diarrhoea, cardiac problems, etc. (Forestry Compendium, 2005). Today, taxol found in *Taxus* species is used to treat cancer (Itokawa, 2003; DeLong and Prange, 2006).

Unlike some countries (i.e. Ireland, UK, Spain, U.S.A. and Canada) yew is not widespread in Turkey, while only *Taxus baccata* L. natively grows mainly in the broadleaf forests of northern Anatolia as a relict species. However Parker and Levington (1999) emphasized that some fine stands of monumental *T. baccata* growing in broadleaf forests still exist in north-eastern Turkey outside Europe (Photograph 13). Actually the presence of *T. baccata* in different parts of Anatolia can be traced back far into history. Theophrastus (1999a) gave detailed information about the yew trees on Mount Ida (western Anatolia), where *T. baccata* was also quite rare as today: '*The yew has also but one kind, is straight-growing, grows readily, and is like the silver-fir, except that it is not so tall and is more branched. Its leaf is also like that of the silver-fir, but glossier and less stiff. As to the wood, in the Arcadian yew it is black or red, in that of Ida bright yellow and like prickly cedar; wherefore they say that dealers practise deceit, selling it for that wood: for that it is all heart,*

Photograph 13: Common yew (*Taxus baccata*) stand in Gümeli Nature Monument (Alaplı/Zonguldak) (K. Cengiz; Archive of Zonguldak Forest Enterprise-2016).

Photograph 14: Common yew (*Taxus baccata*) stand in Gümeli Nature Monument (Alaplı/Zonguldak) found as groups of trees in a mixed stand (N. Aksoy).

when the bark is stripped off; its bark also resembles that of prickly cedar in roughness and colour, its roots are few slender and shallow. The tree is rare about Ida, but common in Macedonia and Arcadia; it bears a round fruit a little larger than a bean, which is red in colour and soft; and they say that, if beasts of burden eat of the leaves they die, while ruminants take no hurt. Even men sometimes eat the fruit, which is sweet and harmless'. Ancient yew symbols on the finds from Troy and some evidence related to Hittite culture also indicate that *T. baccata* was present in that region in ancient times, while it was embraced as the ultimate symbol of life and renewal (Hageneder, 2013). Ancient documents do also reveal that Amanus Mountains (south eastern Anatolia) were not only a source of cedar, boxwood, and cypress (Rowton, 1967) but also of yew, while yew was well favoured by Egyptian palace-furniture makers (Meiggs, 1982). Furthermore, one of the finest heads that have survived from Ancient Egypt, of Queen Tiu, wife of Amenhophet III, and some coffin boards are made of yew, which was probably exported from Amanus Mountains (Meiggs, 1982). Surprisingly, some structures made of yew were found in Central Anatolia, in Gordium, the capital city of ancient Phrygia, whose neighbourhood is almost treeless today. Juniper and yew logs were used for the construction of the outer wall of a royal tomb (Meiggs, 1982), while there was a stool whose front and back faces made of boxwood were elaborately inlaid with yew (Young, 1974; Simpson, 2012).

Although yew still retains its traditional and trade value in Turkey as well as many European countries, they have been strongly depleted mainly because of the direct and indirect actions of mankind (i.e. deforestation, selective felling, grazing or inaccurate planning and management) and partly of their weak competitive ability (Iszkulo et al., 2012). So today, they occur either as individual trees or group of trees in a mixed forest stand, or small patches of yew forests (Mayer and Aksoy, 1986; Svenning and Magård, 1999; Thomas and Polwart, 2003; Piovesan et al., 2009) (Photograph 14), while they represent one of the most endangered priority habitats in a great part of their distribution in Europe (Farris et al., 2012) and *Taxus* have received priority habitat status under Annex I of the EU Habitats Directive in seven different habitat types (European Comission, 2007). Thus, there is an urgent need to define remaining *T. baccata* habitats and apply effective conservation and restoration techniques in Turkey before these wise residents of ancient woodlands become history.

Considering the intensive use of yew through time in Turkey, ancient woodlands with yew have been highly degraded, while remaining ancient stands still continue to be threatened by many natural and social factors. This requires the urgent need for integrative techniques for the conservation and restoration of woodlands containing yew trees.

Can we classify common yew as an ancient wood?

In Turkey, yew is defined as a species whose existence can be traced back from hundreds of years to neolithical ages in primary or natural/near natural woodlands. These are not only appreciated as icons of most important wooded landscapes, but also as unique components of cultural heritage. In this context the main reasons of the classification of yew as an ancient wood is summarized in Figure 13.4 and explained in detail below:

- Yew has been continually used by many civilizations not since hundreds, but thousands of years. This indicates its ability to survive as a woodland species for such a long time, while on the other hand shows its resistance to climatic variability and over-exploitation.
- The wood of ancient yew is of high quality and in high demand, while old individuals of age as 500 can be found in their natural habitats. Yew is a slow-growing species.
- Yew has potentially wide distribution area in Turkey, considering its native stands in northern, western and southern Turkey.
- Yew is easily pruned and shaped and has been a common component in parks, gardens, palaces, cemeteries and churches for centuries and is widely used as a hedging plant in all amenity situations.
- Yew has been an important element of tree symbolism for thousands of years in many different cultures.

Where to find *Taxus baccata* in Turkey?

Taxus baccata L. has a distribution area concentrated mainly in the Euxine broadleaf mixed forest zone in northern Turkey. Other main distributions are on Kaz Mountains (western Anatolia) and Amanus Mountains (eastern Taurus range in southern Turkey (Figure 13.7). Mayer and Aksoy (1986) reported some other locations of *T. baccata* between the altitudinal zones 500 to 1400 m a.s.l., while Davis (1965) remarked some further locations as Çilingoz (Istanbul), Yedigöller National Park (1000 m a.s.l.), Küre to Inebolu (Kastamonu-1000 m a.s.l.), Çoruh (1400 m a.s.l.), Bozdağ (Denizli-1800 m a.s.l.), Gülek Boğazı (İçel) and Amanus (Hatay-1800/1900 m a.s.l.).

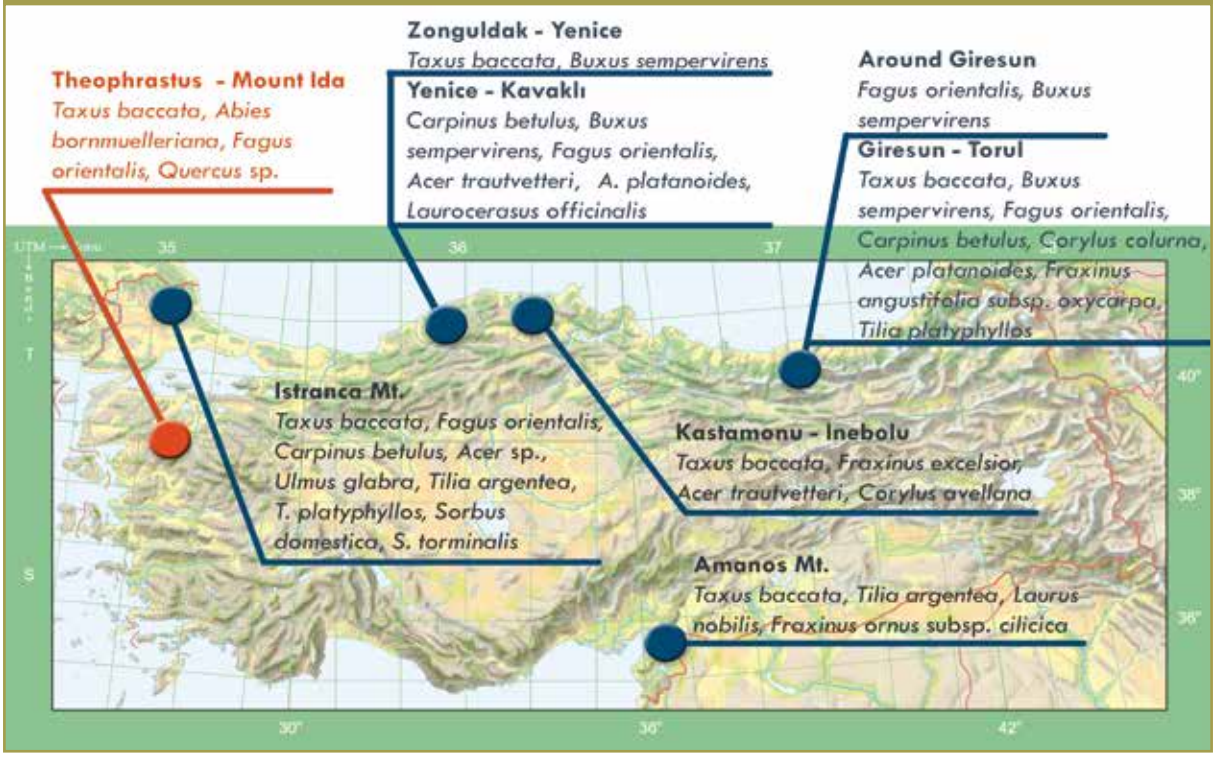
Conservation and restoration of common yew stands in Turkey

In Turkey, populations of yew have been destroyed and others are under threat in many parts of its native range, as it is not able to regenerate or broaden its population (so is the situation with boxwood too). Basically human induced effects (i.e. careless treatment, over-exploitation, unsuitable forestry practises) caused the clear reduction of its distribution area to its present state. Actually, the story of dramatic decline of yew populations in Turkey corresponds well with the story of many other ancient tree species (Figure 13.5). Therefore, today, yew is in the 'Red List of Endangered Species' in Turkey. However a designation for its conservation is still lacking, as well as its restoration in degraded forest landscapes containing ancient yew. It is thought to be very important to research native areas where yew is under threat and to conserve/restore these sites (Çolak et al., 2012) (Photograph 15).

There are some simple, but very important steps to be taken for conserving as well as providing the sustainability of the remaining ancient yew in Turkey based on fundamental principles of nature protection. For example when we consider that *Taxus baccata* L. is distributed in different parts of Turkey and mostly found either as individual or group of old trees scattered

Main distributions of *Taxus baccata* and accompanying tree species
(according to Mayer and Aksoy (1986) from Kırca et al., (2016)

Figure 13.7

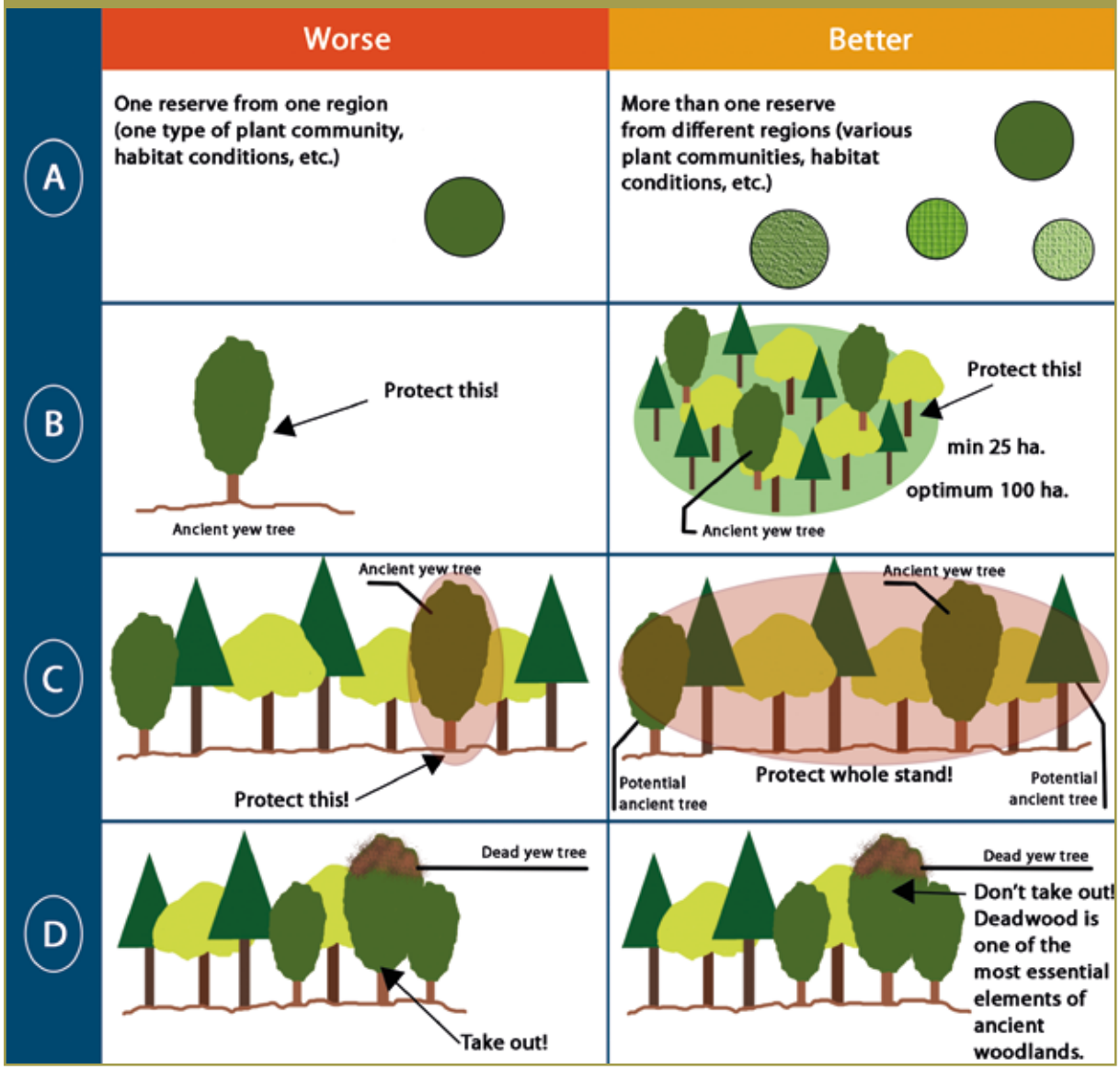


Photograph 15: Common yew (*Taxus baccata*) stand in Gümeli Nature Monument (Alaplı/Zonguldak) (F. Hageneder).

in a forest stand, first of all there is an urgent need to understand that one reserve from one region is not enough. Such an approach would lead to conserve one type of plant community, habitat conditions, etc. that yew has grown into, but overlook other remaining habitats. So, selecting more than one reserve from different regions would provide protecting various plant communities and habitat conditions of ancient yew stands (Figure 13.8a). On the other hand, a landscape approach should be adopted rather than protecting one single ancient yew tree considering that generally minimum of 25 ha reserve area is recommended for providing the sustainability of a tree population (Figure 13.8b). However protecting only the ancient yew trees in a forest stand also wouldn't be enough, while other trees of different species should be considered as potential ancient trees as well (Figure 13.8c). Eventually special attention should be given to dead yew trees, since deadwood of yew as well as of other species is one of the most essential elements of

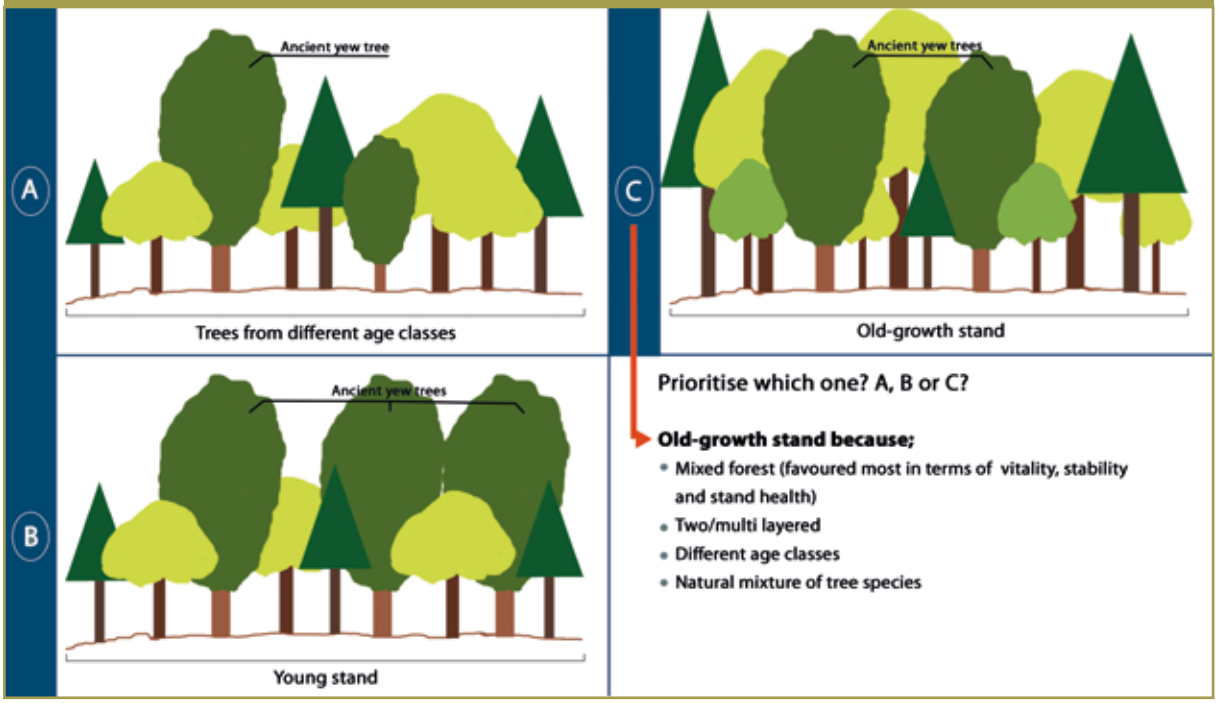
Figure 13.8

Some simple but important issues providing the sustainability of the remaining ancient yew in Turkey (Kırca et al., 2016)



Prioritising stands in reserve selection by the conservation of ancient yew
(Kırca et al., 2016)

Figure 13.9



ancient woodlands (Figure 13.8d).

Yew is generally found in broadleaf mixed forests that represent different characteristics in Turkey, while there must be some further criteria by selecting reserves in order to determine which one(s) need to be protected/restored first. Thus understanding the stand structure plays a vital role for prioritising yew landscapes, which are mainly stands containing trees from different age classes (Figure 13.9a), young stands (Figure 13.9b) or old-growth stands (Figure 13.9c). In this situation old-growth stands should be prioritised firstly because of their stand structure as being composed of mixture of natural deciduous and broadleaf trees and having a two/multi layered stand structure of different age classes (Photograph 16). Such an old-growth stand structure was described by Peterken (1983) and Goldberg et al. (2007) as habitats containing a very high proportion of rare and vulnerable plant and wildlife species as well as providing refuges for characteristic inhabitants of primeval woodlands such as lichens.

A very good example to why prioritising old-growth stands may be given from northern Turkey, Kavaklı (Yenice) located on the slopes facing Black Sea (Figure 13.10). This stand does not only contain yews with a diameter over 110 cm reaching ca 2 m, but these trees are also accompanied by *Carpinus betulus, Fagus orientalis* and *Acer platanoides* who are quite old as well. Furthermore *Buxus sempervirens*, a very rare ancient tree species is also found under *Taxus baccata* as seen in stand profile (Aksoy, 1982) (Figure 13.10). Such a stand would represent an ideal example by the reserve selection in order to understand what to protect first.

The conservation and restoration of ancient common

Photograph 16: Multi-layered common yew (*Taxus baccata*) stand in a mixed forest (Gümeli Nature Monument - Alaplı/ Zonguldak) (N. Aksoy).

yew in Turkey requires a systematic approach in the landscape level. After defining some basic principles as explained above, there is a need to take some main steps in order to respond to the questions 'What' and 'How' to conserve/restore?. There are also some other important issues to be considered by the implementation of conservation and restoration actions, which are summarised below (after Çolak et al. 2012; Kırca et al., 2016):

- In natural stands, yew does not easily re-invade areas where it was once present, endangering its existence in managed areas with careless treatment and over-

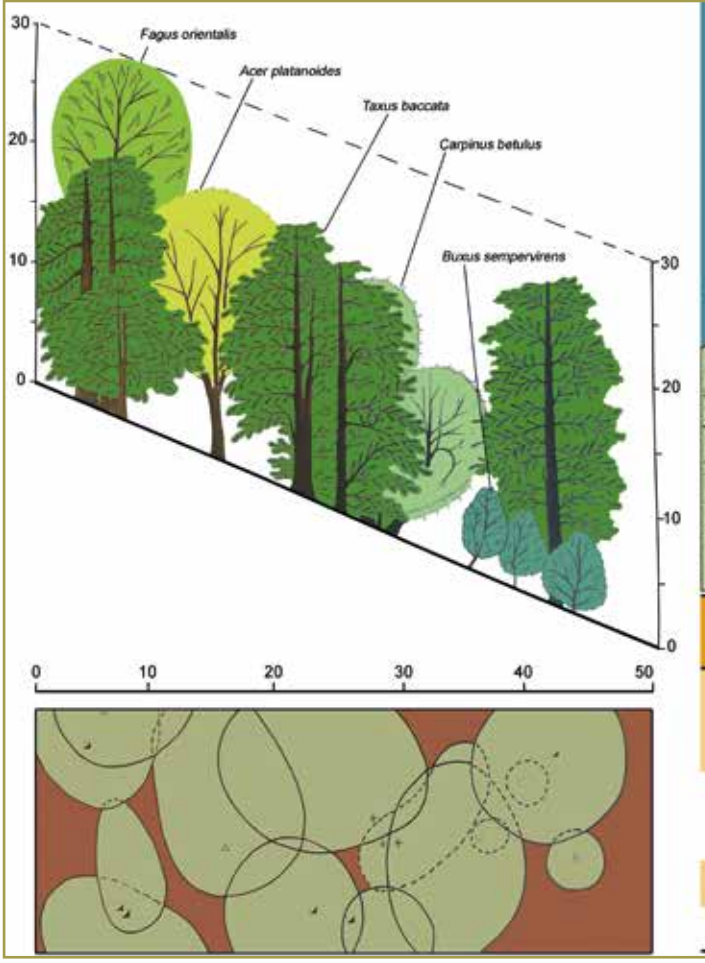
exploitation. It is necessary to keep and preserve yew as groups or strips under tree stands with a dense understorey. It grows very slowly with a very low annual increment, therefore it is important that old individuals should be preserved in terms of nature conservation (Photograph 17).

- It grows naturally from low altitude to high mountains. Therefore adaptation of basic principles of mountain forestry plays an important role by the restoration and conservation of ancient yew forests.
- Yew is shade-tolerant understorey species in pure forests (i.e. beech) and mixed broadleaved forests (Vegetation types: deciduous forests; mixed forests; mountain forests; coniferous forests; riparian forests). In Turkey, it is found in very different forest communities (Mayer and Aksoy, 1986) such as *Carpinus orientalis-Pinus sylvestris forest with Arbutus andrachne, Juniperus oxycedrus, Ulmus minor, Carpinus orientalis, Pinus sylvestris, Quercus macranthera* ssp. *syspirensis* and *Pictacia terebinthus* in northern Turkey, and in *Fagus orientalis-Acer platonoides-Taxus baccata-Carpinus orientalis* forest in western Turkey. Therefore varying conservation/ restoration and silvicultural strategies are required in habitats of different forest plant communities.

Photograph 17: An old common yew (*Taxus baccata*) found in a mixed stand with a dense understorey in Gümeli Nature Monument (Alaplı/Zonguldak) (N. Aksoy).

A stand profile from Kavaklı (Yenice) containing Taxus baccata and diameter and height values of tree species (transformed by Kırca et al., 2016; after Aksoy, 1982)

Figure 13.10



Tree species	Diameter (cm)	Height (m)
Taxus baccata	194	19
	143	22
	116	21
Carpinus betulus	111	19
	75	14
Fagus orientalis	109	29
Acer platanoides	90	22

Case Study 2

What happened to the ancient common boxwood (*Buxus sempervirens* L.)?: From boxwood forest to the red list of endangered species in Turkey (from Çolak et al., 2012)

The word *Buxus* comes from the Greek word 'pyxos, pykos' which means 'hard', and Aristotle and Theophrastus used this name for *B. sempervirens* (Hecker, 1995). In Latin, 'sempervirens' means 'evergreen' indicating its green in all seasons (Çolak, 2003b). Common boxwood had many functions throughout the history and was highly appreciated by cabinet-makers because it had a close, straight grain, was hard and strong but easily worked, and because it had an attractive pale colour with little difference between heart and sapwood. Common boxwood rarely grows to a great height and never produces a thick trunk (Photograph 18), but was a valuable wood for small objects or parts of objects which had to be strong and might need delicate workmanship. It was therefore particularly associated with combs and musical instruments, especially the flute and lyre. In furniture it could be used for beds, couches, chairs, and small tables, but it was more commonly used in inlays and veneers where its pale colour provided an attractive contrast with darker woods (Meiggs, 1982). The hard, highly polished wood of the boxwood was used in Solomon's temple in Jerusalem too (Isaiah, 60:13).

King Assurnaspial (881-859 BC) had shown the Assyrian appreciation of boxwood by including in his booty from a campaign in Syria, after he had crossed the Euphrates at Charchemish, 'beds of boxwood, chairs of boxwood, tables of boxwood inlaid with ivory' (Meiggs, 1982). On the other hand Phyrgians in Central Anatolia used to make their furniture from cedar, aromatic juniper, boxwood, pine wood and walnut. A Phrygian burial mound of the 8th century BC at Gordium (the capital city of ancient Phrygia) contained an ornate boxwood table with intricate geometric juniper inlays and a walnut top. Other furniture from the Gordium mounds shows that Phrygian craftsmen also used maple, oak, cedar, pine, and yew (Young, 1974). Thus boxwood has been widely used particularly for the production of furniture, stick, ashtray, spoon, fork, etc., which still continues today.

In the Roman period, the boxwood was so closely associated with certain objects that Latin poets used the word 'buxum' for comb, flute and top. Since that period it has been widely used for musical instruments. A Roman jury law specifies that the ballots shall be of boxwood, and it may be added that balls of boxwood are used in drawing lots for fixtures in the annual English football-cup competition. Boxwood was also used in Greece for writing exercises and in Rome for drawing exercises as it was in Italy during the Renaissance. In the Erechtheum accounts use of boxwood is found for the frames of ceiling coffers (Meiggs, 1982).

B. sempervirens wood has been used for centuries, and was traditionally used in England particularly to make looms (Hegi, 1957). It was also used for making printing blocks in China many centuries ago. The statue of Apollo in Olympos-Hellas was carved from *B. sempervirens* wood. It is also commonly used to make flutes and other wind instruments, is the best wood of all materials for wood-engraving and is highly prized by turners. Other major uses of *B. sempervirens* are for making chess figures, pipe heads, printing blocks, bowls, combs, jewellery boxes, walking sticks, tool handles, rulers and other such articles (Hausen, 1981; Brondegaard, 1992; Çolak, 2003a). Root wood is also specially prized by turners and cabinetmakers (Chiej, 1984).

Photograph 18: Common boxwood (*Buxus sempervirens*) stand in Kaçkar Mountains National Park (Çamlıhemsin/Rize) (O. Kurtoglu).

Anatolia played an important role, particularly for Mediterranean civilizations, in ancient wood (cedar, oak, pine, fir, etc.) supply, while common boxwood comes into prominence among over 500 shrub and tree taxa found in Turkey. After boxwood sources were severely depleted in Syria, it was no longer an important source of supply for Romans and Greeks. According to Theophrastus (1999a) the most famous box came from Mount Cytorus (Amasra) in Paphlagonia (Central Black Sea Region) and the neighbouring district, and the association of box with the mountain was so close that 'cytoreus' was even used as a synonym for 'buxeus' (Meiggs, 1982). Thus Strabo (1856) also reports that Cytorus was the marketplace and was a source for common boxwood.

In Turkey, the plant has different traditional uses in folkloric medicine too. For instance, the tea form of common boxwood, named as 'şimşir' in Turkish, is drunk a glass per day prior to meals for antihelminthic,

diaphoretic, and cholagogue purposes in Anatolia (Baytop, 1999). Common boxwood owes its popularity not only to tradition, but also to its many landscape uses. Some of the ways the plant can be used are noted by Relf (2001) and Hobhouse (2002). These are (1) As plants alone or in combination with other plant material in structure plantings for homes and public buildings; (2) To separate, define, enclose, or screen areas; (3) To provide background for other plantings; (4) To provide the overall pattern or framework of a formal garden; (5) For framing vistas; to outline a terrace, parking area, flower border, or walk; (6) For planter boxes or large containers; and (7) As topiary pieces, in lieu of sculptures. After the 18th century, the plant was also introduced to the Ottoman gardens (e.g. palace gardens, home gardens through the Bosphorus, etc.) and was highly appreciated. It also featured in gardens of the Middle Ages (i.e. monastery and palace gardens) and baroque gardens in Europe (Çınar and Kırca, 2010). Therefore, the box tree could also be noted as one of the symbols of transition from a naturalistic to a formal garden style in Ottoman gardens.

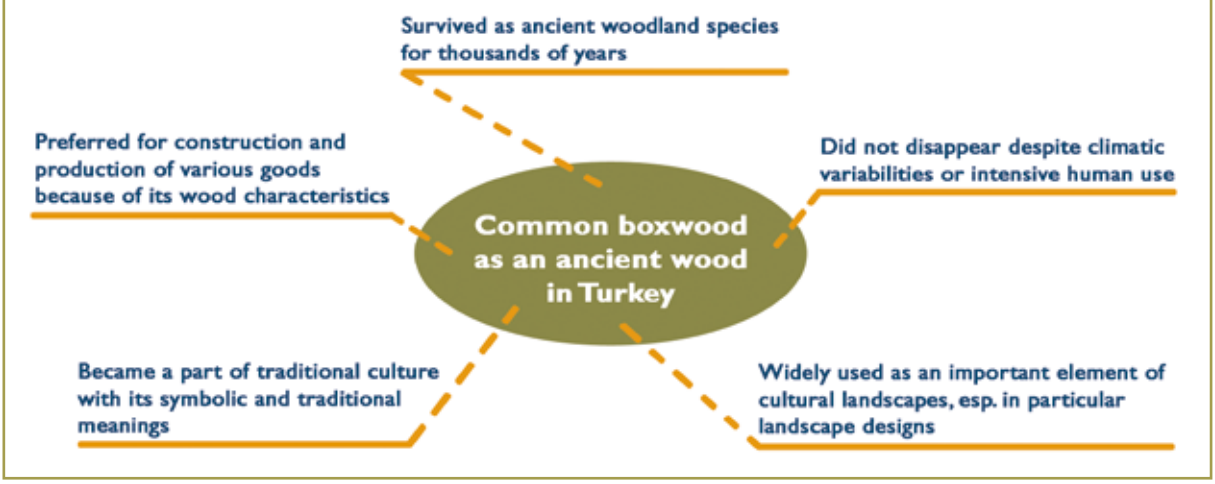
Why common boxwood is classified as ancient wood

The main reasons of the classification of common boxwood as an ancient wood is summarized in Figure 13.11 and explained in detail according to Çolak (2005) below:

- Common boxwood has been continually used by many civilizations not for hundreds but thousands of years. This indicates its ability to survive as a woodland species for such a long time, while on the other hand shows its resistance to climatic variability and over-exploitation.
- The wood of ancient common boxwood is of high quality and in high demand, while old individuals of age as 500 can be found in their natural habitats.
- Common boxwood is a slow-growing species. Seedlings grow very slowly between 1 and 7 years, typically being 15 cm tall after 4 years. Diameter increments are also very slow, with for example, trunks of only 5 cm diameter achieved after 100 years in France (Aichele and Schwegler, 1996), 6.5 cm and 12 cm diameter after 103 and 140 years respectively in Turkey (Çolak, 2003b), with tree trunks up to 50 cm diameter after 500 years according to Erlbeck et al. (1998). The slow growth of common boxwood leads to the formation of a very dense annual ring. The specific gravity of fresh cut wood is 1.2-1.26 g/cm³, and 0.99-1.02 g/cm³ when air-dry, and will sink in water (Çolak, 2003a). Large box tree to 8-12 m high and 60 cm in trunk diameter still exist in Rize (Northeast Anatolia) (Aksoy, 1998). The wood is very hard, heavy, compact and fine-grained. The heartwood is a pale yellow colour, takes a beautiful polish, is not liable to insect attack and it is twice as hard as oak species (Grieve, 1984). The diameter of wood used in turnery is generally about 10 cm and for that reason, large-sized common boxwood have been used for a long time and have mostly disappeared in natural areas such as those in Spain and Turkey from where large quantities of common boxwood have been exported.
- Common boxwood is easily pruned and shaped and is a common component of parks, gardens, palaces, cemeteries, churches and is widely used as a hedging plant in all amenity situations.
- Box tree has a potentially wide distribution area in Turkey, considering its native stands in northern and southern Turkey.
- Common boxwood has been an important element of tree symbolism for thousands of years in many different cultures. It is a revered plant in some Christian cultures, supposedly warding off evil spirits. The tree has numerous religious uses, notably in Europe, which Crosnier (1998) considers to be due to the persistent evergreen foliage of common boxwood symbolizing the continuity of life between this world and the next (holly, *Ilex aquifolium*, is often thought of in the same

Main reasons for the classification of common boxwood (*Buxus sempervirens* L.) as an ancient wood in Turkey (transformed after Çolak et al., 2012)

Figure 13.11



way). In France, branches are cut on Palm Sunday and put on graves, hung inside houses and stables, and even placed in cultivated fields, as protection against misfortune and illness. Sacred common boxwood is supposed to protect a household against anything that might upset the stability of life, including storms, fires and diseases; and for disposal it should be burnt, never thrown away (Crosnier, 1998). In other parts of Europe it is also hung in sanctified homes on Palm Sunday, protecting them from witches and diseases (Hegi, 1957), and in some cultures is symbolically used on woman's day, 15 August (Schmidt, 1990a). Leaves of the plant were also used as an ornament for brides in Thrace (north-west of Turkey) (Kültür, 2008).

From decline to extinction: what happened to the ancient common boxwood in Anatolia?

In Turkey, in many parts of its native range, populations of common boxwood have been destroyed and others are under threat, as it is not able to regenerate or broaden its population (Çolak, 2003c). Basically human induced effects (i.e. careless treatment, over-exploitation, unsuitable forestry practices) caused the clear reduction of its distribution area to its present state. For example, Hegi (1957) reports that 10.000 tonnes of large common boxwood timbers were brought to England from North Anatolia, Turkey in 1876, and clearly, the felling of such quantities of wood in a single year would rapidly deplete a native stand.

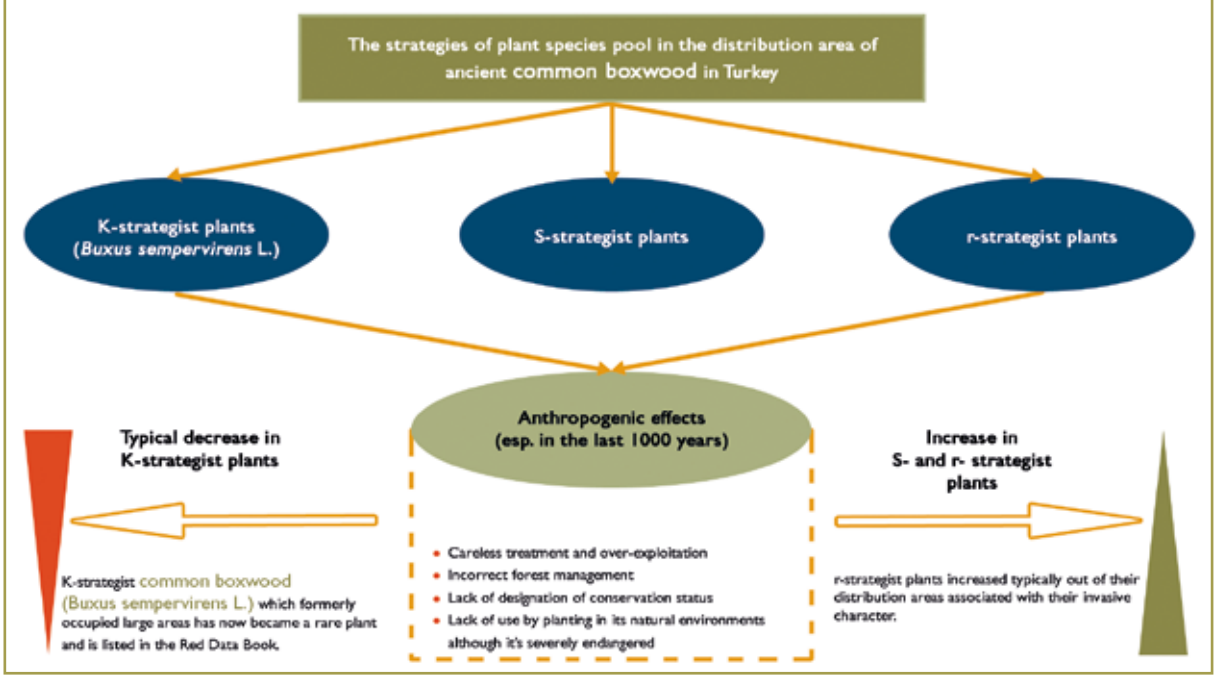
On the other hand, knowing the life strategy of the common boxwood is not only a starting point for nature conservation but will also be very useful in the practice of close-to-nature silviculture. Failure to take notice of the strategies will result in some species declining in abundance while others could invade the forests (Figure 13.12). Based on the research by Çolak (2003a,b,c) common boxwood is characterized as a K-strategist. Therefore, today, common boxwood is on the 'Red List of Endangered Species' in Turkey (Çolak, 2003b). However, a designation for its conservation is still lacking, as well as its restoration in degraded forest landscapes with ancient common boxwood. It is thought to be very important to research native areas where common boxwood is under threat and to conserve/restore these sites.

Restoring degraded forest landscapes to bring back ancient common boxwood into their native habitats

Common boxwood has been widely introduced outside its natural range over many centuries as an ornamental and hedge tree due to its evergreen foliage, but not as a plantation species for wood production (Çolak, 2005). Some typical examples are seen in central Europe where common boxwood has been a major ornamental plant in the palace gardens, baroque gardens, churchyards, villages and cemeteries (Çolak, 2003a). In the Middle Ages, it was planted in churchyards due to its pharmaceutical characteristics and for religious reasons; Great Karl, for example, encouraged the planting of common boxwood in churchyards (Schmidt, 1990b). The American Boxwood Society reports the first planting in the USA in 1653 at

Extinction of common boxwood (*Buxus sempervirens* L.) as a prominent ancient woodland species (transformed after Çolak et al., 2012)

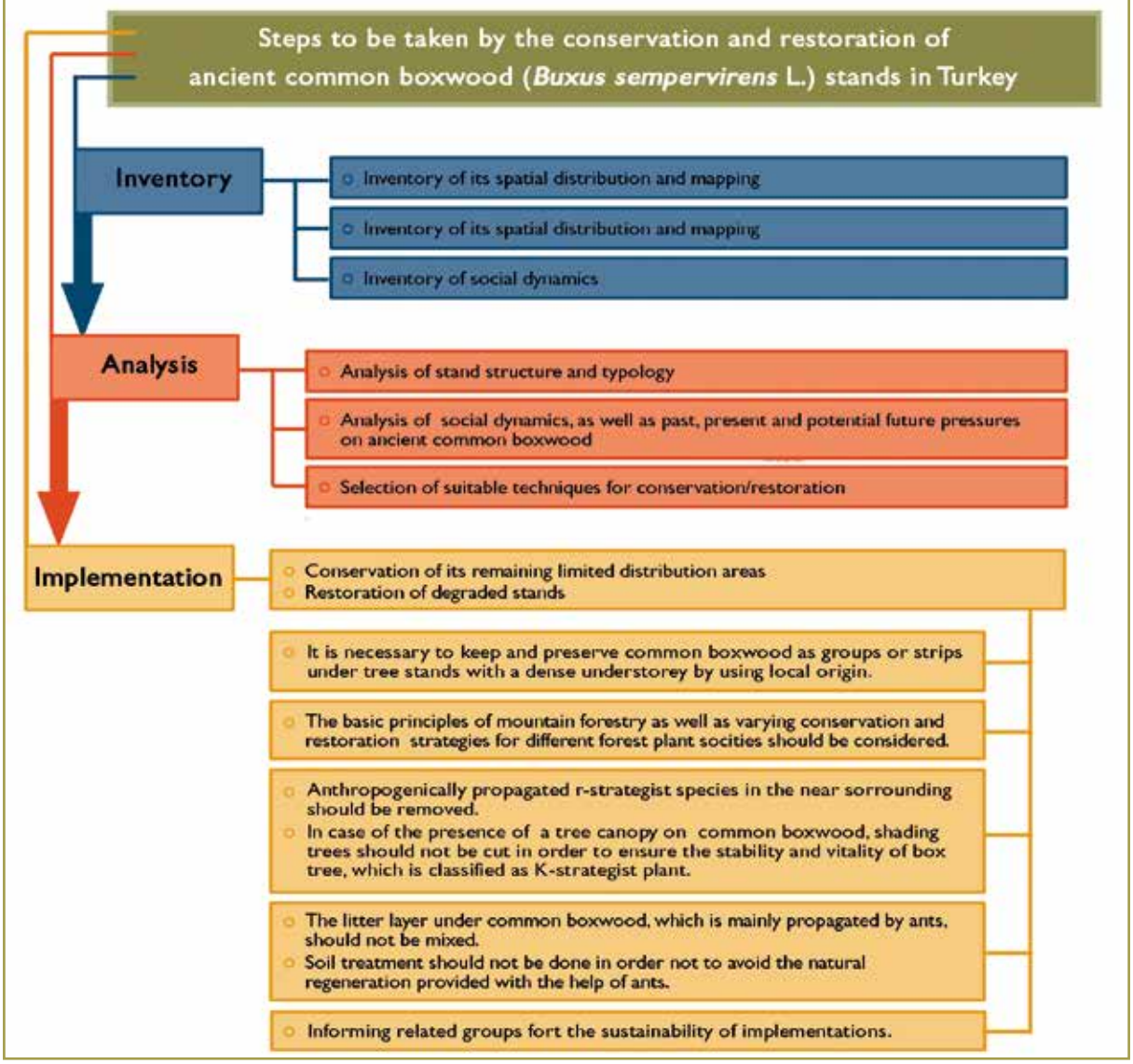
Figure 13.12

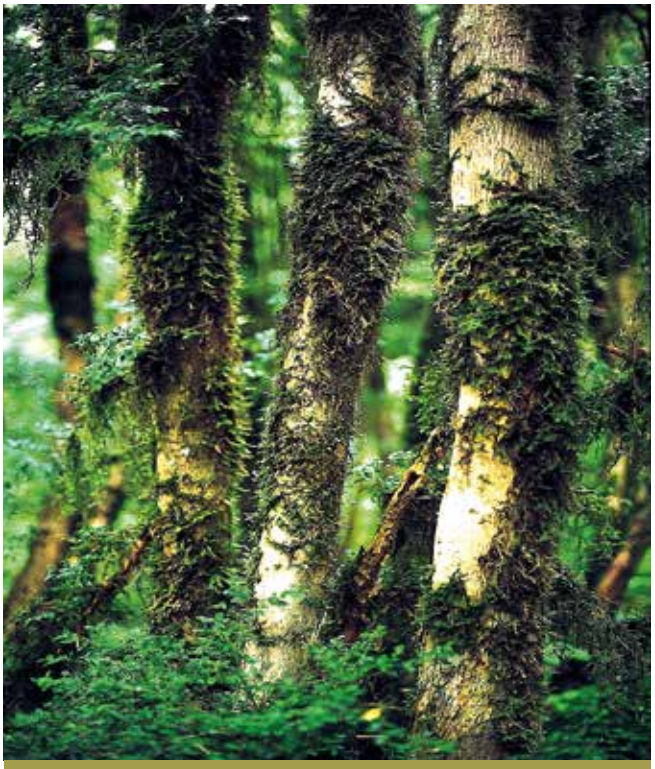


Sylvester Manor on Shelter Island, off Long Island in New York State. The seed came from Amsterdam and it can be seen growing in many public and private gardens in the USA, most frequently in the Mid-Atlantic area. It is probably far more widespread as an introduced species than is indicated in the distribution list. In other words common boxwood is raised today by many nurserymen, landscapers and homeowners for horticultural interests as it is a slow growing, evergreen and easily formed tree, tolerant of pruning, and commonly used in parks, gardens, borders, fountains, hedges, domestic gardens, large formal gardens and in many places individually, in groups and/or hedges. It can be trained to grow in various shapes such as prostrate, globe, half-erect, weeping, columnar, and pyramidal. There are also low or tall forms and fast- or slow-growing cultivars. It is specifically grown in containers, for topiary, and as a bonsai. In Europe, the species is also common in graveyards and churchyards (Çolak, 2005). Far from its use basically in landscape designs in Europe, boxwood has been particularly appreciated for its functional features in construction and art works in Anatolia over thousands of years. Therefore conservation of the last remains of its ancient habitats and restoration of degraded ancient common boxwood stands is not only an ecological need, but also a measure against the loss of 'cultural heritage'. The basic principles for the conservation and restoration of ancient common boxwood in Turkey is summarized in Figure 13.13, while it is represented in 3 main steps which are: (1) inventory of the spatial distribution of remaining ancient common boxwood stands with stand structure and topology (this step should also contain a social inventory in order to understand the social dynamics effecting species' distribution in a given area); (2) analysis of the obtained data and selection of suitable techniques for conservation/restoration and (3) implementation of

Figure 13.13

Basic steps for the conservation and restoration of ancient common boxwood (*Buxus sempervirens* L.) as a prominent ancient wood in Turkey
(transformed after Çolak et al., 2012)





Photograph 19: Common boxwood (*Buxus sempervirens*) grows very slowly with a very low annual increment (Kaçkar Mountains National Park, Çamlıhemsin/Rize) (O. Kurtoglu).

Photograph 20: It is necessary to keep and preserve Common boxwood (*Buxus sempervirens*) as groups or strips under tree stands with a dense understorey (Kaçkar Mountains National Park, Çamlıhemsin/Rize) (O. Kurtoglu).

conservation/restoration practises (Çolak et al., 2012).

In natural stands, common boxwood does not easily re-invade areas where it was once present, endangering its existence in managed areas with careless treatment and overexploitation. It is necessary to keep and preserve common boxwood as groups or strips under tree stands with a dense understorey. It grows very slowly with a very low annual increment, therefore it is important that old individuals should be preserved in terms of nature conservation (Çolak, 2003b) (Photograph 19 and 20). For the continued existence of common boxwood, it is recommended that different regional and altitudinal genetic reserve areas are established, as the species cannot easily regenerate and is classified as an endangered K-strategic species (Çolak, 2003c).

It grows naturally from low altitude to high mountains, rising to 800 m in the Jura, Switzerland, 1500 m in Anatolia, Turkey, 1600 m in the Pyrenees, France, 1900 m in Spain and 2000 m in the Olympics, Greece (Hegi, 1957; Erlbeck et al., 1998). Where introduced, it grows at even higher altitudes, such as in the Andes at 2830 m in Ecuador and 3600 m in Bolivia (Missouri Botanical Garden, 2003). Therefore adaptation of basic principles of mountain forestry plays an important role by the restoration and conservation of ancient box tree forests.

Common boxwood is shade-tolerant understorey species in pure forests (i.e. beech) and mixed broadleaved forests (Vegetation types: deciduous forests; mixed forests; mountain forests; coniferous forests; riparian forests) (Hegi, 1957; Çolak, 2003a). In Turkey, it is found in very different forest communities (Mayer and Aksoy, 1986; Çolak, 2003b) such as *Carpinus orientalis-Pinus sylvestris* forest with *Arbutus andrachne, Juniperus oxycedrus, Ulmus minor, Carpinus orientalis, Pinus sylvestris, Quercus macranthera* ssp. *syspirensis* and *Pictacia terebinthus* in northern Turkey, and in *Fagus orientalis-Acer platonoides-Taxus baccata-Carpinus orientalis* forest in western Turkey. Therefore varying conservation/restoration and silvicultural strategies are required in habitats of different forest plant communities.

Common boxwood has a low reproductive capacity because of the low levels of seed production (Çolak, 2003c). The seed dissemination capacity is also low, most seeds falling within 1-5 m of the source tree to a maximum distance of 20-25 m whereas the majority of the fallen seeds are transported by ants. Seedlings do not emerge on sites where there is no litter layer. Young seedlings are, however, very tolerant to shade, growing with 3.4-65% full sunlight, and demonstrate good growth in small gaps in forest stands. Thus while natural regeneration may be seen in sparsely populated stands, seedlings rarely grow in stratified closed stands with 2-3 strata and regeneration is not observed in open or exposed sites. In the first year, many seeds germinate but the number of seedlings decreases rapidly in following years. However, since there is re-sprouting from the stem and roots following damage to the tree, regeneration is common from such sprouts. Leaves and the bark are reported as lethally poisonous

(Çolak, 2003c). Planting common boxwood requires special attention. The wide planting hole should be deep enough to place the root-ball, and backfilled with porous topsoil which promotes rapid root growth. Balled plants should be planted no deeper than they were growing in the nursery as deep planting causes an early loss of plant vigour and eventual plant death. Periodic heavy watering is more beneficial than frequent light watering as water should reach the entire root-ball, necessary for the development of a healthy, well-branched root system, resistance to drought and nutritional stress (Relf, 2001). It should also be considered that fresh growth is very sensitive to late spring frosts.

Conclusion

The solitary wild fruit trees, which characterize much of the Anatolian landscape today, are considered by Zohary (1973) and Mayer and Aksoy (1986) to be remnants of the woodlands that occupied most of inner Anatolia before the interference of man. As also seen in both case studies 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. These actions also led to the change of species compositions in many forest landscapes, as well as species loss. In this context palaeoecological studies have greatly increased our knowledge of Late Quaternary environmental changes in Turkey and the eastern Mediterranean arising from both climate change and human impact (e.g. Bottema et al., 1993a, 1993b; Eastwood et al., 1998, 1999). However, in Turkey many palynological studies are spatially very limited (e.g. Aytuğ, 1970; Aytuğ and Görcelioğlu, 1993, 1994; Bottema et al., 1993a, 1993b) and correlation of sediment profiles from different regions is often impossible, because of the very distinct local differences in deposition rates. Furthermore, there are chronological problems, particularly for the mid-Holocene onwards, in relation to vegetation development in different regions of the Near East (Çolak and Rotherham, 2006). Still scientific evidences indicate that many tree species (i.e. *Cedrus libani* A. Rich., *Pinus nigra* Arnold. subsp. *pallasiana* (Lamb.) Holmboe, *Cupressus sempervirens* L., *Fagus orientalis* Lipsky., *Juniperus* sp., *Buxus sempervirens* L., *Ulmus* sp.) succeeded to survive in their original habitats from neolithical times until today. Therefore ancient wood in Anatolian is still more 'original' or 'natural' in its composition (see; Schwarz, 1936; Walter, 1968; Schmidt, 1969; Zohary, 1973). Furthermore, many of ancient wood of the vegetation types are felt to have a high ecological resistance and an ability to regenerate.

Considering the previous degradation and the advantages of natural diversity there's an urgent need for integrative conservation and restoration approaches for ancient woodlands in landscape level in Turkey. In this context cultural richness may play a vital role as well as natural diversity. For example, according to Okan and Ok (2006), beliefs on 'yatır' or 'türbe' (graves of ancient holy persons) found on many places in Anatolia create an opportunity for nature protection by transferring tree cult of old shaman Turks. These places and vegetation surrounding them (i.e. oak, pine, beech) are mostly protected. When a single tree or small woodland different from the others is seen, probability of finding such a holy grave or a story about it is strongly high (Okan and Ok, 2006). Some of these trees or woodlands are even the last remnants of ancient vegetation characterizing the area, while some of them may be plantations.

Today the priorities for nature conservation have changed. Woodland conservation priorities are now much broader than preserving ancient fragments, while continuity and connectivity of these particular habitat patches in the landscape level are newly appreciated concepts (Taylor et al., 1993; Tischendorf and Fahrig, 2000; Kırca, 2009) in Turkey. For instance in UK the main threat to woodland is less often the catastrophic loss of whole woods, but the more insidious, creeping attrition, for example, from the prevention of tree regeneration by over-grazing, and the slow death of an aging population of trees in the uplands (Goldberg et al., 2007). Rackham (2003) comments as: 'The ancient woods will remain on the map. A very few will be strenuously protected. More will escape through isolation or small size. The rest will have their guts eaten out of them by deer and sheep'. However in Turkey, the situation seems rather different, while the lack of recognition of importance and therefore gradual loss of ancient trees through clearance for firewood (particularly near rural settlements) or unsuitable forest management practises plays an important role in this process. On the other hand urbanization and industrialization, tourism, human induced forest fires (i.e. Mediterranean region), over-grazing, rural pressure and expansion of infrastructure are still effective as by the continuing isolation and fragmentation of ancient wood habitats.

Recently rediscovered ideas of close-to-nature silviculture are particualrly recommended to be implemented, so the great economic and ecological significance of many ancient woodland species can be recognized. Greater awareness should also be raised about woodland succession, not only in theory but also in practice. On the other hand, many studies showed that approval and active support of the society plays an important role for such projects to be implemented and result successfully (Pimbert and Pretty, 2000; Berkes, 2004; Miller, 2005; Naveh, 2005). If conservation/restoration and the satisfaction of community objectives in a given area could be simultaneously achieved, then the interests of both could be served. Many restoration and conservation practices in Turkey, have been controversial because community development objectives were not necessarily consistent with conservation/restoration objectives in many cases. The needs of different stakeholders were mostly ignored or not taken seriously into consideration by the professionals. Therefore, an integrated approach combining knowledge of ecology,

silviculture, landscape planning and social sciences should be embraced in order to bring ancient woodland species back into their natural habitats in Turkey. Use of these species in specially designed landscapes (e.g. representing their native habitat in some parts of parks, giving information about their traditional use on specially designed signboards placed by the plants, etc.) in or near urban areas would also be helpful to stimulate and increase the knowledge among people for their conservation and restoration.

References

Ágoston, G., 2005. *Guns for the Sultan: Military Power and the Weapon Industry in the Ottoman Empire.* Cambridge University Press, Edinburgh, UK.

Aichele, D.R. and Schwegler, H.W.A., 1996. *Der Kosmos-Pflanzenführer: Blütenpflanze, Farne, Moose, Flechten, Pilze, Algen in 653 Farbbildern.* Franckh-Kosmos Verlag, Stuttgart, Germany.

Akkemik, U., Aytuğ, B. and Güzel, S., 2004. Archaeobotanical and Dendroarchaeological Studies in Ilgarini Cave (Pinarbasi, Kastamonu, Turkey). *Turkish Journal of Agriculture and Forestry* 28: 9-17.

Aksoy, H., 1982. *Eiben- und Eichen-Urwaldreste im Forstamt Yenice (Türkei).* In: Urwald-Symposium Wien, 149-163.

Aksoy, N., 1998. Expeditions to the Box (*Buxus sempervirens*) forest at Firtina Cachment area (Camlihemsin, Rize). *The Karaca Arboretum Magazine* 4(3): 98-108.

Asouti, E., 2005. *Woodland vegetation and the exploitation of fuel and timber at Neolithic Çatalhöyük: report on the wood charcoal macro-remains.* In: Hodder, I. (ed.). Inhabiting Çatalhöyük: Reports from the 1995-9 Seasons, McDonald Institute Monographs 38, McDonald Institute for Archaeological Research and British Institute at Ankara, Cambridge and London, 213-258.

Asouti, E. and Austin, P., 2005. Reconstructing woodland vegetation and its relation to human societies, based on the analysis and interpretation of archaeological wood charcoal macro-remains. *Environmental Archaeology* 10: 1-18.

Asouti, E. and Fairbairn, A.S., 2002. *Subsistence economy in Central Anatolia during the Neolithic: the archaeobotanical evidence.* In: Gerard, F. and Thissen, L. (ed.), The Neolithic of Central Anatolia, internal developments and external relations during the 9th-6th millennia CAL BC, Istanbul: Ege Yayınları, 181-192.

Asouti, E. and Hather, J., 2001. Charcoal Analysis and the Reconstruction of ancient woodland vegetation in the Konya Basin, south-central Anatolia, Turkey: results from the Neolithic site of Catalhöyük East. *Vegetation History and Archeobotany* 10: 23-32.

Aytuğ, B., 1970. Arkeolojik araştırrmaların ışığında İç Anadolu stebi (La Steppe D'Anatolie Centrale a la Lumiere Des Recherches Archeologiques). *Journal of the Faculty of Forestry Istanbul University* Series A, 20(1): 127-143.

Aytuğ, B., 1988. *Le mobilier funéraire du roi Midas.* Wood and Archaeology, Acts of the European Symposium, Louvain-la-Neuve, Council of Europe, Strasbourg, PACT 22: 357-368.

Aytuğ, B. and Görcelioğlu, E., 1993. Anadolu bitki örtüsünün Geç Kuvaterner'deki değişimi. *Journal of the Faculty of Forestry Istanbul University*, Series B, 43(3-4): 27-46.

Aytuğ, B. and Görcelioğlu, E., 1994. *Archaebotany in Anatolia*. Archaeometry 94: The Proceedings of the 29th International Symposium on Archaeometry, Ankara, 393-400.

Baytop, T., 1999. *Therapy with Medicinal Plants in Turkey (past and present).* Istanbul University Publications, No: 3255, Nobel Press House, Istanbul.

Beach, T.P. and Beach, S.L., 2008. Geoarchaeology and aggradation around Kinet Höyük, an archaeological mound in the Eastern Mediterranean, Turkey. *Geomorphology* 101: 416-428.

Berkes, F., 2004. Rethinking Community-Based Conservation. *Conservation Biology* 18: 621-630.

Bottema, S. and Van Zeist, W., 1989. *Middle East vegetation in the Pleistocene and Holocene Examples*. Dr. Ludwig Reichert Verlag, Wiesbaden.

Bottema, S., Woldring, H. and Aytuğ, B., 1993a. Late Quaternary vegetation history and climate in northern Turkey. *Palaeohistoria* 35/36: 13-72.

Bottema, S., Woldring, H. and Aytuğ, B., 1993b. *Palynological investigations on the relation between prehistoric man and vegetation in Turkey*. Proceedings of the 5th Optima Congress, September 1986, Istanbul. 315-328.

Brondegaard, V.J., 1992. Der Buchsbaum. *Forst und Holz* 47(2): 39.

Butler, J.E., Rose, F. and Green, E.E. 2001. *Ancient trees, icons of our most important wooded landscapes in Europe.* In: Read, H., Forfang, A.S., Marciau, R., Paltto, H., Andersson, L., Tardy, B. (ed.), Tools for Preserving Woodland Biodiversity, EU: Naconex, 20-26.

Chiej, R., 1984. *The Macdonald encyclopedia of medicinal plants*. Macdonald, London.

Crosnier, C., 1998. *La cueillette des savoirs: Les usages du végétal, Morvan - Bourgogne.* Parc Naturel Régional du Morvan, Saint-Brisson, France.

Cuinet, V., 2001. *La Turquie d'Asie. géographie administrative, statistique.* Isis, Istanbul.

Çınar, S. and Kırca, S., 2010. Perception of Garden in Turkish Culture. *Journal of the Faculty of Forestry Istanbul University* 60(2): 59-68.

Çolak, A.H., 2001. *Nature Protection in Forest.* Milli Parklar ve Av-Yaban Hayatı Genel Müdürlüğü Yayını. Orman Bakanlığı, Ankara.

Çolak, A.H., 2003a. A General Evaluation of Box (*Buxus sempervirens* L.) under Threat. Deutsche Rhododendron-Gesellschaft, *Immergrüne Blätter* 42: 58-65.

Çolak, A.H., 2003b. Examination of box (*Buxus sempervirens* L.) in Northwest Anatolia, Turkey: a contribution for the preservation of biological diversity and nature conservation. S*wiss Forestry Journal* 154(3/4): 81-89.

Çolak, A.H., 2003c. Research and Observation on r-K-Strategy Plants in the Northwest Anatolian Mountains and Their Significance for Forest Management and Nature Conservation. Deutsche Rhododendron-Gesellschaft, *Rhododendron und immergrüne Laubgehölze Jahrbuch* 123-142.

Çolak, A.H., 2005. *Buxus sempervirens L*. In: Forestry compendium 2005, CABI, Oxford.

Çolak A.H. and Rotherham I.D., 2006. A review of the Forest Vegetation of Turkey: its status past and present and its future conservation. *Royal Irish Academy, Journal of Biology and the Environment* 106(3): 343-355.

Çolak, A.H., Kırca, S., Rotherham, I.D. and Ince, A., 2010. *Restoration and Rehabilitation of Deforested and Degraded Forest Landscapes in Turkey.* Ministry of Environment and Forestry, General Directorate of Afforestation and Erosion Control, Tor Ofset, Istanbul, 566 p.

Çolak, A.H., Kırca, S. and Rotherham, I.D., 2012. *What Happened to the Ancient Common Boxwood (Buxus sempervirens L.)?: From Boxwood Forest to the Red List of Endangered Species in Turkey.* In : Trees Beyond the Wood: An exploration of concepts of woods, forests and trees Conference, Wildtrack Publishing, Sheffield, UK, 105-118.

Darlington, A., 1974. *The galls on oak*. In: Morris, M.G., Perring, F.H. (ed.), The British Oak: Its History and Natural History, The

Botanical Society of the British Isles, E.W. Classey, Berkshire, 298-311.

Davis, P.H., 1965. *Flora of Turkey and the East Eagean Islands* – Volume I. Edinburgh University Press, UK, 567 p.

Deckers, K. and Pessin, H., 2010. Vegetation development in the Middle Euphrates and Upper Jazirah (Syria/Turkey) during the Bronze Age. *Quaternary Research* 74: 216-226.

DeLong, J.M. and Prange, R.K., 2003. *Taxus* spp.: Botany, Horticulture, and Source of Anti-Cancer Compounds. *Horticultural Reviews* 32: 299-327.

Diodorus, S., 1946. *Library of History.* Volume IV, Books 9-12, Loeb Classical Library No. 375, Harward University Press, UK.

Doğu, D., Köse, C., Kartal, S.N. and Erdin, N., 2011. Wood Identification of Wooden Marine Piles from the Ancient Byzantine Port of Eleutherius/Theodosius. *BioResources* 6(2): 987-1018.

Dölarslan, E.S. and Ok, K., 2006. *Conflicts between traditional knowledge and official applications on sustainable forest management: a case from Turkey*. In: Parrotta, J., Agnoletti, M., Johann, E., International Conference on Cultural Heritage and Sustainable Forest Management: the role of traditional knowledge, Florence, Italy, 122-130.

Dufraisse, A. (ed.), 2006. *Charcoal Analysis: New Analytical Tools and Methods for Archaeology*. British Archeological Reports, Book 1483, 111 p.

Eastwood, W.J., Roberts, N. and Lamb, H.F., 1998. Palaeoecological and archaeological evidence for human occupance in southwest Turkey: the Beysehir Occupation Phase. *Anatolian Studies* 48: 69-86.

Eastwood, W.J., Roberts, N., Lamb, H.F. and Tibby, J.C., 1999. Holocene environmental change in southwest Turkey: a palaeoecological record of lake and catchment-related changes. *Quaternary Science Reviews* 18: 671-96.

Ekim, T., 1995. *Türkiye Florası ve Endemikler.* Yeni Türkiye Yayınları, 1/5, Ankara.

Ekim, T., Koyuncu, M., Vural, M., Duman, H., Aytaç, Z. and Adıgüzel, N., 2000. *Red Data Book of Turkish Plants (Ptreidophyta and Spermatophyta)*. Ankara. Barışcan Ofset.

Erlbeck, R., Haseder, I.E. and Stinglwagner, G.K.F., 1998. *Das Kosmos Wald- und Forstlexikon*. Kosmos Verlag, Stuttgart, Germany.

European Commission, 2007. *Interpretation Manual of European Union Habitats.* Eur 27. DG Environment, 142 p.

Farris, E., Fenu, G. and Bacchetta, G., 2012. Mediterranean *Taxus baccata* woodlands in Sardinia: a characterization of the EU priority habitat 9580. *Phytocoenologia* 41(4): 231-246.

Figueiral, I. and Mosbrugger, V., 2000. A review of charcoal analysis as a tool for assessing Quaternary and Tertiary environments: achievements and limits. *Palaeogeography, Palaeoecology, Palaeoclimatology* 164: 397-407.

Forestry Compendium, 2005. *Taxus baccata L.*, Wallingford, UK: CAB International.

Goldberg, E., Kirby, K., Hall, J. and Latham, J., 2007. The ancient woodland concept as a practical conservation tool in Great Britain. *Journal for Nature Conservation* 15(2): 109-119.

Grieve, A., 1984. *A Modern Herbal.* Penguin Books, London, UK.

Hageneder, F., 2013. *Yew*. Reaktion Books, 224 p.

Hausen, B.M., 1981. *Wood injurious to human health*: *A manual*. Walter de Gruyter.

Hecker, U., 1995. *Bäume und Sträucher*. BLV Handbuch, München, 480 pp.

Hegi, G., 1957. *Illustrierte Flora von Mitteleuropa*. Vol. 3, Hansen, München.

Hobhouse, P., 2002. *The Story of Gardening*. Dorian Kindersly, UK, 468 p.

Homer, 1990. *Book 23: Funeral Games of Patroclus*. In: The Iliad. Penguin Books, USA, 559-587.

Iasiah, 60:13. *NIV Study Bible.* Cambridge University Press, 2008, UK.

Iszkuło, G., Didukh, Y., Giertych, M.J., Jasińska, A.K., Sobierajska, K. and Szmyt, J., 2012. Weak competitive ability may explain decline of *Taxus baccata*. *Annals of Forest Science* 69(6): 705-712.

Itokawa, H., 2003. *Taxus: the genus taxus*. Taylor and Francis, London, 453 pp.

Kırca, S., 2009. *Research on the Determination of Landscape Continuity Value Around Belgrade Forest (Istanbul)*. Master Thesis, Istanbul University Institute of Sciences.

Kırca, S., Çolak, A.H. and Rotherham, I.D., 2012. *A Review of the Important Ancient Woods and Ancient Woodland of Turkey: Its Status Past and Present and Its Future Conservation*. In: Trees Beyond the Wood: An exploration of concepts of woods, forests and trees Conference, Wildtrack Publishing, Sheffield, UK, 199-216.

Kırca, S. Çolak A.H., Özalp, G. and Rotherham, ID., 2015. *Wise residents of ancient woodlands: Taxus baccata L. in Anatolian forests*, In: Aksoy, N., Aslan, S. (eds.) Proceedings of the 1st International Yew Workshop 2015, Duzce University, 74-88.

Kotschy, T., 1858. *Reise in den cilicischen Taurus über Tarsus*. Gotha, Perthes.

Kuzucuoğlu, C., 2007. Climatic and Environmental Trends during the Third Millennium B.C. in Upper Mesopotamia. *Varia Anatolica* 19(1): 459-480.

Kültür, S., 2008. An ethnobotanical study of Kırklareli (Turkey). *Phytologia Balcanica* 14(2): 279-289.

Kuniholm, P.I., 1977. *Dendrochronology at Gordion and on the Anatolian Plateau.* Unpublished Ph.D. dissertation (University of Pensylvania).

Longford, C., Drinnan, A. and Sagona, A., 2009. *Archaeobotany of Sos Höyük, northeast Turkey.* In: Fairbairn, A. O'Connor, S. and Marwick, B. (ed.) New Directions in Archaeological Science (Terra Australis 28), Australian National University E Press, Canberra, 121-136.

Louis, H., 1939. *Das naturliche Pflanzenkleid Anatoliens.* Geographische Abhandlungen, 12, Stuttgart.

Carus, L.T., 1916. B*ook V-Beginnigs of Civilization*. In: De Rerum Natura (trans. by William Ellery Leonard). E. P. Dutton & Co. New York. l, 1241-1255.

Mayer, H. and Aksoy, H., 1986. *Wälder der Türkei*. Gustav Fischer Verlag, Stuttgart, 290 p.

McNeill, J.R., 2004. Woods and Warfare in World History. *Environmental History* 9(3): 388-410.

Meiggs, R., 1982. *Trees and Timber in the Ancient Mediterranean World.* Oxford Unniversity Press, New York, 598 p.

Mellaart, J., 1967. *Çatal Hüyük: A Neolithic Town in Anatolia*. New Aspects of Archeology, Mc Graw Hill, New York, 232 p.

Miiler, J.. 2005. Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution*, 20(8): 430-434.

Missouri Botanical Garden, 2003. *Vascular Tropicos database.* St. Louis, USA: Missouri Botanical Garden [http://mobot.mobot.org/W3T/Search/vast.html].

Naveh, Z., 2005. Epilogue: Toward a Transdisciplinary Science of Ecological and Cultural Landscape Restoration. *Restoration Ecology* 13: 228-234.

Noirfalise, A. (ed.), 1987. *Carte de la végétation naturelle des Etats membres des Communautéseuropéennes et du Conseil de l'Europe*. 1 : 3.000.000, deuxième édition. – Luxembourg (Office public. off. Comm. europ.), feuilles 1-4.

Okan, T. and Ok, K., 2006. *Opportunities in Turkish cultural heritage for conservation of natural values.* In: Parrotta, J., Agnoletti, M., Johann, E. (ed.), International Conference on Cultural Heritage and Sustainable Forest Management: the role of traditional knowledge, Florence, Italy, 428-435.

Olson, S.D., 1991. Firewood and Charcoal in Classical Athens. *The Journal of the American School of Classical Studies at Athens*

60(3): 411-420.

Parker, E. and Levington, A., 1999. *YEW- The guardian of time.* In: Ancient Trees - trees that live for 1000 years. Collins and Brown Ltd. Great Britain, 66-75.

Peterken, G.F., 1977. Habitat conservation priorities in British and European woodlands. *Biological Conservation* 11: 223-236.

Peterken, G.F., 1983. *Woodland conservation in Britain.* In: Warren, A. and Goldsmith, F.B. (ed.), Conservation in perspective, Chichester:Wiley, 83-100.

Philippson, A., 1910. *Reisen und Forschungen im westlichen Kleinasien-Heft 5. Karien südlich des Mäander und das westliche Lykien.* Perthes, Gotha.

Pimbert, M.P. and Pretty, J.N., 2000. *Parks, People and Professionals: Putting Participation into Protected Area Management.* In: Ghimire, K.B., Pimbert, M.P. (ed.), Social Change and Conservation, Earthscan Publications, UK, 297-330.

Piovesan, G., Presutti Saba, E., Biondi, F., Alessandrini, A., Di Filippo, A. and Schirone, B., 2009. Population ecology of yew (*Taxus baccata* L.) in the Central Apennines: spatial patterns and their relevance for conservation strategies. *Plant Ecology* 205(1): 23-46.

Pliny the Elder, 1855. *The Natural History of the Forest Trees*. In: Natural History of Pliny, Vol. 3, Bohn's Classical Library, London, 339-435.

Rackham, O., 1976. *Trees and woodland in the British landscape.* London, Dent, 204 p.

Rackham, O., 2003. *Ancient Woodland: its history, vegetation and uses in England* (2nd ed.), Castlepoint Press, 624 p.

Relf, D., 2001. *Boxwood in the Landscape*. Publ. No: 426-603, Virginia Tech. USA: Virginia Cooperative Extension.

Rose, F., 1999. Indicators of ancient woodland: The use of vascular plants in evaluating ancient woods for nature conservation. *British Wildlife* April, 241-251.

Rowton, M.B., 1967. The Woodlands of Ancient Western Asia. *Journal of Near Eastern Studies* 26: 261-277.

Schmidt, G., 1969. *Vegetationsgeographie auf ökologisch-soziologischer Grundlage*. Leipzig. G. Teubner Verlagsgesellschaft.

Schmidt, A., 1990a. *Der Buchsbaum (Buxus sempervirens* L.*)*. In: Bayerischer Forstverein (Hg.), Sträucher im Wald und Flur. Ecomed, Landsberg, Germany, pp. 87-93.

Schmidt, O., 1990b. *Vögel und Sträucher*. In: Bayerischer Forstverein (Hg.), Sträucher im Wald und Flur, Ecomed Landsberg, Germany, pp. 499-509.

Schwarz, O., 1936. Die Vegetationsverhaltnisse West-anatoliens. *Botanisches Jahrbuch* 67: 297-436.

Senitza, E., 1989. *Waldbauliche Grundlagen der Libanonzeder (Cedrus libani A. Rich) im Westtaurus/Türkei.* Dissertation 34, Wien, Universität für Bodenkultur.

Simpson, E., 2012. *Royal Phrygian Furniture and Fine Wooden Artifacts from Gordion.* In: The Archaeology of Phrygian Gordion, Royal City of Midas: Gordion Special Studies 7. (C. B. Rose, Ed.), University of Pennsylvania Press, 149-164.

Strabo, 1856. *The Geography of Strabo*. Trans.: H.C. Hamilton, Esq., W. Falconer, M.A., Vol.2, John Childs and Son, London.

Svenning, J.-C. and Magård, E., 1999. Population ecology and conservation status of the last natural population of English yew *Taxus baccata* in Denmark. *Biological Conservation* 88(2): 173-182.

Taylor, P.D., Fahrig, L. Henein, K. and Merriam, G., 1993. Connectivity Is a Vital Element of Landscape Structure. *Oikos*, 68(3): 571-573.

Theophrastus, 1999a. *Book 3: Of Wild Trees.* In: Enquiry Into Plants, Harward University Press, Edinburgh, UK, 159-286.

Theophrastus, 1999b. *Book 4: Of The Trees and Plants Special to Particular Districts and Positions.* In: Enquiry Into Plants, Harward University Press, Edinburgh, UK, 287-416.

Theophrastus, 1999c. *Book 5: Of the Timber of Various Trees and Its Uses.* In: Enquiry Into Plants, Harward University Press, Edinburgh, UK, 417-475.

Thomas, P.A. and Polwart, A., 2003. *Taxus baccata* L. *Journal of Ecology* 91(3): 489-524.

Tischendorf, L. and Fahrig, L., 2000. On the usage and measurement of landscape connectivity. *Oikos* 90(1): 7-19.

Tournefort, J.P., 1636. *A Voyage into the Levant*. print. by I.L. for Andrew Crooke, 2. Ed.

Ürgenç, S., 1998. *Ağaçlandırma*. İ.Ü. Orman Fakültesi Yayını, Bahçeköy, İstanbul.

Vernet, J.-L., 1997. *L'homme et la forêt méditerranéenne de la préhistoire à nos jours*. Editions Errance, Paris, 241 p.

Walter, H., 1956. Das Problem der zentralanatolischen Steppe. *Naturwissenschaften* 43(5): 97-102.

Walter, H., 1968. *Die Vegetation der Erde* (Band 2). Jena, VEB. Gustav Fischer Verlag.

Watkins, C., 1988. *The Idea of Ancient Woodland in Britain from 1800.* In: Salbitano, F. (ed.) Human Influence on Forest Ecosystems Development in Europe, Pitagora Editrice, Bologna, 237-246.

Wick, L., Lemcke, G. and Sturm, M., 2003. Evidence of late glacial and Holocene climatic change and human impact in eastern Anatolia: High-resolution pollen, charcoal, isotopic and geochemical records from the laminated sediments of Lake Van, Turkey. *The Holocene* 13(5): 665-675.

Willcox, G., 1992. Bilan des données anthracologiques du Proche-Orient. *Bulletin de la Société Botanique de France* 139: 539-551.

Willcox, G., 2002. *Evidence for ancient forest cover and deforestation from charcoal analysis of ten archaeological sites on the Euphrates.* In: Thiébault S. (Ed.), Charcoal Analysis. Methodological Approaches, Palaeoecological Results and Wood Uses, BAR Int. Series, 1063: 141-145.

Woldring, H. and Cappers, R., 2001. The Origin of the "Wild Orchards" of Central Anatolia. *Turkish Journal of Botany* 25: 1-9.

Xenophon, 1976. *Anabasis - Book IV*. University of Oklahoma Press, USA.

Young, R.S., 1974. Phrygian Furniture from Gordion. *Expedition* 16(3): 2-13.

Zohary, M., 1973. *Geobotanical foundations of the Middle East*. 2 Vol., Gustav Fischer Verlag, Stuttgart.

Zorlu, T., 2008. *Innovation and Empire in Turkey: Sultan Selim III and the Modernisation of the Ottoman Navy*. Tauris Academic Studies, London.