Pollen deposition in moss polsters and pollen traps in the Central Stara Planina Mts (2002–2005)

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Abstract. The present study is a first attempt at applying the pollentrap method in the Central Stara Planina Mts by investigating the relationship between pollen assemblages and source vegetation. Five pollen traps were placed in Mt Shipchenska for four consecutive years (2002–2005). Moss samples were also collected from the immediate vicinity of the traps. The values obtained for the pollen traps are presented in percent and compared for each of the four years and with the values obtained for the moss samples. The results of the pollen traps are presented also as Pollen Accumulation Rate (grains cm^{-2} yr^{-1}). They indicate that the *Pinus* pollen is overrepresented in the pollen traps and in the moss samples, but the moss samples show higher *Pinus* and *Picea* percentage than the pollen traps, probably due to the different type of collection and preservation of pollen grains. The cyclicity of the *Fagus* pollen productivity explains the variation in *Fagus* values in the pollen spectra. The higher pollen accumulation in the 2002/2003 pollen traps for *Quercus, Corylus,* and *Betula* indicates more favourable climatic conditions and more intensive flowering in 2003.

Key words: Central Stara Planina Mts (Mt Shipchenska), pollen traps, surface moss samples

Introduction

The relationship between vegetation and pollen rain is of great importance for palaeoecological interpretations. Modern pollen analogues (both pollen traps and surface moss samples) are used by palaeoecologists in order to determine quantitatively the composition of the main arboreal and non-arboreal pollen taxa in recent pollen spectra and to compare them with that of fossil assemblages (Hicks & Birks 1996). Trapping experiments from Northern Europe (Hicks 1985, 1986, 1994) have proven the necessity of pollen monitoring as a basis for interpreting the fossil pollen spectra. In 1996 the European Pollen Monitoring Programme (EPMP), now Pollen Monitoring Programme (PMP), was launched and Bulgaria plays an important role in it.

Modern pollen deposition monitored by pollen traps and moss samples are still rare in the Bulgarian mountains (Stefanova 2000; Tonkov & al. 2001). Forty-four surface moss samples from the high-altitude slopes of the Balkan Range were investigated and implications for pollen preservation and pollen dispersal of main tree species were published by Filipovitch & Lazarova (1997).

The present study is a first attempt at applying the method of pollen trapping in the Central Stara Planina Mts by investigating the relationship between pollen assemblages and vegetation which produces them.

Area of investigations

Mt Shipchenska (1328 m) is part of the Central Stara Planina Mts in Central Bulgaria (Fig. 1). Forests of *Fagus sylvatica* are most abundant in this part of the mountains. Mixed forests of *F. sylvatica* with *Picea*

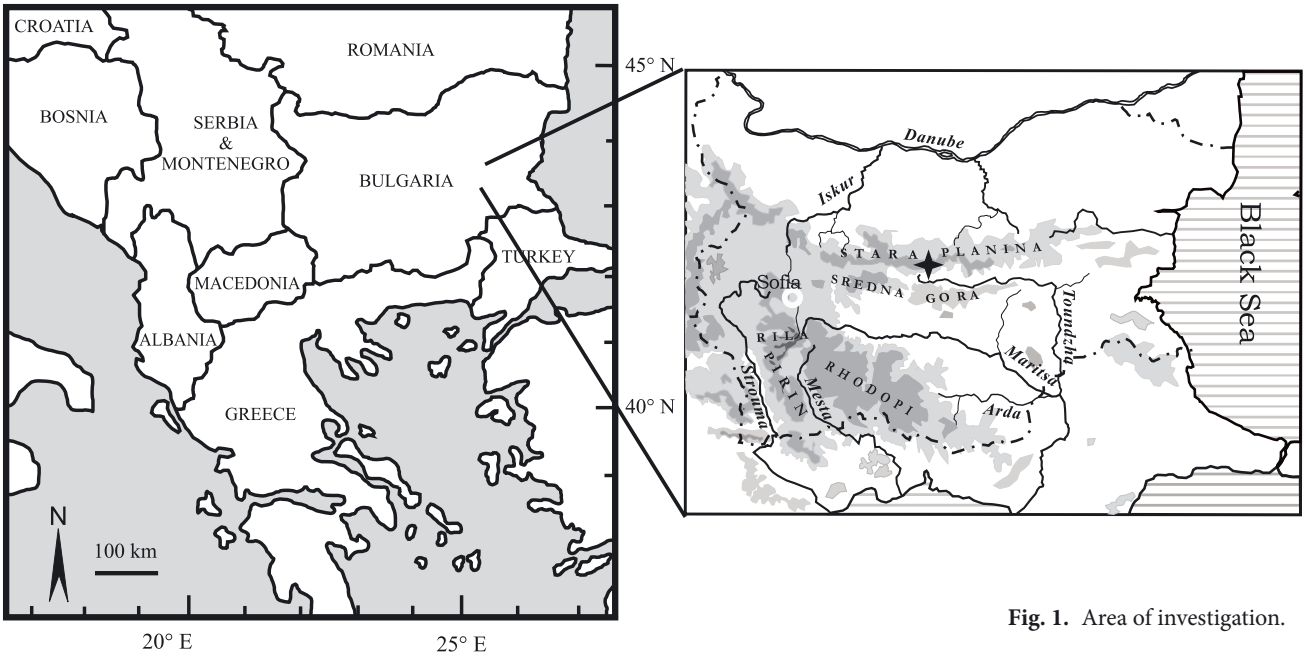

Fig. 1. Area of investigation.

abies also occur. Mixed deciduous forests of *Quercus dalechampii* with *Carpinus betulus* and of *F. sylvatica* with *C. betulus* are rare in this area. Limited areas are covered by herb communities of *Agrostis capilaris, Nardus stricta,* and *Bellardiochloa violacea,* replacing *F. sylvatica* and *Abies alba* forests (Bondev 1991). Clearly delineated vegetation belts are absent in this part of the mountains.

Communities of *P. sylvestris* occur at different altitudes, as well as planted *P. nigra* and *P. sylvestris* forests at lower elevation. The foothills of the mountain are covered with deciduous forests dominated by *Q. dalechampii, C. betulus, Ulmus glabra, Tilia cordata,* and *Fraxinus excelsior*.

The climate in the region under study is mildly continental but precipitation increases and temperature decreases with altitude rise (Velev 2000).

Material and methods

Five pollen traps (Ptr) were placed in Mt Shipchenska, within different vegetation communities and along an altitudinal transect (Ptr1 at 1310 m, Ptr2 at 1195 m, Ptr3 at 1061 m, Ptr4 at 895 m and Ptr5 at 690 m), for four successive years (2001/2002, 2002/2003, 2003/2004 and 2004/2005). Initially, the pollen traps were placed in October 2001, with a full calendar year as collection season for the pollen traps, up to the next October. Establishment of the pollen-trap stations and laboratory preparation of the pollen samples followed Hicks & al. (1996).

Moss polsters were collected once a year, in October, from the immediate vicinity of the traps according to the following method: 6–7 small, equally-sized subsamples of moss (a single sample with diameter of about 5 cm) were amalgamated into one sample. The subsamples were collected within a radius of 5–6 m of each pollen trap and consisted of plant material only. They should reflect the range of the species and life-forms growing within the area around the trap.

The number of sunny/cloudy days for 2002, 2003, and 2004 from 1st March to 1st June was determined. The location of the pollen traps and surrounding vegetation is described in Table 1.

The values obtained for the pollen traps are presented in percent and compared for each of the four years and with the values obtained for the moss samples (Fgs. 2-5). The pollen sum used for percentage calculation is minimum 750 pollen grains per each sample. The results are presented also as annual Pollen Accumulation Rate (PAR) (grains cm^{-2} yr^{-1}).

Results

Of the five traps (Ptr S1, S2, S3, S4, and S5), two (S2 and S3) produced results for four consecutive years.

Pollen trap S1 disappeared in 2004 and 2005 and S4 and S5 disappeared in 2005 (Fig. 6).

Pinus diploxylon type (*P. sylvestris* and *P. nigra*) and *Fagus* were the most abundant pollen taxa in the pollen spectra. *Pinus* diploxylon type showed the highest percentage in the two sites situated in a deciduous forest with isolated trees of *P. nigra* and *P. sylvestris,* near a planted *P. sylvestris* forest (S4 and S5) at 639 m and 895 m a.s.l. (Figs 2, 3, 4). Nearly all moss samples showed higher (30–55 %) percentage values of the *Pinus* diploxylon type than the pollen traps (8–35 %). The same was true for *Picea*. The highest *Fagus* percentage occurred in the site located in a *Fagus/Picea* forest, but that pollen taxon occurred also in all other sites (Figs 2-4). *Quercus, C. betulus* and *Tilia* registered relatively low percentage values (1–15 %), even in sites situated in deciduous forests. *Acer* and *Ulmus* were underrepresented. *Robinia* pollen occurred with high values (5–20 %) (Figs 2, 3) in the pollen trap S5 (for 2002 and 2003). P*oaceae* showed the highest percentage (20–60 %) in the highest part of the mountains (at 1195–1310 m a.s.l.).

Total pollen accumulation of *Fagus* in the pollen traps was higher in 2003 than in 2002, 2004 and 2005 (Fig. 6). *Betula* and *Quercus* recorded the highest pollen accumulation in 2003. The highest total PAR was established for 2003.

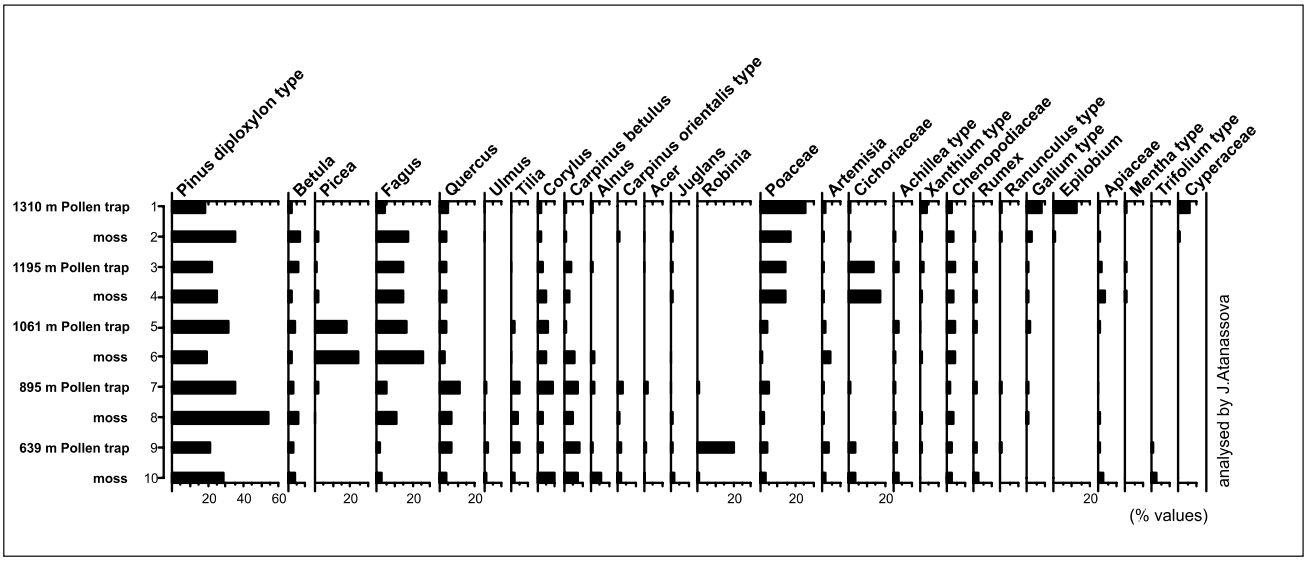

Fig. 2. Pollen traps and moss samples (2002).

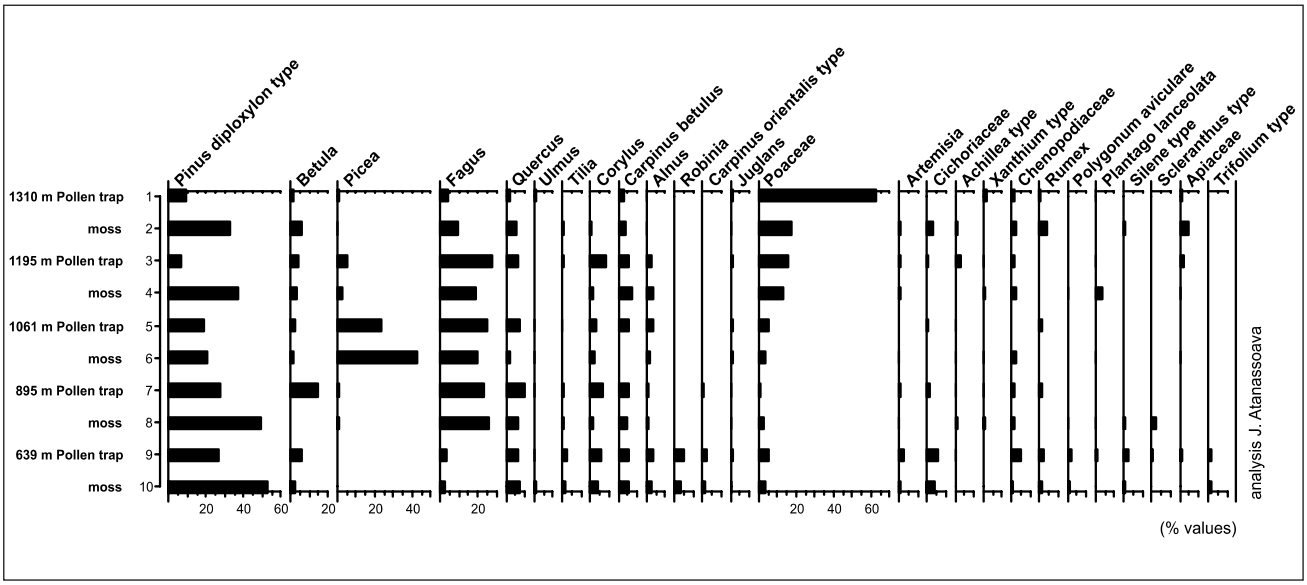

Fig. 3. Pollen traps and moss samples (2003).

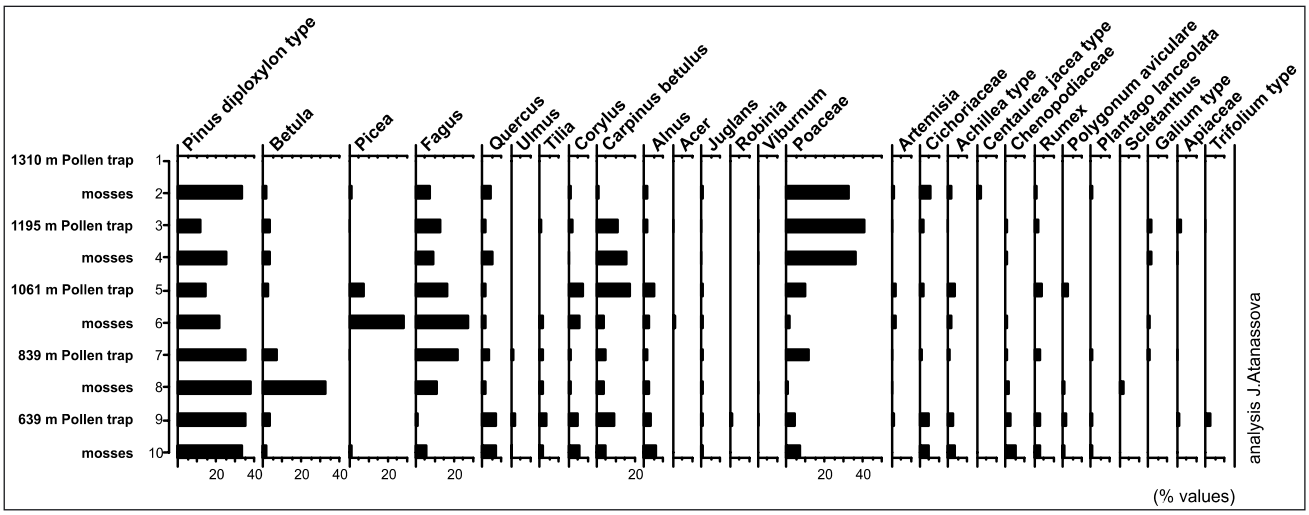

Fig. 4. Pollen traps and moss samples (2004).

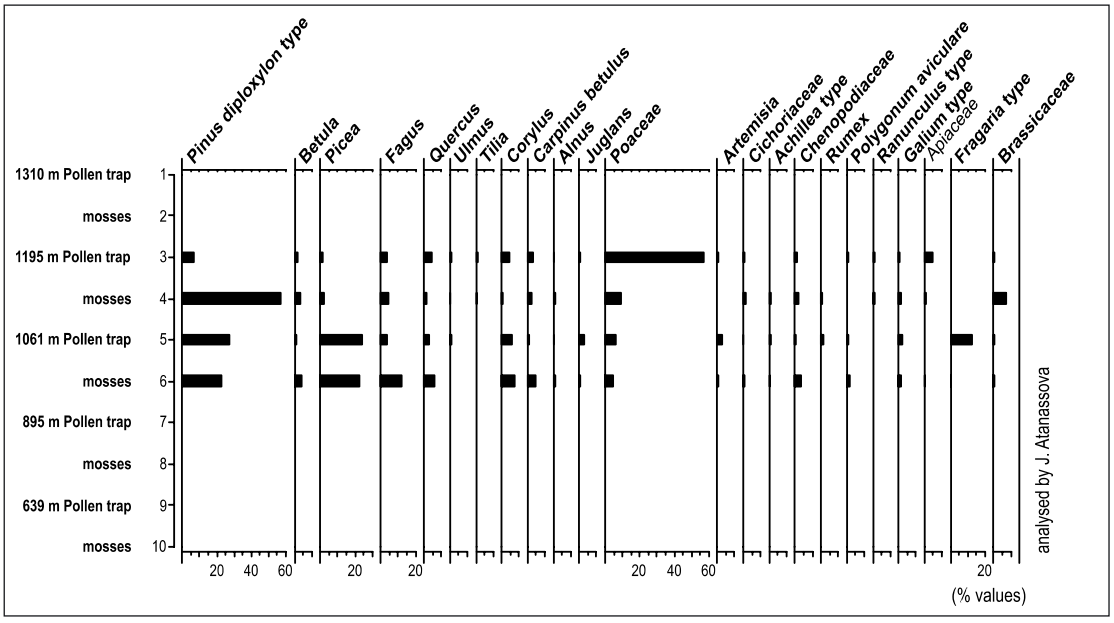

Fig. 5. Pollen traps and moss samples (2005).

Discussion

The results indicate that *Pinus* pollen dominates the assemblages. The percentage values are lower in the pollen traps than in the moss samples. The reason could be either in the different pollen-collecting qualities, or in the differential preservation in the traps and mosses. This fact was established also by Räsänen & al. (2004). *Pinus* PAR at the deciduous forest sites was surprisingly high (about 2000 to 4000 grains/cm^2). This fact could be explained by the absence of clearly delineated vegetation belts in Mt Shipchenska, where various types of forest vegetation occur at short altitudinal intervals. Communities of *P. sylvestris* and *P. nigra* occur at different elevations, and single trees of these species are also common in the deciduous forests. *Fagus* has shown the highest percentage values in 2002/2003 (Fig. 3). It is known that the pollen productivity of *Fagus* varies from year to year, with a cyclicity of two years, which could be the explanation of this fact. Higher pollen accumulation in the 2002/2003 pollen traps for *Quercus, Corylus,* and *Betula* is also visible (Fig. 6). The highest pollen accumulation of the main deciduous trees in the 2002/2003 pollen traps indicates more favourable climatic conditions and more intensive flow-

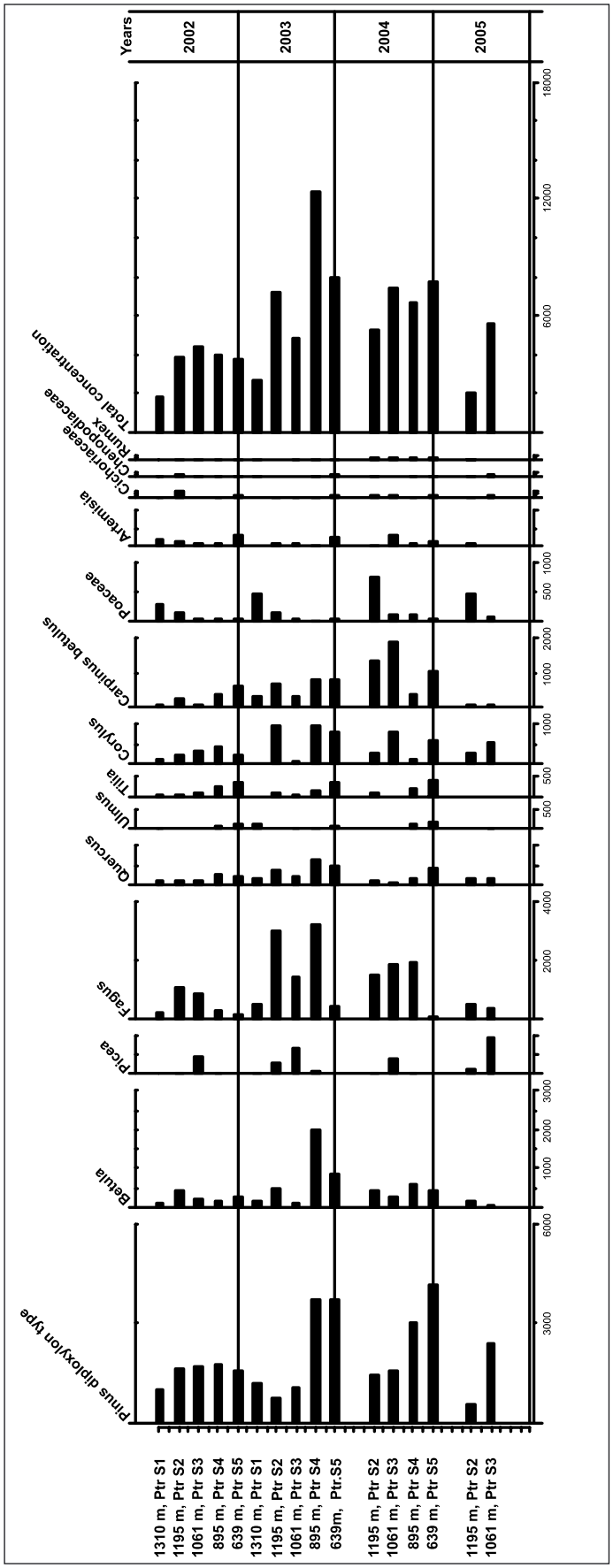

Fig. 6. Pollen accumulation rates of selected taxa (2002–2005).

ering in 2003. This could be connected to a greater number of sunny days (63) in the region in the spring of 2003 (from 1st March to 1st June) in comparison to 2002 (50) and 2004 (57). *Quercus* has shown low representation in the pollen traps and moss samples in the deciduous forests, which is difficult to explain. *Acer* and *Ulmus* are also underrepresented. Finds of insects in the pollen traps could explain the high percentage of *Robinia pseudoacacia, Epilobium* and *Cichoriaceae* (Fig. 2). In the last 15–20 years *R. pseudoacacia* has expanded in the deciduous forests at lower elevation.

Conclusions

1. Moss samples show higher *Pinus* and *Picea* percentage than in the pollen traps, probably due to the different type of collection and preservation of pollen grains.
2. *Pinus* pollen is overrepresented in the pollen traps and moss samples. This could be credited to the high pollen productivity and good pollen preservation.
3. Deciduous trees (*Quercus, Betula, Corylus*) probably flower more intensively in the years with more sunny days in spring.
4. Insects in the pollen traps could explain the high values of enthomophyllous species (as *R. pseudoacacia, Epilobium* etc.)
5. More data from long-term pollen traps and surface moss samples in the Bulgarian mountains are needed to understand the specific processes of pollen production, pollen dispersal and pollen preservation of the main arboreal and non-arboreal taxa, as influenced by local climate, type of vegetation communities, and altitude.

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