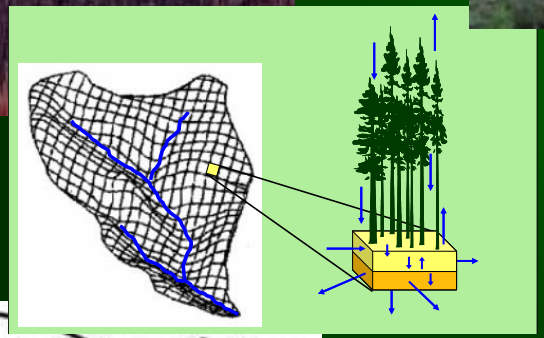
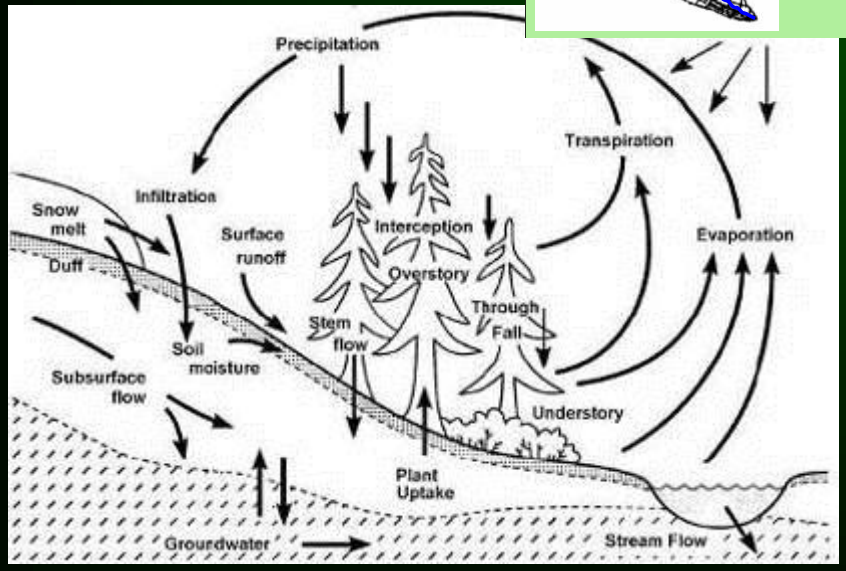
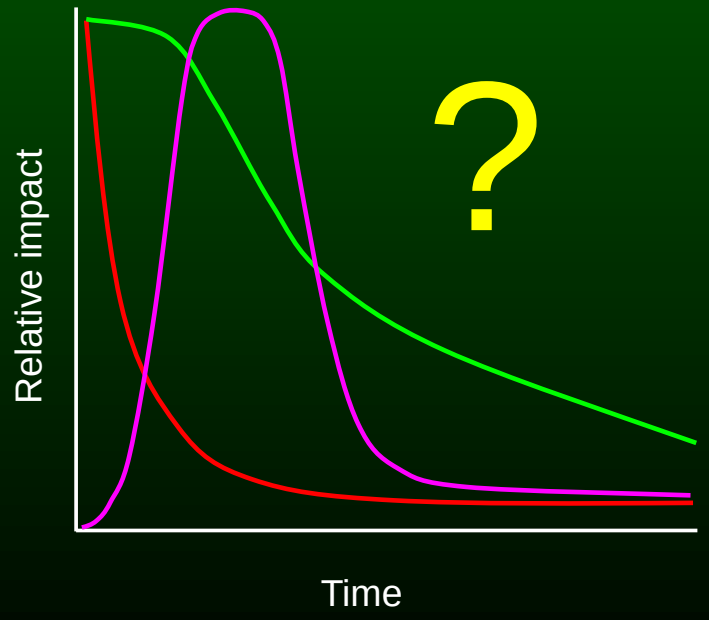
Effects of Simulated MPB on Hydrology and Post-attack Vegetation & Below-ground Dynamics

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




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


Relative impact
Time
?

Broad research questions

- *How much extra water is produced after different levels of "red attack" ?* (Pablo Piña)

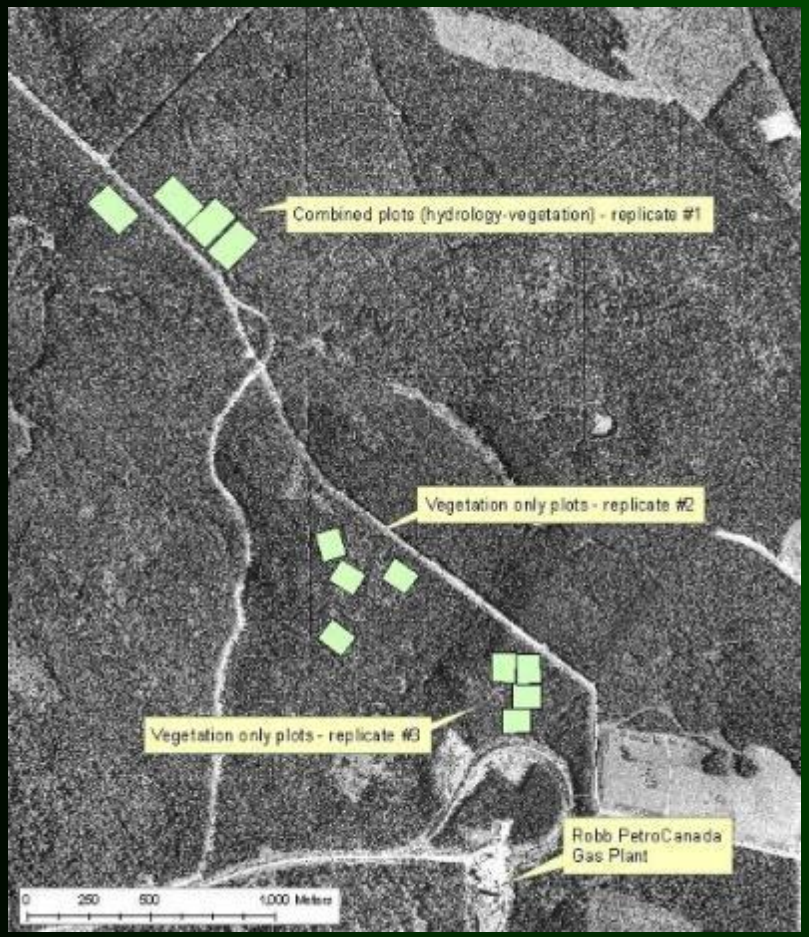
- *What are the early trajectories of vegetation and below-ground responses after different levels of "red attack" ?* (Anne McIntosh)

Approach & treatments

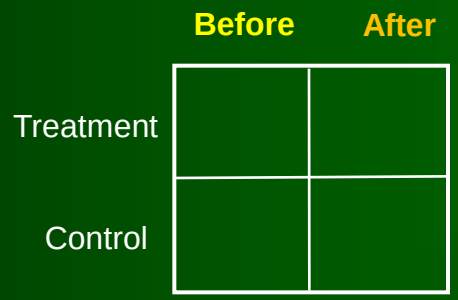
- Simulate MPB attack
  - issue of "control" (B.C. experience)
  - variable density herbicide treatment

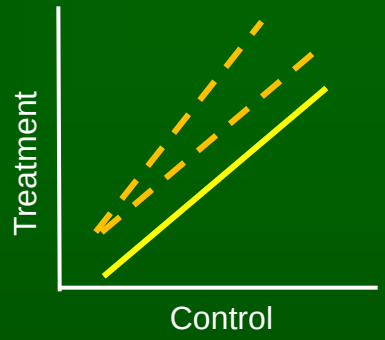
- [1] Control (untreated)
- Simulated MPB attack ([2] 50% & [3] 100% overstory kill)
- [4] Clearcut - harvested to simulate "salvage logging"

Study area & design



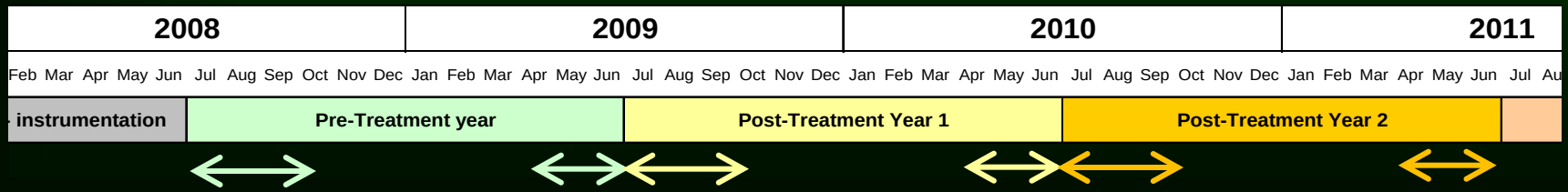
- Process study

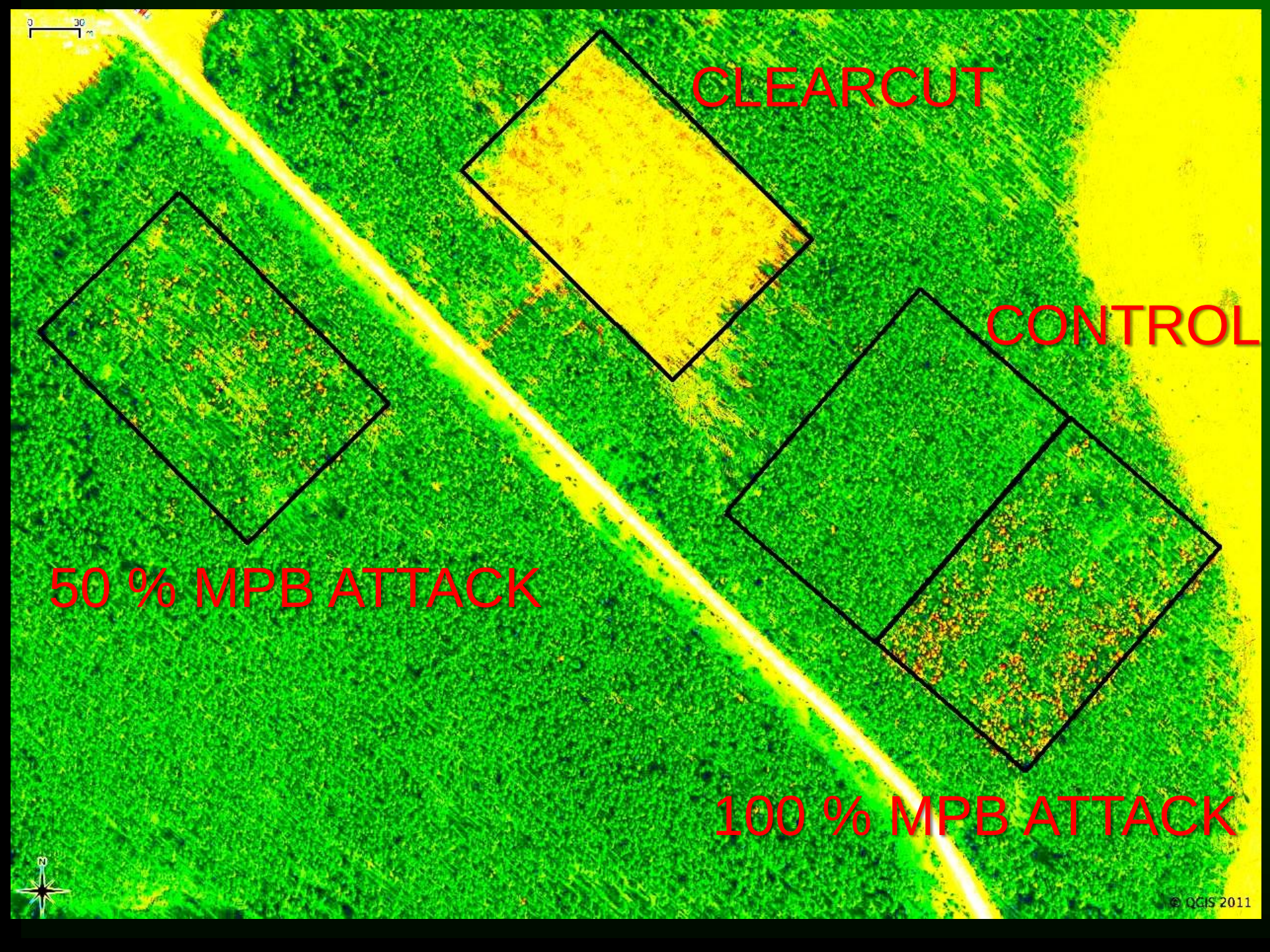




- Pre-treatment (1 year)
- Post-treatment (2 years)

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




0
30
m
CLEARCUT
CONTROL
50 % MPB ATTACK
100 % MPB ATTACK
N
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Post-attack hydrology responses
Pablo Piña, PhD Candidate

How much extra water is produced after different levels of "red attack" ?

Forest stand water cycle

Gross precipitation + Evaporative demand

Overstory transpiration

Canopy interception

Forest floor interception

Soil moisture storage

Forest stand water cycle

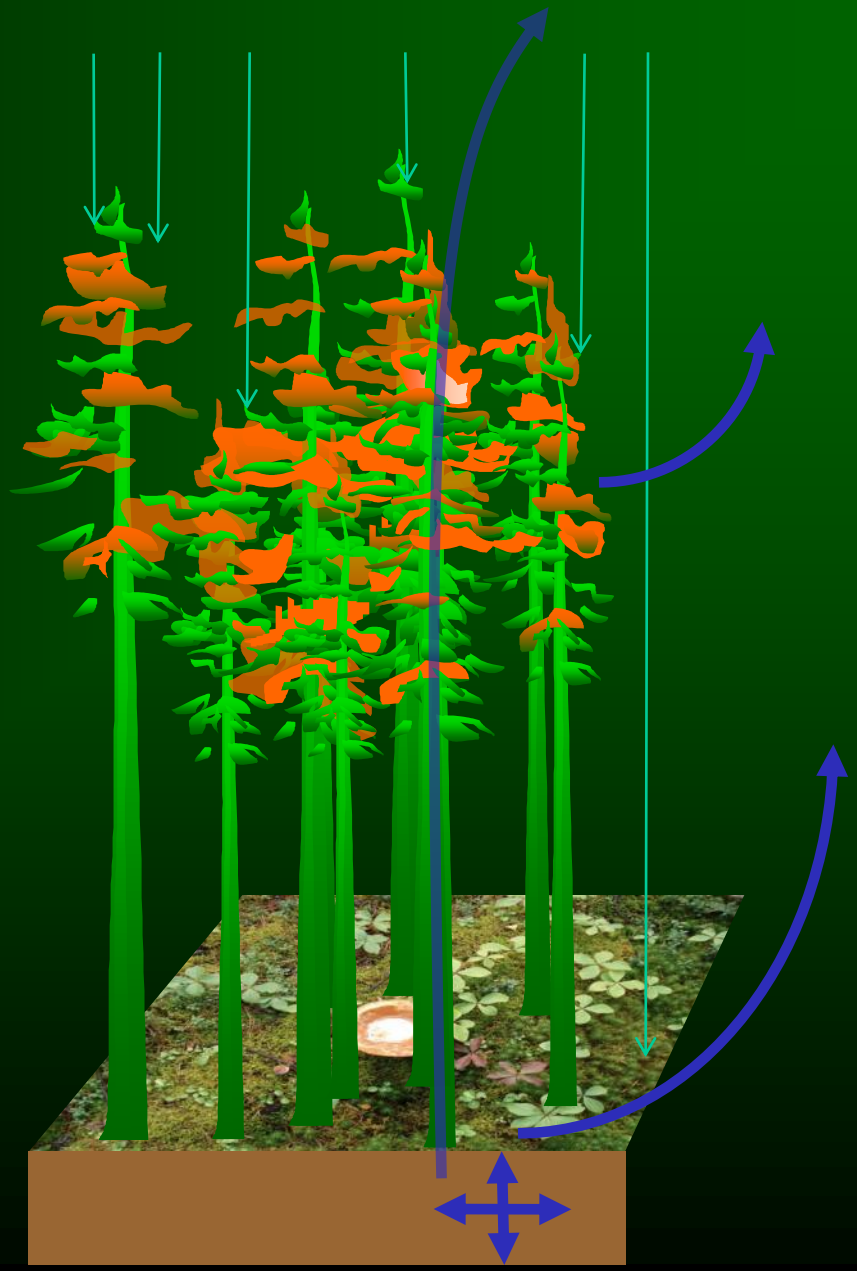
Canopy interception

Net precipitation

Overstory transpiration

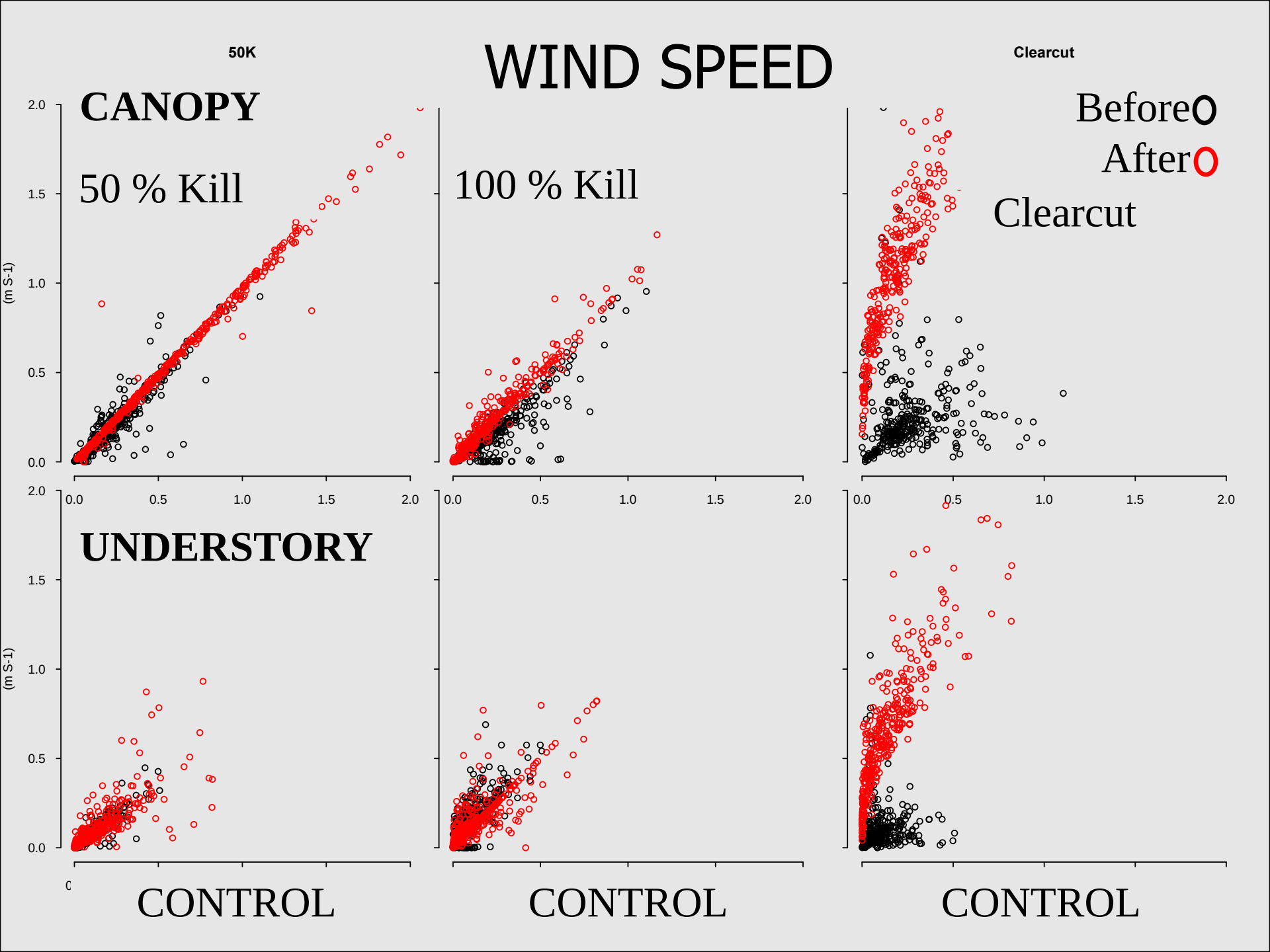
Forest floor interception

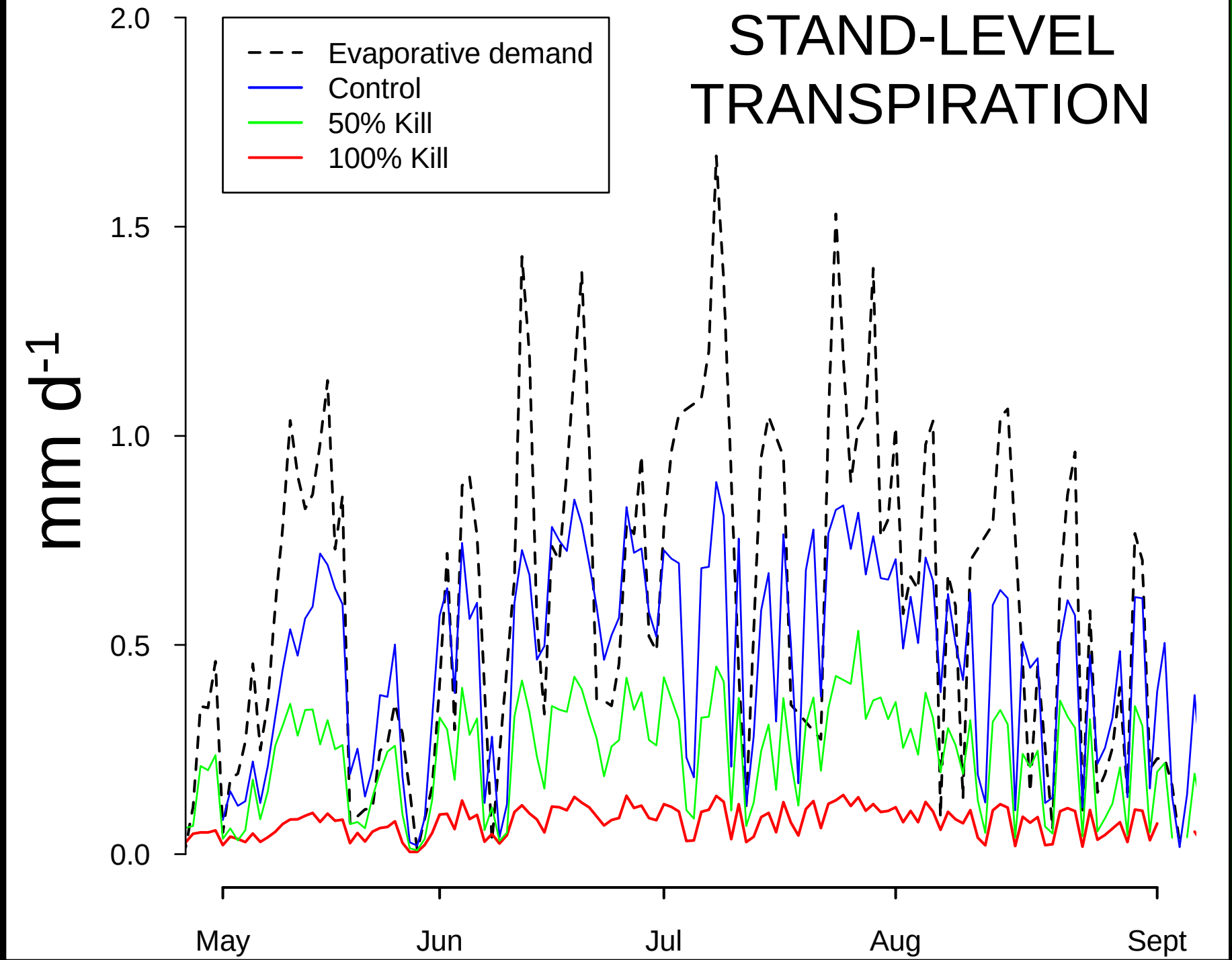
Soil moisture recharge



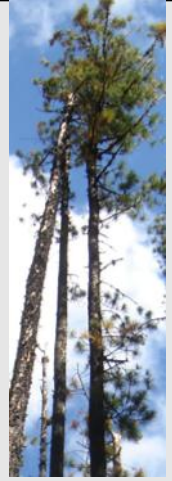
Transpiration instrumentation

Thermal Dissipation Probe


WIND SPEED
50K
Clearcut
CANOPY
50 % Kill
100 % Kill
Before
After
Clearcut
UNDERSTORY
(m S-1)
(m S-1)
0.0
0.5
1.0
1.5
2.0
CONTROL
CONTROL
CONTROL


STAND-LEVEL TRANSPIRATION
Evaporative demand
Control
50% Kill
100% Kill
mm d-1
2.0
1.5
1.0
0.5
0.0
May
Jun
Jul
Aug
Sept

TREE TRANSPIRATION



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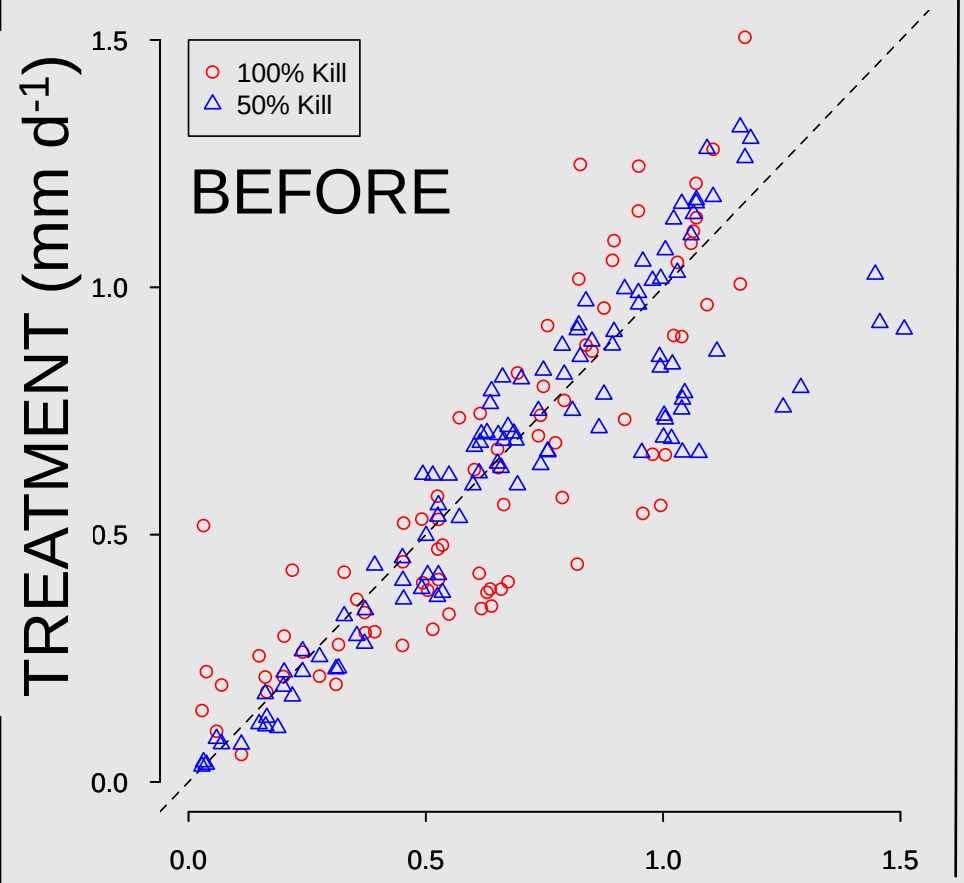
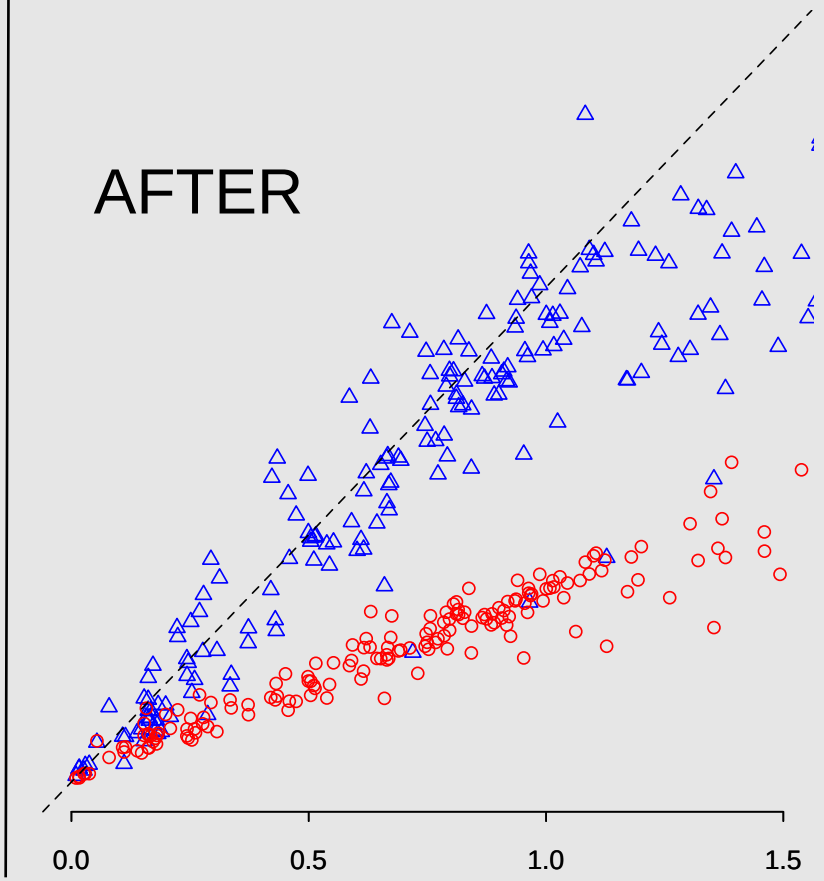
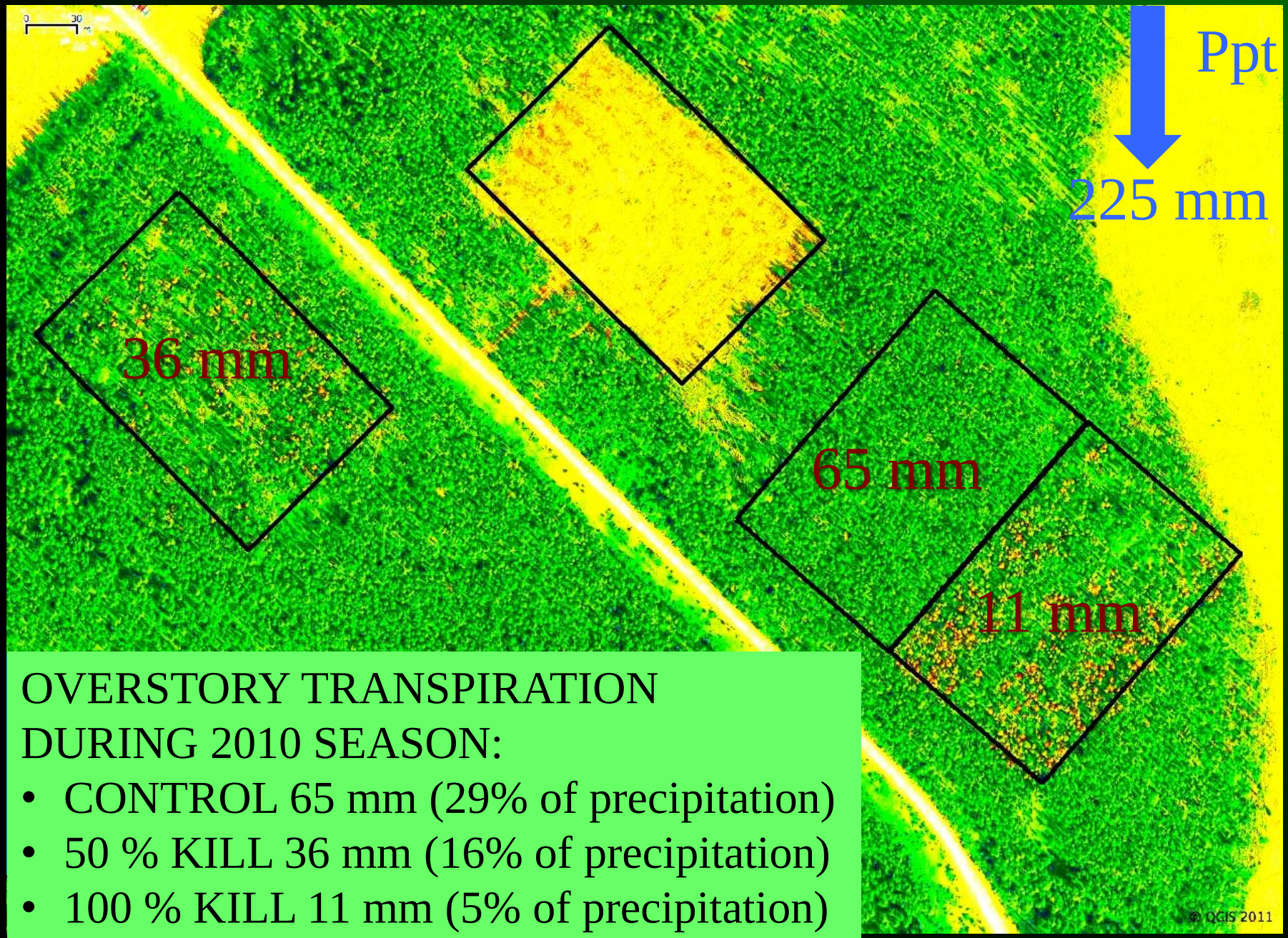






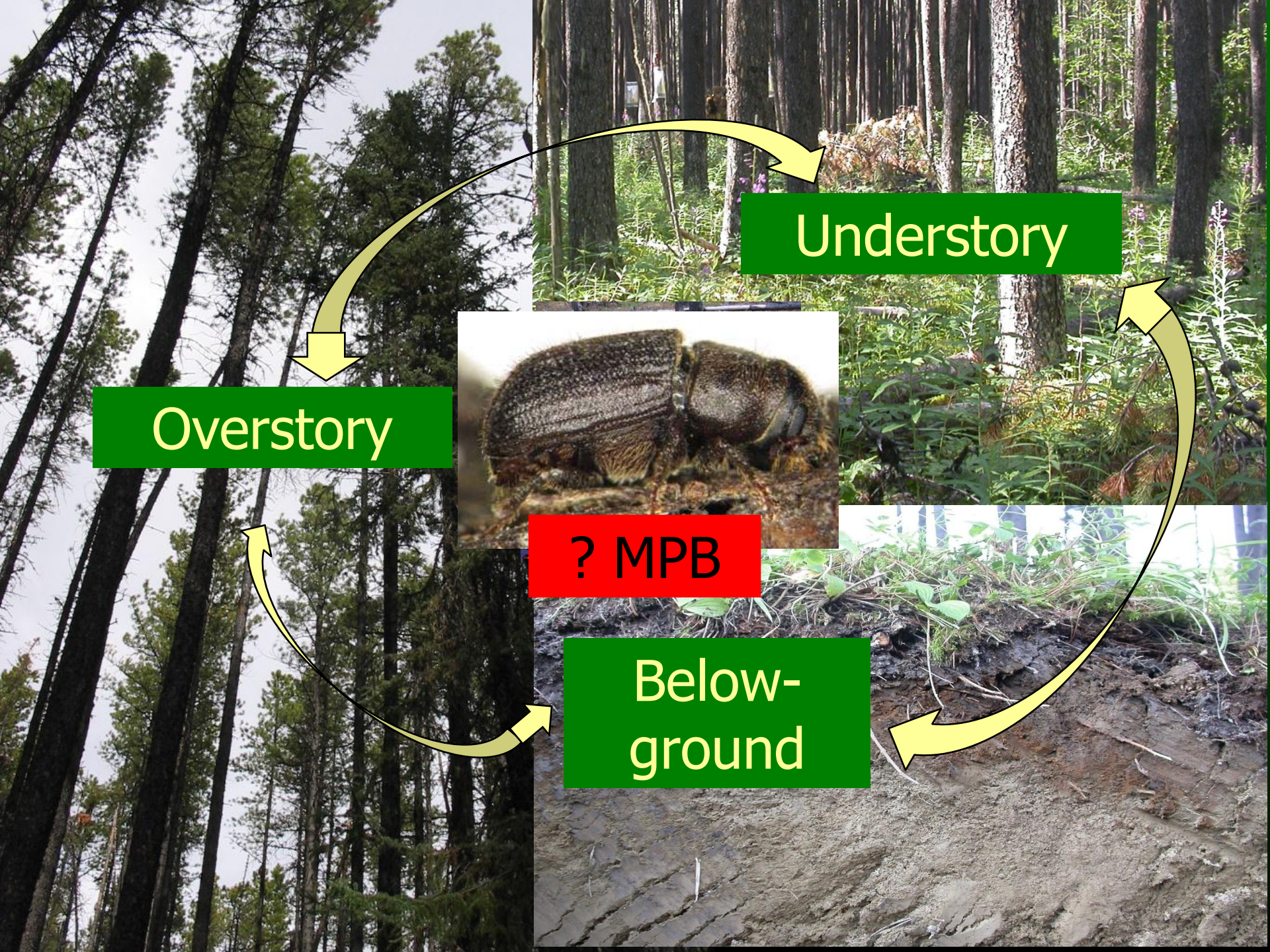
OVERSTORY TRANSPIRATION DURING 2010 SEASON:

- CONTROL 65 mm (29% of precipitation)
- 50 % KILL 36 mm (16% of precipitation)
- 100 % KILL 11 mm (5% of precipitation)

Post-attack vegetation & below-ground responses

Anne McIntosh, PhD Candidate

What are the early trajectories of vegetation and below-ground responses after different levels of "red attack" ?

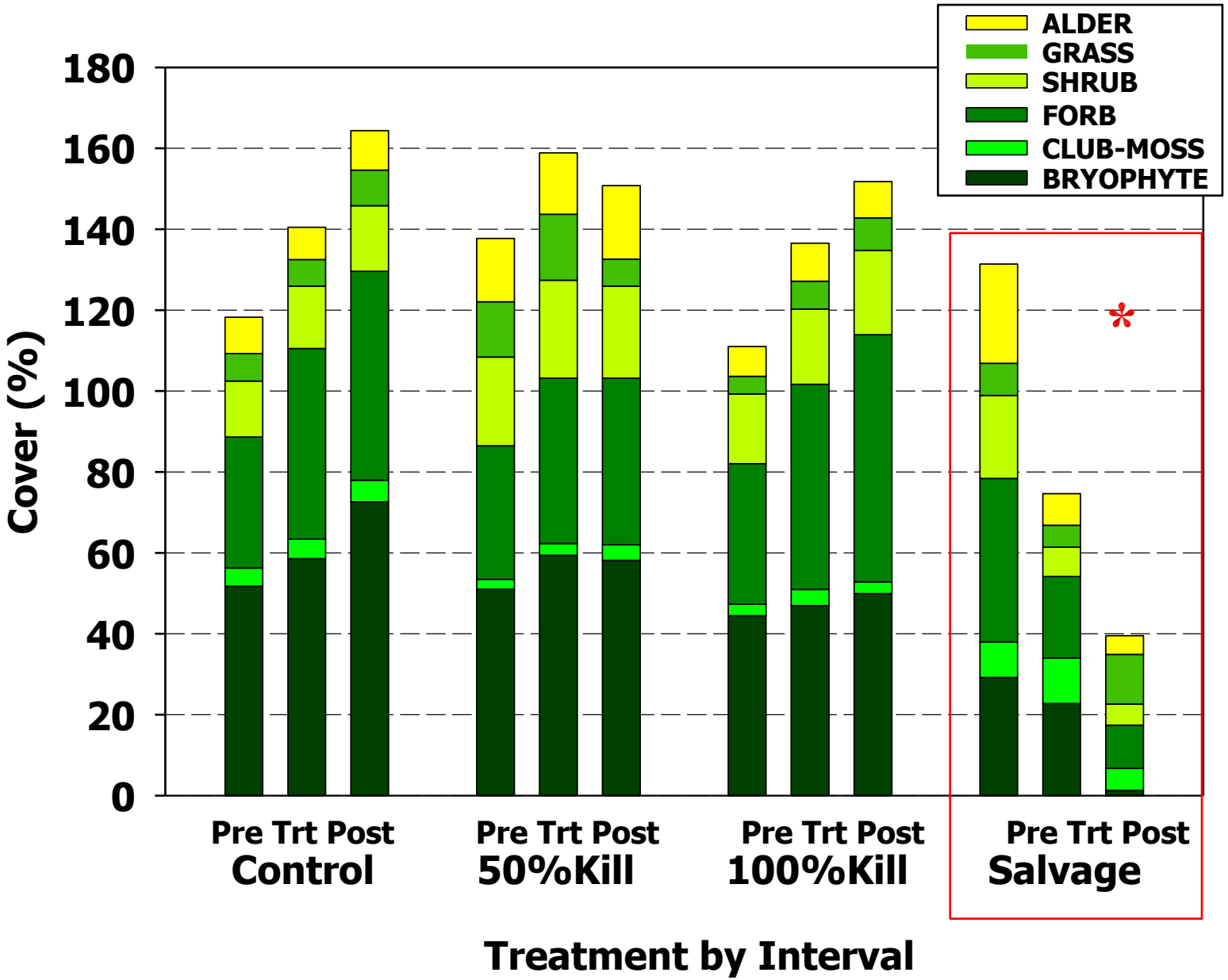

Understory
Overstory
? MPB
Below-
ground

Post-attack vegetation & below-ground response objectives

What are the early trajectories of vegetation and below-ground responses after different levels of "red attack" ?

1. Overstory forest structure
2. Understory plant community composition
   (shrubs, seedlings, plants (herbs, grasses, bryophytes)
3. Future regeneration potential of these stands
4. Recruitment of downed woody debris (DWD)
5. Changes in below-ground processes
   (nutrient availability, microbial community, decomposition)

Understory cover



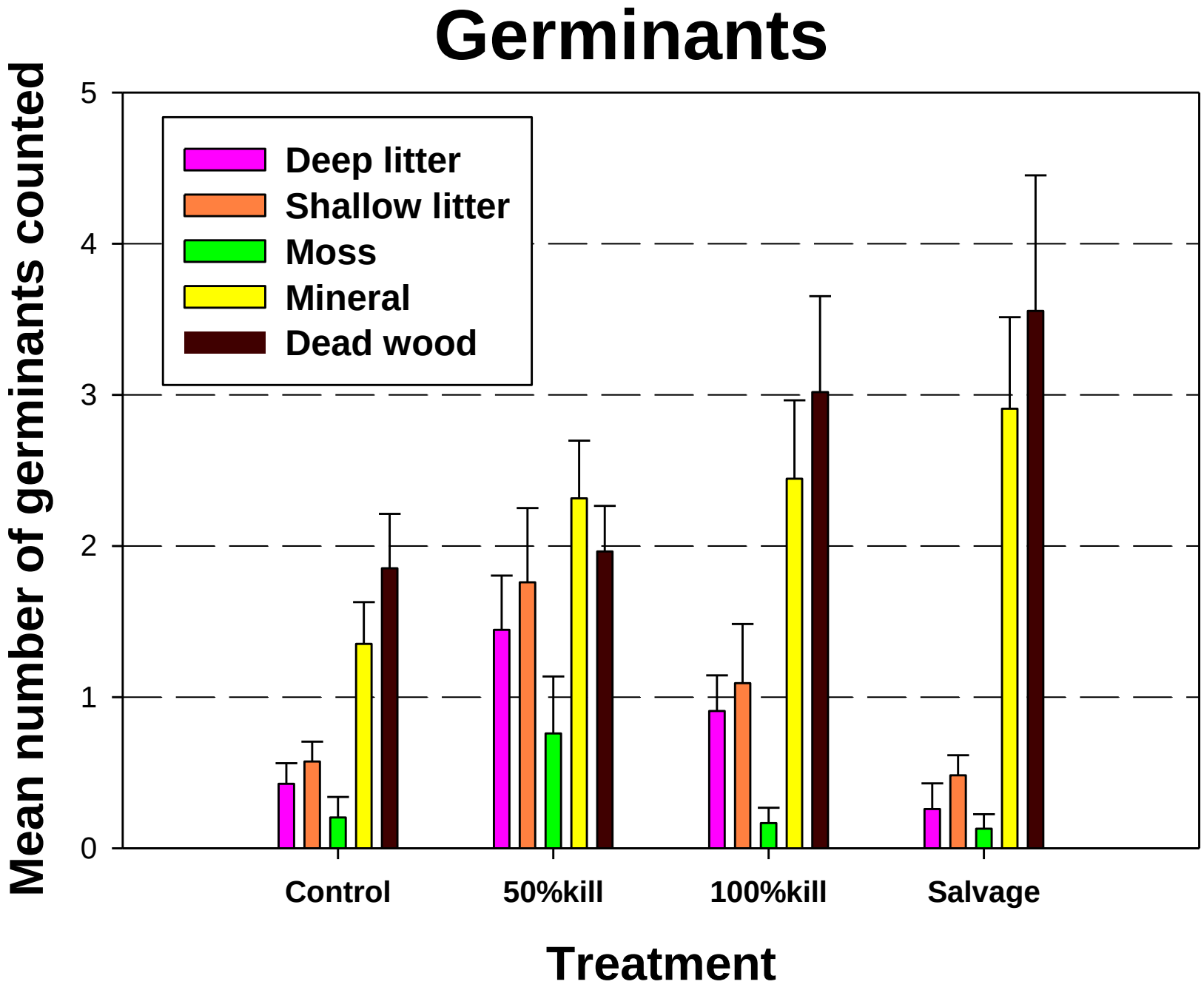
Germination study (2010)

What is the regeneration potential of these stands 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 weekly


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

Recap & the future…

Forest stand water cycle

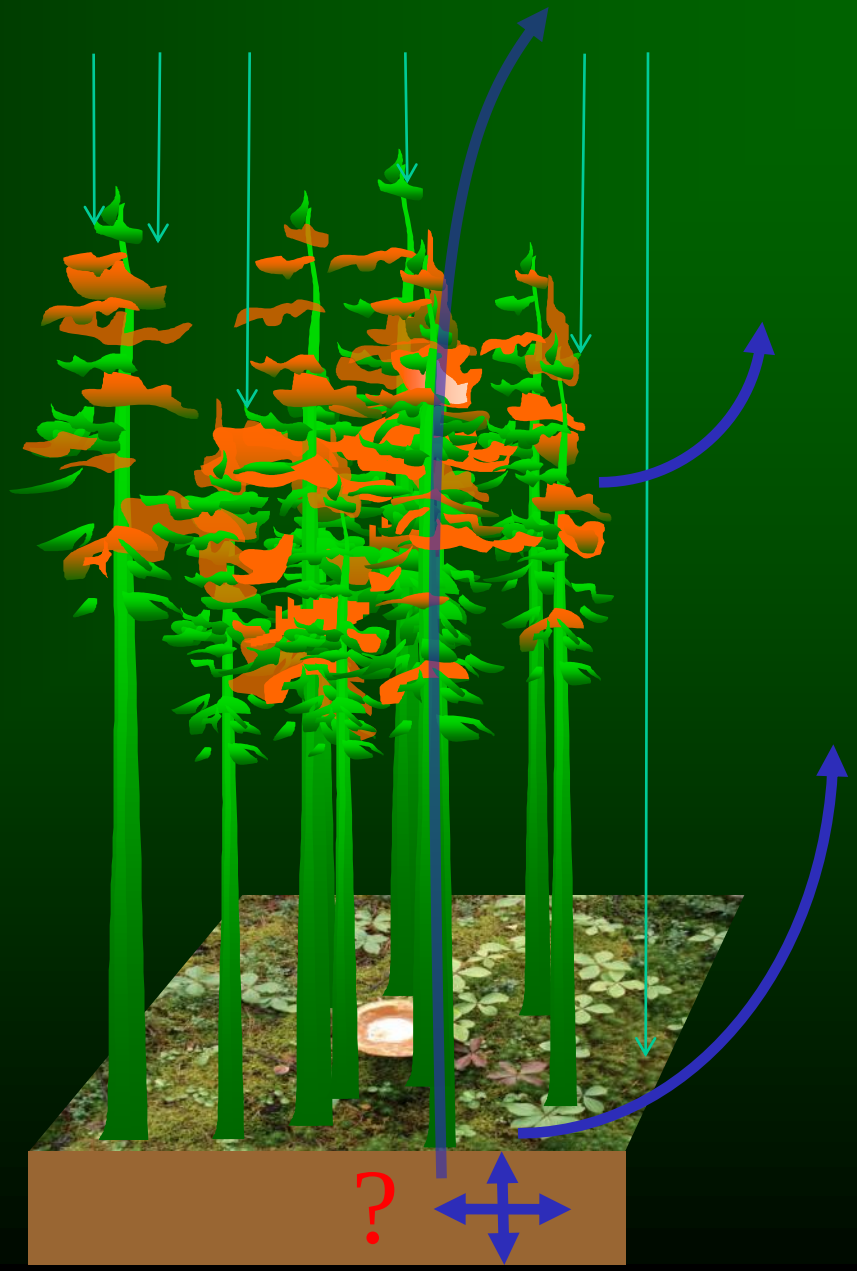
Canopy interception ✗

Net precipitation ✗

Overstory transpiration ✓

Forest floor interception ✗

Soil moisture recharge ✓



Main findings (mid-way 2nd post-treatment yr)

Treatments: represent a gradient of MPB attack

Stand evapo-transpiration reduced by treatments

- Less transpiration: red (dead) and treated green trees
- Untreated trees aren't transpiring more

Soil moisture increased

- Surface 20 cm clear treatment effect
- Surface 5 cm clear gradient with treatment

Understory

*No change… yet?

Regeneration?

Potential ☺

Below-ground

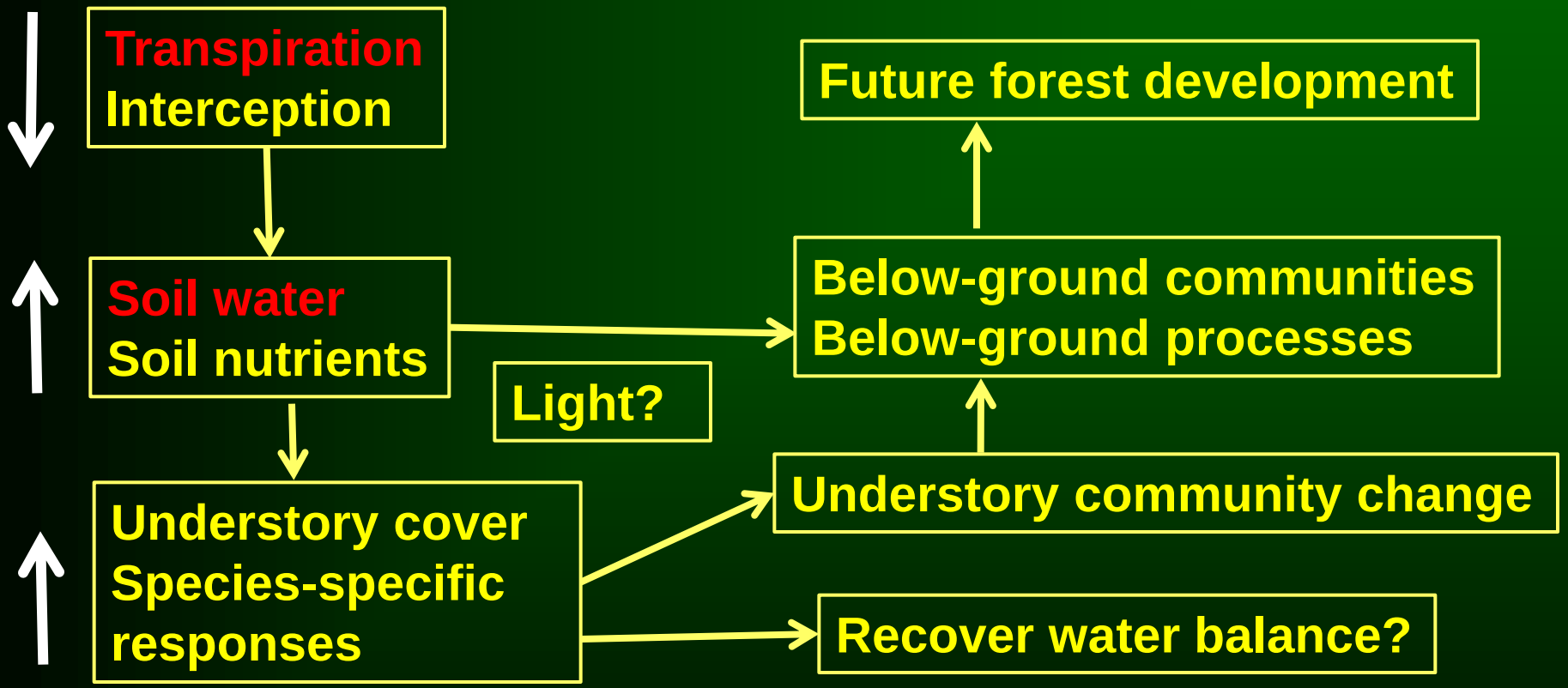
No change …yet?
*not all data

Overstory

Trees are dying

MPB

As we move to grey attack…



Support for the work

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

…Thank you for listening

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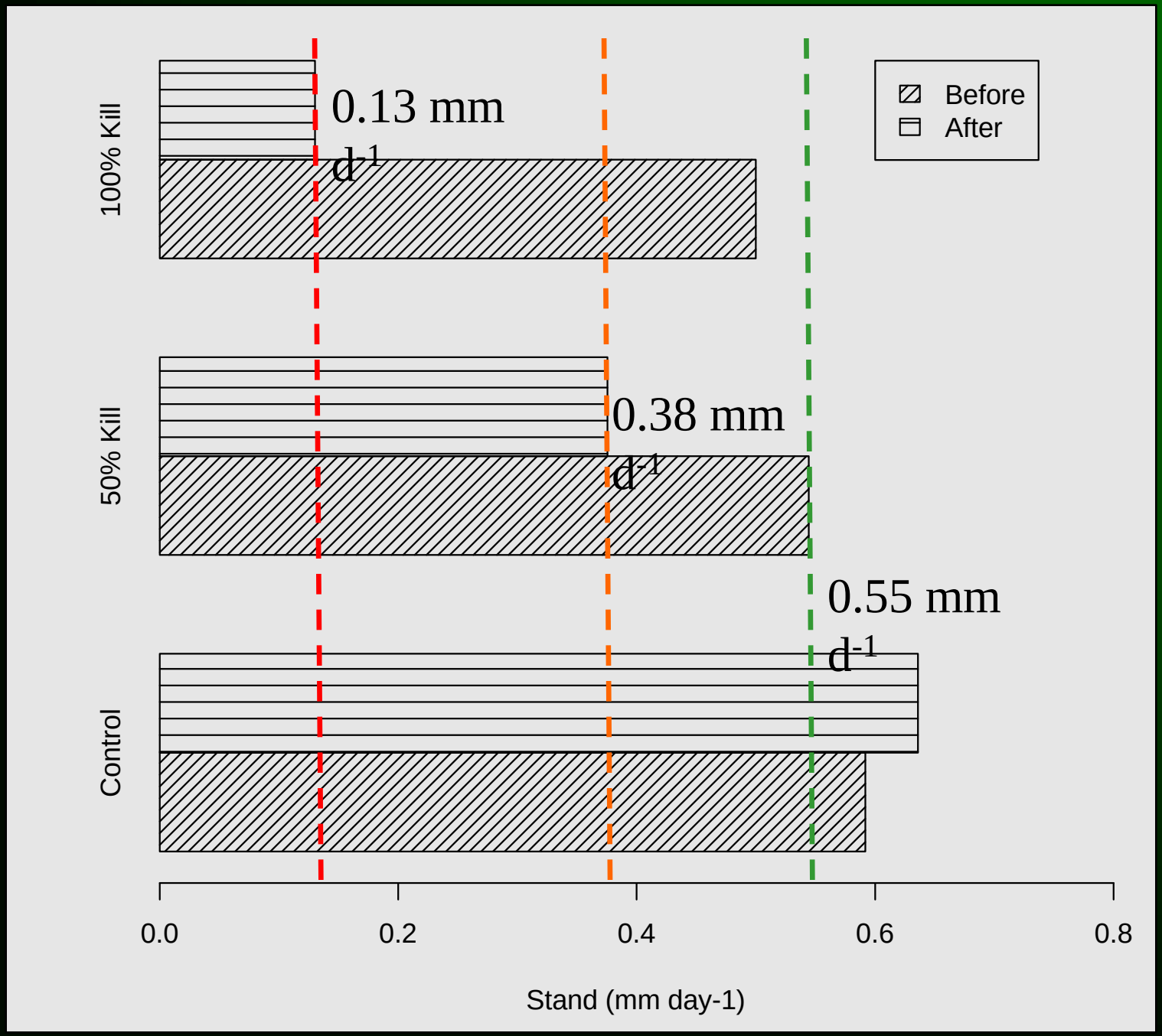
100% Kill
50% Kill
Control
0.13 mm d-1
0.38 mm d-1
0.55 mm d-1
Before
After
0.0
0.2
0.4
0.6
0.8
Stand (mm day-1)