FACT SHEET

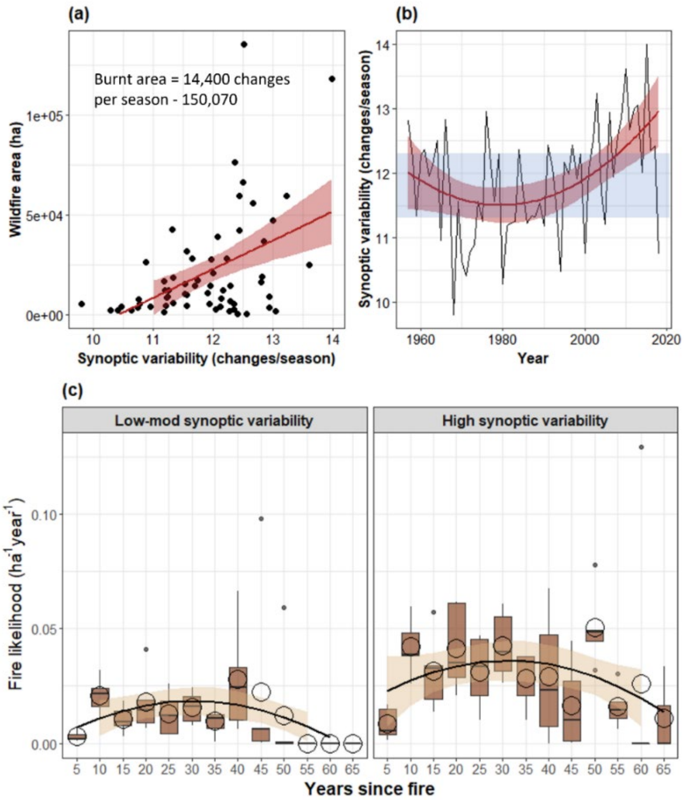
Self-thinning forest understoreys reduce wildfire risk, even in a warming climate

Zylstra, P. J.; Bradshaw, S. D.; Lindenmayer, D. B. Environmental Research Letters (2022), https://doi.org/10.1088/1748-9326/ac5c10

Main findings

- Fire (including prescribed burning) affects forest flammability for decades. In SW Australia, the effects lasted **43-56 years**.
- After a short (**5-7 years**) period, the main effect of fire was to increase forest flammability by promoting dense regrowth.
- Forest understoreys naturally self-thin, and after this point, forests in SW Australia were **7 times less likely to burn** than forests recovering from fire (Table 1).
- Although climate change has made forests of all ages more likely to burn, mature forests were **3 times less likely to burn** than recently (5-7 years) burned forests, even in the worst years.
- The strongest climatic effect was from an increase in *synoptic variability*, or the number of high and low-pressure systems per season, allowing less time for suppression operations to contain fires.

Fig. 1 | Climatic drivers and flammability feedbacks.



Ecological cooperation

These trends offer new tools for living with fire. We can cooperate with natural processes in two steps:

- Reconciliation -

Protect mature forest rather than treat it as a hazard.

- Reinforcement -

Use the advantages offered by self-thinning to rapidly suppress fires and expand the area of mature forest by nursing regrowth areas into maturity.

a) Annual area of wildfire correlates closely with the mean annual number of synoptic changes per season (synoptic variability, red shaded area shows standard error). **b)** Synoptic variability has a strong, nonlinear temporal trend with a pronounced increase since 1980 (red shaded area shows standard error, blue shading marks moderate synoptic variability). **c)** The likelihood of forest fire at a one-hectare point had an initial increase after fire, followed by a long-term decrease in likelihood as forests matured in both years of low (left) and high (right) synoptic variability. Circles mark mean values for each age class, and the lines mark the long-term trends, with the brown shaded area marking the standard error.

Feedback Details

For each category, rows list the age range of that period, then the recorded return period of fires. Feedback strength is the likelihood of fire in disturbed forest / likelihood in mature forest.

Synoptic variability	Young forest	Regrowth forest	Disturbed forest	Mature forest	Feedback strength
Low-moderate <12.30 changes/season	0 – 5 years 1 fire in 323 years	6 – 43 years 1 fire in 63 years	0 – 43 years 1 fire in 62 years	>43 years 1 fire in 313 years	5.1
High >12.30 changes/season	0 – 7 years 1 fire in 67 years	8 – 56 years 1 fire in 30 years	0 – 56 years 1 fire in 31 years	>56 years 1 fire in 208 years	6.8
All	0 – 7 years 1 fire in 100 years	8 – 56 years 1 fire in 43 years	0 – 56 years 1 fire in 43 years	>56 years 1 fire in 323 years	7.4

Background

The study builds on a large body of existing evidence.

Fig. 2. Severe fires are driven by plant structure and composition. This has been shown mechanistically (Zylstra *et al* 2016), and the importance of the understorey has been shown empirically for jarrah forests (Cheney *et al* 2012, Cruz *et al* 2022).

Fig. 3. Fire germinates dense understoreys that drive severe fires, and self-thin in the absence of fire.

Fig. 4. This is well documented for the Southern Forests of WA, but it has also been shown across south-eastern Australia (e.g. (Wilson *et al* 2018, McColl-Gausden *et al* 2020)).

The same trends have been measured for forests in south-east Australia (Zylstra 2018).

Stats

- Study area: **528,343 ha** of National Park.
- Study period: **65 years**
- Total measurements: **2,035**
- Climatic variables: **19**

Fig. 2 | Forests with dense understoreys (a) usually burn with greater severity than those with open understoreys (b)

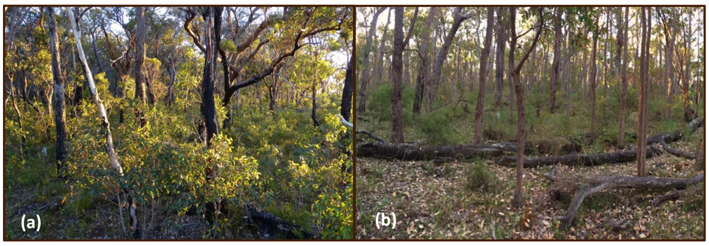


Fig. 3 | Fire germinates dense understorey growth, that later self-thins. **a)** Regrowth following a low-severity fire, **b)** the same forest self-thinned 60 years after fire.

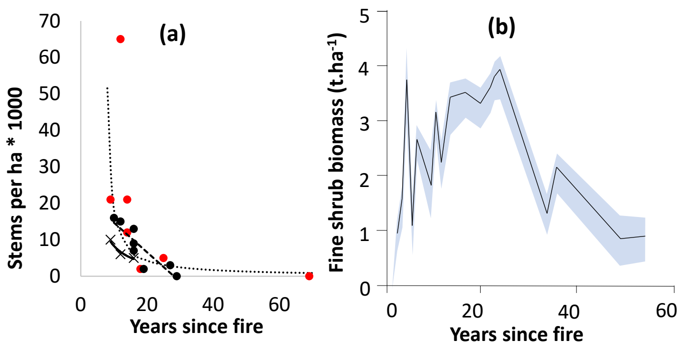


Fig. 4 | These dynamics have long been known. For example, **a)** (McCaw *et al* 2002) showed that numbers of dominant shrubs in tall forests of the SW decline dramatically after fire, and **b)** (Burrows 1994) showed that fine shrub biomass peaked at 22 years, then declined thereafter.

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