

Burning giants in the tropics

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- In the Wet Tropics of North Queensland, land managers use low-intensity fires to try to keep World Heritage Area rainforest from invading the understories of threatened giant eucalypt forest.
- These giant eucalypts need rare naturally-occurring high-intensity fires for regeneration. Burning these forests with low-intensity fires may actually affect their long-term health and negatively impact other non-target species.



Will prescribed burning of giant eucalypt forests really help their regeneration?

Rainforest in the understories of Rose Gum forest - natural phenomena or management problem?

The need to maintain a mosaic of rainforest and eucalypt forest in the Australian Wet Tropics World Heritage Area poses a perplexing conundrum for land managers. Rose Gum (*Eucalyptus grandis*) dominated giant eucalypt forests at the margins of World Heritage tropical rainforests are habitats for threatened marsupials like the Yellow-Bellied Glider. Rainforest developing in the understoreys of these forests is believed to threaten the dominant overstorey eucalypts and associated fauna. Land managers prescribe frequent low-intensity fires to try to stop rainforest species from establishing in Rose Gum forests understory. However, these practices are not consistent with the ecology of Rose Gum forest:

1. Rose Gums are obligate seeders and need rare, large, high-intensity landscape fires for successful regeneration. Low-intensity fires do not stimulate Rose Gum regeneration because they do not release seeds stored in the canopy or create conditions suitable for initial growth. Repeated fires may kill young Rose Gum trees that do not have fully developed bark and these fires can reduce the protective capacity of the bark of mature trees.
2. Under current climatic conditions, rainforest expansion averages 0.6m/decade, and is occurring across all landscape conditions likely due to a global driver like increased atmospheric CO₂. Using low-intensity fire to control this process is difficult because rainforest will only burn under exceptional conditions. Also, many rainforest species recover from a single fire. Natural and rare high-intensity fires will likely enable Rose Gum regeneration throughout the landscape. The landscape ecology and plant functional biology of Rose Gum forest suggest that they are ecologically like secondary rainforest. Abstaining from prescribed burning and letting Rose Gum forests regenerate naturally from rare large fire events best approximates their regeneration ecology.



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Supporting Evidence

| Title | Aim | Key Results |
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| Bowman D.M.J.S., Murphy B.P., Boer M.M., Bradstock R.A., Cary G.J., Cochrane M.A., Fensham R.J., Krawchuk M.A., Price O.F. & Williams R.J. (2013) Forest fire management, climate change, and the risk of catastrophic carbon losses. 11, 66-67. | reviews the fire management of forest types in relation to fire return time and Alternative Stable States ecosystem theory | Shows the contrasting responses of forest biomass to wildfire and possible alternative fire management scenarios. For a forest adapted to infrequent, stand-replacing fire, although seeds survive high-intensity fires (eg stored in canopy-borne capsules), climate-driven reductions in intervals between stand-replacing fires can kill off immature regrowth, leading to subsequent regeneration failure. |
| Harrington G.N. & Sanderson K.D. (1994) Recent contraction of wet sclerophyll forest in the wet tropics of Queensland due to invasion by rainforest. Pacific Conservation Biology, 1, 319-327. | Documents the contraction of giant eucalypt forest due to rainforest incursion | Shows the extent of eucalypt forest and woodland in the Wet Tropics Bioregions with a rainforest understorey has increased based on comparison of aerial photography. |
| Little J.K., Prior L.D., Williamson G.J., Williams S.E. & Bowman D.M.J.S. (2012) Fire weather risk differs across rainforest - savanna boundaries in the humid tropics of northeastern Australia. Aust Ecol, 37, 915-925. | Evaluate the microclimatic conditions and fire risk across a rainforest-savanna boundary | Fire risk among the vegetation types decreased from savanna, tall eucalypt forest, then rain forest, a pattern that was consistent across each transect. Only very rarely would rain forest or giant eucalypt forest be flammable, despite being adjacent to highly flammable savannas. These results demonstrate the very strong effect of vegetation type on microclimate and fire risk, compared with the weak effect of elevation, consistent with a fire-vegetation feedback. |
| Stanton P, Parsons M, Stanton D & Stott M. (2014) Fire exclusion and the changing landscape of Queensland's Wet Tropics Bioregion 2. The dynamics of transition forests and implications for management Australian Forestry, 77, 58-68. | A synthesis of the need for fire management in the Wet Tropics of Australia | Concludes that rain forest expansion must be halted with management burning |
| Stanton P, Stanton D, Stott M & Parsons M. (2014) Fire exclusion and the changing landscape of Queensland's Wet Tropics Bioregion 1. The extent and pattern of transition. Australian Forestry, 77, 51-57. | Mapping of landscape change in the Wet Tropics of Australia | Shows the extent of eucalypt forest and woodland in the Wet Tropics Bioregions with a rainforest understorey has increased over 30 years. |
| Tng D. Y. P., Goosem S., Jordan G. J. & Bowman D. M. J. S. (2014) Letting giants be— rethinking active fire management of old growth eucalypt forest in the Australian tropics. J. App. Ecol. (in press). | A synthetic review of recent literature on the fire management of old growth forest, with an emphasis on tropical giant eucalypt forest in Australia | Concludes that giant eucalypts occupy the ecological niche of emergent rain forest pioneers and should be managed by total fire suppression |
| Tng D. Y. P., Jordan G. J. & Bowman D. M. J. S. (2013) Plant traits demonstrate that giant eucalypt forests are ecologically convergent with rainforest not savanna. PLoS One 8, e84378. | experimentally examines if giant eucalypt forest in the tropics and temperate zones are ecologically convergent with each other and with their respective associated rain forest | giant eucalypt forest in the tropics and temperate zones are ecologically convergent with each other and with their respective associated rain forest. Giant eucalypt forest is functionally divergent from open vegetation |
| Tng D. Y. P., Murphy B. P., Weber E., Sanders G., Williamson G. J., Kemp J. & Bowman D. M. J. S. (2012) Humid tropical rain forest has expanded into eucalypt forest and savanna over the last 50 years. Ecol. Evol. 2, 34-45. | experimentally examines the ecological correlates of rain forest expansion in Far North Queensland and projecting the effect of this expansion into giant eucalypt forest | Rain forest is expanding across all geologies and environmental setting at a average maximum rate of 0.6m linear distance per decade. Projections of this expansion predicts that it will be over 2000 years before this expansion fully engulfs gaint eucalypt forest, assuming no natural disturbance |
| Tng D. Y. P., Williamson G. J., Jordan G. J. & Bowman D. M. J. S. (2012) Giant eucalypts – globally unique fire-adapted rain-forest trees?. New Phytol. 196, 1001-1014. | Globally contextualized review of the literature of the functional biology and ecology of giant eucalypts and their relation to rain forest in Australia | Concludes that giant eucalypts occupy the ecological niche of emergent rain forest pioneers |
| Unwin GL. (1989) Structure and composition of the abrupt rainforest boundary in the Herberton Highland, north Queensland. Australian Journal of Botany, 37, 413-428. | A transect study to describe the structural and floristic features of a tropical rainforest-eucalypt forest boundary | Concludes that rainforest are expanding in an upland region of Far North Queensland |

| Title | Aim | Key results |
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| <p>Warman L. & Moles A.T. (2009) Alternative stable states in Australia's Wet Tropics: a theoretical framework for the field data and a field-case for the theory. <i>Landscape Ecology</i>, 24, 1-13.</p> | <p>Reviews the landscape ecology of rain forests, giant eucalypt forest and savanna in the context of Alternative Stable States models</p> | <p>Concludes that giant eucalypt forest can be an unstable ecological state is in various stages of succession towards rainforest</p> |
| <p>Williams P.R., Parsons M., Jensen R. & Tran C. (2012) Mechanisms of rainforest persistence and recruitment in frequently burnt wet tropical eucalypt forests. <i>Austral Ecol.</i> 37, 268-275.</p> | <p>Evaluate proposed mechanisms of rainforest expansion and retreat in wet tropical eucalypt forests</p> | <p>Recruitment of new rainforest plants in the ecotone was most abundant in the initial year after fire. If this post-fire pulse of recruitment is left undisturbed, it can facilitate the subsequent germination of additional rainforest species. A variety of tropical rainforest species can persist under a frequent fire regime through resprouting.</p> |