Mistletoe infection alters the transpiration flow path and suppresses water regulation of host trees during extreme events

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Overview

1) Background on mistletoes
2) Assumptions
3) Water use of mistletoes
4) Ecosystem implications of mistletoe infection
5) Mistletoe and tree mortality

Background on mistletoes

Establishment

- spread by birds
- hemi-parasite that relies on host tree
- attaches to branch and taps into xylem
- redirects carbon, nutrients and water
- forms dense branch structure

Benefits of mistletoe presence

- fertilization effect on soil through high leaf turnover
- keystone species for floral and faunal biodiversity

Background on mistletoes

Mistletoe physiology

- lower photosynthesis rates
- maintains lower water potentials
- minimal to no stomatal regulation
- higher transpiration rates

- cooling effect on the ecosystem
- favourable microclimate in mistletoe clumps during warm days

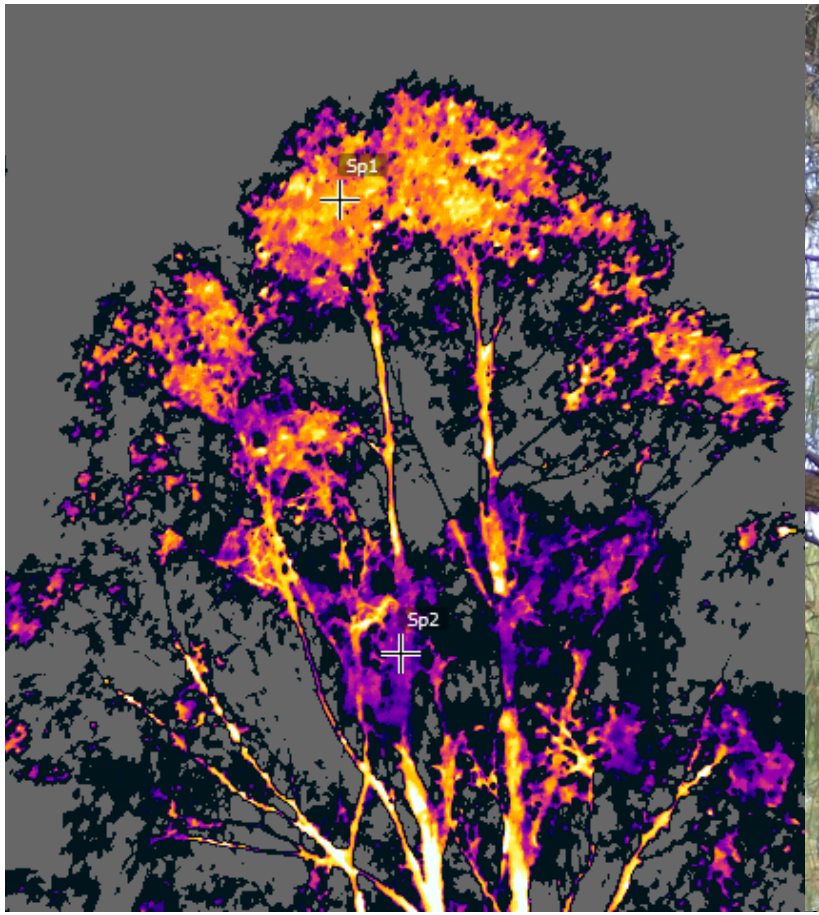


Photo from AU-Cum tower by Wouter Maes

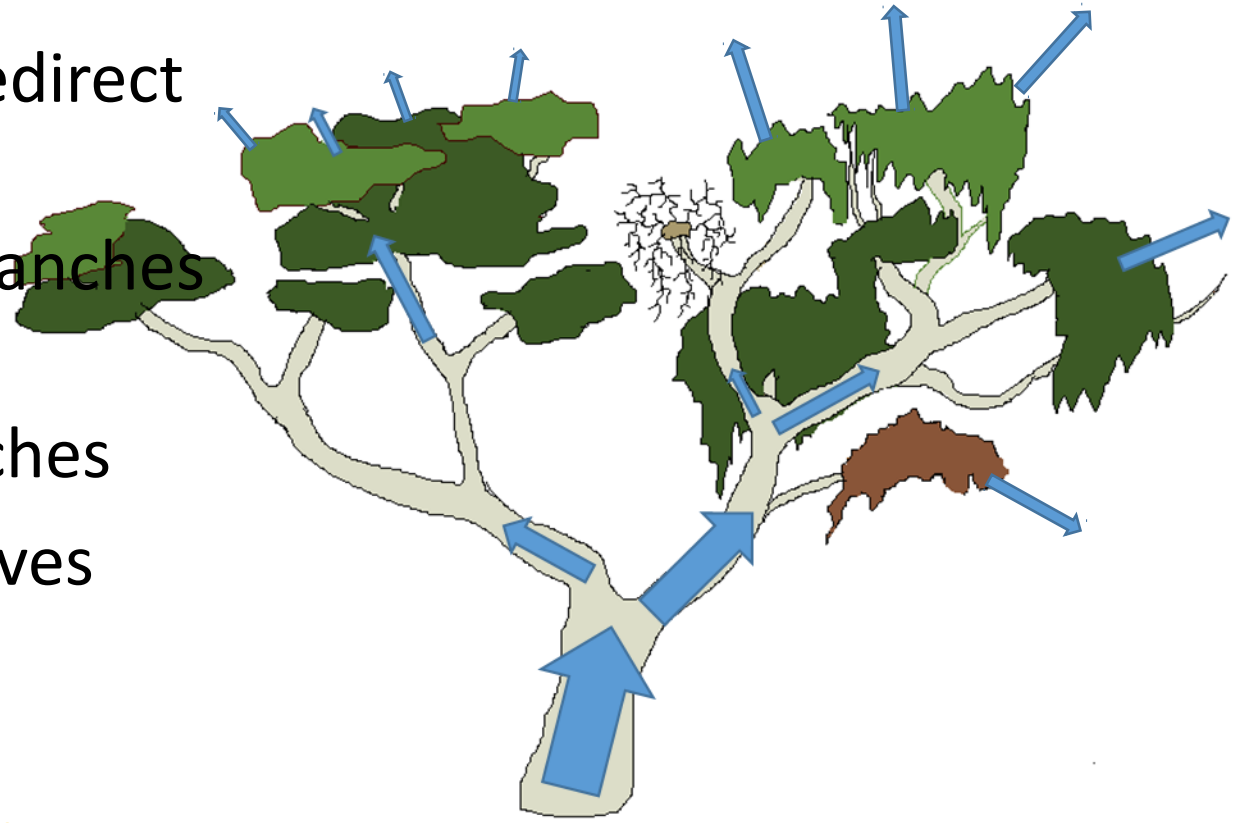
Photo from Skye Wassens

Assumptions

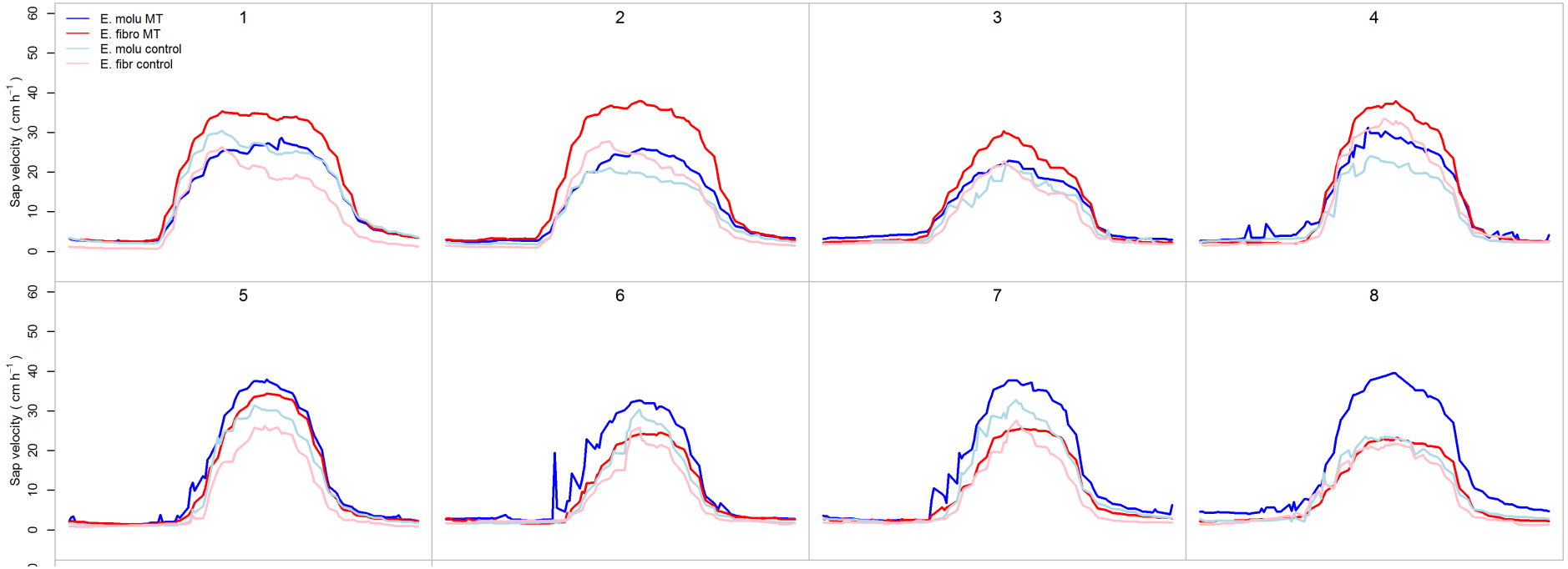
Mistletoe redirects water flow path in host tree

- maintains lower water potentials to redirect water towards mistletoe branch
- higher water flow towards infected branches vs. uninfected branches
- exaggerates water stress in host branches
- increased stomatal closure of host leaves

- *water leaks out through the mistletoe*
- *higher overall water use of infected vs. uninfected trees*

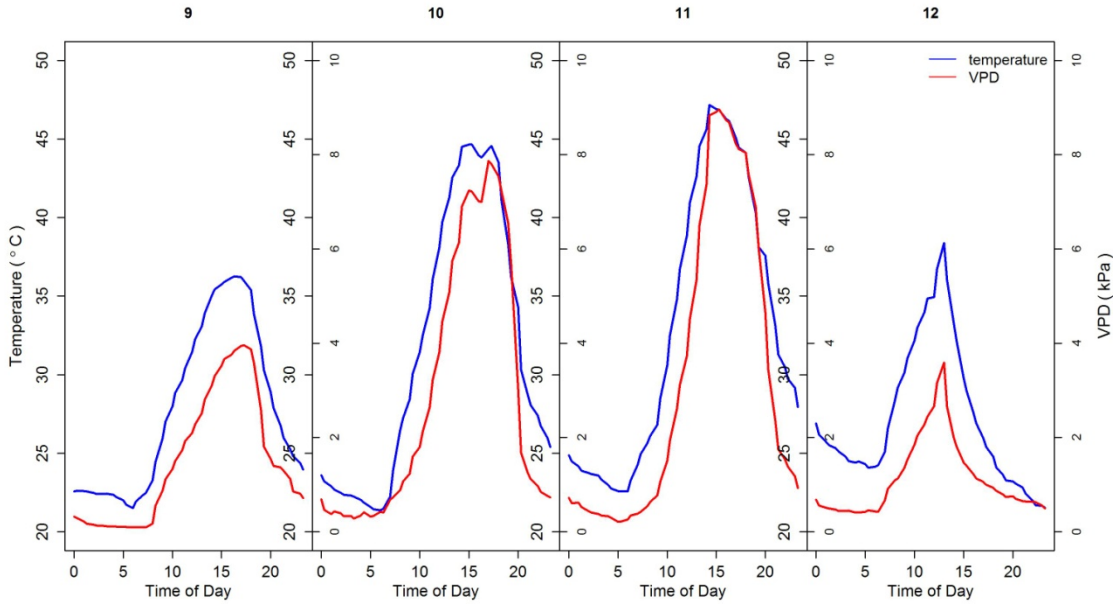


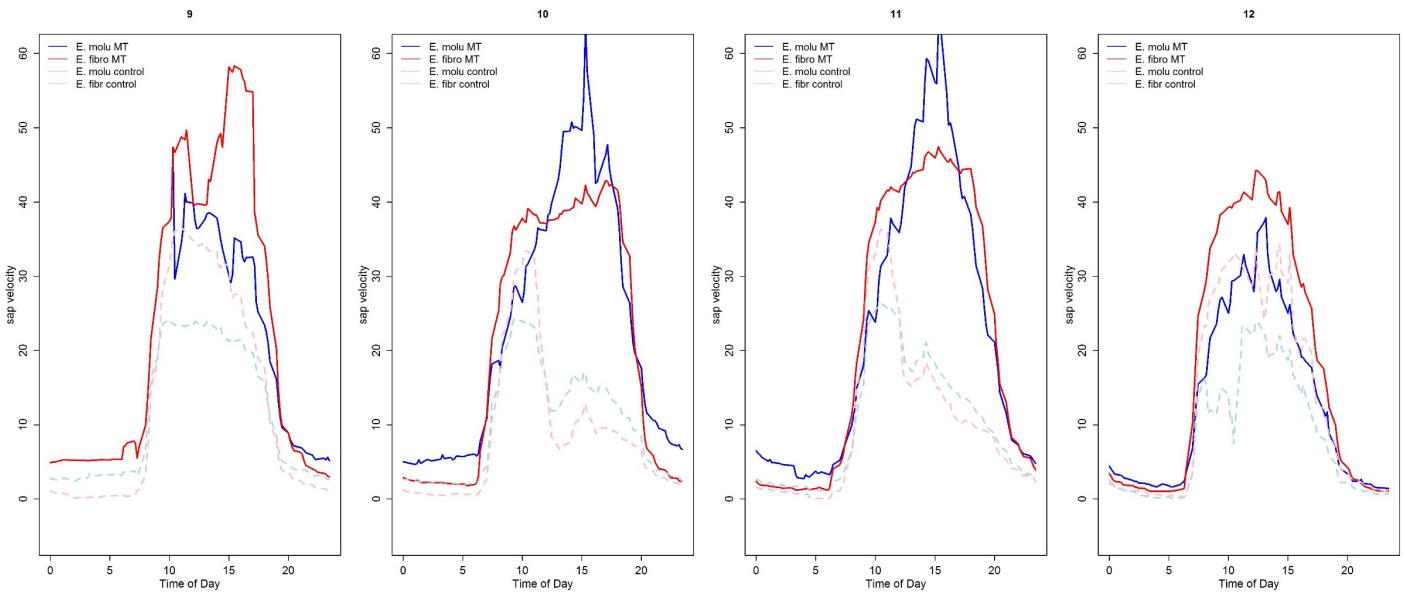
Water use of mistletoes *(monthly scale)*



- monthly diurnals of sap velocity from infected vs. uninfected trees
- infected trees have higher water use than uninfected trees in every month
- uninfected trees show decreased sap velocity rates in the arvo in warm months (January – April)

Water use of mistletoes *(extreme heat)*

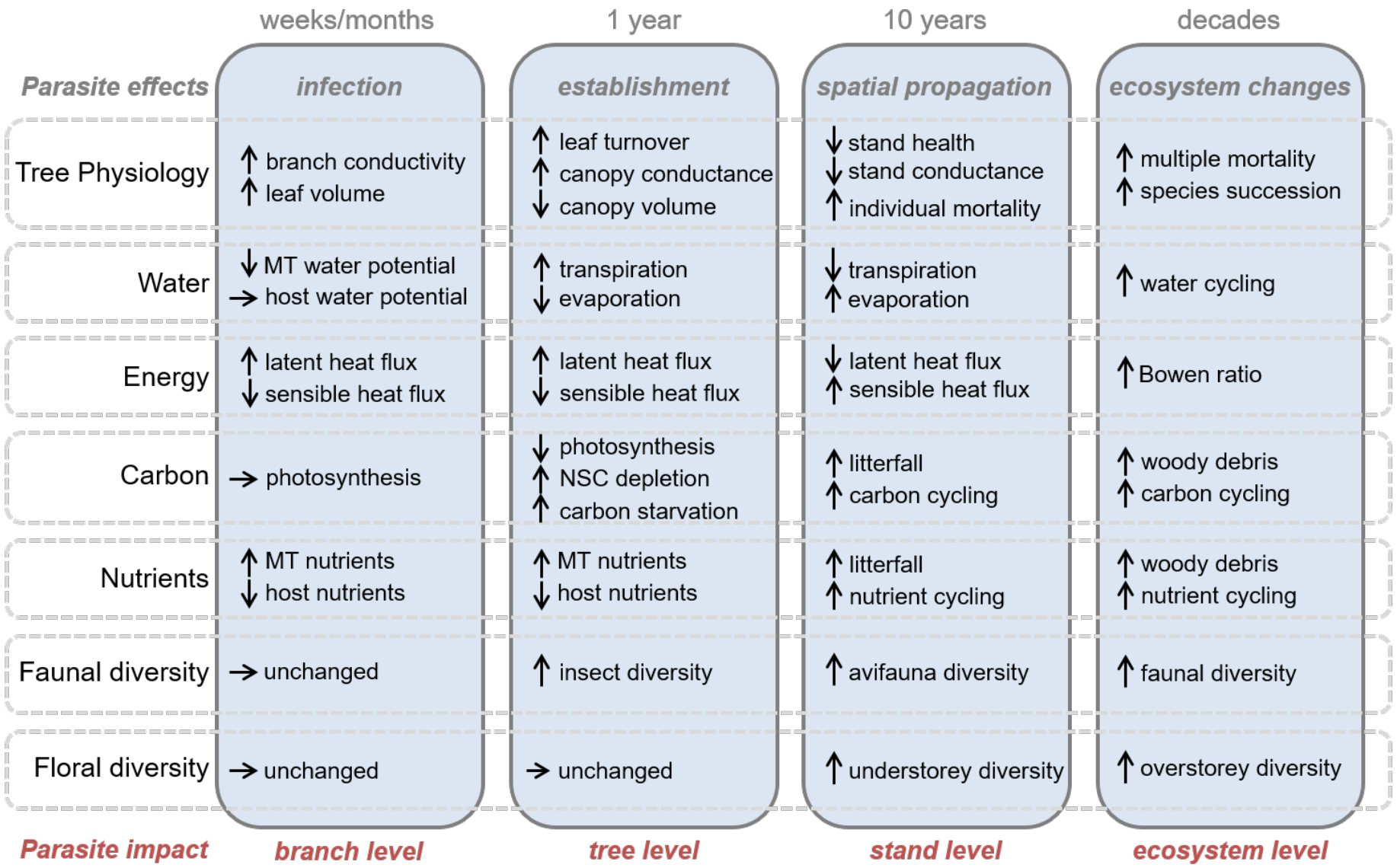




- 4 days during extreme heat in February 2017
- peak air temperature: 47 °C / 117 F
- peak vapour pressure deficit: >9 kPa

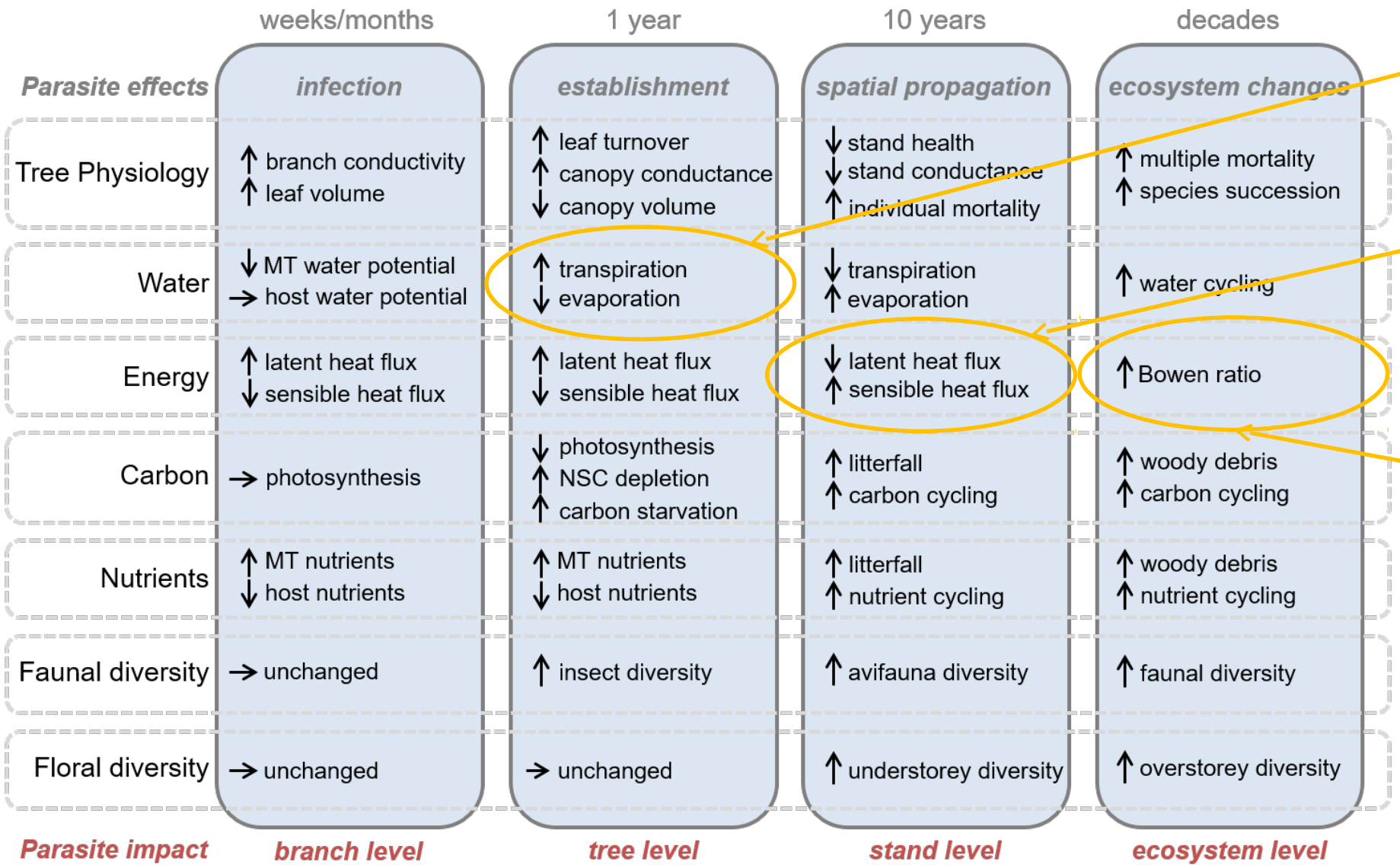
- sap velocity measurements indicate unregulated water use of infected trees
- water use of uninfected trees declines with increasing VPD

Ecosystem implications



Griebel et al., 2017 *Environmental Research letters*

Ecosystem implications



Initially increased cooling through LE ↑

when too abundant decreased cooling through LE ↓

Mistletoe modifies the energy balance of the ecosystem

positive + negative feedback with climate change

Griebel et al., 2017 *Environmental Research letters*

Mistletoe amplifies mortality

- Mistletoe distribution is increasing in SE Australia (*Turner et al., 2016)*
- Mistletoe distribution is shifting northwards with warming climate (*Dobbertin et al., 2006*)
- Higher mortality in forests with mistletoe in combination with droughts

- Mistletoe infection adds stress on host tree on top of increased climate stress
- With a warming climate extreme heat and prolonged droughts will be more frequent
- We anticipate that mortality rates in infected forests will increase further

Questions?!

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Thank you

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