

Seed release after a mountain pine beetle outbreak

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Rocky Mountain lodgepole pine (*Pinus contorta* var. *latifolia*)

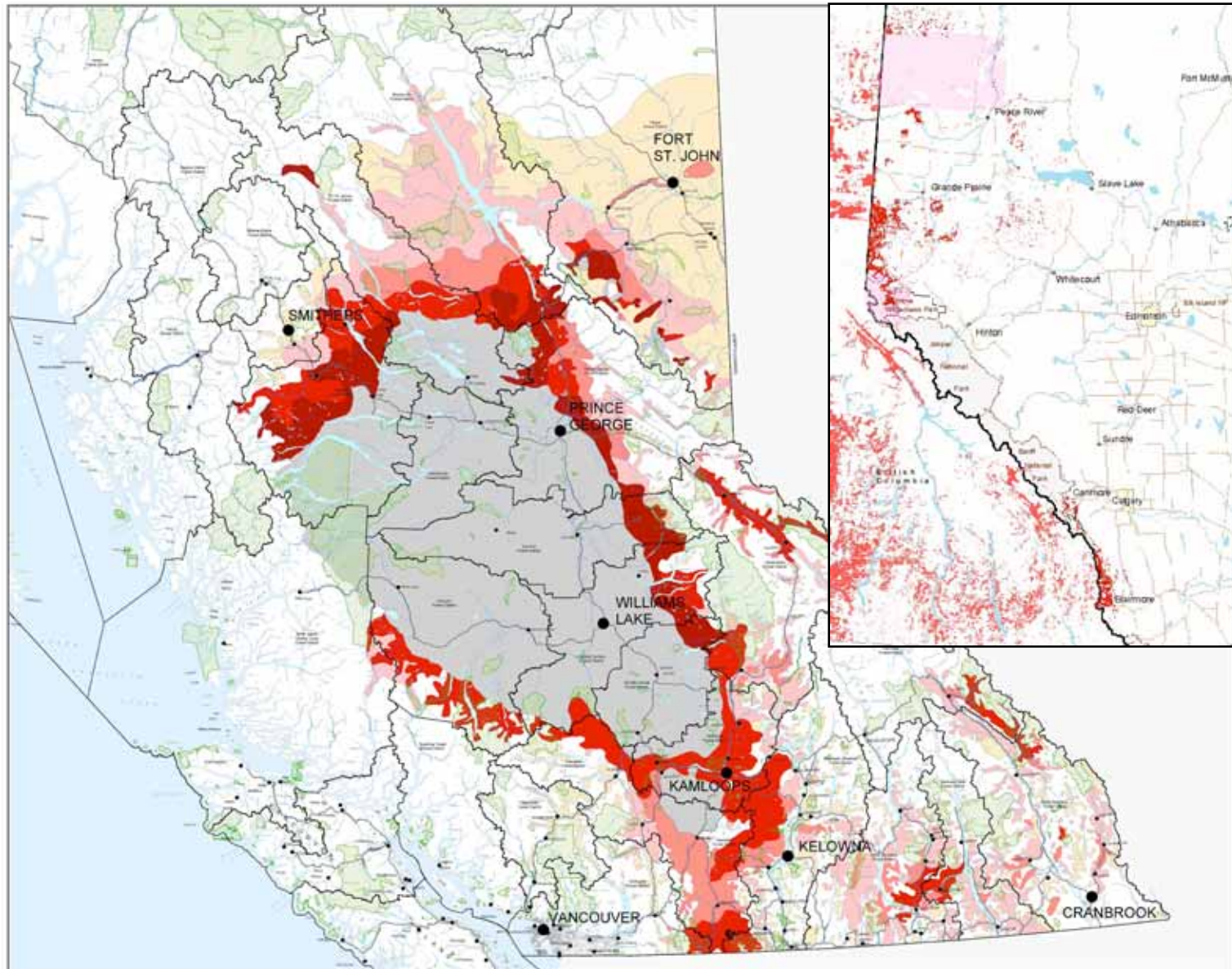


Natural regeneration post MPB outbreak?



Natural regeneration under its own canopy?

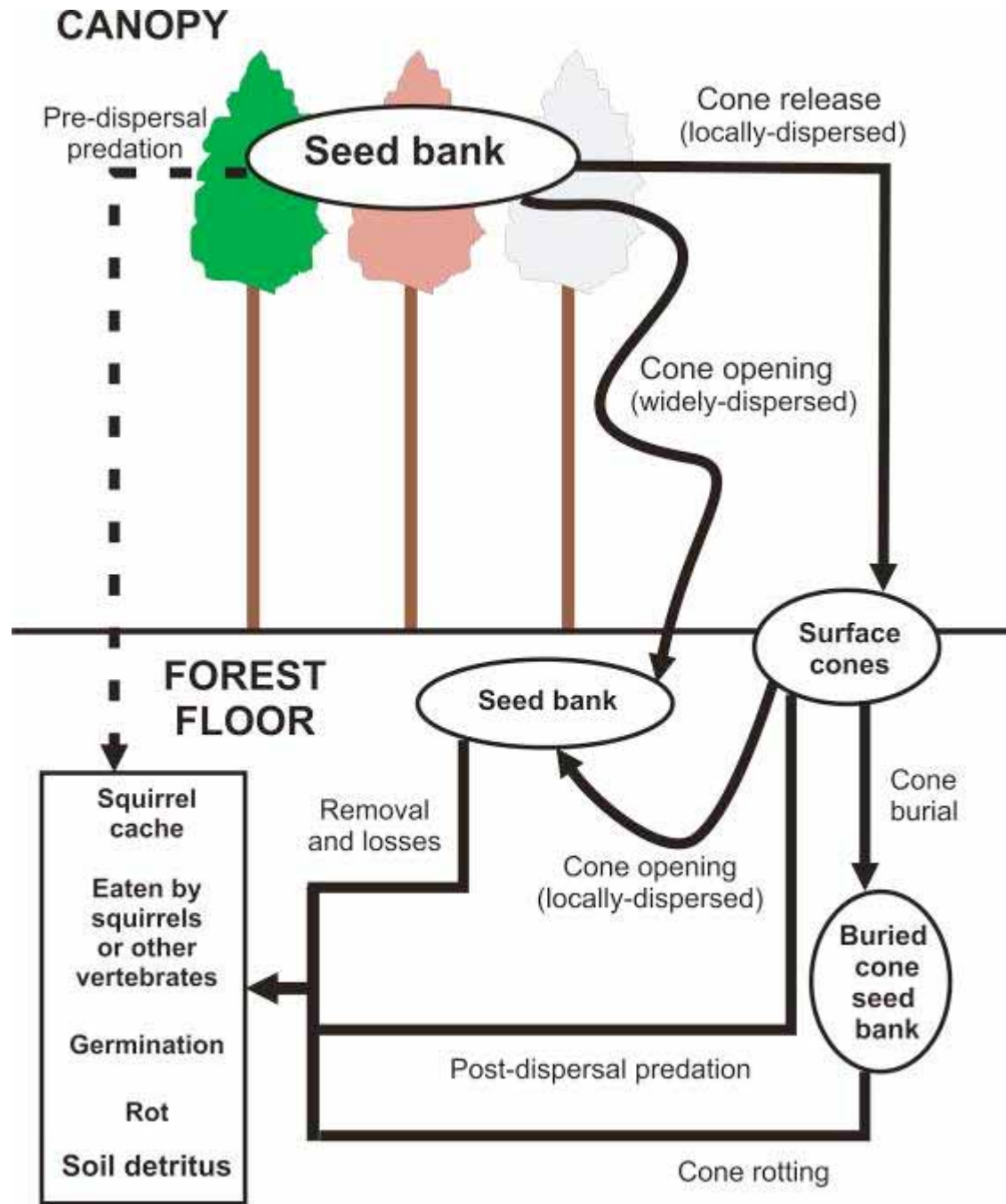
Over 10 M ha killed, 46% in 2007 and ~ 76% in 2015



The resin bond



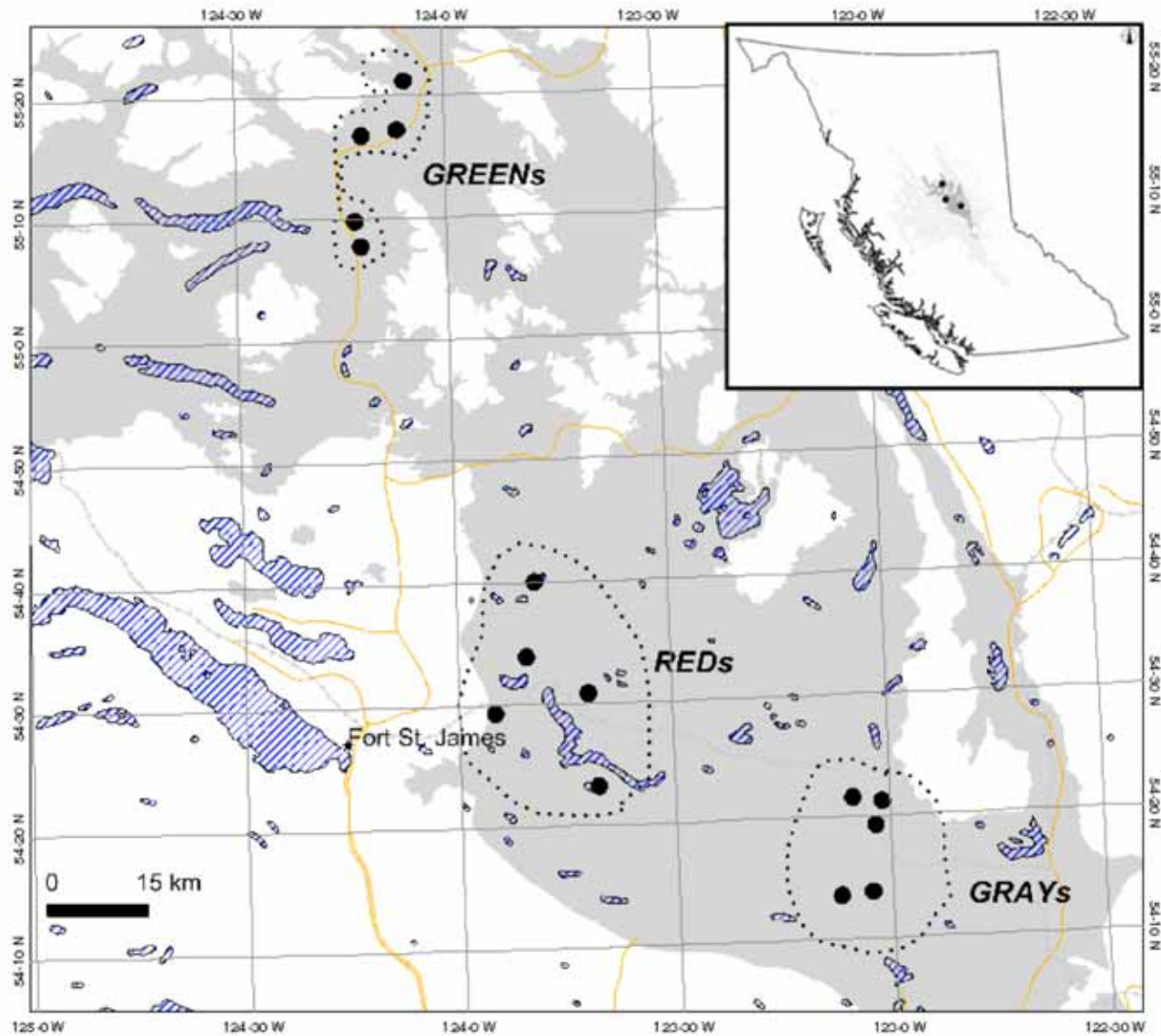
Seed
banks
post
MPB



Research objectives

- The first objective was to determine if canopy seed release after a MPB outbreak in lodgepole pine forests occurs and how.
- The second objective was to model the temporal changes in the canopy and forest floor seed banks after a MPB outbreak.

Methods - Research sites



Methods – MPB-attacked stands



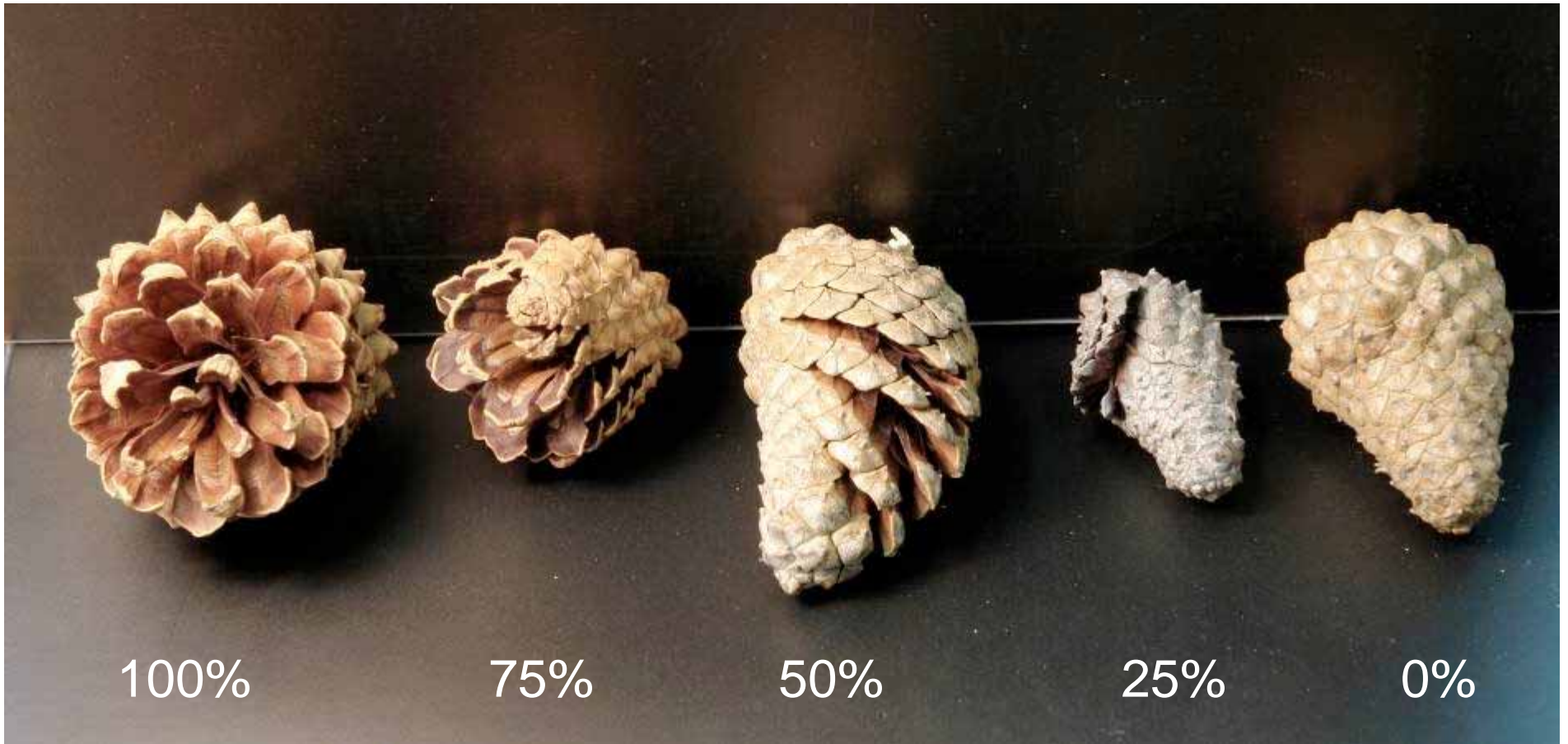
Methods – Surface cones (recently fallen canopy cones)



Methods - Live residual trees



Methods - Cone openness



100%

75%

50%

25%

0%

Open

Partially open

Closed

Methods - Buried cones

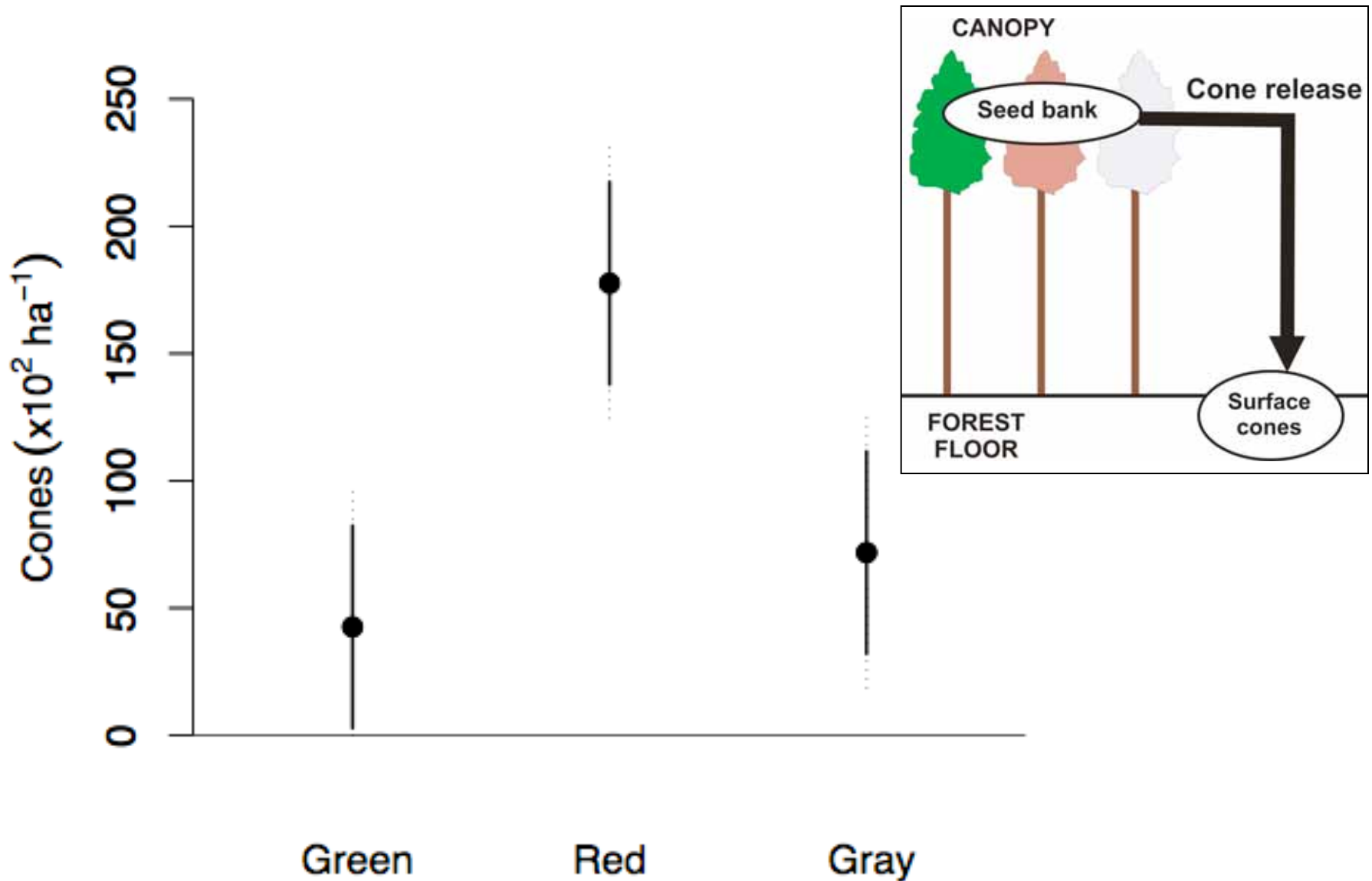
Embedded in moss



Below moss



Results – Canopy-cone release

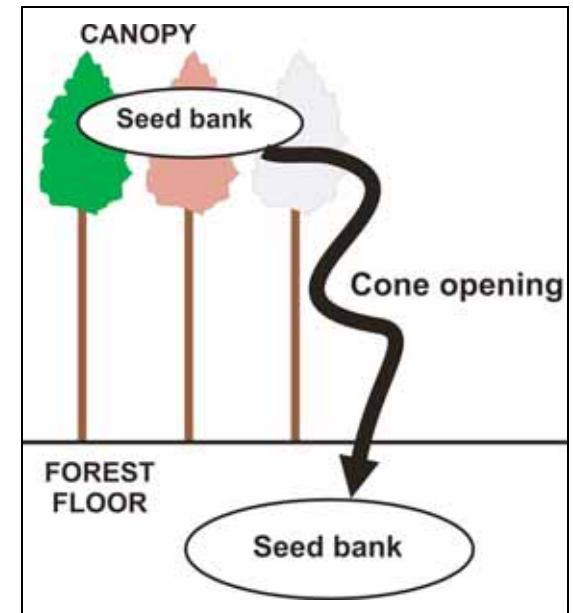
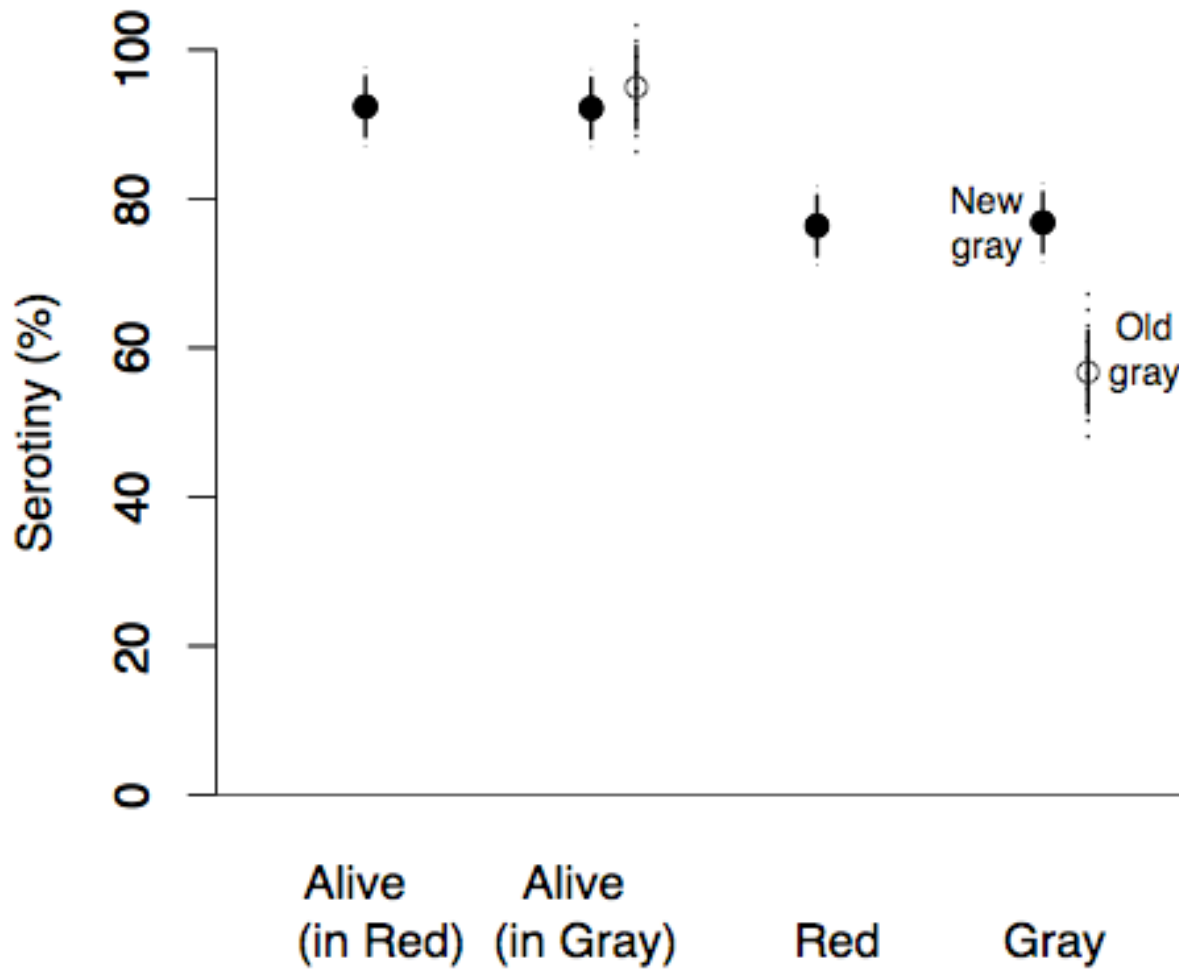


Results – Canopy-cone release



Cones are released onto the forest floor due to crown friction resulting in twig breakage.

Results – Canopy-cone opening (Partial loss of serotiny)

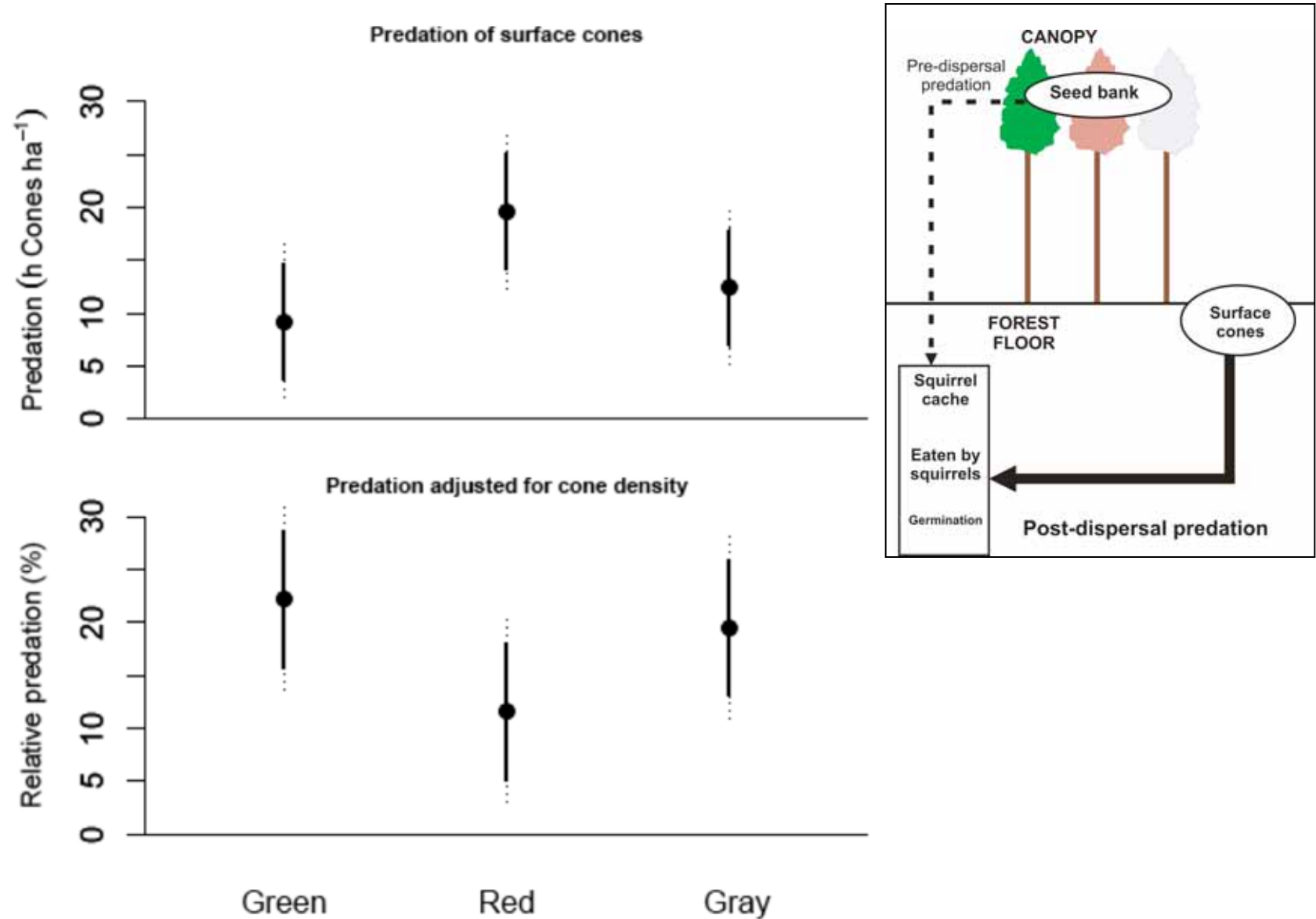


Results – Canopy-cone opening (Partial loss of serotiny)



Canopy cones open due to increase sun exposure and weathering resulting in a partial loss of serotiny.

Results – Squirrel predation

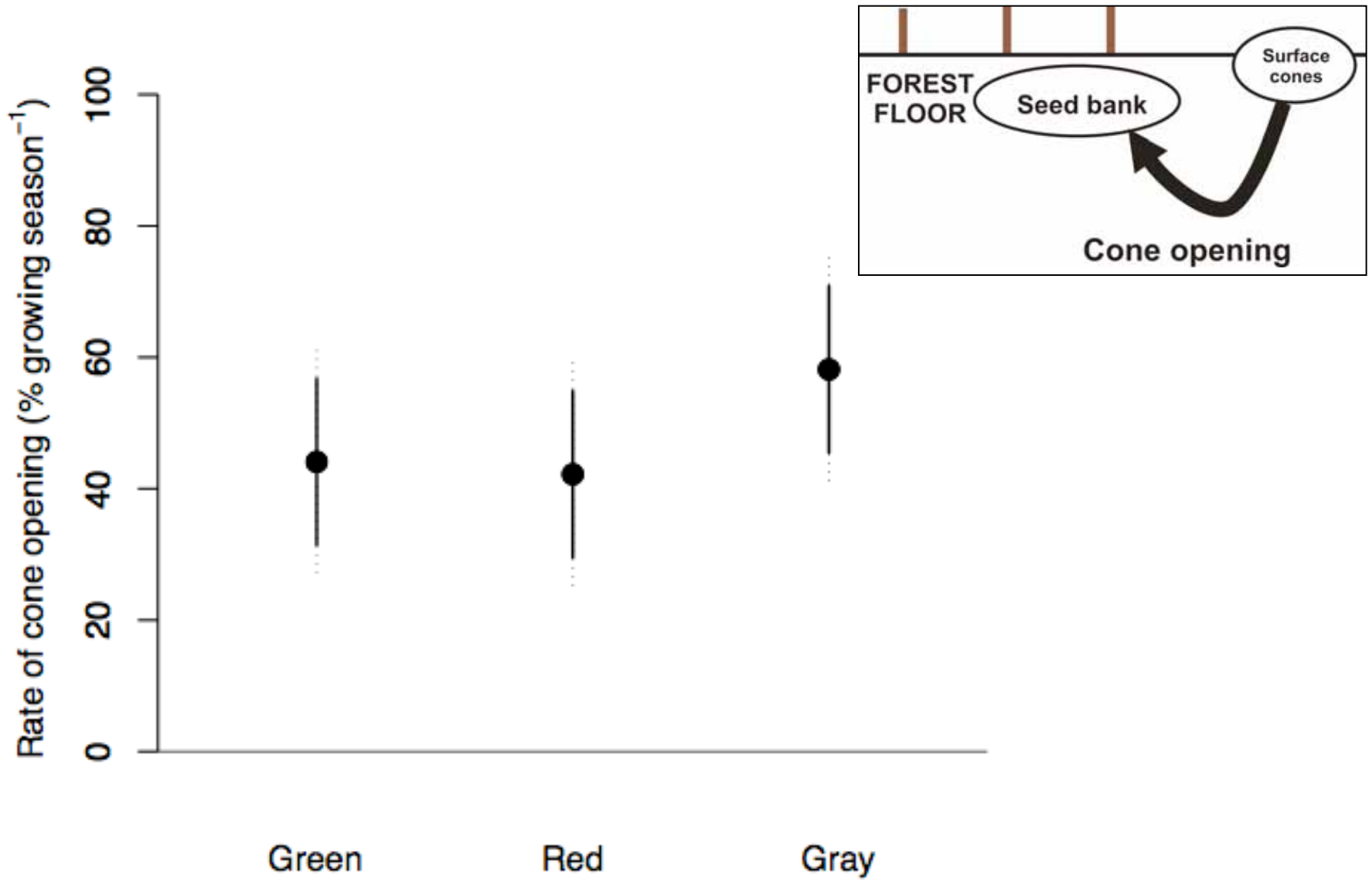


Results – Squirrel predation



Squirrel predation persists in MPB-attacked stands resulting in a sustained reduction in the number of canopy cones.

Results – Forest floor-cone opening



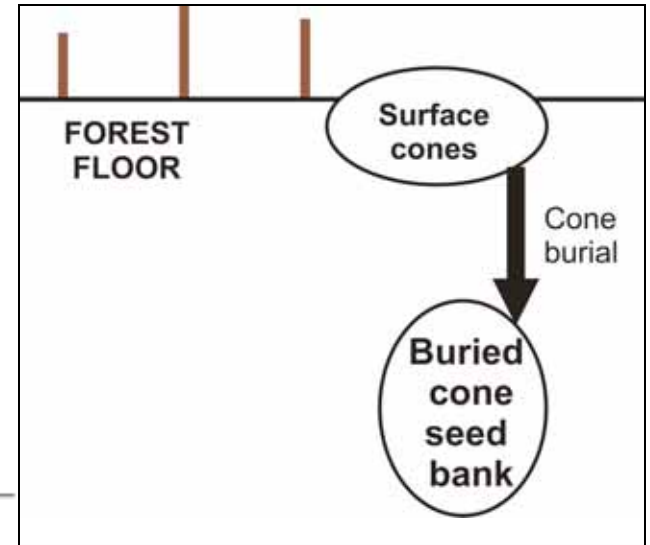
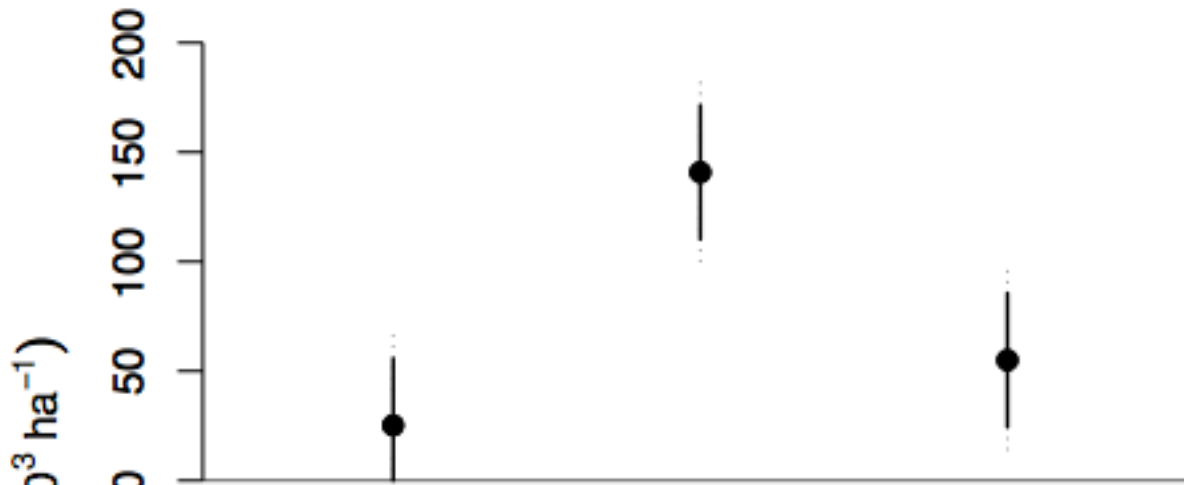
Results – Forest floor-cone opening



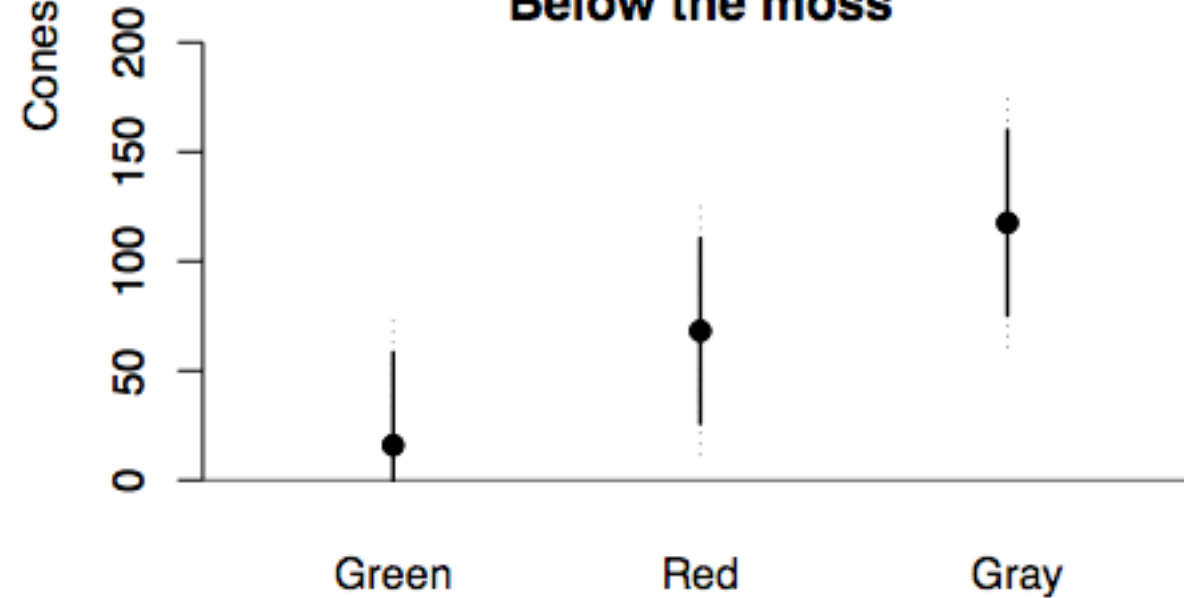
Surface cones open and release seed due to soil-surface heating.

Results – Cone burial

Embedded in moss



Below the moss

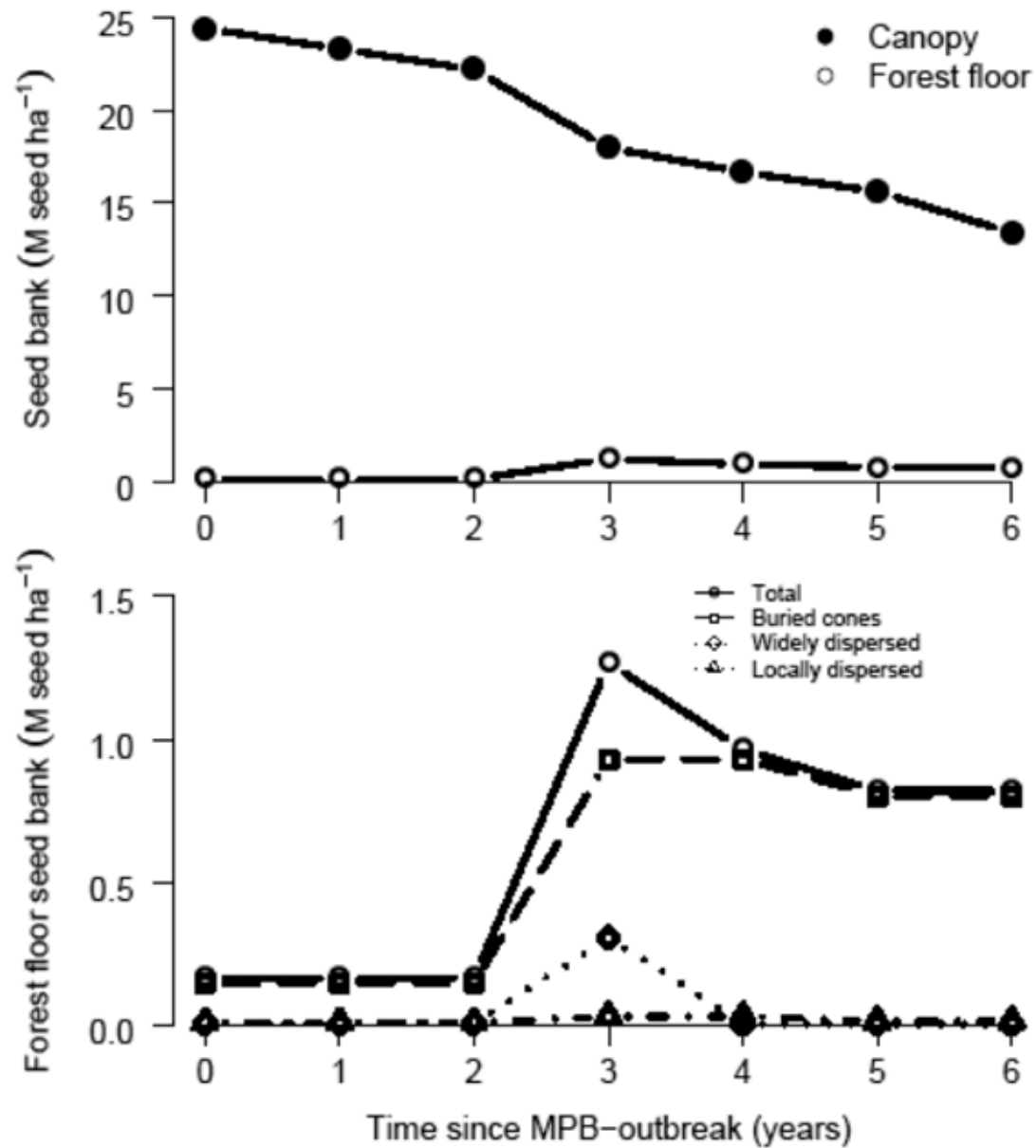


Results – Cone burial



A forest floor-seed bank develops and maybe ecologically important if a secondary disturbance re-exposes these buried cones.

Results- Seed banks



After 6 years post MPB-outbreak, 45% of the canopy seed were released while 6% are still in cones buried in the forest floor.

Conclusions

- After six years, 45% canopy seed released
- Release via breakage, increased cone opening, and squirrel predation
- Forest floor-seed bank develops
- If normal levels of regeneration are to occur, either anthropogenic or fire disturbances must happen relatively soon after tree mortality.

What about fire post MPB?



Cone consumption by fire post MPB?



Acknowledgements



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