ECOSYSTEM DYNAMICS

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Studies are being conducted on Macquarie Island to determine effects of global warming on native vegetation, including the Macquarie Island cabbage (*Stilbocarpa polaris*), one of the distinctive megaherbs of the Subantarctic (photo by Dr Marcus Schortemeyer).

We aim to improve understanding of theory and process in ecological systems and to apply this knowledge to important biological questions such as the maintenance of biodiversity and responses to global climate change.

Understanding how plant communities have already changed and how they will be affected by future environmental variables requires an interdisciplinary approach. The Group brings together expertise that spans scales from the biophysics of light capture by photosynthetic membranes to the modelling of long-term vegetation dynamics. We aim to link physiological and biological processes across scales to understand complex patterns in vegetation.

A common interest within the Group is the role of spatial and temporal heterogeneity in determining the response of plant communities to environmental conditions and, in particular, to global climate and atmospheric change. By predicting what may happen to plant communities under certain conditions, appropriate management regimes can be established.

HIGHLIGHTS

- There is a pressing need to understand how plants will respond to the progressive increase in atmospheric [CO_2] and associated climate warming. However, prediction of vegetation responses to climate warming is complicated by our recent discovery that growth under elevated [CO_2] lowers freeze tolerance, making even extremely freeze-tolerant evergreen species more vulnerable to frost damage at warmer freezing temperatures. We hypothesised that these effects might be indirect, as stomatal closure under elevated [CO_2] can cause daytime leaf temperatures to be warmer than under ambient [CO_2], and such warmer temperatures might interfere with the natural seasonal acclimation to freezing conditions. This hypothesis was tested under field conditions with a system of infra-red ceramic lamps to warm snow gum leaves during daytime, increasing the diurnal temperature range without affecting temperature minima. Elevated [CO_2] and daytime warming delayed acclimation to freezing temperatures for 2-3 weeks. Thus, warmer daytime leaf temperatures under elevated [CO_2] delay seasonal development of freezing tolerance, paradoxically making plants more susceptible to frost damage as growing seasons lengthen with climate warming.

- Mangroves dominate tropical coastal vegetation, but are replaced by herbaceous salt marsh at latitudes above 32° N and 40° S. Freeze/thaw events can induce embolism in hydraulic tissue that disrupts water transport from roots to shoots. Vulnerability to freeze/thaw-induced embolism is reduced with decrease in conduit diameters, but this comes at the expense of water transport. Vulnerability to freeze-induced xylem embolism was examined in the five most poleward mangroves in Australia and Florida. Species with wider vessels suffered 60-100% loss of hydraulic conductivity after freezing and thawing under tension, while species with narrower vessels lost as little as 40-13% of conductivity. Thus, freeze-induced embolism can affect latitudinal limits of mangrove species through either massive embolism following freezing or constraints on water transport due to vessel size.