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Forest inventory tree core archive reveals changes in boreal wood traits over seven decades

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Boreal forests play an important role in the global carbon cycle (C), and there is increasing interest in understanding how they react to environmental changes, including nitrogen (N) and water limitations, which may influence future forest growth and C storage. Utilizing tree cores archived by the Swedish National Forest Inventory, we measured stemwood traits, including stable N and C isotope composition, which provides information on N availability and water stress, respectively, as well as N and C content, and the C/N ratio over the period 1950–2017 in two central Swedish counties, Jämtland and Västernorrland, covering an area of ca. 55,000 sq. km (n = 1038). We tested the hypothesis that wood traits change over time and that temporal patterns would vary depending on alternative dendrochronological reconstruction methods, i.e. the established standard “single tree method” (STM) or a conceptually stronger “multiple tree method” (MTM). Averaged across all MTMs, our data showed that all five wood traits for *Picea abies* and *Pinus sylvestris* changed over time. Wood $\delta^{15}N$ declined strongly, indicating progressive nitrogen limitation. The decline in $\delta^{13}C$ followed the known atmospheric $\delta^{13}CO_2$ signal, indicating there was no change in water stress. In addition, wood N increased significantly, while C and C/N ratios declined over time. Furthermore, wood trait patterns sometimes differed between dendrochronological methods. The most prominent difference was for $\delta^{15}N$, where the slope was much shallower for the STM compared to MTMs for both species, indicating that mobiity of contemporary N is problematic when the STM is used, leading to much less sensitivity to detect historical signals. Our study shows strong temporal changes in boreal wood traits and also indicates that the field of dendroecology should adopt new methods and archival protocols for studying highly mobile element cycles, such as nitrogen, which are critical for understanding environmental change in high latitude ecosystems.