2011

SU, Sofia

FRI - BAS, Sofia

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Project

State and prospects of the Castanea sativa population in Belasitsa mountain: climate change adaptation; maintenance of biodiversity and sustainable ecosystem management.

Funded by: EEA and Norway Grants.

Beneficiary: Forest Research Institute at the Bulgarian Academy of Sciences

Report

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Recommended citation:

Tonkov, S., I. Velichkov, G. Popov, G. Hinkov, T. Zlatanov. 2011. Pollen analysis on the vegetation history of European chestnut (Castanea sativa Mill.) on the northern slopes of Belasitsa mountain, Southwest Bulgaria. In: Zlatanov T, I Velichkov, B Nikolov (eds.) State and prospects of the *Castanea sativa* population in Belasitsa mountain: climate change adaptation; maintenance of biodiversity and sustainable ecosystem management. Project BG 0031 EEA report.

Introduction

The history and origin of the sweet chestnut forests in Belasitsa mountain have always been of great interest for foresters and botanists. Their present wide distribution on the northern slopes of the mountain is usually explained by cultivation since Greek and Roman times. The aim of the present palynological investigation was to enlighten upon the origin of these forests in the context of the hypothesis stated by Krebs et al. (2004) about the existence of possible sweet chestnut Quaternary refugia in the mountains of the Balkan peninsula.

Material and methods

In June 2010 a sediment core for pollen analysis was obtained with a hand-coring equipment from a mire in the locality Gjola (735 m a.s.l.). The core was 240 cm deep and the water depth was 25 cm. The lithological composition of the sediments was:

(*i*) 0-80 см – yellow-brown clay with sand; (*ii*) 80-100 см – hard grey clay with sand; (*iii*) 100-180 см – brown clay with some sand; (*iv*) 180-200 см – grey yellow clay with sand; (*v*) 200-220 см – hard dark-brown clay and (*vi*) 220-240 см – hard clay with sand.

The core was sampled at each 10 cm for pollen analysis of fossil pollen and spores. Altogether, pollen grains originating from 16 tree (shrub) and 36 herb taxa (including ferns and aquatics) were determined. The quantitative participation (in %) of the main pollen taxa (species) is presented on a basic pollen diagram (Fig. 1) constructed with TGView 2.0.2. software (Grimm, 2004).

The absolute age of three sediment samples was determined in the Laboratory of Radiocarbon Dating at Uppsala University, Sweden. The results and their calibrated values (95,4% probability) in years BP and BC/AD are presented in Table 1.

Table 1. Absolute age of sediment samples

^{14}C Lab. №	Depth (cm)	^{14}C Dates (yrs. BP)	Calibration (yrs. BP)	Calibration (yrs. BC/AD)
UA-41250	76-90	686±30	560-690 (625)	1320 AD
UA-41527	120-126	1474±30	1306-1406 (1356)	594 AD
UA-41249	176-190	7099±44	7840-8010 (7925)	5900 BC

Results and Discussion

The pollen diagram reveals the dynamics in the vegetation cover of the study area for the last 8000 years on the basis of the changes in the proportions of the main tree and herb species. The radiocarbon dates indicated different sedimentation rates. For the period 5900 BC - 594 AD the deposition of sediments was rather slow, i.e. 1 cm of compact sediment (clay) was deposited on average for 108 years. Later on, the

sedimentation rate has increased from 18 years/cm (594 AD - 1320 AD) to 8 years/cm during the last 600 years, which probably was a result of increased erosion caused by anthropogenic activities.

On the pollen diagram (Fig. 1) three basic stages of vegetation development are recognized which can be assigned to three pollen zones (Bel-1, Bel-2 and Bel-3). The first stage (Bel-1) has begun more than 8000 years ago (~6000 BC) when the main tree species at the altitude of the study site was sweet chestnut (*Castanea sativa*). It was accompanied by some oaks (*Quercus robur*-type), alder (*Alnus*), oriental hornbeam (*Carpinus orientalis*), hop hornbeam (*Ostrya carpinifolia*), beech (*Fagus*), lime (*Tilia*), pine (*Pinus*), manna-ash (*Fraxinus ornus*) and walnut (*Juglans*). On drier places with lower soil humidity were distributed various herb species from Chenopodiaceae, Asteraceae, Brassicaceae. Among them dominated mugwort (*Artemisia*) with up to 50-70%. For this stage there is no archaeological or paleoethnobotanical data indicating that the Neolithic people had introduced sweet chestnut in the study area. The palynological information confirms that by that time *Castanea sativa* was spontaneously growing on the northern slopes of Belasitsa mountain. The same conclusion can be applied to walnut (*Juglans*). According to Velchev (1971) walnut is native to some parts of the country as Vrachanska mountain in NW Bulgaria, where at some places this species is growing on rocky, sandy terrains together with other relict plants, far away from settlements.

The nearest palynologically studied site is a peat-bog above the upper tree line in Maleshevska mountain (Tonkov, Bozilova, 1992). On the pollen diagram the appearance of *Castanea* and *Juglans* is synchronous, about 3000 years later (2900 BC) than in Belasitsa mountain, and coincides with the existence of Early Bronze age settlements in the Struma valley.

The beginning of the second stage (Bel-2) of the dynamic changes in the forest cover of Belasitsa mountain, according to the radiocarbon dating, can be defined ca. 2900 BC. First of all, it is characterized by a sharp decline in the abundance of *Artemisia* pollen. The participation of *Castanea, Pinus, Alnus, Tilia* increases and pollen of fir (*Abies*) is also recorded. These changes presume an increase in air and soil humidity which has

had a favorable effect on the enlargement of the forest cover. Later on, during the time of the Roman colonization, the cultivation of sweet chestnut was widely practiced as its fruits and timber were used for various purposes. On the pollen diagram the participation of plants - indicators for anthropogenic disturbance in the natural forest cover (Chenopodiaceae, *Polygonum aviculare*, *Cirsium*-type, Cichoriaceae) increases.

The paleobotanical data from peat-bogs situated above the present upper tree line in the western part of Belasitsa mountain revealed the vegetation dynamics at high altitudes during the last ca. 2200 years (Panovska et al., 1990; Tonkov, 2007). Low quantities of *Castanea* pollen transported upslope are present in the fossil record. After II-III centuries AD the participation of *Castanea* is uninterrupted which fact is explained with the increasing agricultural activity of the local people. By that time, at higher altitudes, on the place of the deforested coniferous and partly beech woods have spread groups of junipers (*Juniperus)* and various herbs. The rise of *Castanea* pollen appears synchronous with that of walnut (*Juglans*) and plane-tree (*Platanus*). Quite probably, since historical time has started the enlargement of the vegetation belt (300-800 m a.s.l.) dominated nowadays by *Castanea sativa* on the northern slopes. For Northern Greece the distribution of *Juglans, Castanea* and *Platanus* dates back since 1200 BC and their enlargement was particularly pronounced during the time of the Roman colonization (Bottema, 1980, 2000).

The third stage in the forest history of Belasitsa mountain (Bel-3) is confined to the last 2-3 centuries. It is characterized by a widespread of *Castanea* forest communities and partly by a slight increase of beech (*Fagus*). Beyond doubt, this was the period of the strongest anthropogenic impact on the natural forest cover in the mountain.

Conclusion

The new palynological record from Belasitsa mountain provides information on the changes in the forest cover at low-mid altitudes for the last 8000 years. It clearly confirms that *Castanea sativa* was spontaneously growing in the mountain before the Struma valley was populated in Neolithic time. The subsequent enlargement of the sweet chestnut vegetation belt is associated with the anthropogenic activities since

the time of the Roman colonization as local people have started to use the timber and fruits for various purposes.

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Fig. 1. Mire Gjola, Belasitza Mts.
Pollen diagram