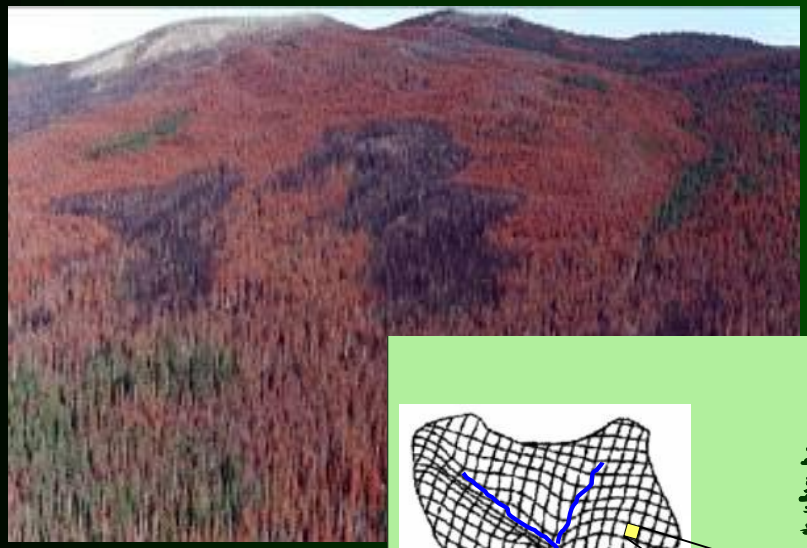
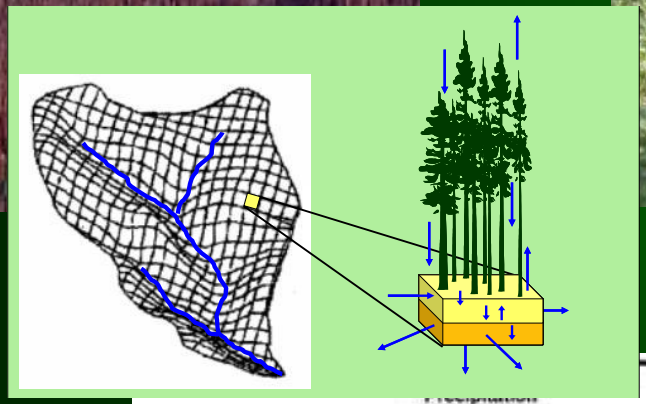
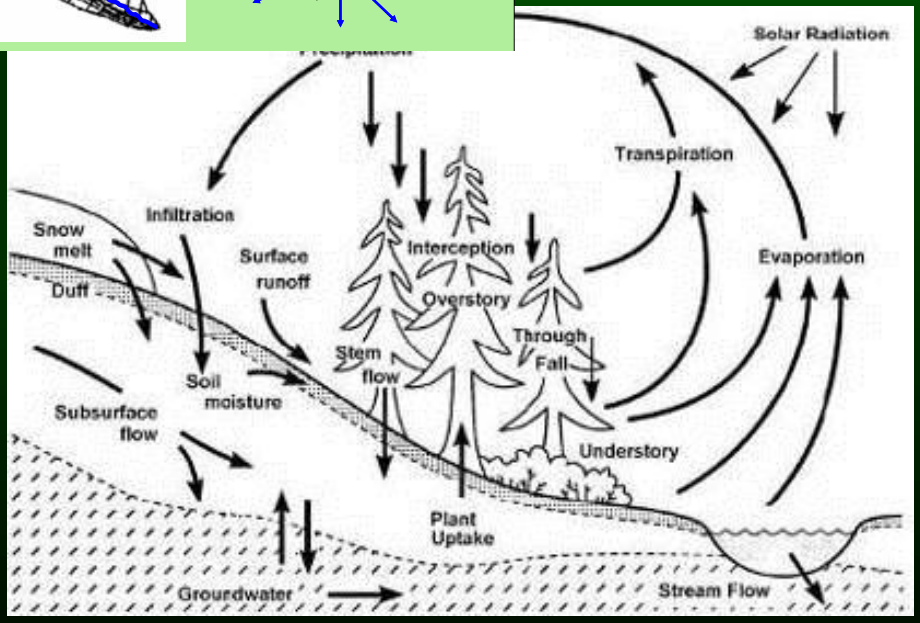
Effects of Simulated MPB Early Red Attack on Hydrology, Post-attack Vegetation, Fuels, & Below-ground Dynamics

Principal investigators: Drs. Uldis Silins and Ellen Macdonald
Ph.D. projects: Anne McIntosh and Pablo Piña-Poujol
Lead field technician: Pete Presant






Solar Radiation
Transpiration
Infiltration
Snow melt
Surface runoff
Interception
Evaporation
Duff
Overstory
Through Fall
Stem flow
Soil moisture
Subsurface flow
Understory
Plant Uptake
Groundwater
Stream Flow

Broad research questions

- *Is MPB red attack a threat to the hydrologic regime of these stands?* (Pablo Piña)

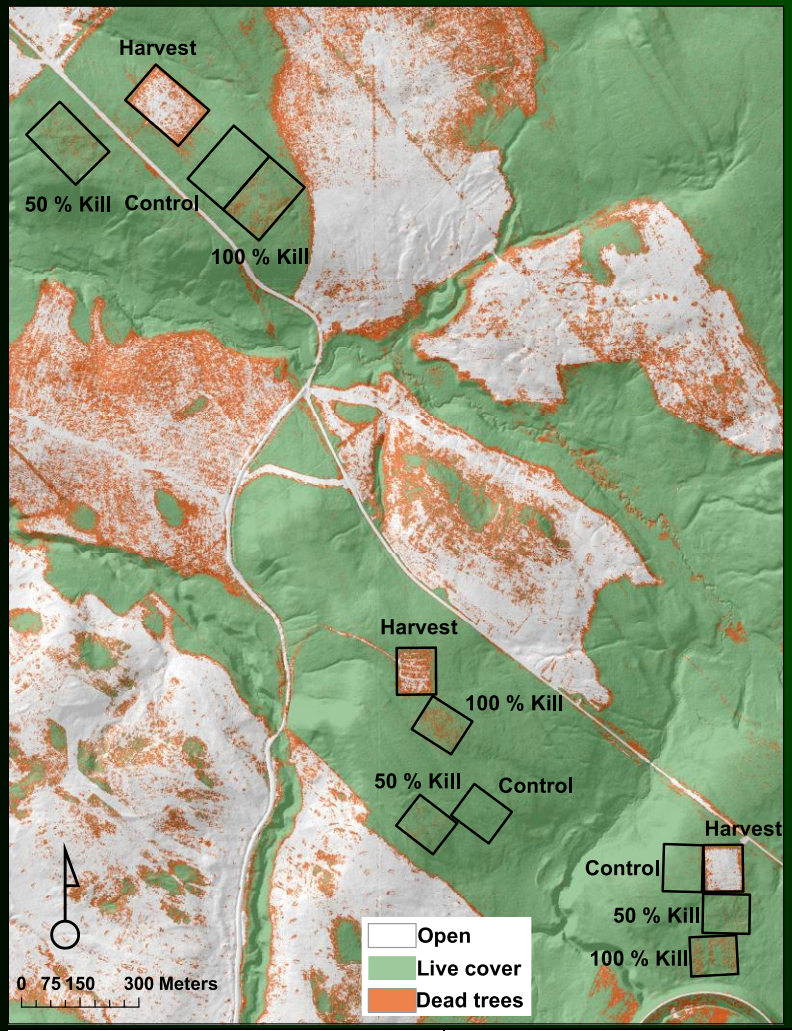
- *How resistant are vegetation, fuels, and below-ground dynamics to different levels of "red attack" ?* (Anne McIntosh)

Approach & treatments

- Simulate MPB attack
  - issue of "control" (B.C. experience)
  - variable density herbicide treatment

- [1] Control (untreated)
- Simulated MPB attack ([2] 50% & [3] 100% overstory kill)
- [4] Clearcut - harvested to simulate "salvage logging"

Study area & design



- Study processes that govern;
  - *Forest water balance*
  - *Understory veg. dynamics*

- Pre-treatment (1 year)
- Post-treatment (2 years)

- 2.2 ha treatments (water balance)
- + 2 x 1.2 ha replicates (vegetation)

Post-attack hydrology responses
Pablo Piña, PhD Candidate

Is MPB red attack a threat to the hydrologic regime of these stands?

Forest stand water cycle

Gross precipitation + Evaporative demand

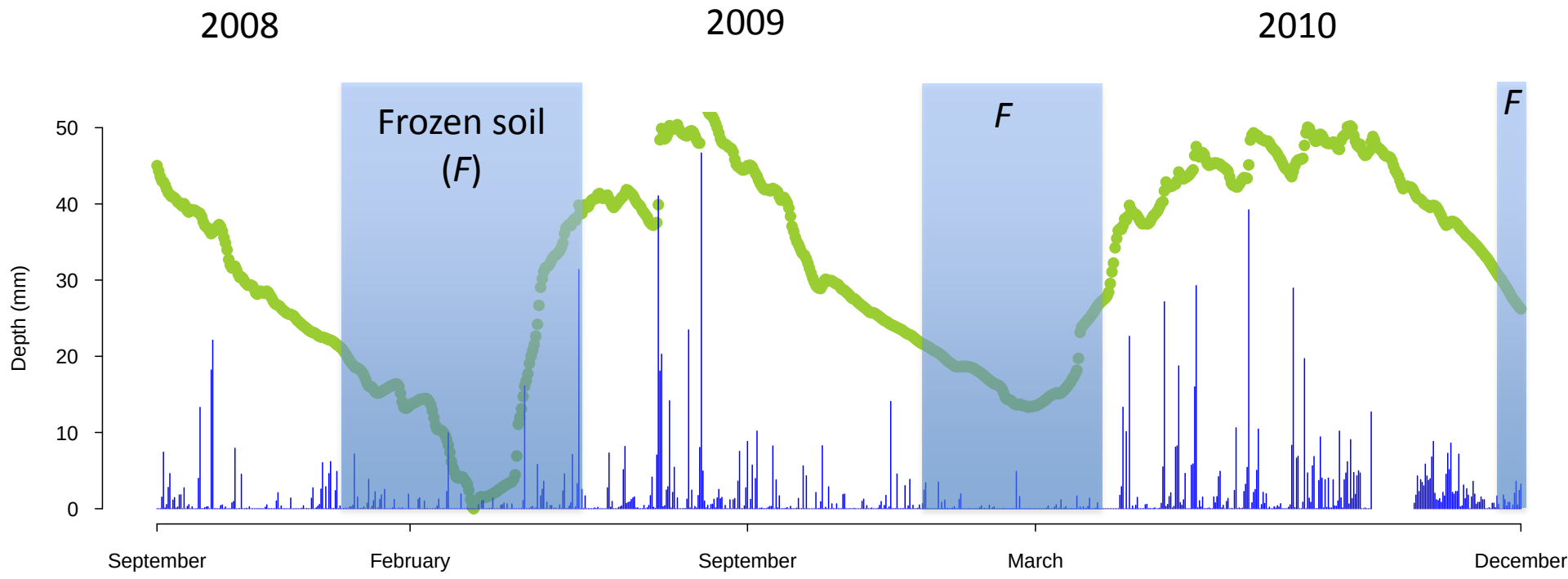
Overstory transpiration

Canopy interception

Forest floor interception

Soil moisture storage

Typical time series of soil moisture storage availability and precipitation in the Upper Foothills



Three things here:

1. Periods of frozen soils have considerable length and contribution to recharge during spring melt
2. Soil moisture has a clear response to rain events larger than ~8 mm
3. Precipitation has a pattern in terms of rain and snow events' intensity

Forest stand water cycle

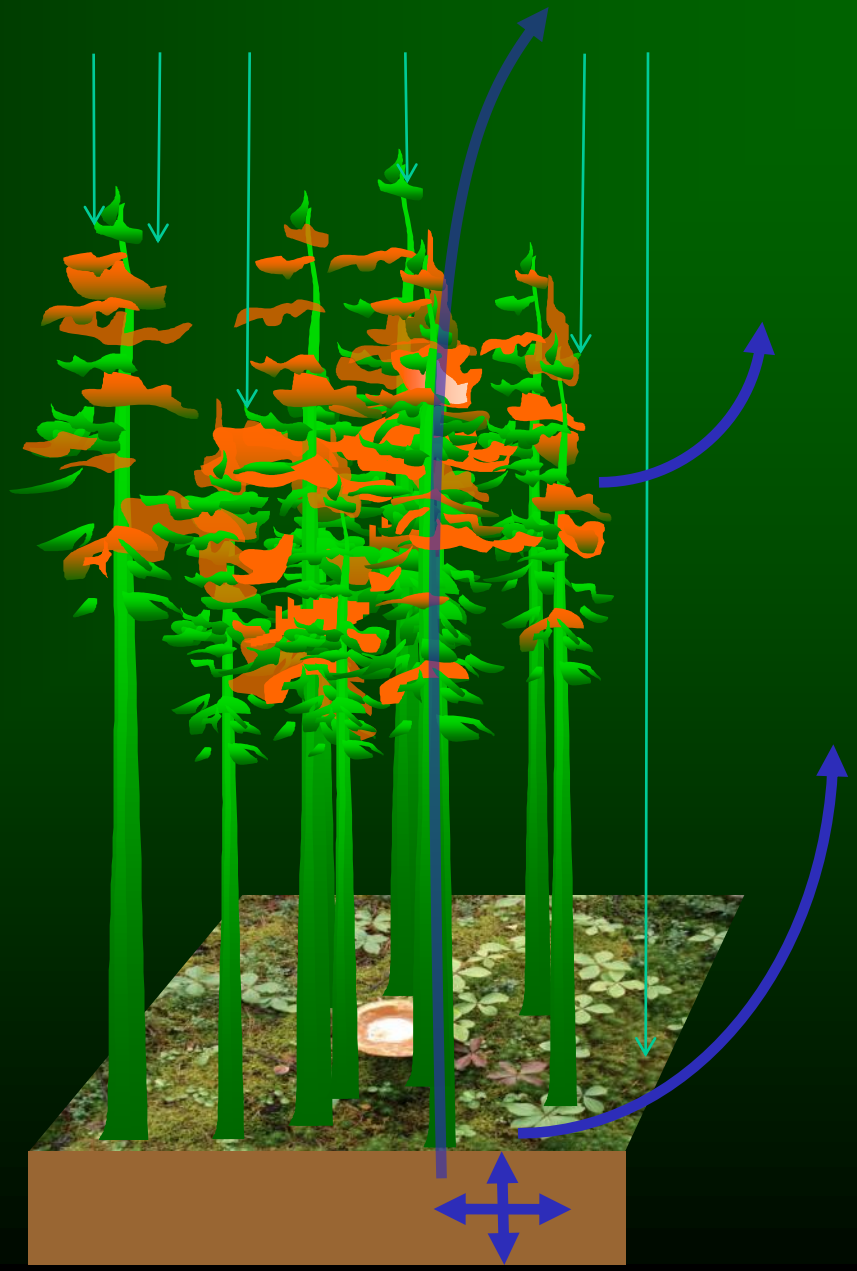
Canopy interception

Net precipitation

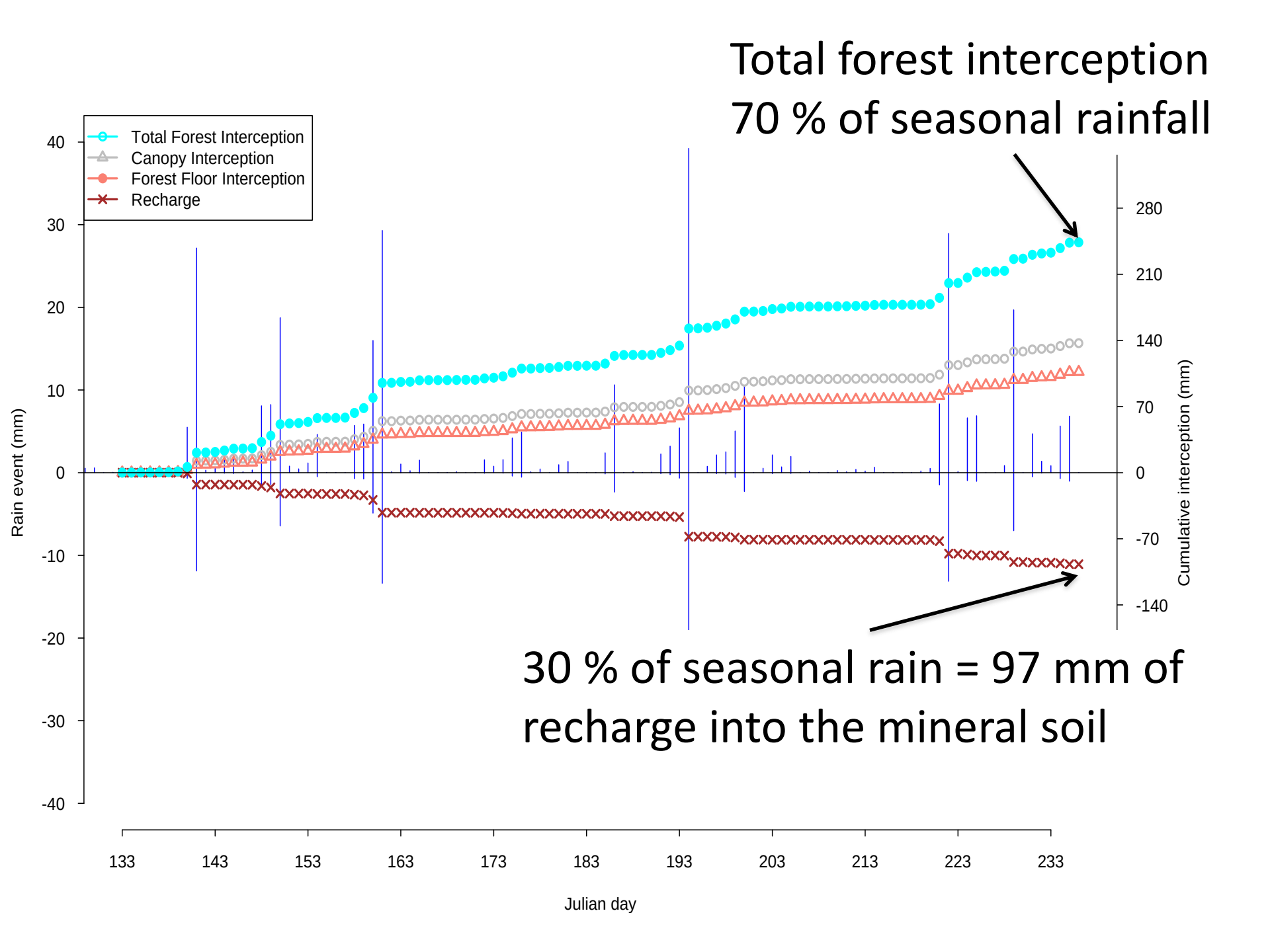
Overstory transpiration

Forest floor interception

Soil moisture recharge



Characterizing rainfall interception


Total forest interception
70 % of seasonal rainfall
Total Forest Interception
Canopy Interception
Forest Floor Interception
Recharge
Rain event (mm)
Cumulative interception (mm)
Julian day
30 % of seasonal rain = 97 mm of recharge into the mineral soil

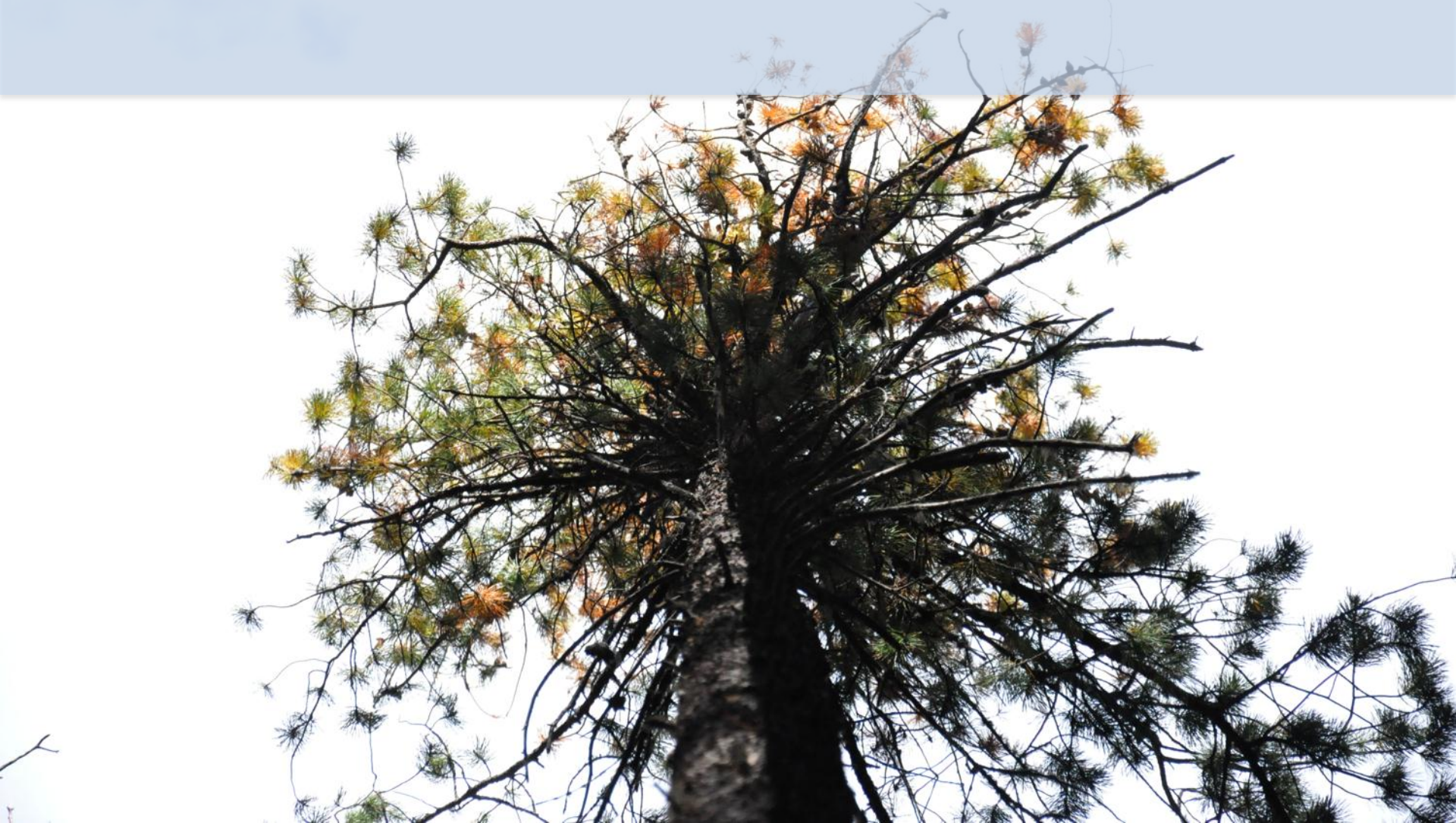
Characterizing lodgepole pine transpiration

Thermal Dissipation Probe

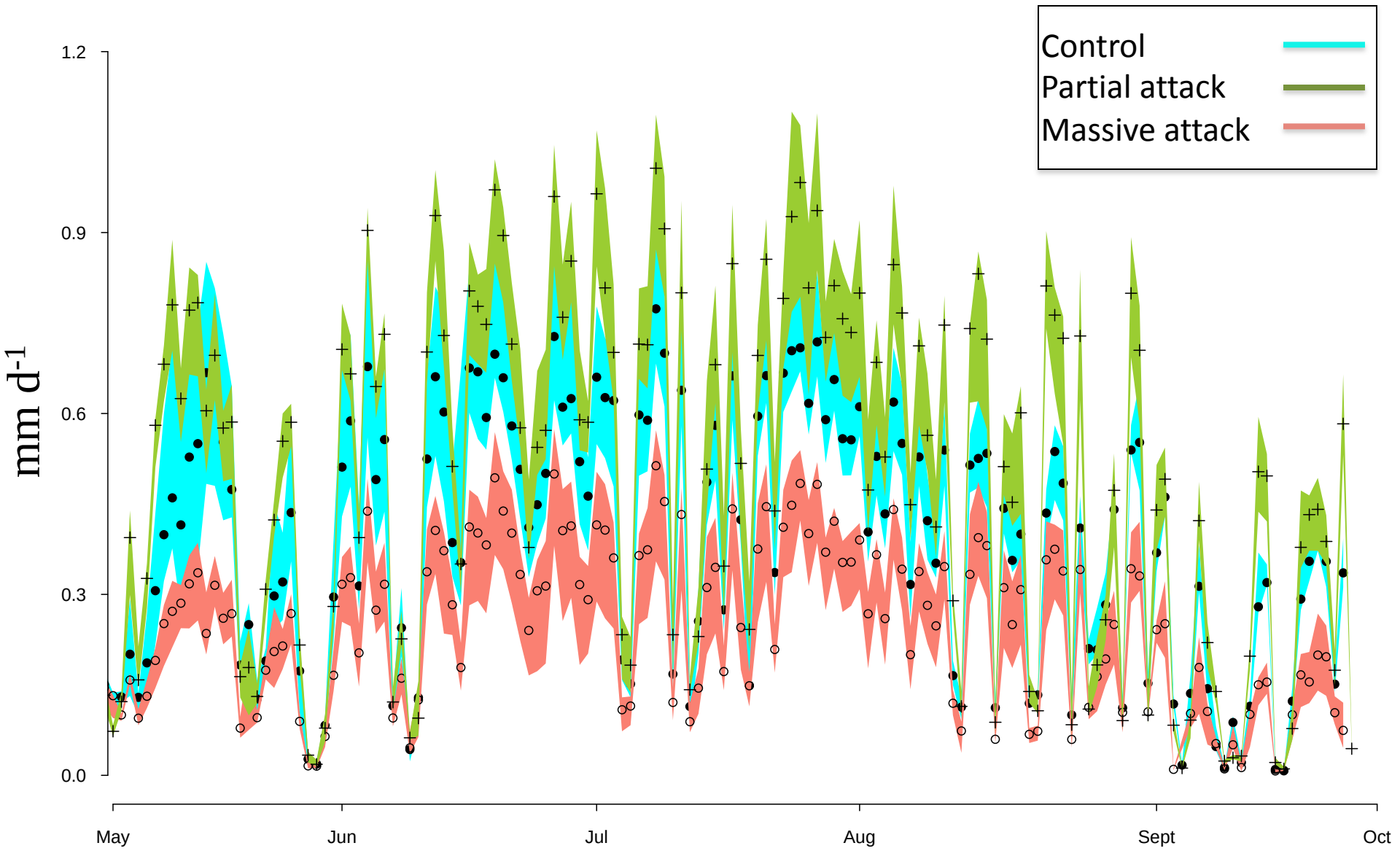
Overstory transpiration…

Fading Rates?

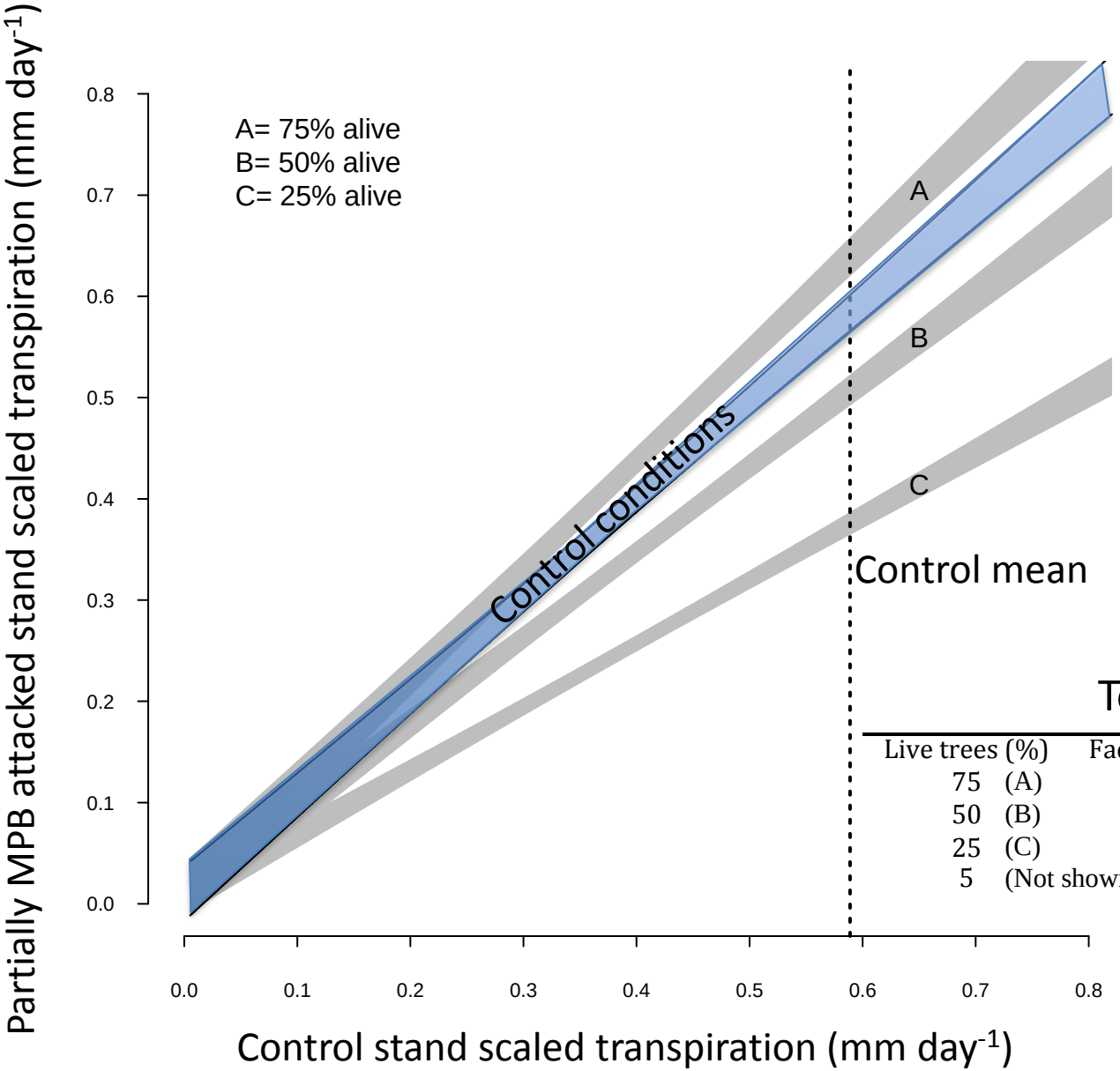
Compensatory Response?



Range of seasonal transpiration for live trees: tree scale



Modeled scenarios to scale transpiration using relationships developed in the experimental units: stand scale



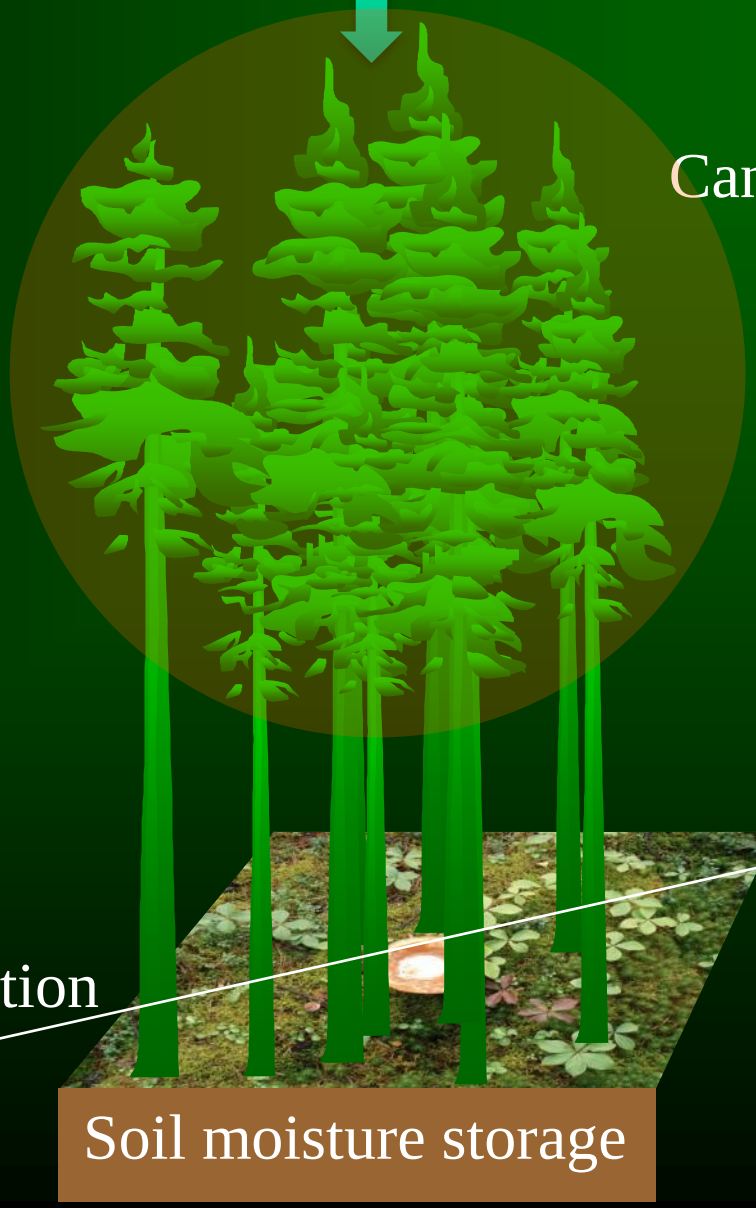
Totals per season

Live trees (%)		Fading trees (%)	Dead trees (%)	T_{st} (mm)
75	(A)	15	10	85
50	(B)	30	20	67
25	(C)	45	30	50
5	(Not shown)	56	39	36

control conditions = 77 mm

Forest stand water cycle

Gross precipitation + Evaporative demand



Overstory transpiration
16%

Canopy interception
48%

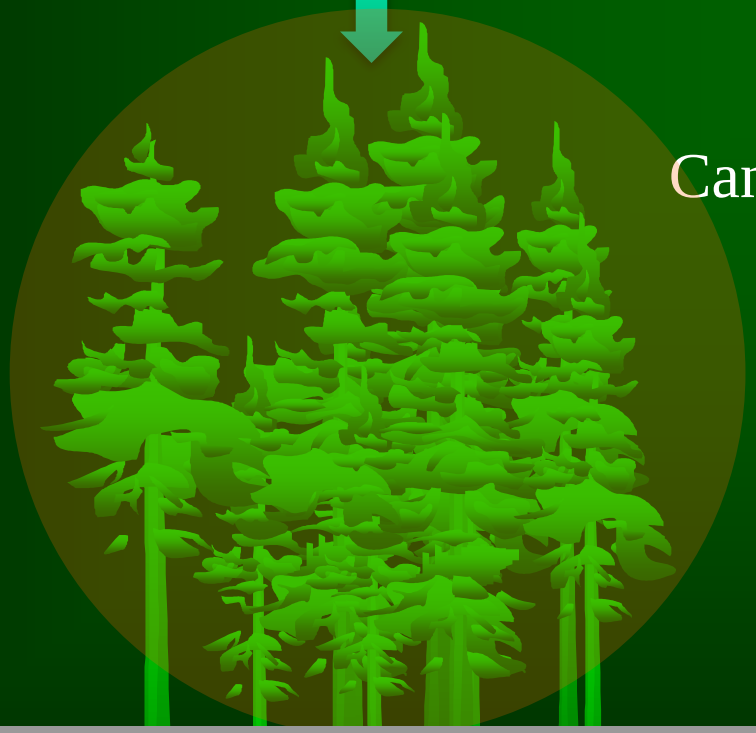
Total forest
interception
70%

Forest floor interception
34%

Soil moisture storage

Forest stand water cycle

Gross precipitation + Evaporative demand



Overstory transpiration

Canopy interception

Is there a clear response in the soil moisture dynamics after an early Mountain Pine Beetle attack? … come to the workshop to find out ☺

Soil moisture storage

Post-attack vegetation, fuels, & below-ground response

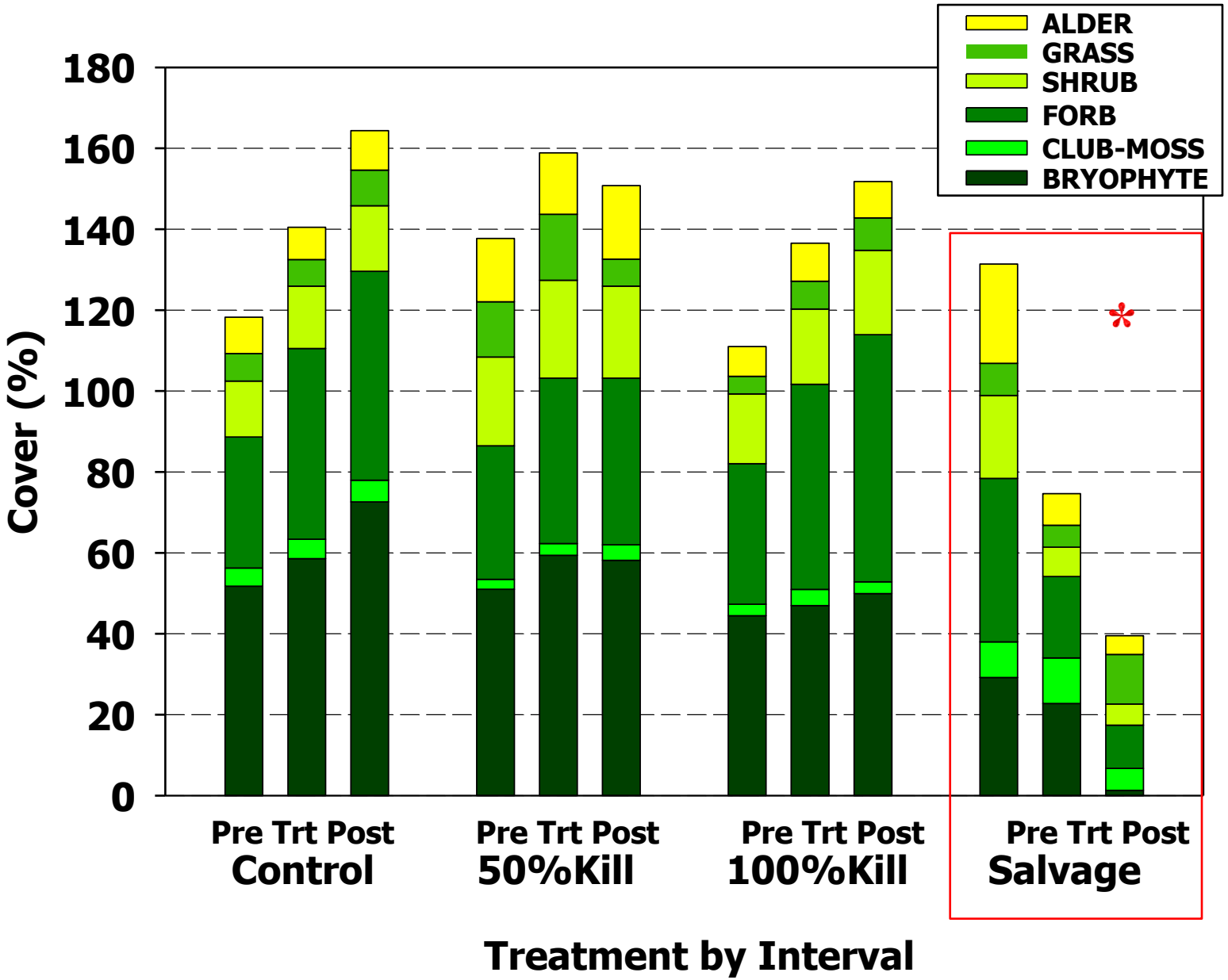
Anne McIntosh, PhD Candidate

- *How resistant are vegetation, fuels, and below-ground dynamics to different levels of "red attack"?*

1. Understory plant community composition
2. Future regeneration potential of these stands
3. Recruitment of downed woody debris (DWD)
4. Changes in below-ground processes

   (pH, decomposition, nutrient availability, microbial community, decomposition)

Understory cover



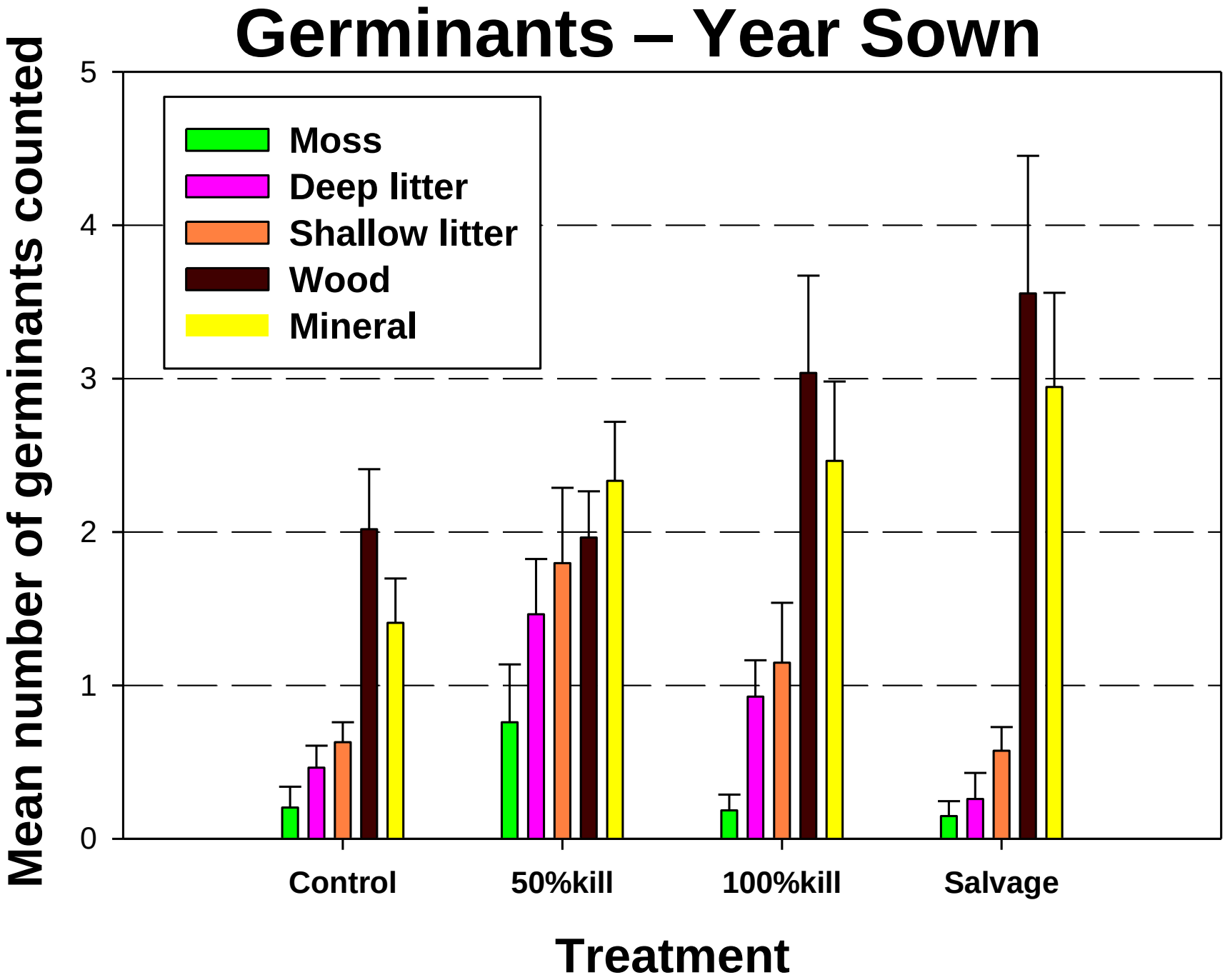
Germination study (Post-treatment yr)

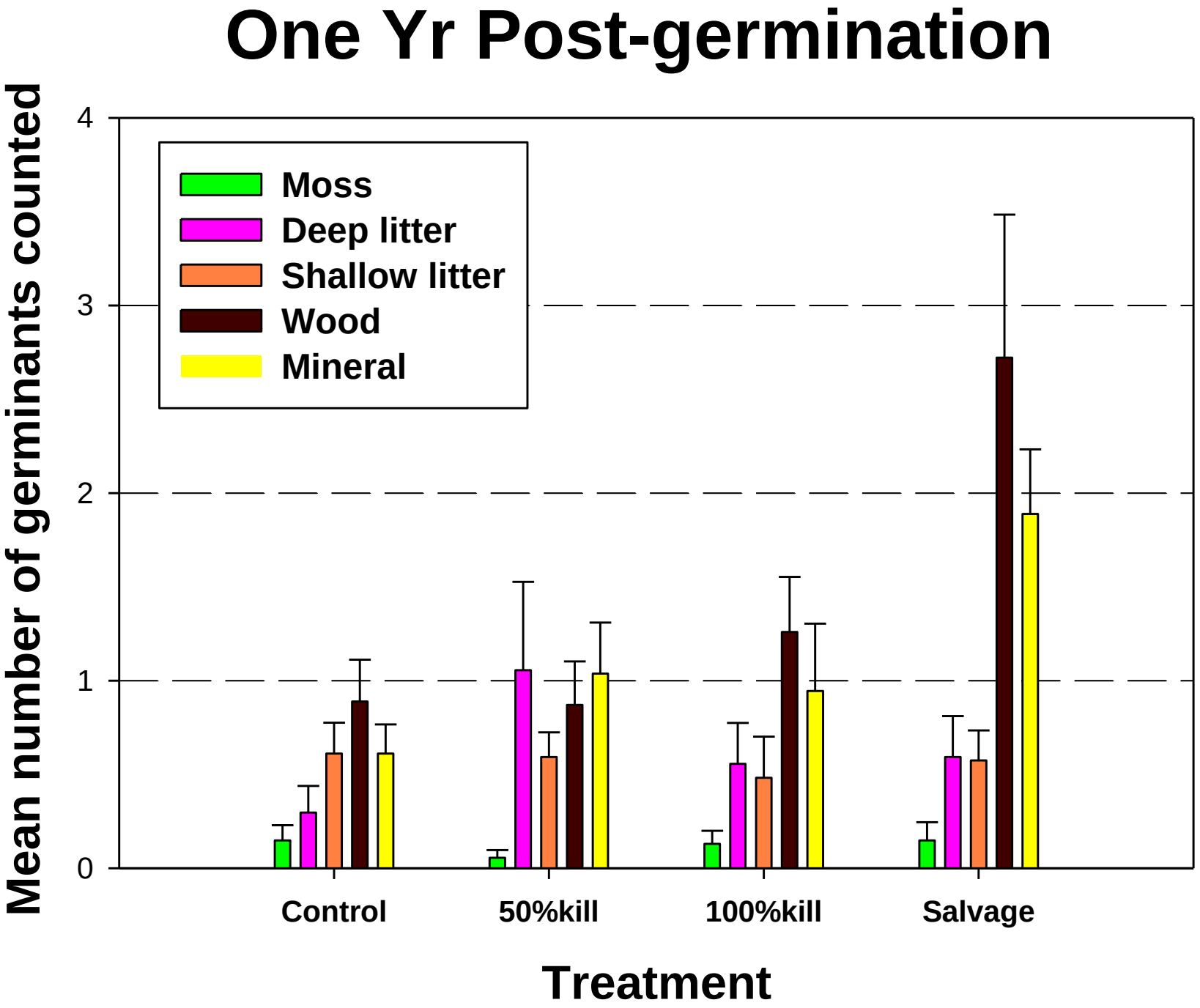
What is regeneration potential after MPB?

Quadrats on 5 substrates sowed w/ seed:

- LFH < 2.5 cm
- LFH > 2.5 cm
- Mineral soil
- Moss
- Dead wood (decay class 4-5)

Monitored germination


Germinants – Year Sown
Mean number of germinants counted
0
1
2
3
4
5
Moss
Deep litter
Shallow litter
Wood
Mineral
Control
50%kill
100%kill
Salvage
Treatment


One Yr Post-germination
Mean number of germinants counted
4
3
2
1
0
Moss
Deep litter
Shallow litter
Wood
Mineral
Control
50%kill
100%kill
Salvage
Treatment

Recap & the future…

Main findings – stand hydrology

Stand evapo-transpiration depended on level of attack reduced by 100% attack & salvage

- 100%kill: Dying trees had decreased transpiration
- 50%kill: Living trees can compensate in partial attacked stands

Soil moisture increased

- Surface 20 cm clear treatment effect
- Surface 5 cm clear gradient with treatment (data not presented - come to the workshop!)

There are regional effects too… come to the workshop!

Main findings

Understory

*No change… yet?

Regeneration?

Unlikely…

MPB

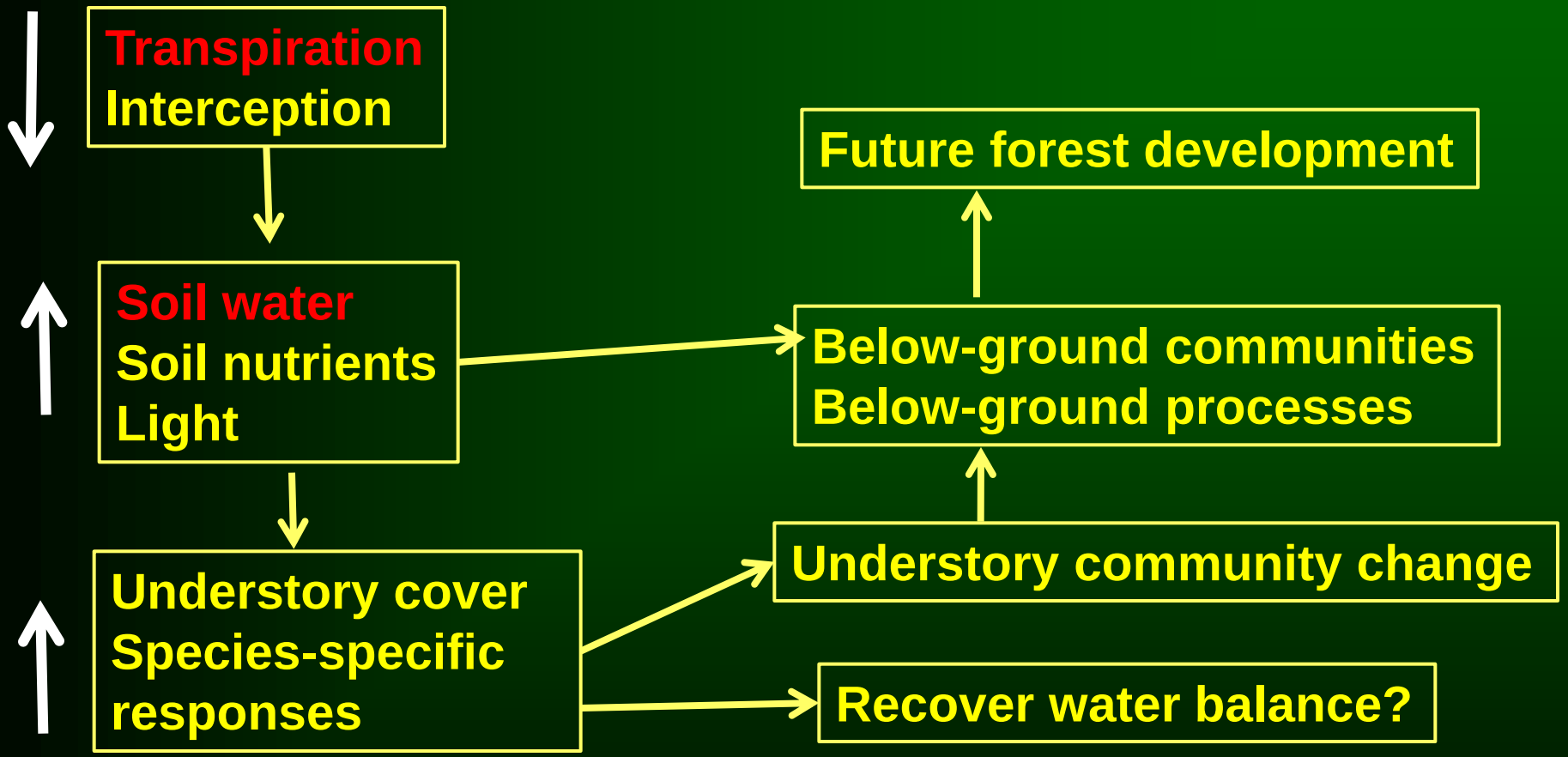
Overstory

Trees are dying

Below-ground

No change …yet?

As we move to grey attack…



Support for our work

- Foothills Research Institute
- FRIAA / AB SRD
- West Fraser Timber Co. Ltd.
- NSERC
- Killam Trusts
- CONACYT
- Milo Mihajlovich
- Field Assistants

…Thank-you for listening

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