

Conservation of Biodiversity and Noble Hardwoods in Turkish Forests

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Abstract: Turkey is one of the richest countries in terms of biodiversity due to mainly its geographical location and different climatic conditions. Relatively large portions of plant and animal species are endemic and available only in this land as genetic resources. Yet, forest ecosystems in Turkey have been exploited under different civilizations within the last few millennia, which resulted in undesirable impacts on biodiversity. Noble hardwoods are important part of biodiversity due to their ecological and economical values. Although exact figures on the current importance of noble hardwoods in Turkey are not yet available, indigenous some noble hardwoods having commercial value are alder, walnut, ash, hornbeam, lime, maple and chestnut. The development of an appropriate strategy for conservation and enhancement of the potential of noble hardwood forests requires a deep understanding of the genetic structure and biology of the species, and geographical variability of the potentials. Thus, various technical, social and legal actions should be taken to conserve and improve biodiversity in forest ecosystems.

Key words: Biodiversity, conservation, forest ecosystem, Turkey

INTRODUCTION

Biological diversity refers to the variety of life forms: the different plants, animals and microorganisms, the genes they contain, and the ecosystems they form^[1,2]. This living wealth is the product of hundreds of millions of years of evolutionary history, and each constituent of diversity is important to maintain for the welfare and sustainable development. Turkey contains the wild relatives of many domestic plants, thus forming one of the eight major gene centers on earth^[3]. The biodiversity of Turkey is deteriorating because of Turkey's rapid human population growth and associated intensive or unwise utilization of natural resources and habitats.

In Turkey about 9.5 million ha area is covered by hardwoods and 5.7 million ha as coppices over a total forest area of 21 million ha. 10.5 million ha of the forests are unproductive or highly degraded due to excessive exploitation^[4,5]. Noble hardwoods, along with other dominant species such as oak, beech, pine, or fir contribute to very complex forest communities. Although precise figures on the current importance of Noble Hardwoods are not yet available, in terms of area occupied, their potential for forestry practice is beyond any doubt.

Unfortunately, no detailed information on species composition in the particular type of protective forest is yet available in Turkey, and no specific conservation program has yet been perfectly established.

Forest Biodiversity in Turkey: Turkey occupies a transitional extending between middle and tropical belts, and continental part of Asia and the eastern part of the Mediterranean region. This geographical position leads to not only difference of climatic regimes but also various floristic regions. Generally, the northern parts of Turkey contain a part of the Euro-Siberian flora; the western and southwestern parts of Turkey cover most of the eastern Mediterranean floristic region and its flora. The interior part of the Anatolia is in the occurrence areas of the Irano-Turanian floristic region^[6].

The total forest area in Turkey is 21 million ha and forests consist of 54% coniferous and 46% broadleaved stand. Broadleaved species are represented by the following tree species: oak (29%), beech (6%) and other broadleaved (11%). The most important coniferous tree species are pine (42%), juniper (6%), fir (3%) and others (3%). The total annual volume increment amounts to 32 million m³ from which around 8.5 million m³ belong to broadleaved^[5]. The forested area is slightly increasing in Turkey, mainly due to the regeneration and extension. Over 120 000 ha of forest have been established in Turkey through regeneration of land that has recently been forested and extension of forest on new areas (afforestation) or on former other wooded land. In Europe the largest areas of forest plantations can be found in Spain (1.9 million ha), Turkey (1.8 million ha) and United Kingdom (1.7 million ha)^[7].

According to TBFRA (2000) 8 950 vascular plant species are reported to be known in Turkey. Of these, 2 656 species are endemic to Turkey. The total number of fern species in Turkey is 78 and the number of moss species is 234. A total of 132 mammal species, 635 other vertebrate species, and 450 bird species are reported to be known in Turkey^[8,9]. 12 plant and 20 animal species have become extinct recently in Turkey, and 1701 vascular plant species are classified as rare species^[8,9].

Factors Affecting Biological Diversity: Biological diversity is the variety of life and its processes in a given area. The variety of life and its processing in a given area are constantly changing. These changes have occurred since life began and they will continue, with or without the presence of humans^[2,8,10]. Major factors that cause the decline of forest biodiversity in Turkey include^[11,15]: (a) fragmentation of habitats and populations, which result in small and often isolated demes which suffer local extirpation, (b) human exploitation, which exceeds the ability of species and communities for regeneration and recovery, (c) introduction of toxics and pollutants, which either kill individuals outright or impair their natural functioning (d) introduction of exotic species, (e) conversion of wild areas to agriculture and other intensive human use, and (f) alterations in the structure and function of ecosystems, which emphasize production of a limited number of commercially valuable species.

Maintain Biodiversity in Forest Ecosystems: To achieve the goal of maintaining all naturally occurring species in viable populations, both general and specific activities must be included in the basic strategy for maintaining biodiversity. As the biodiversity concept also covers genetic and ecosystem diversity, as well as ecological processes, the most efficient strategy must be to preserve as much as possible of original forests, and to imitate the dynamics, structure and function of the natural ecosystems in a given region in managed forests^[16].

In Turkey, only small areas of productive forests are protected, and they are not evenly distributed over the forested regions. Furthermore, many forest reserves established in forests with the aim of preserving the natural forest flora and fauna are not in a natural state. They have experienced some human impact, but are left for free development and to recover. About 5% of the country (4 million ha) has been protected from any commercial use and this small allocation is not sufficient for comprehensive conservation of the natural resources of Turkey (Table 1). About 13% of the forests are not available for wood supply due to conservation or protection reasons and Turkey has

about only 1.2% of the forest area in the strict protection category^[7]. Protecting species and their genes can be done best through protecting them within their natural habitats, eventually within ecosystems where they live with other species^[17]. *In situ* conservation is considered as the best solution for the conservation of genetic resources, because it maintains the evolutionary potential and adaptive capacity of the involved populations (Table 1).

Gene banks are currently maintained by the Turkish Ministries of Forestry. Seeds of fruit trees and commercially valuable timber and fiber species are stored to protect genetic variability. More than 150 seed orchards with an area of 817 ha have been established for major timber species to produce genetically improved forest trees. While Turkey has several arboreta and botanical gardens useful for conservation purposes, expansion of such resources is needed^[11,13].

In reforestation and afforestation sites monocultures should be avoided, and mixtures and alternate patches of species for multiple utilization purposes should be planted. In large afforestation areas, patches of unplanted sites should be reserved to create habitat diversity to support biodiversity. Natural regeneration of forest species, wherever possible, should be encouraged, and clearcutting method should be used only in small-scale operations^[13,18]. Care should be taken to avoid introducing non-native species to an area unless species and/or provenance trials prove them to be appropriate, both individually and within the prevailing ecosystem.

In production forests to increase the effectiveness of various silvicultural, administrative, and social forestry services the sizes of current forest operation units should be reduced to about 5000 ha, and thus enable the administration to give respect to biodiversity objectives^[18]. Harvesting, logging, thinning and transportation activities in production forests should be reviewed and modified in view of national biodiversity objectives. Special attention should be paid to the most vulnerable species groups.

Additional national parks and nature conservation areas should be identified and designed to represent each biogeographical region in Turkey. A national biodiversity reserve network should be developed to incorporate existing and new natural parks and nature conservation areas into a national program^[13,18]. Natural parks and nature conservation areas should be used for research and educational programs by regional universities and research organizations, and these conservation areas should be divided into zones where multiple use management is possible and restricting ecotourism to selected areas so that natural biota are protected.

Table 1: Conservation areas in Turkey^[4,11,13]

Type of protection	Total area (ha)	Numbers	% area of country
National parks	686 531	33	0.8
Nature parks	69 137	16	0.09
Nature protected areas	83 524	33	0.1
Nature monuments	334	54	0.0004
Seed stands	46 266	345	0.06
Gene conservation forests	16 210	115	0.02
Clonal seed orchards	1261	54	0.001
Wildlife conservation areas	1 800 000	109	2.32
Specially protected forest areas	400 000	13	0.5
Protection forests	367 917	53	0.47
Rest and camp areas	15 946	428	0.02
State farms	381 162	38	0.5
Total	3 868 288		4.88
Protected conservation programs	7 371 265		9.5

Forest lands designated as protection forests in Turkey constitute only about 1.5 % (368 000 ha) of the total forest areas (Table 1). Recognizing that a great proportion of land is subject to landslides, floods, and soil erosion, additional lands should be acquired, developed and designed as protection forests. Lands around dams, municipal watersheds, major highways, railroads, and industrial zones should be targeted as Protection Forests. Gene conservation forests are designed as natural forests characterized by uneven age structure and managed like production forests. Currently 79 gene conservation forests totaling about 9 400 ha have been set aside by the Turkish Forest Trees and Seeds Improvement Research Directorate^[19]. New gene conservation forests are needed to ensure better representation of the other species, and diverse ecosystems and habitats, and new gene management zones representing different habitats in the country along with their management plans are urgently needed for sustainable forestry in the future.

Degraded forests and agricultural lands should be identified and rehabilitated, and should be regarded as security values for the ecological health of nearby communities^[13]. Rivers and streams, and narrow strips along them are under strong pressure by local people in Turkey, being converted into unsuitable land use alternatives. Detailed administrative and legal arrangements should be made to save and improve riparian and wetlands ecosystems.

Poplar farming, one of the most successful agroforestry practices in Turkey, and other agroforestry activities including homegardens and plantation crop combinations in villages should be encouraged and expanded, and there is a clear need to develop efficient agroforestry systems and practices in Turkey.

Conservation of Noble Hardwoods in Turkey: Noble hardwoods are very important and contribute to increasing the interspecific diversity of forests in Turkey as in most European countries^[20,22]. Noble

Hardwoods represent a heterogeneous group, defined as: scattered and relatively rare species, species with high value of wood, and species with high ecological demands. The most important Noble Hardwood genera or tree species in Turkey would be: *Acer* spp., *Fraxinus* spp., *Ulmus* spp., *Betula* spp., *Tilia* spp., *Carpinus* spp., *Prunus* spp., *Ostrya* spp., *Creataegus* spp., *Vaccinium* spp., *Sorbus* spp., *Juglans regia*, *Castanea sativa*, *Alnus glutinosa*, *Pyrus malus* and *Malus sylvestris*. The importance of these species in Turkey is difficult to estimate. Noble hardwoods cover about 3% of the total forest area in Turkey. However, these species are usually mixed with other dominant species and their proportion is thus underestimated.

Unfortunately, we have no information about their contribution to financial revenues of Turkish forest enterprises, and although exact figures on the current importance of Noble Hardwoods in Turkey are not yet available, indigenous some noble hardwoods having commercial value are alder, walnut, ash, hornbeam, lime, maple and chestnut. The economic value of timber of the other native noble hardwoods might be insignificant, but in terms of forest biodiversity, ecosystem stability and forest environmental protection, their significance for the country's forestry is considerable. As the species most often occur as isolated individuals or small groups, their share in mixed hardwood stands is highly variable and hard to assess. In addition, owing to their former labeling as secondary tree species, they usually were disregarded in former forest inventories.

One of the main problems affecting the consistency of hardwood species in Turkey is related to silvicultural treatments applied to the forest communities where they are growing. Coppice treatments are dangerous to forest biodiversity, as all the equilibria among species are completely manipulated, creating more possibilities for the eliophile and more aggressive species^[23]. Variability is also severely reduced because of the long survival time of stumps which reduces the advantages of natural regeneration. Some species are also endangered because of human pressure from exploitation, grazing and, more significantly, from fires. Resources are endangered for species growing in plain forests because of the dramatic reduction of forest areas through agriculture and industrial expansion.

There are signs of new dangers, which are related to increasing global environmental changes, such as pest and disease attack. Stress symptoms are also occurring more frequently, mostly in the Mediterranean areas where the forest climax communities are really sensitive. Some peculiar phytosanitary problems are affecting species such as *Castanea sativa* (*Endothia parasitica*) and *Ulmus* spp. (*Ophiostoma ulmi*)^[23,24].

The most important threats to the genetic resources of Noble Hardwoods are past intensive forest management, including the negative effects of clearcutting, industrial pollution, decreasing population sizes due to different factors and resulting in genetic drift, inadequate silvicultural practices and geneflow from unknown sources.

The program for Noble Hardwoods genetic resources conservation should take into account the preservation of population variability, at the provenance and local population level and the family variability and individual variability within families. The *in situ* preservation of Noble Hardwood genetic resources in Turkey including mixed and pure, even-aged and uneven-aged, well-managed forests and nature protected stands where regular silvicultural operations such as care, cleaning and thinning should be carried out.

Conclusions: Although precise figures on the current importance of Noble Hardwoods are not yet available, in terms of area occupied, their potential for forestry practice is beyond any doubt. The motivation for a conservation program on Noble Hardwoods originates from the awareness of their economic and ecological value as well as their relative rarity. Conservation of genetic resources of Noble Hardwoods should be given the highest priority in any extensive program of forest resources management. It is very important to conserve the existing genetic diversity of forest stands in which Noble Hardwoods are present.

The main strategies for preserving biodiversity should be the following: (1) protection of forests in nature reserves, (2) alternatives to the current dominant forestry methods (e.g. clearcutting), and (3) environmental protection measures, or considerations for the fauna and flora in the daily activities within all forestry practices.

Mixed stand structures can be maintained and improved. Parts of the forests should be reserved for different kinds of conservation purposes. In addition to these special protected areas, where any forestry activity is prohibited, there should exist small ecological biotopes within managed forests also worth of protection. Forest management needs to consider explicitly diversity also on the landscape and regional level. Natural regeneration in small gaps is generally recommended, large scale clear cuts and planting of pure coniferous forests should be avoided. There is a strong need for a detailed inventory, mainly of minor or rare species and especially of Noble Hardwoods although all forest stands in the country are covered by forestry management plans.

To save biodiversity in forests of Turkey the politicians, the public and decision makers should be persuaded that management for biodiversity is important for reasons of ethics, esthetics, and the

reaping of direct economic benefits, and essential for the preservation of ecosystem services. Resource planners and managers must work with the factors which affect biological diversity, and can often limit their potential negative effects through restoration, mitigation, or enhancement of populations and habitats.

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