

Late Holocene changes in the high-altitude vegetation of mountainous areas of north-central Greece and the role of grazing.

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Abstract

Palynological studies have been carried out in the Lailias, Belles, Voras and Pieria (Flambouro) mountains which are located in north- central Greece. The four mountainous sites share some common geological and vegetation features. All sites have crystalline bedrocks and the high altitude forest vegetation is dominated by beech and/or pine forests though there are differences among these areas regarding the extent of these forest types, their location in relation to the coring sites etc. A distinct subalpine zone is present in all sites except Lailias and is dominated by *Juniperus communis* ssp. *nana*, ericaceous dwarf shrubs and extended grasslands. A comparative palynological study of the changes in the high-altitude vegetation of the four sites is attempted covering the Late Holocene. Pollen types related with human induced disturbance (e.g. forest clearings, animal husbandry) are compared up against pollen types of major forest vegetation units. Signs of local grazing pressure can be traced in various time periods in the diagrams of Beles, Lailias and Pieria. Though traceable in the Voras diagram, grazing pressure seems to have no major impact on the forest vegetation.

Key words: pollen analysis, vegetation, Greece, Voras, Lailias, Beles, Pieria

Introduction

Human impact on the natural vegetation of eastern Mediterranean has a long history of several thousand years (Bottema and Woldring 1990). Human impact manifested itself in the form of forest clearings, cultivation of land but quite often as animal husbandry.

Pollen analysis and reconstruction of past vegetation have been performed in several mountainous regions in northern Greece. In all sites signs of human impact have been traced and in many cases are well documented by historical or archaeological data (e.g. Gerasimidis et al. 2003, Athanasiadis et al. 2003).

This study compares the different vegetation histories of the Late Holocene in the mountainous regions of Pieria (Flambouro), Voras, Beles and Lailias (Figure 1) located in north-central Greece giving emphasis to grazing activity. Information on the sites of coring (coordinates, altitude, local and regional vegetation) can be found in previously published works

(Gerasimidis 2000, Athanasiadis et al. 2003, Gerasimidis et al. 2009, Gerasimidis and Panajiotidis 2010). All sites share same geological features having crystalline bedrock and their dominant forest types are beech and or pine, though there are differences among these areas regarding the extent of these forest types their location in relation to the coring sites etc. With the exception of Lailias, there is a clear subalpine zone in all sites where grasslands and dwarf juniper (*Juniperus communis* ssp. *nana*) and ericaceous shrubs dominate the vegetation.

Materials and Methods

Standard procedures were used for the preparation and counting of pollen grains (Faegri and Iversen 1989). Pollen diagrams were created using Tilia and TGView 2.0.2 software (Grimm 2004). Radiocarbon dates were calibrated with the help of CALIB 6.0 (Stuiver and Reimer 1993). Sum of pollen types (AP + NAP), upon which pollen percentage (PP) values were calculated, includes major forest tree species, subalpine species and pollen types indicators of grazing or forest clearings in local (Asteraceae, Cichoriaceae, Caryophyllaceae, Rubiaceae,) or regional scale (*Plantago*, *Artemisia*, Chenopodiaceae, *Rumex*) mountainous regions with a crystalline bedrock (Mazier et al. 2006). Clustering and zonation of the diagrams was based on the same, as above, assemblage of pollen types.

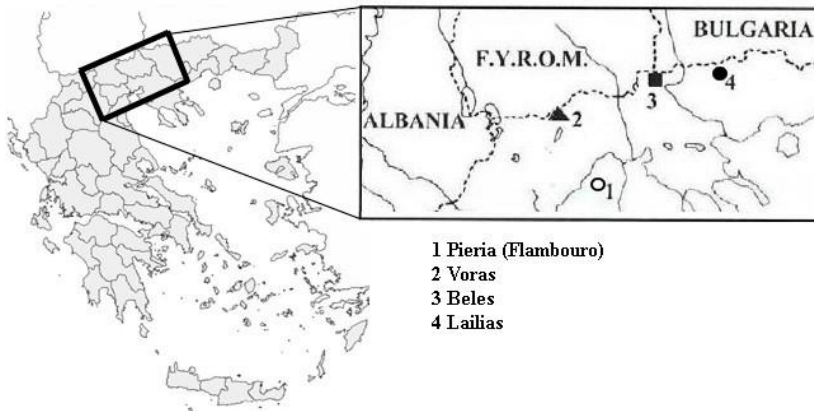


Figure 1. Map showing the locations of the coring sites in north-central Greece.

Results- Discussion

The composite diagram (Figure 2) comprises the Beles (BE), Voras (VR), Lailias (LA) and Pieria (Flambouro, FL) pollen diagrams. The original diagrams of Voras and Lailias cover a larger time period but in this study we take into consideration their late Holocene period for which there is a good time resolution between consecutive samples (around 100 years per 10 cm) for most part of the diagrams. In this respect Beles diagram has the best time resolution, with a time 'window' between samples of ca. 30 years per 10 cm.

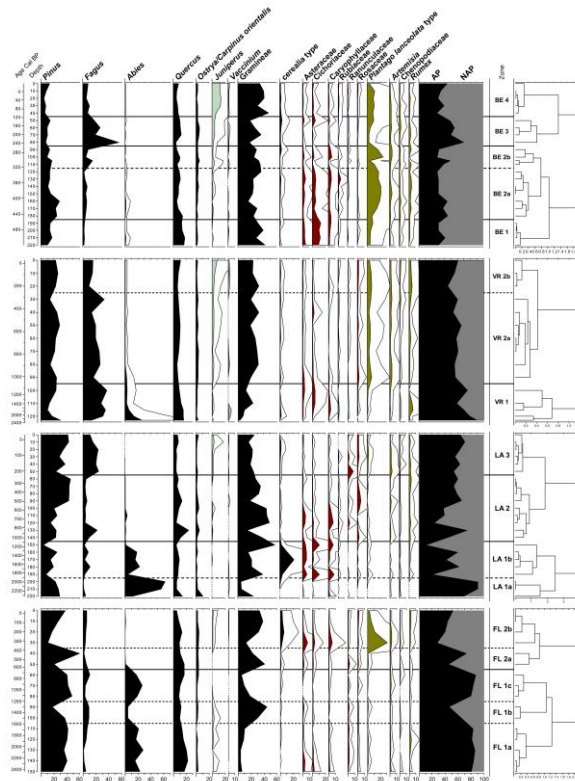


Figure 2. Composite diagram of Pollen Percentage values for the four cores analyzed. Beles (BE) , Voras (VE), Lailias (LA) and Pieria (Flambouro, FL).

In the Beles Mountains grazing pressure appears for the first time at the base of the diagram in a period that coincides with the start of the Turkish occupation (Athanasiadis et al. 2003). The large PP values of *Plantago lanceolata* type together with those of Asteraceae, Cichoriaceae,

Caryophyllaceae, Rubiaceae, indicate the strong grazing pressure around the coring site (BE 2a-b). In the boundary of subzones BE 2a- BE 2b clear impact on forest vegetation is implied by the alternating high values of grazing pollen indicators with low values of forest pollen types and vice versa. This pattern is also seen among the same indicators and pollen of *Juniperus* (BE 2a-b, BE3, BE4). A possible explanation is that usually juniper shrubs were burned, as they are not edible by domesticated animals, to provide fields for grazing (Prof. V. Papanastasis pers. comm.).

In Voras Mountains all pollen indicators of grazing show in general low values with the exception of *Plantago lanceolata* type. The constant presence of the latter as well as of Chenopodiaceae and *Rumex* (subzones VR 2a-b) indicate grazing pressure in the region which is mainly taking place in the subalpine zone. This is supported by the fact that there are no tremendous changes in forest cover as indicated by the comparison of the AP/NAP curve of Voras with those of the other diagrams.

In Lailias mount the pattern of alternating magnitude in PP values between indicators of grazing and major forest types is again detected in the upper and lower boundaries of subzone LA1b as well as in part of zone LA2. In the same subzone the abundant presence of cerealia type indicates also cultivation of land. Interestingly, PP values of *Plantago lanceolata* type are very low and the curve is fragmented.

In Pieria (Flambouro) diagram a first short event of fir decline (FL1b) indicates forest clearings and logging as no pollen indicators of grazing are significantly present. After the second and as it appears permanent decline of fir (FI2a-b) around the coring site, a major shift in the values of grazing indicators, coinciding with the establishment of the Katafygi village (Gerasimidis et al. 2008), is observed (base of FI2b).

It is important to notice that in the sites with a distinct subalpine zone (Pieria, Voras, Beles) the decline of grazing pressure in the recent decades has led to a rise in PP values of juniper marking a qualitative change in the composition of the vegetation.

Clear indications of human impact were found on the forest vegetation of most north-central Greece Mountains, examined in this study. Most of the pollen indicators proposed in the published literature are found to be good 'tools' in evaluating the spatial dimension and intensity of human activity manifested mainly as animal husbandry.

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