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Monumental *Castanea sativa* Mill. Individuals on the Slopes of Genya Mountain, Artvin, Turkey

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Keywords: Dendrochronology, gene conservation, chestnut blight, ink disease, heritage, Black Sea Region.

Abstract

Aged trees are considered as a valuable source of information on the past ecological conditions and social life where they are found, and their documentation and preservation are vital for the continuity of benefits they provide. Nineteen *Castanea sativa* Mill. individuals on abandoned agricultural plots near Artvin city center (Turkey) were measured for diameter at breast height (DBH), circumference at breast height (CBH) and height. DBH and CBH ranged between 72 cm and 186 cm, and between 231 cm and 615 cm, respectively. The highest tree is 22.20 m tall and the shortest is 13.65 m. Estimated ages of the trees ranged from 135 to 342 years. With their size and age, these trees can be designated as monumental trees. Protection of these trees will help in conserving *C. sativa* genetic resources and in passing the information they hold in their annual rings to future generations.

INTRODUCTION

Forest resources, in general, provide so many functions and values that every living in the world, in one way or another, depends on. People exploit these renewable sources for wood products, clean air and water, recreation, research and many other benefits. Moreover, people have been in close relationship either with forest as a whole (e.g. hunting, wood for building or fuel) or individual trees (e.g. fruit tree species, cultural and social show) especially in rural areas.

Natural resources of the World have been experiencing continuous loss for many centuries, but at an accelerated rate since the industrial revolution. Land-use changes, especially conversion of forested areas into both agricultural and urban use, are generally considered as one of the main reasons for these large losses occurred and are still occurring in forested areas, creating fragmented and degraded forest ecosystems. In some cases the damage can be so severe that once a thickly forested area becomes a barren land. Presence of aged trees (also known as monumental trees) in or around such areas indicates that not only these areas once were natural forests but also such areas can be forested again.

Monumental trees are considered as a valuable source of information on the past ecological conditions and social life where they are found. The annual rings of trees are sort of "time capsules" and thus can serve as a useful tool in tracking the environmental changes (e.g. extreme climatic events such as drought and flood, and fire) through time (Gümüüş and Yavuz, 1994).

Monumental trees may also be important for their role in local people's life style by providing information on daily lives of past inhabitants. During their long life, these trees have witnessed all social and natural events that left deep impacts on locals' lives. Moreover, they also play an important role in transferring stories of significant events to future generations. The stories can be related to these trees and they may become standing symbols of the past events, linking them to present. Preservation of such trees can ensure the continuity of above mentioned benefits of monumental trees.

For a tree to be considered as monumental, it should possess several features: 1) it should be outstandingly old and large compared to other ordinary members of the same

species, 2) it should have a special place in local history, culture and folklore, and 3) it should be able to link the past to the present and the present to the future with its natural life span (Asan, 1991).

Due to its rugged and inaccessible terrain, Eastern Black Sea Region of Turkey is quite rich with monumental trees and stands. They include members of species such as *Picea orientalis*, *Abies nordmanniana*, *Carpinus betulus*, *Platanus orientalis*, *Fagus orientalis*, and *Quercus hartwissiana* (Gül et al., 1999). Artvin, located at the eastern end of the Black Sea Region, is very diverse in geography and climate, creating a very unique biodiversity. To protect this diversity, two national parks, three nature protection areas and a nature park have been established within the boundaries of Artvin province (Kurdoğlu, 2001).

The area has been inhabited by various civilizations since 3000 B.C., leaving a rich and diverse cultural heritage, including the ways by which the forest resources have been and can be utilized for daily human needs. Increased pressure over natural resources with increased population resulted in over-utilization and in some cases depletion of these resources.

Presence of old and large chestnut trees was reported near deserted Naşop Mezra (mezra is a name given to agricultural fields that are inhabited temporarily in summer months and usually located at higher elevations than the permanent settlement with a few dwelling units in the Eastern Black Sea Region of Turkey) on the northern slopes of Genya Mountain, 10 km southwest of Artvin city center (N.N. Karahan and E. Çagal, pers. commun.). The goals of this study were 1) to document the chestnut individuals found on Genya Mountain, Artvin, Turkey, 2) to compare these individuals to other reported monumental trees in the region, and 3) to discuss the significance of protecting these trees.

MATERIALS AND METHODS

The center of the study area (measured at tree number 7) is located on 41°09'19"N and 41°48'48"E coordinates and the elevation ranged from 925 m (tree number 19) to 1042 m (tree number 18). The site is an old abandoned settlement area with leveled grounds on which once wheat and maize were cultivated. The cultivation plots are now covered with grass and are being used as pasture. There is a dirt road winding around the plots that reaches to one of Artvin Municipality's drinking water reservoirs (Fig. 1).

The site was visited in the summer of 2006 and a total of 19 chestnut trees, most of which located along the dirt road and a few in the leveled plots, were measured for diameter (cm), circumference (cm) and height (m). Diameter at breast height (DBH) was measured at 1.30 m twice. Measurement angles were perpendicular to each other and the average of the two measurements is reported here for each tree as DBH. Circumference at breast height (CBH) was measured with a measuring tape. Height measurements were carried out using a height-meter (SILVA ClinoMaster™, Silva Sweden AB, Sollentuna, Sweden). To estimate tree ages, an increment core (at least 15 cm long) was taken with a tree increment borer at 1.30 m on each tree. Number of annual rings was counted on each core and divided by length of the core. Finally, this value was multiplied by

$$\left[\frac{DBH}{2} - BarkThickness \right]$$

to obtain an approximate age for a given tree (Genç and Güner, 2000). In estimating tree ages, time to reach 1.30 m height was not taken into consideration. Coordinates (degrees) and elevation (m) from the sea level of each tree were determined with a GPS receiver (Garmin eTrex®, Garmin International Inc., Olathe, Kansas, USA).

RESULTS AND DISCUSSION

The Trees

Measured characteristics of the 19 trees are given in Table 1. DBH and CBH ranged between 72 cm and 186 cm, and between 231 cm and 615 cm, respectively. The tallest tree is 22.20 m tall and the shortest is 13.65 m. Estimated ages of the trees range from 135 to 342 years.

DBH and CBH of the largest tree (tree number 11) in this study (Table 1) are similar to those of other monumental *C. sativa* individuals in Isparta, Turkey and the monumental trees belonging to other genera of Fagaceae family in The Eastern Black Sea Region. Genç and Güner (2000) reported a monumental *C. sativa* stand near Isparta in which the DBH of the largest 12 trees ranged between 159 cm and 242 cm and the CBH of these trees ranged from 474 cm and 650 cm. Gül et al. (1999) reported a *Fagus orientalis* individual with 206 cm DBH and 647 cm CBH near of Trabzon; a *Quercus hartwissiana* individual with 113 cm DBH and 355 cm CBH near Şalpazarı, Trabzon; a *F. orientalis* individual with 170 cm DBH and 534 cm CBH near Maçka, Trabzon; and another *F. orientalis* individual with 202 cm DBH and 635 cm CBH near Akçaabat, Trabzon.

Personal interviews with local people (H. Gazihan, (age = 83) – one of many inheritors of the whole land –, N.N. Karahan (51), E. Çağal (67), and A. Saraç (80), pers. commun.) indicated that the plots have not been cultivated for at least 40 years. In fact, all plots are covered with grass and some plots adjacent to forested area have *Picea orientalis* individuals on them. Interviewees' accounts connect a parallel conclusion regarding the probable age of these trees. H. Gazihan's account was very informative because as she remembers these trees being large and old even when she was a kid. She also remembers that one of their most favorite winter activities was grilling the chestnuts that her late father collected from these trees and sharing them with their neighbors at their house.

The study area is surrounded with *Picea orientalis* and *Castanea sativa* mixed forest. Whether the chestnut trees mentioned in this paper are remnants of these forests or are plantings is not clear. However, presence of other chestnut trees in the surrounding stands suggests that they are more probably remnants of previous natural stands. The reason for leaving these trees during forest clearing for agriculture may be two fold. First, it is known that nuts of these trees were consumed by locals and this fruit collection might have served as an incentive to keep them around the cultivation plots. And second, in agricultural fields of Anatolia it is common to see trees which mark borders between neighboring plots and serve as a shaded rest place for agricultural workers (Birand, 1968). Being situated along the road or on the borders between plots may suggest that these trees were left intentionally after clearing the area for cultivation.

One might think that these trees are plantings and other chestnut trees in the surrounding stands originated from these plantings. Although possible, if this were the case, one would expect to see other kinds of fruit trees with observed chestnuts, especially of *Juglans* spp. and *Corylus* spp., members of which are also found naturally in the region and of which nuts and wood are also valued by the local people.

Tree Rings Tell so Much

Dendrochronology is the study of climate changes and past events by comparing the successive annual growth rings of trees or old timber. With dendrochronological methods it is possible to determine environmental conditions at a given time in the past for a region (Akkemik, 2000). These methods can also be used to evaluate a species' growth capacity, ecology, and restoration potential when most of the species' populations go extinct after a catastrophic event such as fire, glacial events, or disease as in the case of *Castanea dentata* in the Northeastern United States (McEwan et al., 2006). Besides their widths, many more anatomical features of the annual rings have proven to be useful for identifying tree responses under a wide variety of environmental events (Wimmer, 2002).

C. sativa appears to be a suitable species for dendrochronological dating because it forms annual rings and is a ring-porous species (Romagnoli et al., 2004). For a dendrochronological study a master chronology must be prepared and this requires presence of old and still living trees. Once a known sequence is developed from these trees, it can be compared with wood samples from other sources of timber and when an overlap is detected between the two samples it is possible to investigate even further past events (Akkemik et al., 2004). Thus, protecting old trees is important for dendrochronological studies where developing known annual ring sequences is essential.

Genetic Variability of *Castanea sativa* Mill. and its Importance

C. sativa Mill. is a multipurpose species cultivated for its wood and nuts in all Mediterranean and Central regions of Europe (Bounous, 2002). Besides its economic importance, chestnut's agro-ecological role (fire and erosion protection, habitat for biodiversity, recreation, etc.) resulted in increased interest in chestnut cultivation (Robin et al., 2006). Palynological data show that *C. sativa* Mill. was present during the Tertiary but disappeared from the Western Europe during Pleistocene glaciations, surviving mainly in South-west Asia (Huntley and Birks, 1983). In the last 2,000 years, beginning during the Roman period, it has undergone a new rapid expansion towards Europe and Turkey is considered being one of the centers of origin for *C. sativa* Mill. (Zohary and Hopf, 1988).

The genetic variability in *C. sativa* Mill. has been assessed both in natural populations and in cultivated varieties (Fineschi et al., 1994; Villani et al., 1994, 1999; Pereira-Lorenzo and Fernandez-Lopez, 1995). The general picture is that cultivation has caused a consistent decrease in the amount of genetic variation but there are still regions, acting as important natural sources of genetic diversity, which can be of great relevance for the conservation of chestnut biodiversity and adaptive potential. Among the regions investigated, Turkey represents the area with the highest genetic diversity (Casasoli et al., 2001). The genetic diversity in *C. sativa* Mill. within Turkey is so high that close to interspecies level genetic differentiation was observed between Hopa (Artvin), from north-eastern Anatolia and Bursa, from western Anatolia, populations (Villani et al., 1999).

Ensuring the future of economically and environmentally very important *C. sativa* Mill., especially in the presence of devastating Chestnut Blight caused by *Cryphonectria parasitica* and Ink Disease caused by *Phytophthora cambivora* and *P. cinnamomi* in recent years (Robin et al., 1994; Gurer et al., 2001; Vannini and Vettraino, 2001; Vettraino et al., 2001; Fleisch, 2002; Erincik et al., 2003), requires efficient protection and management of genetic resources of this species in northwestern Turkey, where the genetic variation is high. In addition to present protected areas containing *C. sativa* Mill. stands, designation of these 19 individuals in Artvin as monumental trees will help conserving *C. sativa*'s genetic diversity in the region.

CONCLUSIONS

Castanea sativa Mill. is an important component of Europe's temperate forest ecosystems and provides benefits to people living in rural areas. In north-western corner of Turkey (near Artvin city center) 19 aged *C. sativa* individuals were found and measured for this study and it is concluded that;

- Size and age of all trees measured in this study equal or exceed previously registered monumental trees belonging to Fagaceae in Turkey.
- Evidence indicate that these trees had not been cut when the area was cleared for agriculture and were protected by the owners of the wheat and maize plots primarily for nut production and with other incentives (to serve as border bearings and shade providers, etc.).
- Due to their age, these trees keep a long record of past environmental events in their annual rings.

- Previous studies on the origin of *C. sativa* in Europe indicate that the origin is western Asia and the genetic diversity in Turkish populations of *C. sativa* is quite high. Therefore, conservation *C. sativa* genetic resources, including the trees measured for this study, carries utmost importance in ensuring *C. sativa*'s presence in the future.

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Tables

Table 1. Measured size characteristics of 19 *Castanea sativa* Mill. individuals included in this study.

Tree No.	DBH ¹ (cm)	CBH ² (cm)	Height (m)	Age ³
1	168	500	19.05	317
2	174	580	22.20	312
3	72	231	19.35	142
4	101	355	17.40	179
5	128	480	13.80	244
6	81	278	17.85	141
7	115	391	16.80	220
8	76	247	13.65	135
9	88	285	14.85	172
10	89	314	21.15	160
11	186	615	19.05	342
12	118	383	19.35	210
13	73	245	16.65	142
14	89	306	18.30	174
15	115	605	19.50	205
16	118	400	18.75	224
17	117	350	18.75	189
18	99	339	21.75	180
19	115	424	19.05	224

¹ Average of two perpendicular measurements of diameter at breast height (1.30 m).

² Circumference at breast height (1.30 m).

³ Estimated age in years.

Figures

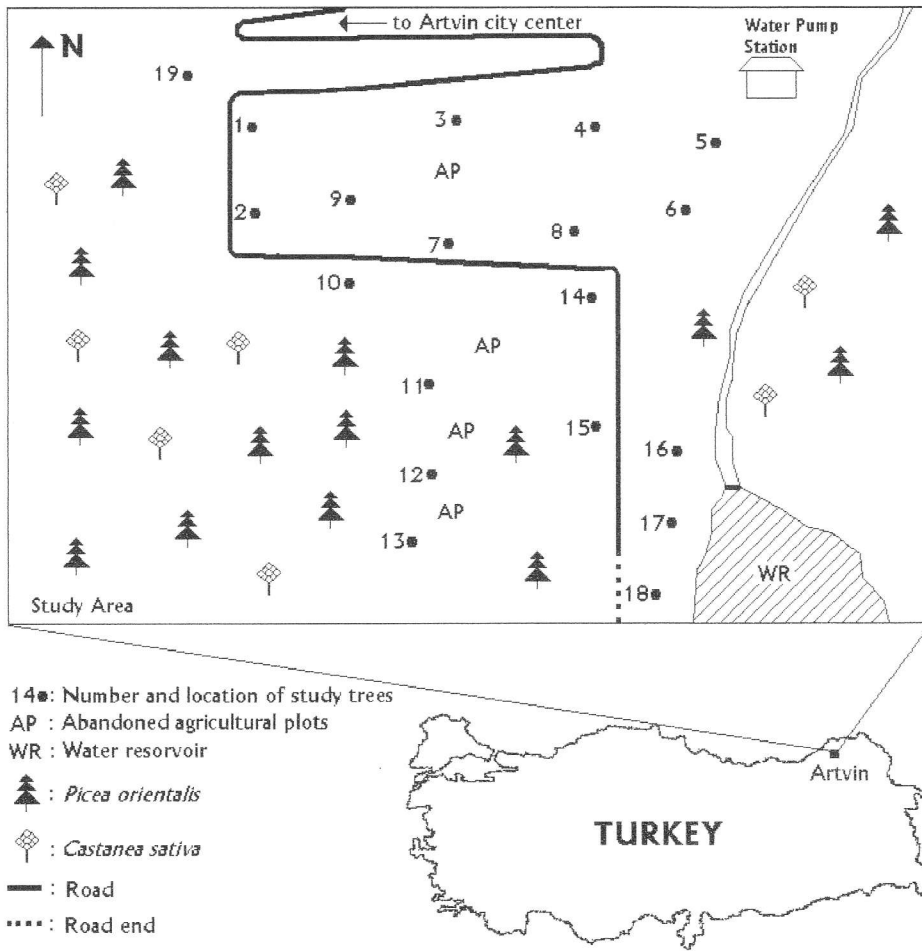


Fig. 1. A sketch (not to scale) of the study area showing approximate location of study trees.