

Functional Plant Biology

Contents

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‘Measuring Impacts of Climate Change on Plants’ Special Issue

Foreword:

Measuring impacts of climate change on plants

David S. Ellsworth and David T. Tissue

Photosynthesis and respiration decline with light intensity in dominant and suppressed *Eucalyptus globulus* canopies

A. P. O’Grady, D. Worledge, A. Wilkinson and M. Battaglia

439–447

We examined gradients in photosynthesis, respiration and foliar nitrogen within canopies of dominant and suppressed *Eucalyptus globulus* trees. All three declined significantly in relation to light intensity. Net photosynthesis was similar in dominant and suppressed trees at any given canopy position but suppressed trees had a higher respiration rate relative to dominant trees, potentially leading to lower carbon use efficiency within suppressed trees.

Thermal acclimation of respiration but not photosynthesis in *Pinus radiata*

Lai Fern Ow, David Whitehead, Adrian S. Walcroft and Matthew H. Turnbull

448–461

This study confirmed that the balance between respiration and photosynthesis in *Pinus radiata* increased at low temperature due to increasing dark respiration (R_d) (acclimation) and decreasing photosynthesis. The lower ratio resulted from lower R_d (acclimation) but greater photosynthesis at higher temperatures. These findings support an overall reduction in the potential for positive feedback of respiration in the carbon cycle as temperatures increase.

The impact of defoliation on nitrogen translocation patterns in the woody invasive plant, *Buddleia davidii*

Marc M. Thomas, Pete Millard, Michael S. Watt, Matthew H. Turnbull, Duane Peltzer and David Whitehead

462–469

The authors describe the impact of defoliation on nitrogen translocation and uptake in an invasive weed and present new insights to our understanding of nitrogen remobilisation in semi-deciduous species. As nitrogen provides the foundation of future plant growth, this study is useful to predict the success of biocontrol with leaf herbivores.

Photoprotective carotenoids and antioxidants are more affected by canopy position than by nitrogen supply in 21-year-old *Pinus radiata*

Sabine Posch, Charles R. Warren, Mark A. Adams and Helmut Guttenberger

470–482

Irrespective of canopy height, additional N supply increased the light harvesting capacity in needles of 21-year-old *Pinus radiata* but did not affect light utilisation processes. The imbalance of the two processes was not counteracted by photoprotective carotenoids and antioxidants but pools of these compounds were only strongly affected by canopy height.

Cover illustration: Water droplets on a *Eucalyptus saligna* leaf after a recent rainfall (Photo: D. Ellsworth).

Impacts of fire on forest age and runoff in mountain ash forests

Stephen A. Wood, Jason Beringer, Lindsay B. Hutley, A. David McGuire, Albert Van Dijk and Musa Kilinc

483–492

Previous studies in mountain ash forested water catchments have shown that catchment water yield has a strong relationship with forest age such that there is an increase in runoff with forest succession. However, using sap-flow and eddy covariance techniques, this paper shows that contrary to these previous studies, measurements of whole-forest evapotranspiration were relatively constant across stand age between 24 and 296 years, due to a trade off between decreasing overstory leaf area index and increasing understory.

Mechanisms linking plant productivity and water status for a temperate *Eucalyptus* forest flux site: analysis over wet and dry years with a simple model

David A. Pepper, Ross E. McMurtrie, Belinda E. Medlyn, Heather Keith and Derek Eamus

493–508

A simple process-based model was applied to a tall *Eucalyptus* forest flux site over consecutive wet and dry years. Both the model calibration procedure and a sensitivity analysis provided insight into key ecosystem parameters and mechanisms linking productivity and site water status in wet versus dry years and on an intra-annual timescale.

An analysis of the sensitivity of sap flux to soil and plant variables assessed for an Australian woodland using a soil–plant–atmosphere model

Melanie Zeppel, Catriona Macinnis-Ng, Anthony Palmer, Daniel Taylor, Rhys Whitley, Sigfredo Fuentes, Isa Yunusa, Mathew Williams and Derek Eamus

509–520

Application of a soil–plant–atmosphere model to an Australian woodland showed that sapflow was sensitive to changes in rooting depth, stand leaf area, whole tree hydraulic conductance and critical leaf water potential. The model accurately replicated hourly, daily and seasonal patterns of sapflow while demonstrating independence of sapflow and moisture of the top 80 cm of soil.

Why is plant-growth response to elevated CO₂ amplified when water is limiting, but reduced when nitrogen is limiting? A growth-optimisation hypothesis

Ross E. McMurtrie, Richard J. Norby, Belinda E. Medlyn, Roderick C. Dewar, David A. Pepper, Peter B. Reich and Craig V. M. Barton

521–534

Why do CO₂-enriched leaves have reduced leaf [N] and stomatal conductance? And, why is there a tendency for plant growth to be more responsive to elevated CO₂ under water-limited conditions, but less responsive under nitrogen-limited conditions? The authors advance a growth-optimisation hypothesis that may help answer these questions. They describe a simple model of the annual carbon–nitrogen–water economy of plants, that incorporates an hypothesis that annual net primary production is maximised. The model leads to answers to the above questions in terms of how high CO₂ affects leaf photosynthesis.