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Intra-annual stem growth of co-occurring temperate eucalypts in relation to climate variability, competition and fire history

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Forest growth is considered as an important global carbon sink but its responses to environmental changes remain uncertain. Tree stems are a predominant carbon pool in temperate eucalypt forests, representing a substantive component of their net productivity and carbon dynamics. Despite their importance, our understanding of factors controlling stem growth in these evergreen forests remains limited partly because the dominant eucalypts lack distinct growth rings. Unravelling eucalypt species' growth responses to climate from other factors, such as competition and disturbances like fire, is challenging due to the lack of long-term growth data. To address this gap, we present six years of monthly measurements of stem-diameter changes (as basal area increment, BAI) of two co-occurring dominant eucalypts from different sub-genera (*Eucalyptus obliqua* and *E. rubida*) across seven sites in a natural temperate forest of south-eastern Australia. We used linear mixed-effect models to examine the relative importance to monthly BAI of species, monthly climate indices and their potential lag effects (temperature and rainfall), inter-tree competition, and recent fire history (long-unburnt, prescribed fires, wildfire). Monthly BAI peaked in spring and autumn and was lowest in summer with significant differences between species during spring and summer. Overall BAI variation was most clearly associated with maximum mean temperature, having a hyperbolic relationship with increases in BAI up to species-specific temperature optima and decreases thereafter. Rainfall, particularly autumn rainfall, influenced seasonal patterns in BAI, while inter-tree competition and recent fire history were of comparatively minor importance. BAI also varied strongly between years reflecting the opportunistic growth behaviour of eucalypts including higher annual growth rates during and after periods of high rainfall and transient decreases in BAI during extended drier periods. Our study provides field-based evidence of different growth niches for co-existing eucalypts in natural temperate mixed forests and highlights the importance of intra-annual climate variation to better understand overall productivity in temperate evergreen forests.