NSW Bushfire Risk Management Research Hub

Shifting fire regimes and how plant species respond

Many NSW ecosystems need fire, but conserving threatened plant species requires an understanding of their responses to fire frequency, the seasons in which fires occur, and the severity of previous fires. Knowledge is lacking on the specific fire needs and tolerances of many plant species, both common and threatened, but NSW Bushfire Risk Management Research Hub researchers have worked towards filling these gaps. Understanding what species need to establish new plants after fire, to ensure the persistence of that population, can lead to better informed management, and the tools to burn for a healthy future.

Where we looked

Due in part to the unprecedented scale of the 2019–20 bushfires, Hub researchers and partners in the Department of Planning and Environment (DPE) conducted studies across NSW and beyond, from threatened *Pomaderris* species and wet sclerophyll ecological communities in the south, to iconic post-fire flowering species such as the Gymea lily (*Doryanthes excelsa*) further north. As well as field work, large historical datasets were compiled to investigate the broader patterns of the effects of different fire regimes on species.

Bodalla pomaderris: Research shows a longer interval between fires results in more seedlings. Photo Jackie Miles DPE

Is it all about frequency?

Plant species in many NSW ecosystems have adapted to particular fire regimes to maintain healthy populations. Fire frequency is important and is the most well-studied aspect of the fire regime.

Fire frequency is listed as a threat for well over half of all threatened species endemic to NSW. If fires exceed a species' persistence threshold, that species is at greater risk of decline. This is particularly the case for obligate-seeding species, which die in fire and depend entirely on seed germination to recover. However, both fire severity and fire seasonality can contribute to shifts in suitable persistence thresholds.

Hazard reduction burn at Heathcote National Park. PHOTO: Peter Taseski, DPE

Record-breaking fire season

We assessed the impacts of fire severity using the Google Earth Engine Burnt Area Map (GEEBAM), developed by DPE. GEEBAM was used to classify fire severity from low to extreme .

Burn seasons were defined as:

- **spring** burns – August to October
- **summer** burns (usually wildfires) – December to February
- **autumn** burns – April to June.

Severe fires occur naturally as part of the fire regime, but the extent of extreme fires that occurred over the Black Summer season broke all records. The Hub found:

- a total of 1.88 million hectares of native vegetation in NSW burned sooner than the minimum recommended fire interval, a 36% increase compared to the previous 60 years
- reductions in the survival of resprouting species at sites where fire frequency was also high
- lower seedling recruitment, depending on a species' seed size and dormancy type.

Figure 1 shows the large increase, after Black Summer, of areas which had burned sooner than the minimum interval, compared to the previous 60 years. They included rainforests, heathlands, wet sclerophyll forests, and alpine areas.

Extreme and extensive fires may mean more time between fires is needed for recovery, particularly for sensitive species such as obligate seeders. Work on *Bodalla pomaderris* shows a longer interval between fires increases seedling recruitment.

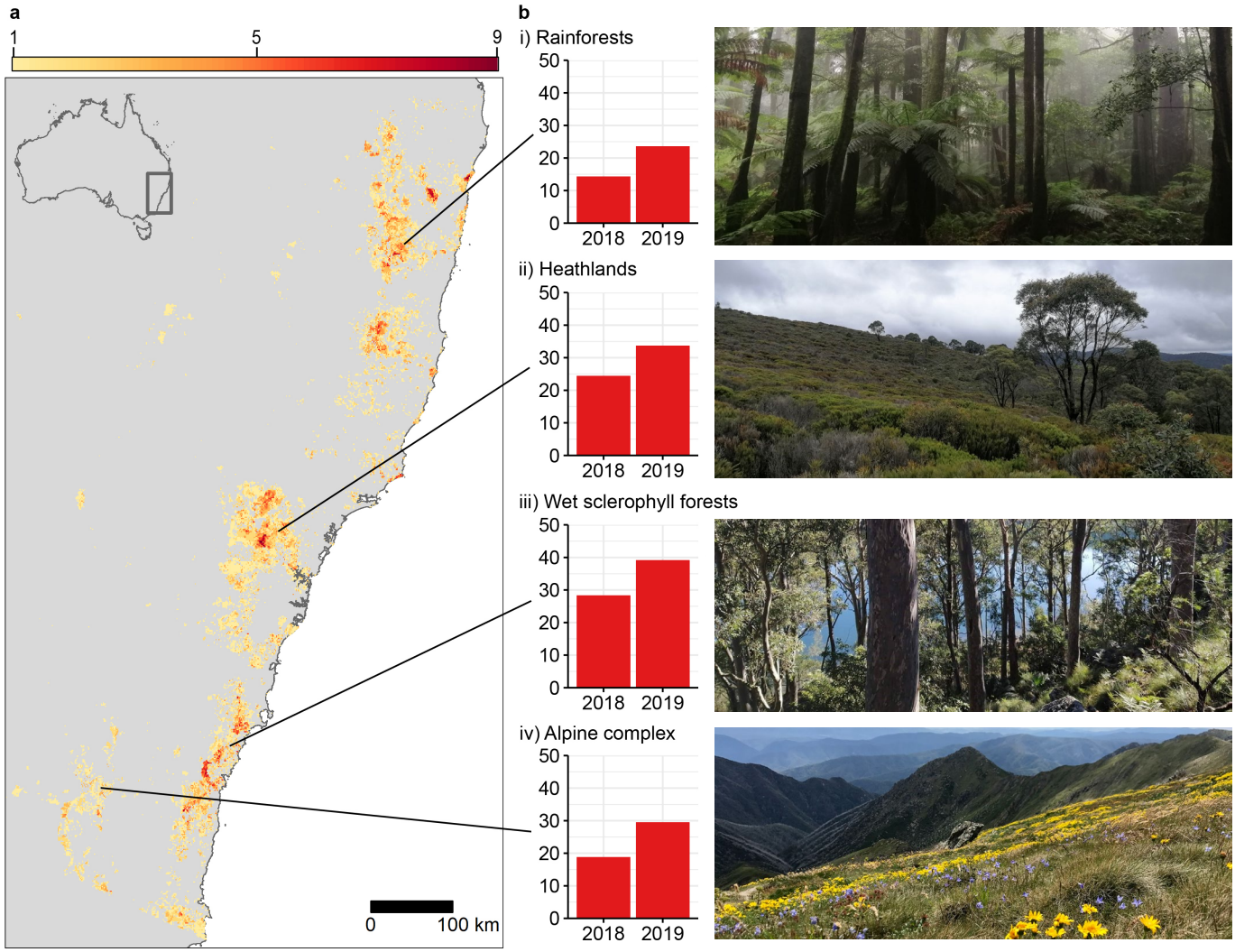

Figure 1: Fires which occurred sooner than minimum intervals from 1960 to 2020 across NSW. (a) Mapped frequency of fires (1 to 9) below minimum intervals from 1960 to 2020. (b) Percentage of total area (y-axis) that burned below minimum intervals at least once from 1960 to 2018–19 ('2018') and from 1960 to 2019–20 ('2019') (x-axis) for 4 vegetation formations: (i) rainforests, (ii) heathlands, (iii) wet sclerophyll forests, and (iv) alpine complex. Alpine photo: C Kirchhoff. Le Breton et al. (2022)

When fire seasons shift

Compared to the historical annual hot season fire window, wildfires are starting much earlier and continuing later, shifting fire seasonality. Hazard reduction burns also are mainly conducted outside the hot season to ensure safe and controlled conditions. Research undertaken by the Hub and DPE quantified plant species' responses to fires occurring outside of the historical hot season, showing:

- Fire season shift can affect the life cycle of some species, with potential effects dependent on a species' life history.
- Species with seasonal germination mechanisms can suffer reduced recruitment, depending on season of burn. Obligate seeders, like the threatened Woronora beard-heath (*Leucopogon exolasius*), recruit in greater numbers after spring and summer fires than winter burns.
- Post-fire flowerers such as Gymea lily and mountain devil (*Lambertia formosa*) persist due to their prolific resprouting abilities, however fire season can cause changes to the proportion of plants flowering, as well as seed resources, such as lipids. Flowering was maximised after summer wildfires or prescribed autumn burns for Gymea lilies and the mountain devil.

Climate change

Recent record-breaking fires in natural systems around the world indicate the fire regime is changing. Climate change is driving more frequent fires, broadening the seasons across which fires occur, and the Black Summer bushfire season showed the extremes that can be reached. One way to ameliorate the threats plants face from ongoing climate change is to manage in an informed way those species and ecological communities most at risk.

Flowering of the iconic Gymea lily was maximised after summer wildfires or prescribed autumn burns. Photo: Rosie Nicolai, DPE

The threatened Woronora beard-heath (*Leucopogon exolasius*) recruits more seedlings after spring and summer fires, compared to winter burns. Photo: Brian Towle, DPE

Flowering was maximised after summer wildfires or prescribed autumn burns for the mountain devil (*Lambertia formosa*). Photo: Michael Van Ewijk

Recommendations

Areas previously burnt in extremely severe fires could take longer to recover. We recommend leaving a longer interval between burns to assist plant recovery. Additionally, avoiding burning a block in the same season each time could help avoid potential negative effects on susceptible plant species, particularly threatened obligate-seeding species with seasonal germination.

Associated articles

- Le Breton et al. (2022) Megafire-induced interval squeeze threatens vegetation at landscape scales (https://bit.ly/MegafireVegetation)
- Thomsen & Ooi (2022) Shifting season of fire and its interaction with fire severity (https://bit.ly/SeasonofFire)
- Nolan et al. (2021) Limits to post-fire vegetation recovery under climate change (https://bit.ly/PostFireRecovery)
- Paroissien & Ooi (2021) Effects of fire season on the reproductive success *Doryanthes excelsa* (https://bit.ly/FireSeasonGymeaLily)

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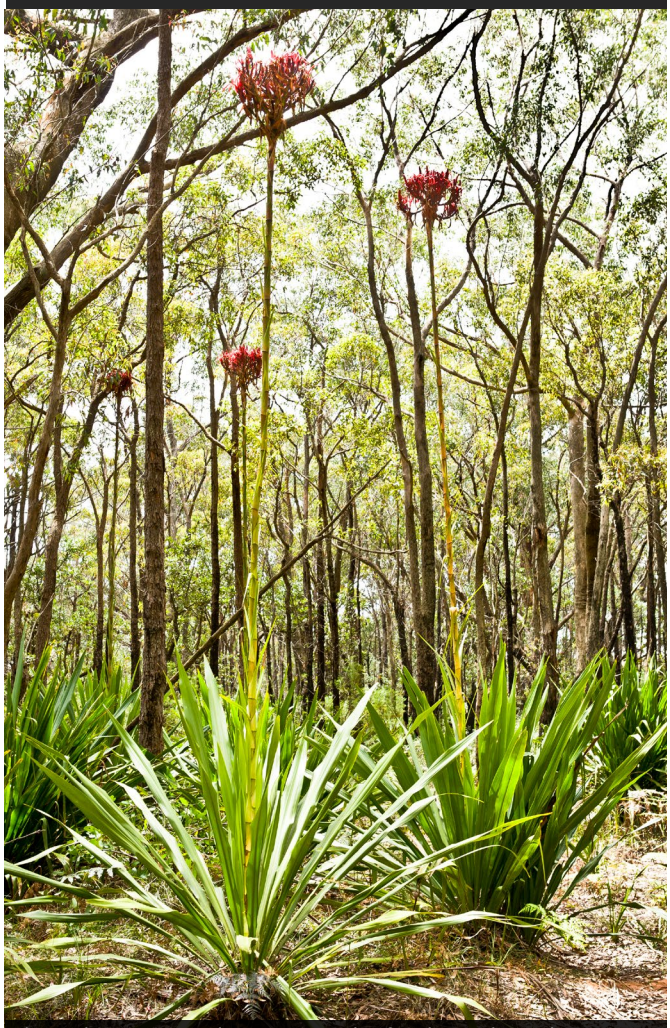
As part of a team that implements hazard reduction burning, it is really great to see thorough and wholistic research being undertaken on fire regimes and how these regimes and the fire severity affects various species within the landscape, not just threatened species either; I look forward to seeing how this work translates into the way we manage fire, now and into the future.

Leigh Nolan, NPWS Team Leader



The Hub investigated 15 sites south of Sydney where the Gymea lily grows. Photo: Lucas Boyd, DPE

The **NSW Bushfire Risk Management Research Hub** (www.bushfirehub.org) is a partnership between researchers at the University of Wollongong, Western Sydney University, the University of NSW and the University of Tasmania, supported by the NSW Department of Planning and Environment and the NSW Rural Fire Service.

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