The contraction of pencil pine populations in northern Tasmania

Natural Hazards Research Australia

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Response, resilience, and recovery of Tasmania's endangered Pencil Pine using a multi-archive palaeoenvironmental record

The fate of *Athrotaxis cupressoides* (pencil pine) in Tasmania remains uncertain under future climate change and fire weather projections. Using palaeoecology, palaeoclimatology and species distribution modelling, we identify a northward contraction of pencil pine populations in response to shifts in climate over millennia. This research aims to inform management in locations presenting the greatest longevity of climatic suitability in the face of increasing climate change and wildfire events.

Research context:

Recent climate-driven fire activity in Tasmania threatens the persistence of long-lived hyper fire sensitive tree species, including palaeoendemic conifer *Athrotaxis cupressoides* (pencil pine). Future-proofing these systems is challenging, particularly when attempting to apply contemporary ecosystem management strategies to such long-lived plant species (e.g., >1000 years), which operate and respond over timescales much longer than neo-ecological observations can detect.[1,2] Thus, to appropriately manage these ecosystems, it is critical to understand the response of such species to perturbations (e.g., fire and climate) at appropriate timescales. Doing so more accurately reflects their natural resilience and response, in turn, identifying which areas should be prioritised for current management intervention in the face of increasing wildfire and ongoing climate change.[3]

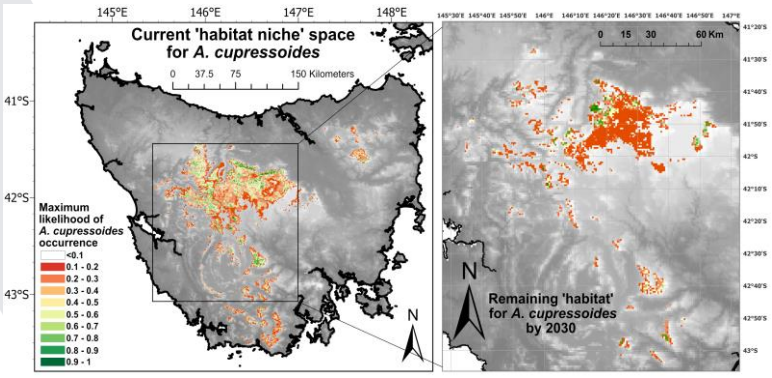

Figure 1: Maps showing current habitat distribution of *Athrotaxis cupressoides* in Tasmania relative to climate-based habitat suitability (left); predicted habitat remaining by 2030 under the SSP370 future climate scenario, with limited high-resilience habitat (>0.5 likelihood of occurrence) contracted toward the northwest of the island.

Approach:

Palaeoecology (lake sediments):

- Fossil pollen, charcoal analysis, radiocarbon (^{14}C) dating, geochemistry

Palaeoclimatology (speleothem):

- Stable isotopes, trace elements, Uranium-Thorium (U-Th) dating

Species Distribution Modelling:

- MaxEnt - coding (*Rstudio),* spatial analysis (*ArcGIS*)

Key findings:

- Palaeoecology reveals a strong long-term relationship between high-moisture and high resilience, reproduction and post-fire regeneration in pencil pine.
- *Athrotaxis* distribution has contracted to the northwest of Tasmania throughout recent millennia.[4-6]
- Only 6% of current populations will exist within climatically suitable habitat by 2030 (Fig. 1), with only 15% of total current populations existing by 2050, in areas of low climate-based resilience.
- A loss of 93% of total habitat is predicted by 2050, with remaining habitat existing in disequilibrium with climate (low climate-based resilience) contracted toward to northwest.

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Further information

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