6 ka Mean July Temperature in Eastern Canada from Bartlein and Webb's (1985) Pollen Transfer Functions: Comments and Illustrations

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Fossil pollen are the most abundant form of proxy data for testing postglacial climate models. A large data set of pollen surface samples linked with climate stations has been used to calculate temperature and precipitation as transfer functions (Bartlein and Webb 1985, Gajewski 1988) and as response surfaces (Prentice et al. 1991). Fossil pollen diagrams from lake sediment permit climate reconstruction through postglacial time and specifically for the alleged hypsithermal.

The most ambitious effort using multiple-regression to derive transfer functions was Bartlein and Webb (1985) who partitioned eastern North America into 13 calibration regions of which 11 are relevant to Canada. Using 211 pollen diagrams they identified the 6 ka pollen spectrum, calculated the mean July temperature using the function from the region with the best modern analogue and mapped the results. They found that at 6 ka: 1) the steepest latitudinal temperature gradient was roughly 100 km north of its modern position in the latitude of the southern Great Lakes, 2) southern and south-central Canada was over one degree warmer than today, 3) residual ice sheets kept the near-north over 2 degrees cooler than today and 4) the southern prairie provinces were only as warm or cooler than today.

We applied their transfer functions to the 6 ka pollen spectrum in each of 41 pollen diagrams ranging westward from Newfoundland to Saskatchewan, Minnesota and North Dakota (Fig. 1). Figures 2-6 show five Ontario pollen diagrams spanning the postglacial together with the calculated mean July temperature. Our results generally confirm their results, but three insights were derived.

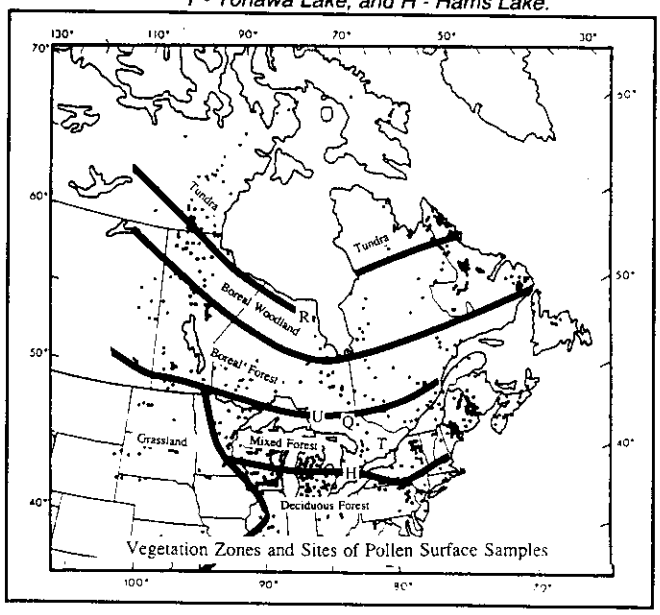
1) Although Lake Superior generates a distinctively cold July air mass today, at 6 ka the July temperature near the lake was anomalously 2.5 degrees warmer than today (Fig. 3), whereas a more distant site was only a half degree warmer (Fig. 4). This implies that at 6 ka lake Superior did not generate a distinctive summer air mass.

2) In the western states adjacent to the prairie provinces the 6 ka temperature was calculated to be cooler than today which is inconsistent with evidence that it was warmer than today (McAndrews 1966). We feel that this is because ragweed (Ambrosia), which has proliferated historically because it is adapted to European disturbance, was not used to calibrate the regional transfer function. Immediate prehistoric ragweed pollen abundance unrelated to human disturbance occurs southward in the relatively warm Mississippi valley region, but at 6 ka it was more abundant northward, implying warmer summer temperatures.

3) There is no modern pollen analogue for the high 6 ka beech (Fagus) pollen percentage of southern Ontario. We suspect that the temperature may be higher than calculated.

We suggest that new and better regional transfer functions be derived: 1) by using only surface samples where the regional pollen rain is expressed, i.e. lake surface sediment, 2) by using calibration samples where pollen identifications are reliable, and 3) by using immediately prehistoric spectra where vegetation is disturbed and not in equilibrium with the environ-

Fig. 1 — Map of northeastern North America showing vegetation zones and surface sample sites used by Bartlein and Webb (1985) to derive transfer functions. Letters locate pollen diagram sites: R - R Lake, U - Upper Mallot Lake, Q - Lake QB, T - Tonawa Lake, and H - Hams Lake.



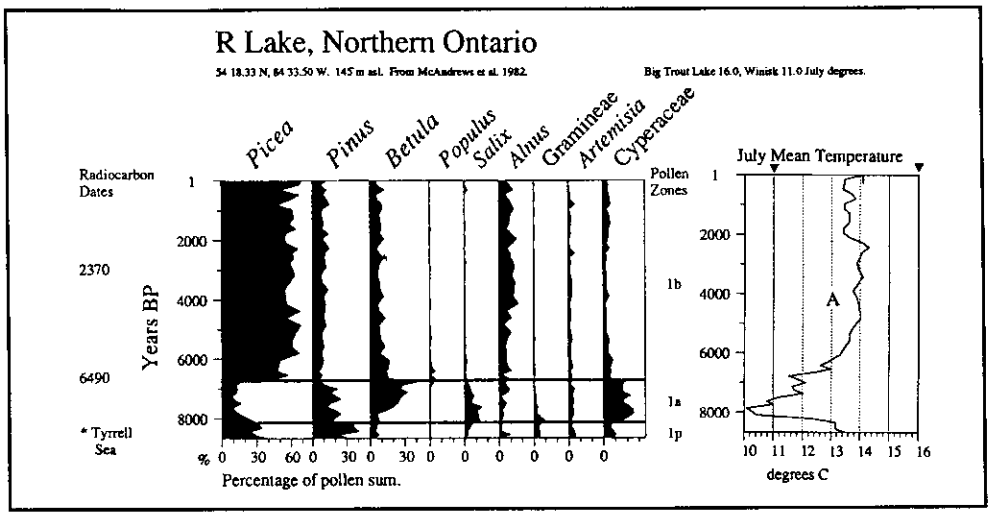


Fig. 2. *Pollen diagram for R Lake (McAndrews et al. 1982) and derived mean July temperature showing that 6 ka temperature was lower than today due to residual glacier ice. The temperature curve was smoothed using an unweighted three-point running mean of values derived from transfer function A of Bartlein and Webb (1985). Triangles indicate the mean July temperature values at the two nearest climate stations: Winisk on the coast is 100 km distant whereas Big Trout Lake is inland and 380 km distant. Pollen zones follow McAndrews (1993); subzone 1p contains recycled pollen (cf. McAndrews 1984) and thus produces a spuriously high temperature.*

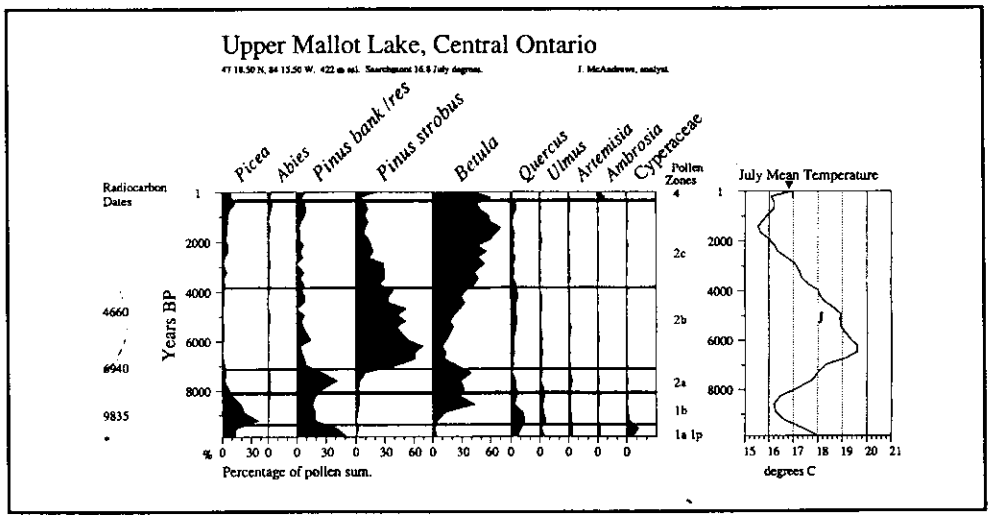


Fig. 3. *Pollen diagram for Upper Mallot Lake and smoothed mean July temperature using transfer function J. Note that the hypsithermal at 6 ka is about 3 degrees higher than today implying that Lake Superior did not have a cooling effect on local climate. Searchmount climate station is 40 km inland from Lake Superior and 60 km distant.*

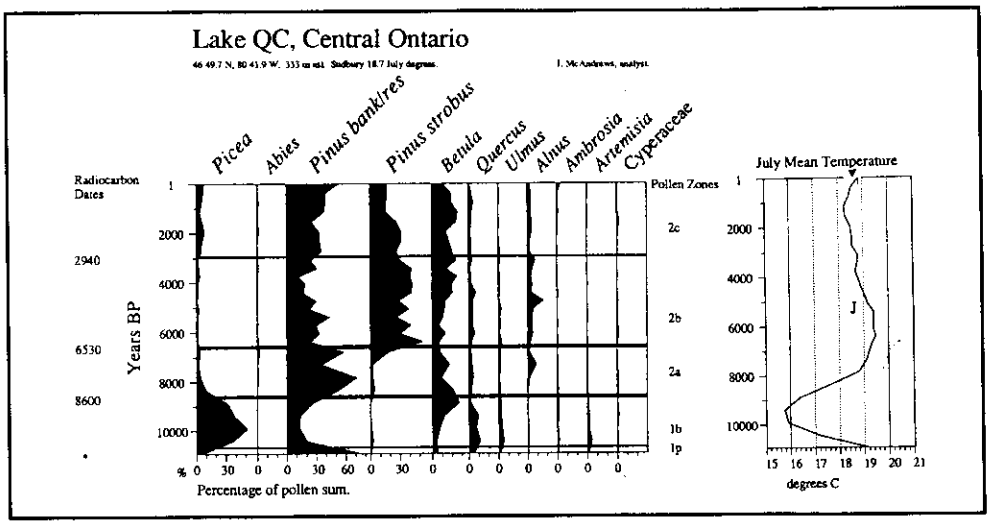


Fig. 4. *Pollen diagram for Lake QC and smoothed mean July temperature using transfer function J. Note that the 6 ka temperature is similar to that of Upper Mallot Lake. Sudbury climate station is 40 km distant from Lake QC.*

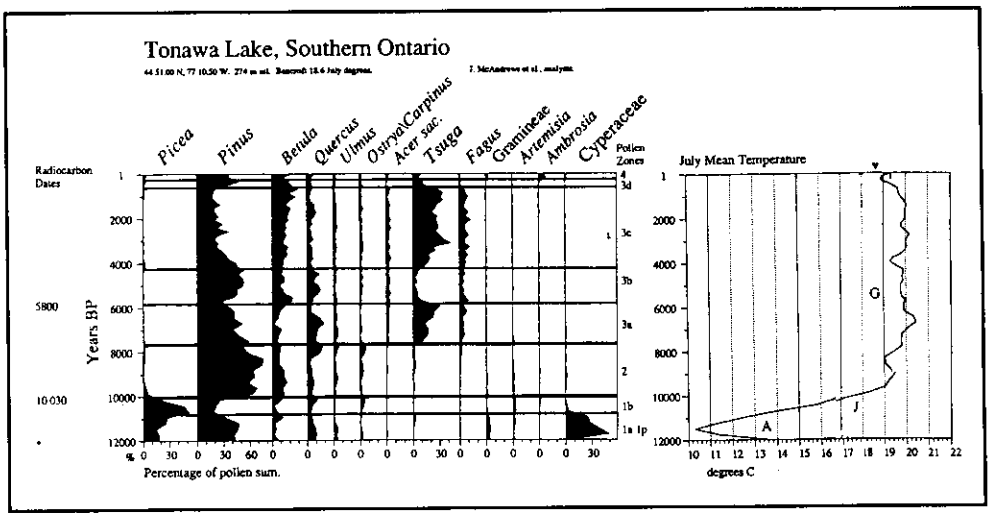


Fig. 5. *Pollen diagram for Tonawa Lake and smoothed transfer functions G, J, and A. Bancroft climate station is 55 km distant.*

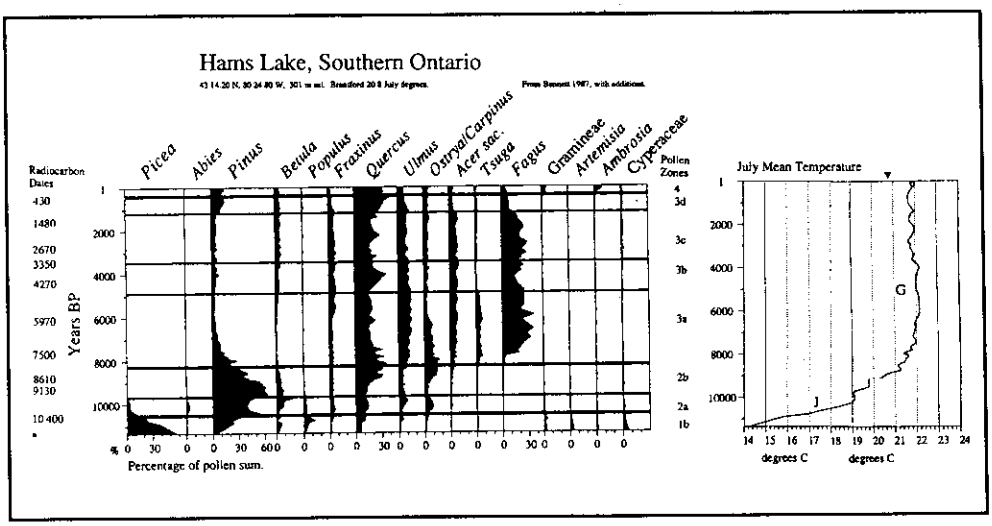


Fig. 6. *Pollen diagram for Hams Lake adapted from Bennett (1987) with additions and smoothed transfer functions G and J. Brantford climate station is 15 km distant.*

ment. In addition statistical confidence intervals need to be calculated.

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