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NEW ENGLAND NOTE

COMPARISON OF POLLEN AND STOMATA IN LATE-GLACIAL AND EARLY-HOLOCENE LAKE SEDIMENTS FROM EASTERN MASSACHUSETTS

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The analysis of stomata in lake-sediment cores is increasingly used as a paleoecological tool. Stomata are less likely than pollen grains to be dispersed over long distances, and thus stomate records supplement and enhance interpretations based on pollen data by providing information about patterns and composition of local vegetation (e.g., Froyd 2005; Hansen 1995; Parshall 1999; Pisaric et al. 2000, 2003; Yu 1997). Stomata have been analyzed in modern and fossil sediments in many regions, oftentimes to gain a better understanding of past changes in the position of boreal treeline (e.g., Clayden et al. 1996, 1997; Gervais and MacDonald 2001; Gervais et al. 2002; Hansen et al. 1996; Leitner and Gajewski 2004; Pisaric et al. 2001). We have conducted the first study of this type in New England, analyzing conifer stomata in the late-glacial and early-Holocene sediments of Berry Pond, Massachusetts. Comparison of the stomate record with pollen data tests the ability of both approaches to reflect the history of vegetation at the study site.

STUDY SITE AND METHODS

Berry Pond (42.620°N, 71.087°W, 43 m elevation) is a small (1.6 ha) pond located in the Town of North Andover (Essex County) in northeastern Massachusetts. The present-day vegetation

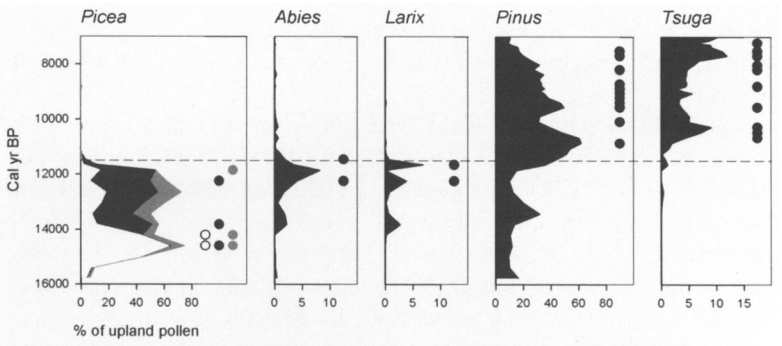

Figure 1. Plots of pollen percentage and stomate data for Berry Pond. The stomate data are shown as presence versus absence; each dot represents the presence of one to three stomata in the pollen sample. For the *Picea* pollen and stomate data, white fill = *P. glauca*, black fill = *P. mariana*, and gray fill = undifferentiated *Picea*.

features *Pinus strobus, Quercus* species, and other hardwoods (Hall et al. 2002). A 13-meter-long core was raised from the pond in October of 2003. Details of the coring and subsequent laboratory analyses are available elsewhere (Oswald et al., 2007). Stomata were identified at 400× magnification during analysis of pollen samples from the late-glacial and early-Holocene intervals of the core (~16,000–7000 calibrated ^{14}C years before present; cal. yr. BP). *Picea* pollen grains were discriminated to species following Hansen and Engstrom (1985), and *Picea, Abies, Larix, Pinus*, and *Tsuga* stomata were identified following Hansen (1995).

RESULTS AND DISCUSSION

There is strong agreement between the stratigraphic patterns of pollen and stomata (Figure 1). Pollen assemblages from ~16,000 to 14,000 cal. yr. BP are dominated by *Picea glauca*, and that time period is the only interval where *P. glauca* stomata are present. The stomate data indicate that *P. mariana* was also present, although its occurrence is not reflected by the pollen data. It is possible that some of the undifferentiated *Picea* pollen was that of *P. mariana*. *Pinus* pollen reaches ~15%, but no *Pinus* stomata were encountered. This result is consistent with a pollen-vegetation calibration study by Bradshaw and Webb (1985) that found 10–15% *Pinus* pollen where *Pinus* trees were absent. We interpret these data as

reflecting *Picea glauca*-dominated forest, which suggests cool climate and well-drained soils (e.g., Thompson et al. 1999; Viereck et al. 1983, 1986).

The pollen record shows a transition from *Picea glauca* to *P. mariana* at ~14,000 cal. yr. BP and high *P. mariana* pollen percentages between ~14,000 and 11,500 cal. yr. BP. *Picea mariana* stomata are present during that interval, but *P. glauca* stomata were not encountered. *Abies* and *Larix* pollen percentages peak at the end of the late-glacial interval, and *Abies* and *Larix* stomata occur between ~12,500 and 11,500 cal. yr. BP. The shift from *P. glauca*-dominated forest to vegetation featuring *P. mariana*, *Abies*, and *Larix* has been observed at other sites in Massachusetts (Lindbladh et al., 2007). These changes may represent vegetational responses to cooler climatic conditions during the Allerød and Younger Dryas intervals (e.g., Björck et al. 1998; Stuiver and Grootes 2000) and the development of wet, acidic soils (e.g., Viereck et al. 1983, 1986).

Pollen percentages of *Picea, Abies*, and *Larix* decline abruptly and remain low after ~11,500 cal. yr. BP. That change is mirrored by the absence of *Picea, Abies*, and *Larix* stomata higher in the core. *Pinus* pollen percentages increase rapidly at ~11,500 cal. yr. BP, followed shortly by an increase in *Tsuga* pollen percentages. *Pinus* and *Tsuga* stomata were encountered in nearly all samples between ~11,500 and 7000 cal. yr. BP. The shift from *Picea*- to *Pinus*-dominated pollen assemblages in response to rapid warming at the end of the Younger Dryas interval is seen in records across eastern North America (e.g., Shuman et al. 2002).

The analyses of stomata and pollen in the sediments of Berry Pond show a close correspondence between these two types of paleoecological data between ~16,000 and 7000 cal. yr. BP. The similarity of the major changes may indicate that the plant communities growing near Berry Pond, as evidenced by the stomata, had a similar composition to the regional vegetation, as reflected in the pollen data. The occurrence of relatively homogeneous vegetation is plausible given the lack of substantial topographic variation in northeastern Massachusetts. Alternatively, the parallel changes in the stomate and pollen data may result from the relatively small pollen source area of the lake basin. Because of its small surface area, Berry Pond likely receives much of its incoming pollen from nearby vegetation (e.g., Sugita 1994), such that the stomata and pollen data are sampling a similar part of the

landscape. Additional studies of modern and fossil patterns of pollen and stomate occurrence are needed to better understand how these different paleoecological proxies represent spatial patterns of vegetation in temperate forests.

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