Submitted Abstract

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Abstract

The alpine treeline on mainland Australia is dominated by various subspecies of Eucalyptus pauciflora; broad-leaved evergreen trees with a mallee (multi-stemmed) growth form, affectionally known as snowgums. They can re-sprout after fire from a basal lignotuber and may live for up to 300-400 years.

We collected empirical data across a range of early life-history recruitment stages to determine how recruitment may limits range expansion at alpine treeline. We estimated canopy-stored seed, seed rain, soil seed bank germination and tracked the survival of naturally occurring seedlings down 30 m into the sub-alpine woodland. After wildfire, naturally occurring seedlings were tracked and compared between burnt and un-burnt sites, above and below treeline. Field germination and seedling survival was assessed via seed and seedling transplants above and below treeline and in experimentally warmed plots using open-top chambers. Germination potential was assessed in the laboratory under different warming treatments. Seedling frost resistance was also assessed from transplants above and below the treeline.

We incorporated this empirical recruitment data into the LANDIS-II framework, a spatially explicit landscape simulation model, with flexible temporal and spatial resolution that is designed to simulate vegetation community succession with the incorporation of disturbances, such as fire. Here, we specifically parameterised LANDIS-II for the study region to simulate snowgum stand dynamics and disturbances and then estimated the probability of snowgum range expansion over set time periods and environmental scenarios.

The change in elevation after 20 years of simulations, where the probably of snowgums occurring was 50%, indicated only a 2 m shift in elevation. However, in different areas of the treeline, there was a simulated shift 8 - 40 m in elevation after 100 years. The migration rates per year for snowgum across diffuse treelines between 1640 m and 1890 m where snowgum currently exist show similarly very small increases in elevation (0.5 – 1.0 m), but only when fire disturbance and climate change are included in the models. In-filling within diffuse snowgum stands near treeline is more likely, rather than an upward migration of the alpine treeline.

Our results concur with other local studies indicating that snowgum recruitment and subsequent range expansion is limited by very low recruitment success under natural conditions, despite ample seed production and high seed viability. Given that snowgums may live for hundreds of years, and are rarely killed by fire, recruitment every 100 years or so may be sufficient to maintain high elevation populations.