Change in growth patterns preceding tree mortality: synthesis from a new global ring-width database

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Abstract

Tree mortality is a key factor influencing forest functions and dynamics, but our understanding of the mechanisms leading to mortality and the associated changes in tree growth rates are still limited. We compiled a new global tree ring-width database from sites where both dead and living trees were sampled (more than 7000 trees from 190 sites; 36 species), and compared the growth patterns between trees that died and those that survived a given mortality event.

We observed a decrease in radial growth rates before death in 85% of the mortality events. The magnitude and duration of the reduction were highly variable (1-200 years), with longer and stronger reductions for gymnosperms, and trees that died from competition (relative to drought-induced mortality). Angiosperms and trees that died following to biotic attacks (especially bark beetles), however, typically showed a short growth reduction. Changes in inter-annual variability and temporal autocorrelation in growth before tree death were also observed, but the trends varied depending on the metrics used to characterize them.

Growth reductions before mortality are nearly universal, but their magnitude and duration are species- and site-specific. This variability provides valuable information on the nature of the mortality process, with abrupt changes in growth shortly before death potentially revealing hydraulic failure and/or bark beetle attack, and long-term growth declines indicating carbon depletion.

Keywords: tree mortality, growth, ring, width, drought, forest

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