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The McAbee Early Eocene macroflora

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Background

Fossil floras of early Eocene Okanagan Highlands sites in British Columbia (Canada) and Washington state (USA) provide a rich resource for studying the evolution of North American temperate forest communities (Fig. 1). The McAbee site, west of Kamloops B.C., consists of a laterally extensive (~2km) outcrop of bedded lacustrine shale dated to ~51 Ma near the middle of the Early Eocene Climatic Optimum (EECO, 50-52 Ma) (Greenwood et al., 2005), the warmest period of the Cenozoic. The macroflora has been reported on by several workers based on opportunistic collecting by both amateur and professional collectors. A least 3 ferns (*Azolla*, *?Dryopteris* and cf. *Osmunda*), 2 species of *Ginkgo*, 13 conifers (e.g., Cupressaceae – *Chamaecyparis*, aff. *Cunninghamia*, *Metasequoia* and *Thuja*; Pinaceae – *Abies*, *Pinus* and *Pseudolarix*; and Taxaceae – cf. *Torreya*), at least 62 different dicot leaf morphotypes and an additional 28 types of angiosperm reproductive structures are recorded from the flora (Dilhoff et al., 2005).

Materials and Methods

Reported here is an analysis of the macroflora using 2 samples collected independently by 2 different individuals, separated in time by 20 years. The BU sample was sorted into leaf morphotypes using the *Manual of Leaf Architecture* (LAWG, 1999) and described using the characters therein. Mean leaf area and leaf margin type for each morphotype was then used to estimate mean annual temperature (MAT) and mean annual precipitation (MAP) (Wilf et al., 1998; Greenwood et al., 2005).

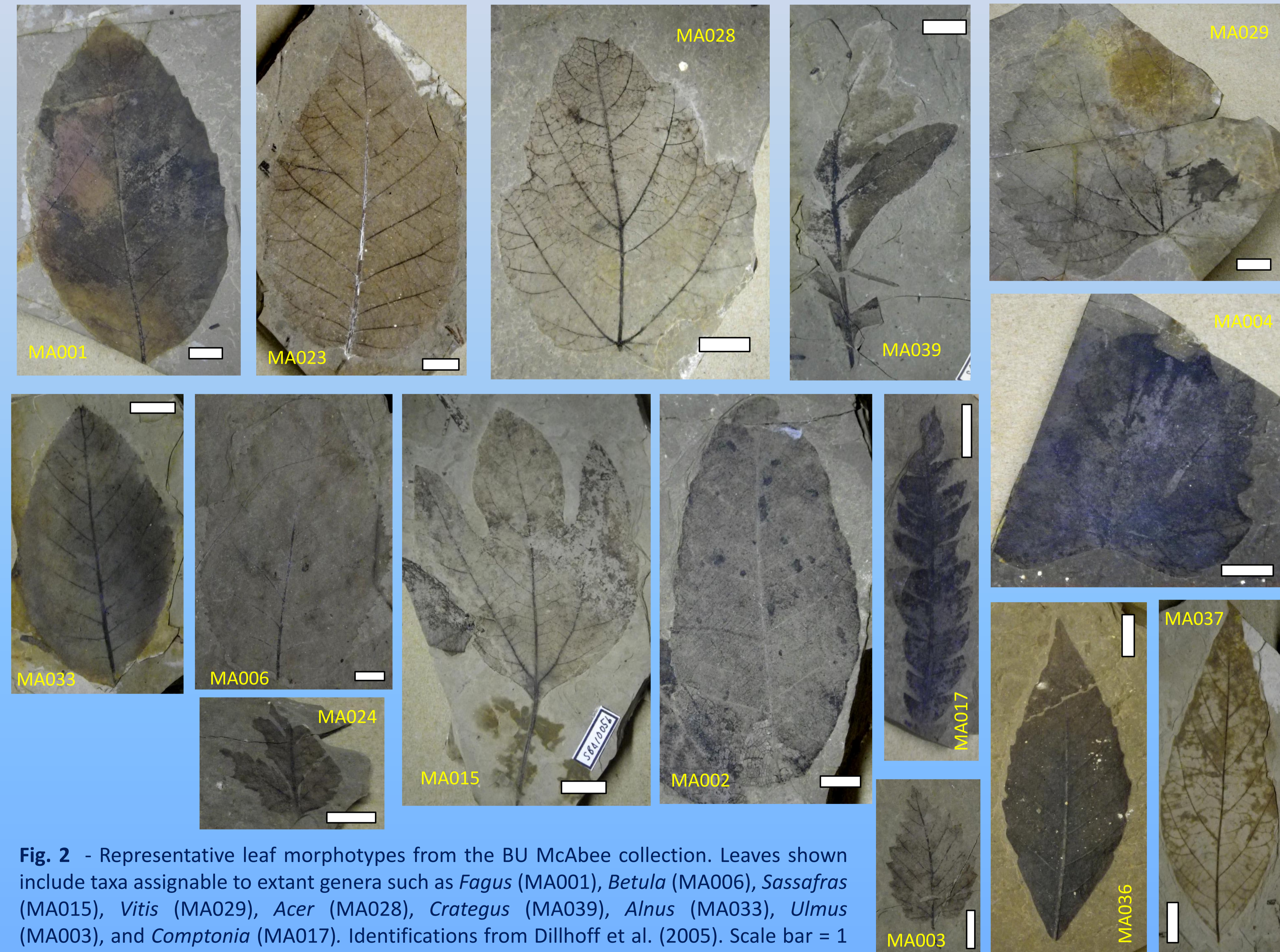


Fig. 2 - Representative leaf morphotypes from the BU McAbee collection. Leaves shown include taxa assignable to extant genera such as *Fagus* (MA001), *Betula* (MA006), *Sassafras* (MA015), *Vitis* (MA029), *Acer* (MA028), *Crataegus* (MA039), *Alnus* (MA033), *Ulmus* (MA003), and *Comptonia* (MA017). Identifications from Dilhoff et al. (2005). Scale bar = 1 cm. Photos by 1st author. All specimens collected by S.B. Archibald under permit (RBCM).

Results

Combined, the 2 samples yielded 280 dicot leaf compression fossils from 2 quarries; the BU sample would appear to have been preferentially collected for novel leaf taxa and so likely over-estimates floral diversity. Diversity for individual samples reported here ranges from 24 (n = 124 leaves) to 44 dicot leaf morphotypes (n = 156) (Fig. 2). Based on leaf physiognomy of the 2 samples, paleoclimate is characterized as microthermal and mesic, consistent with previous analyses. Mean annual temperature was estimated as 12.8°C ± 3.4° (n = 24; USask sample) or 10.1°C ± 2.3°C (n = 44, BU sample) using leaf margin analysis with the 'wet sites' equation compared to the previously published 13.5°C ± 2.5° using NLR analysis (Fig. 3). Mean annual precipitation estimated using leaf area analysis (Wilf et al., 1998) was 99cm/yr -30, +43cm (USask sample) or 117cm/yr -35, +51cm (BU sample), consistent with the previously published estimate of 108 ± 35cm/yr using NLR analysis; the taphonomic bias towards smaller leaves in lake sediments indicates that the upper bound of the error for the estimate based on leaf area should apply (Fig. 4).

Acknowledgements

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References

- Dilhoff, Leopold, and Manchester. 2005. The McAbee flora of British Columbia and its relation to the Early-Middle Eocene Okanagan Highlands flora of the Pacific Northwest. *Can. J. Earth Sci.* 42: 151-166.
- Greenwood, Archibald, Mathews, and Moss. 2005. Fossil biotas from the Okanagan Highlands, southern British Columbia and Northeastern Washington State: climates and ecosystems across an Eocene landscape. *Can. J. Earth Sci.* 42: 167-185.
- Leaf Architecture Working Group. 1999. *Manual of Leaf Architecture – Morphological description and categorization of dicotyledonous and net veined monocotyledonous angiosperms*, pp. 1-67.
- Wilf, Wing, Greenwood, and Greenwood. 1998. Using fossil leaves as paleoprecipitation indicators: An Eocene example. *Geology* 26: 203-206.

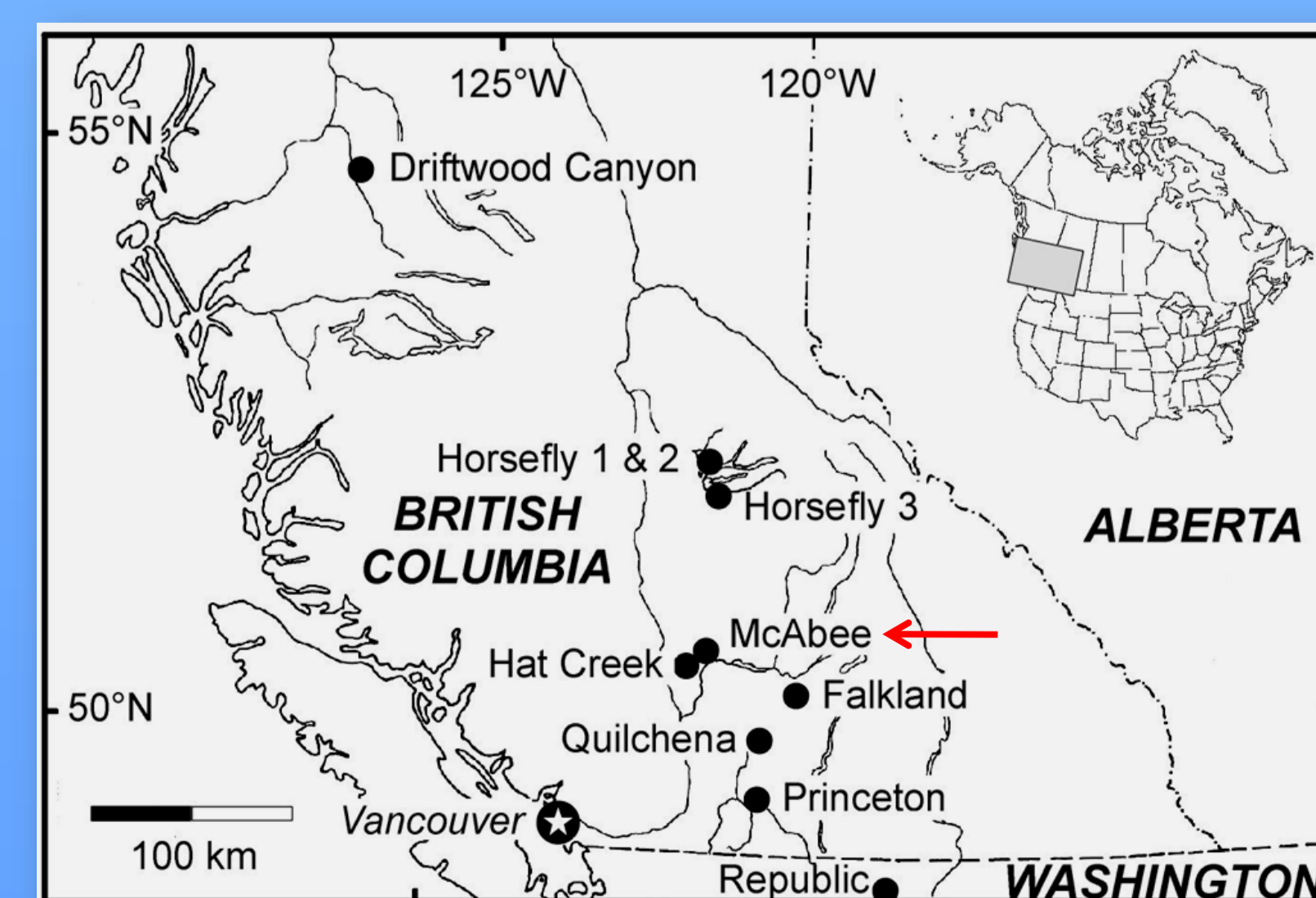


Fig. 1 – Map of Okanagan Highlands early Eocene sites, including McAbee (arrow).

Fig. 3 - Histogram comparing the estimates of MAT for the McAbee macroflora using leaf margin analysis (U Sask & BU samples) and NLR analysis (from Greenwood et al., 2005).

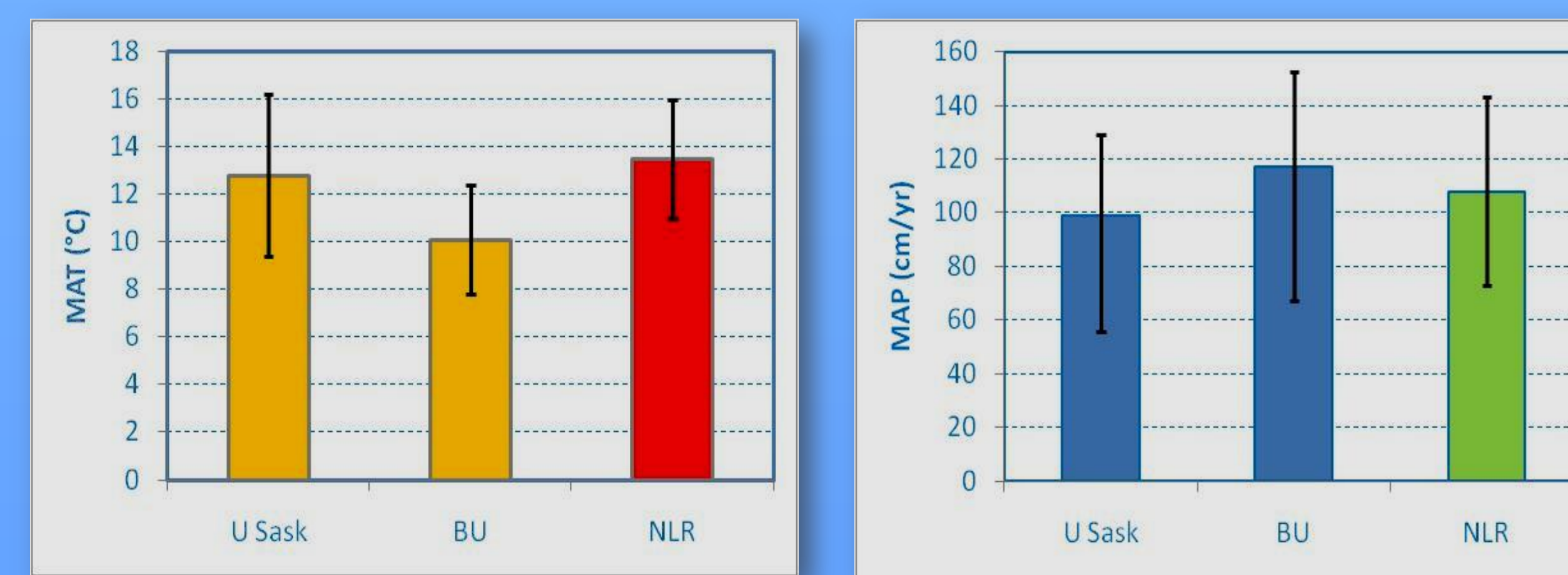


Fig. 4 - Histogram comparing the estimates of MAP for the McAbee macroflora using leaf area analysis (U Sask and BU samples) and NLR analysis (from Greenwood et al., 2005).