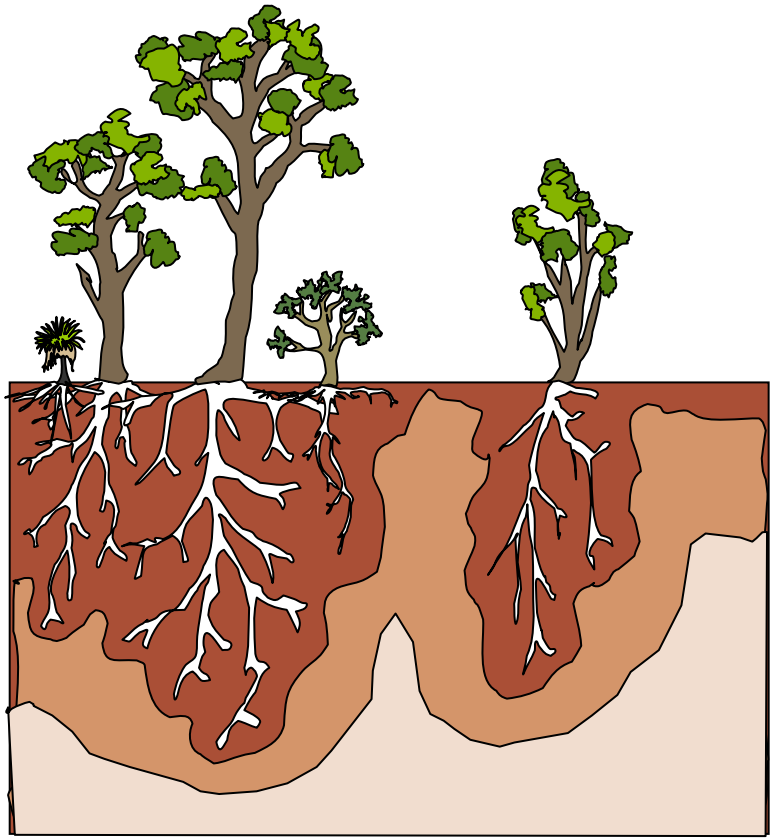

Tree transpiration and catchment water yield

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Natural and
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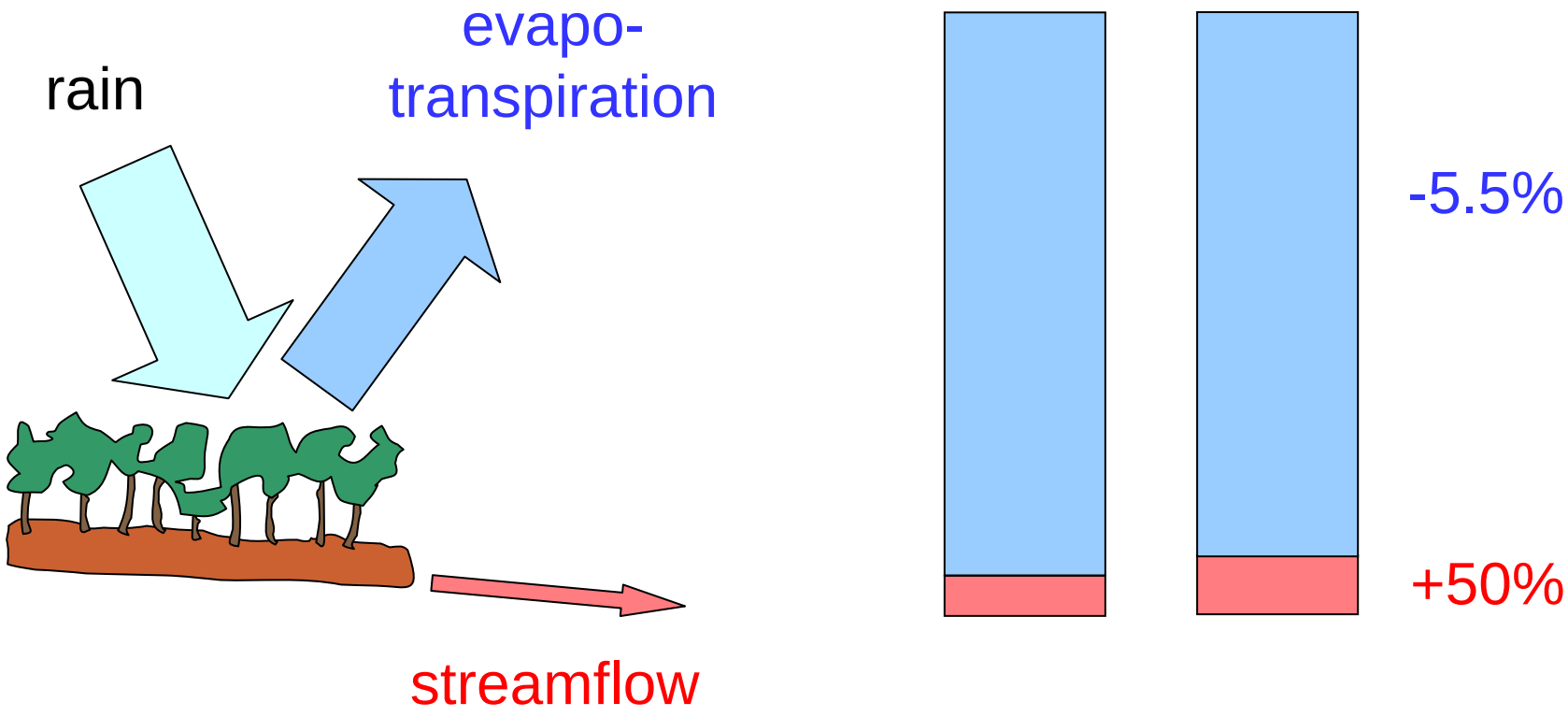
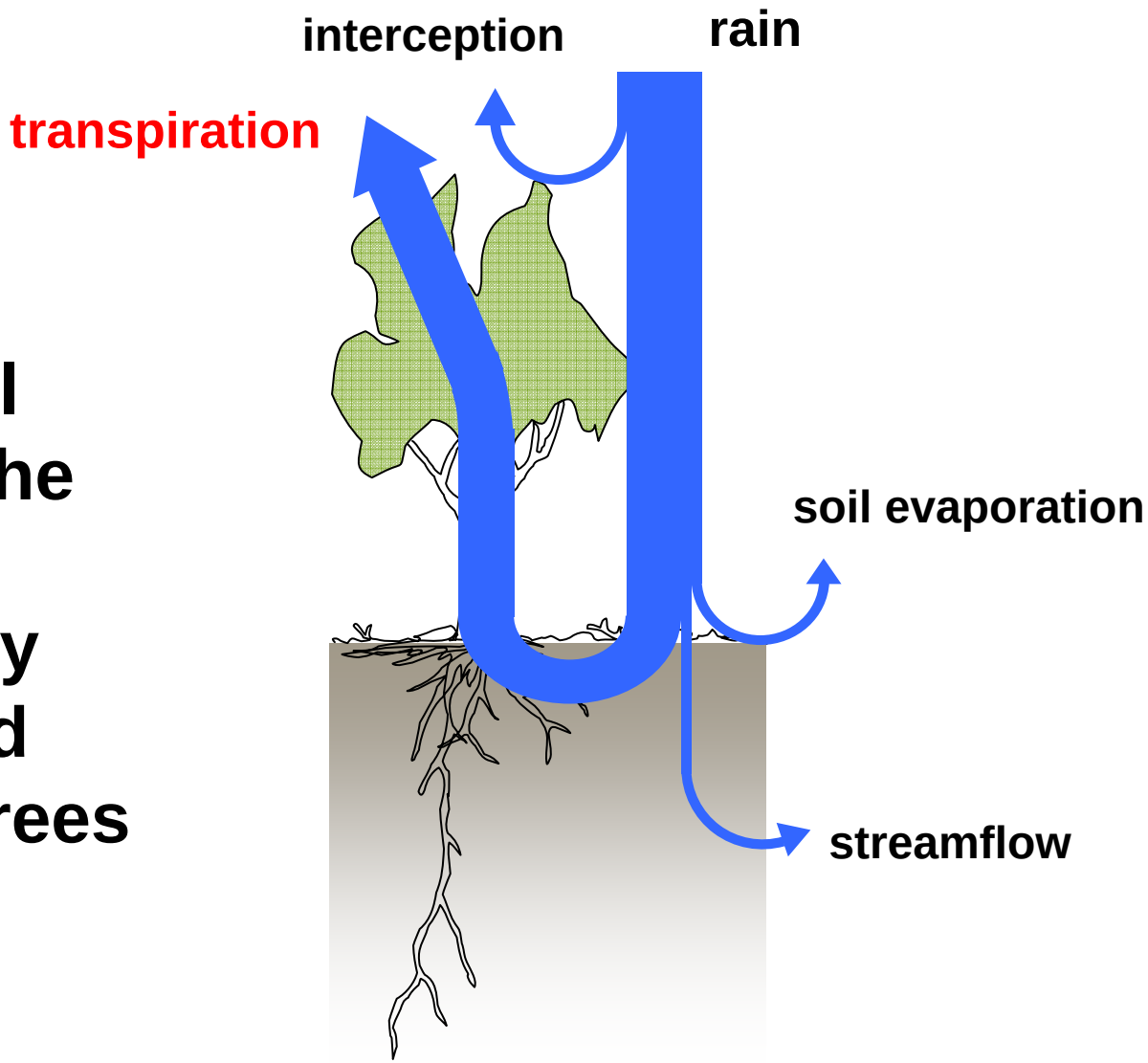
The fate of rainfall in jarrah forest catchments: mostly evapotranspiration, little streamflow



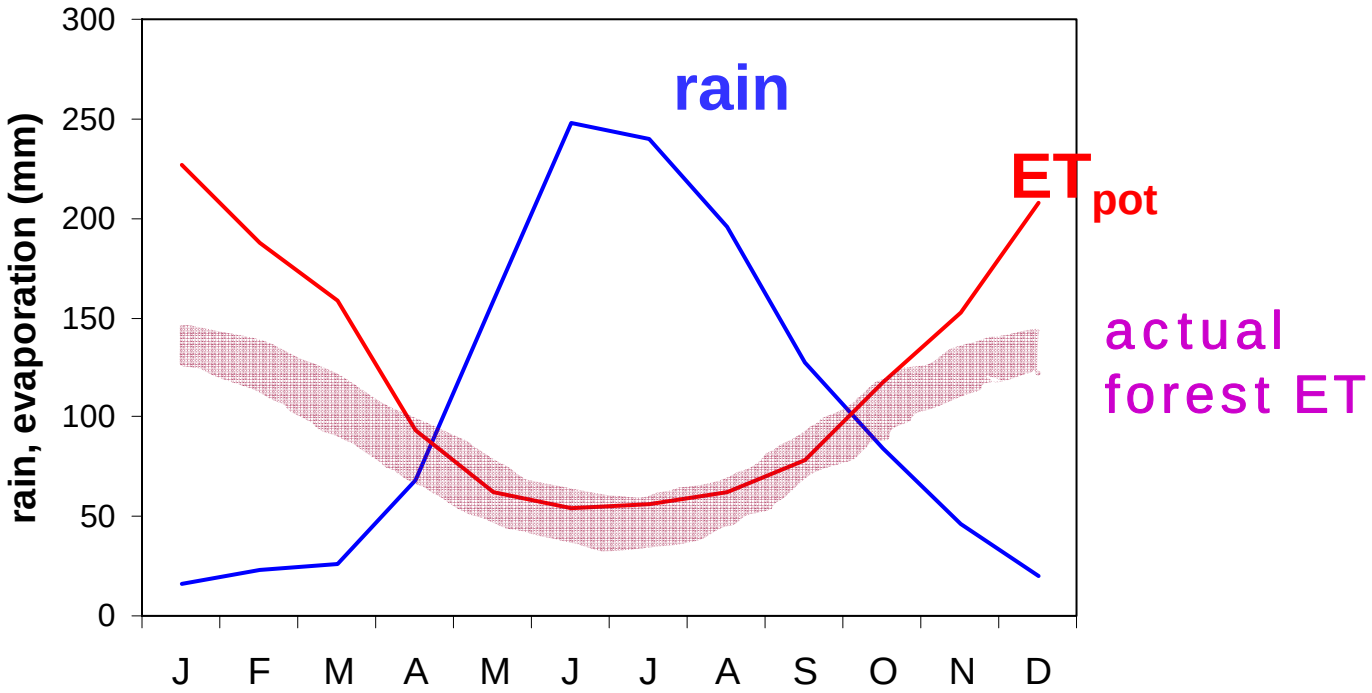
Small change in ET - big change in streamflow

Most rainfall infiltrates in the soil and is subsequently taken up and transpired by trees

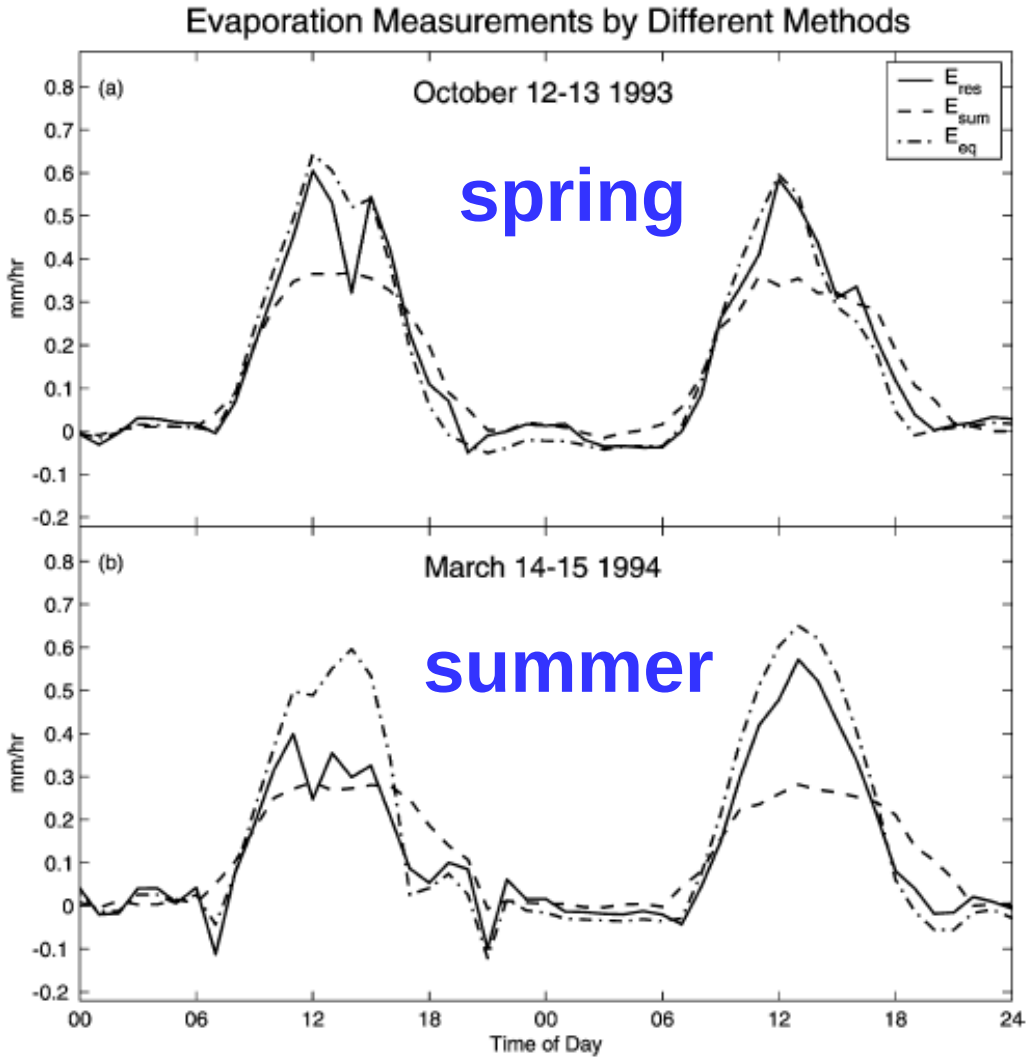


Year-long transpiration is sustained by:

- evergreen foliage
- deep roots
- large storage capacity of the soil



Transpiration is maintained over summer



transpiration
spring

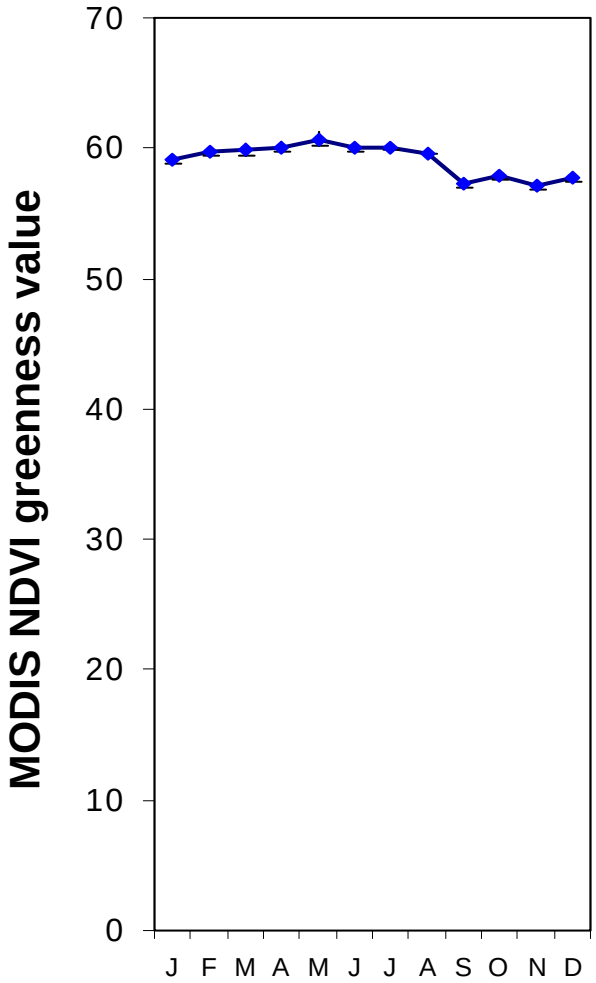
2.48 mm d^{-1}

transpiration
summer

2.77 mm d^{-1}

Silberstein *et al.* (2001)

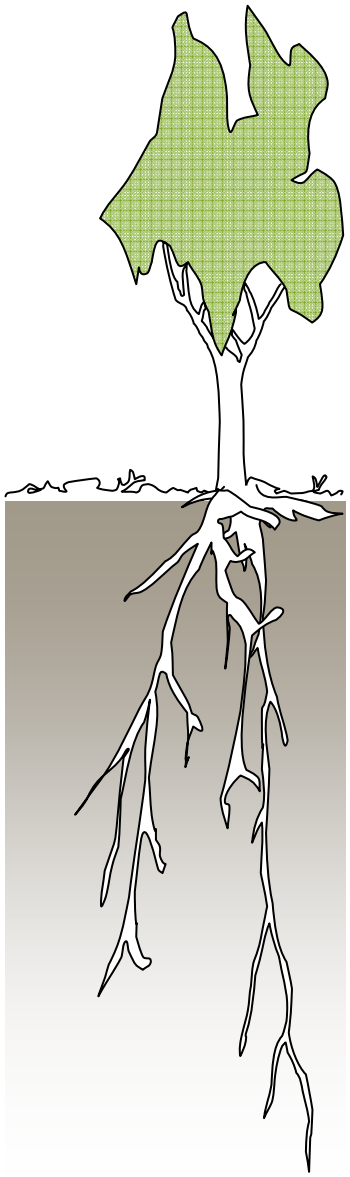
Jarrah forest maintains a high leaf area index over summer

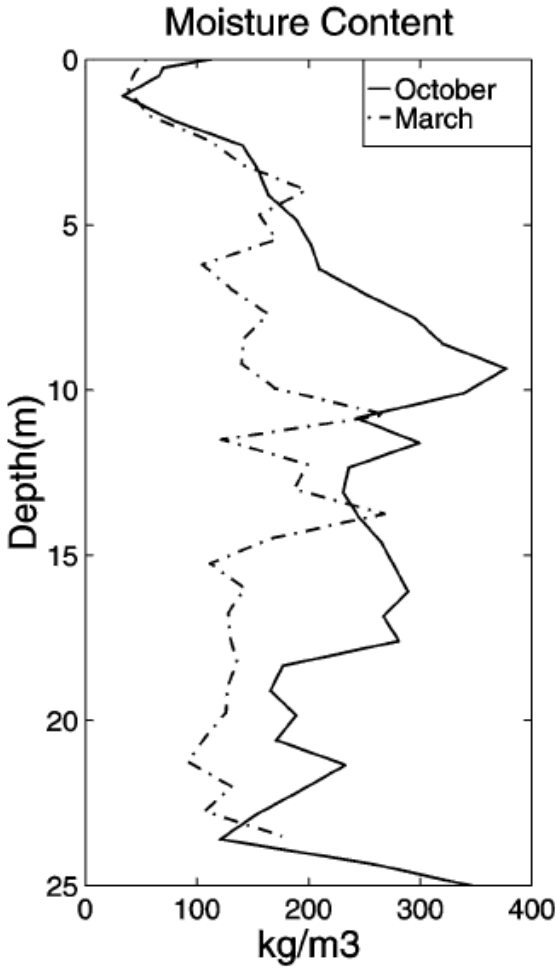


2003-2005

Veneklaas, unpubl.

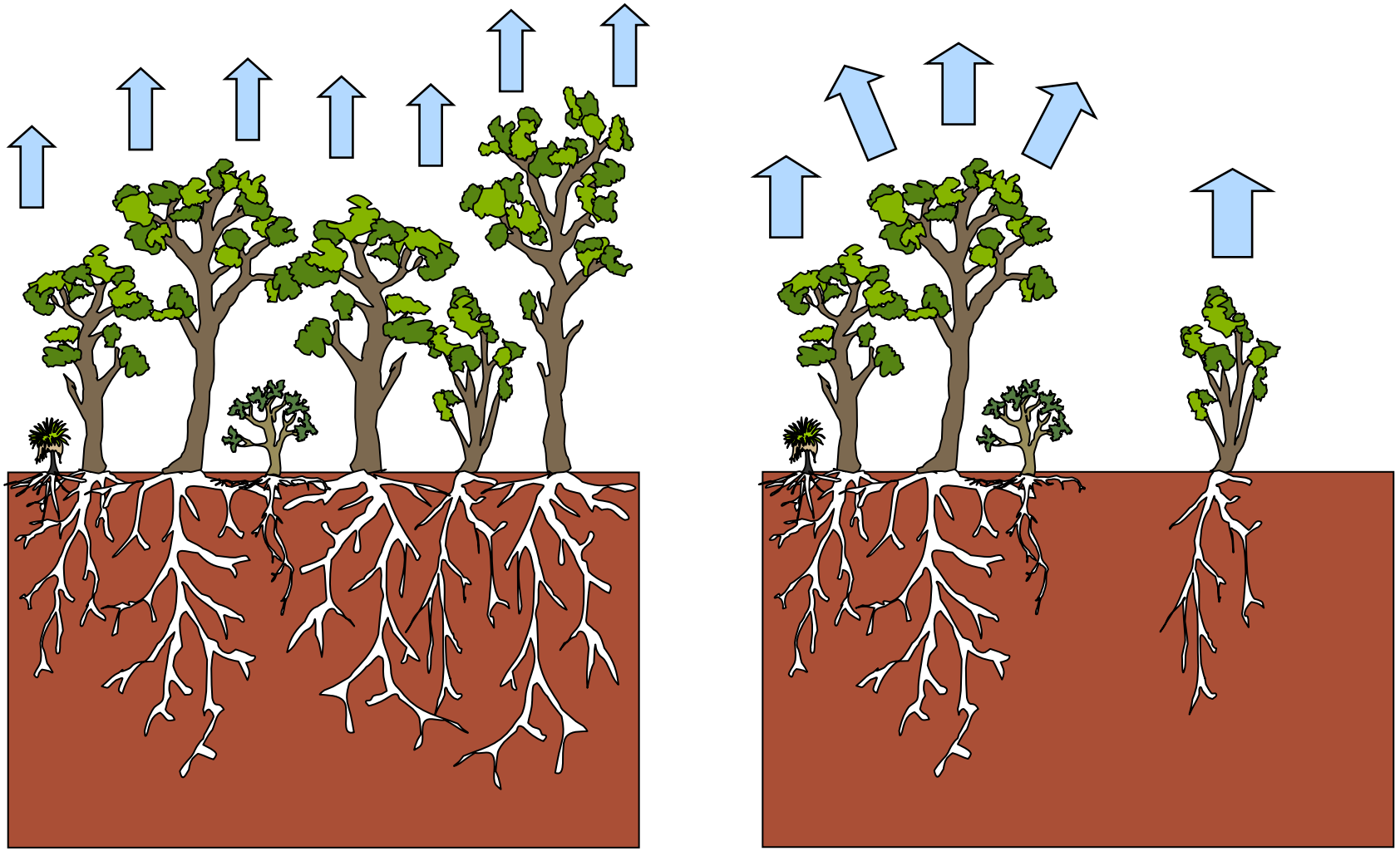
Soil-stored water is taken up by deep roots over summer





Silberstein *et al.* (2001)

Thinning affects leaf area and rates of transpiration



Remaining trees: more soil water, more energy, drier air.

Does this compensate for the reduction in LAI?

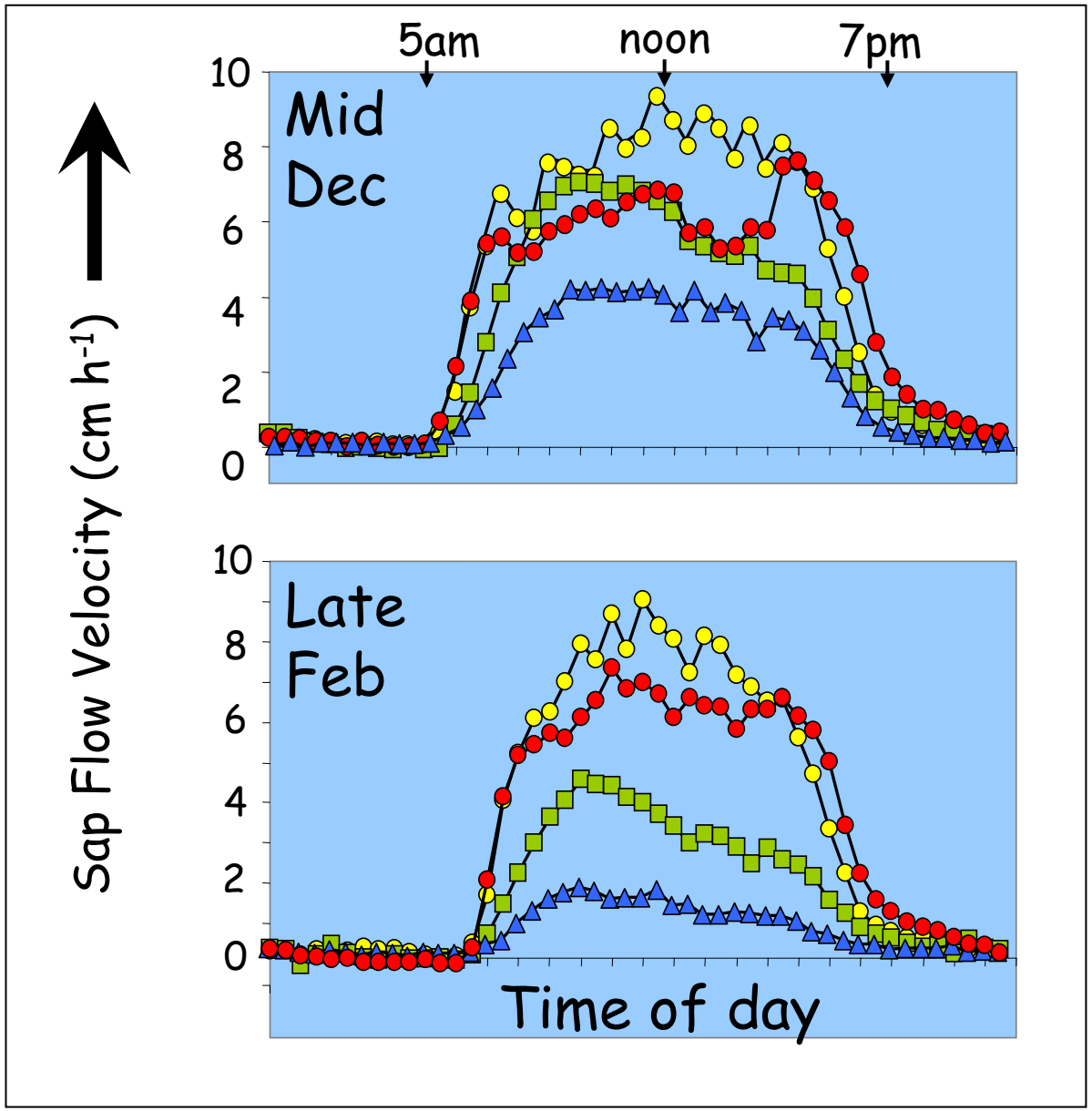
How will the remaining trees respond to thinning?

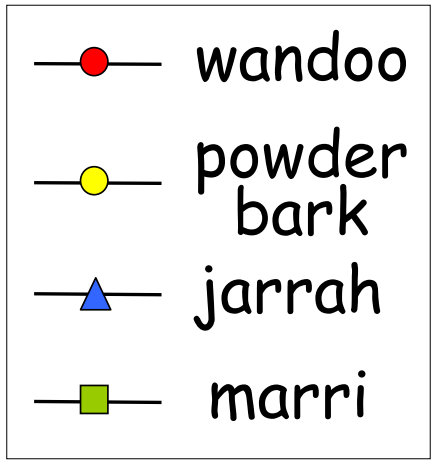
Their response depends on:

Magnitude of change in soil moisture and canopy microclimate (“supply and demand”)

Ecophysiological traits of the trees

Different response of eucalypts to a drying environment





Jarrah is relatively responsive – avoids dehydration

Poot & Veneklaas, unpubl.

Jarrah will probably make use of greater water availability

How to quantify these changes?

Whole-tree water use is best measured with the heat pulse technique

Comparison of pre- and post-thinning transpiration

Possible approaches:

1. Plot-based, scaling up from individual trees
2. Mechanistic, quantifying relationships with soil moisture and microclimate

Challenges:

- variability of soil moisture, weather etc.
- variability between trees
- accuracy?

Will tree responses be immediate?

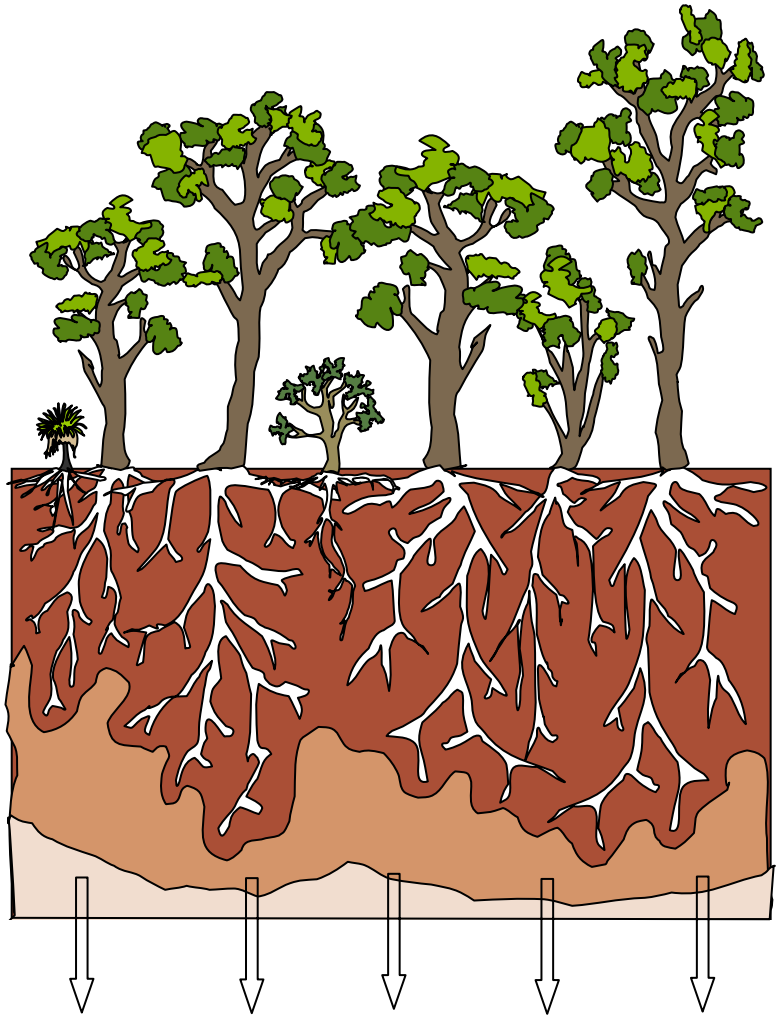
Fast response to canopy openness

Slow changes in soil moisture due to increased recharge

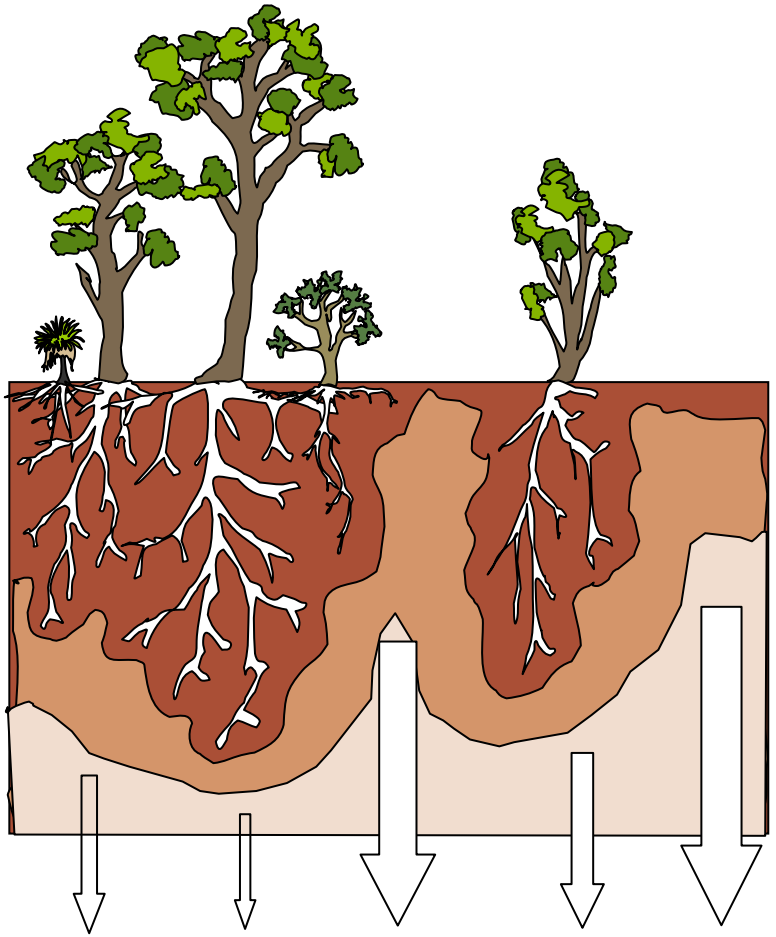
Slow changes in root distibution (colonization of root space of removed trees)

Slow growth of remaining trees, new trees and understorey

Soil moisture distribution affects tree access to water, and recharge

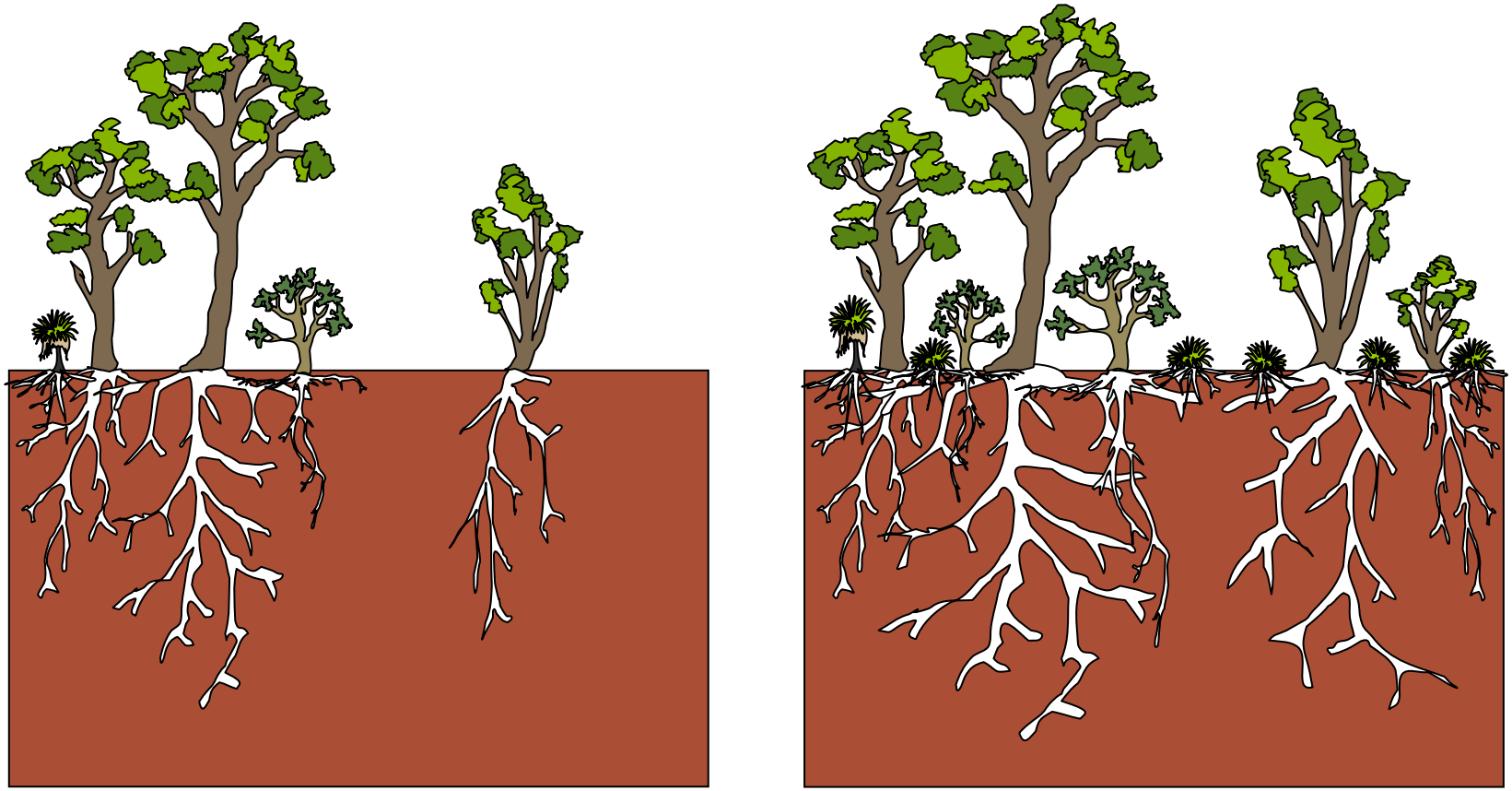


recharge

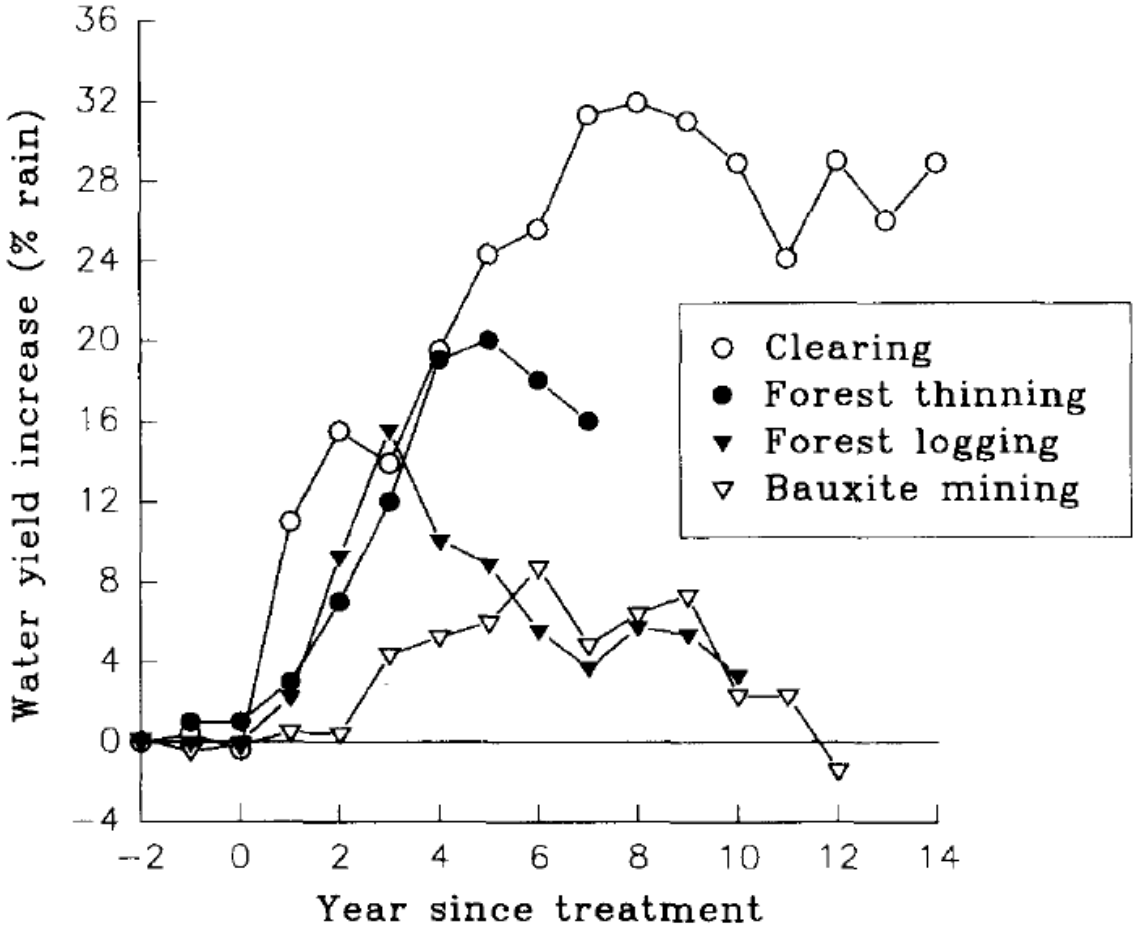


recharge

Post-thinning: expansion of canopy and root systems



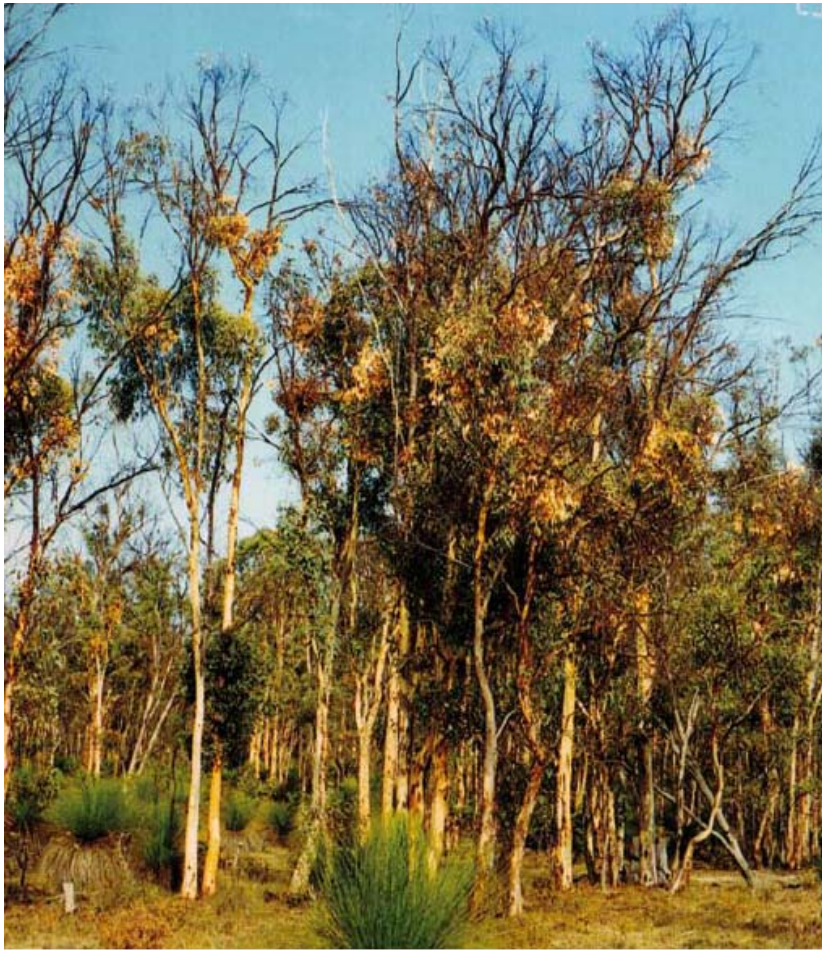
Response at the catchment scale will take several years



Catchment response even slower now, due to multi-year drought?

Ruprecht & Stoneman (1993)

Two related issues:



Forest management to change the hydrology

Forest response to a changing hydrology

Conclusions

Thinning is likely to cause changes in tree transpiration that will favour streamflow

Tree transpiration can be measured, but an accurate assessment of the impact of thinning requires a long-term study and sound (large) sampling strategies

Tree transpiration studies should be done alongside detailed weather, microclimate and soil moisture monitoring