Structure and Dynamics of **Range-margin *Pinus banksiana*** forests in Minnesota, USA

Kyle G. Gill, Anthony W. D'Amato, and Shawn Fraver

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The University of Vermont

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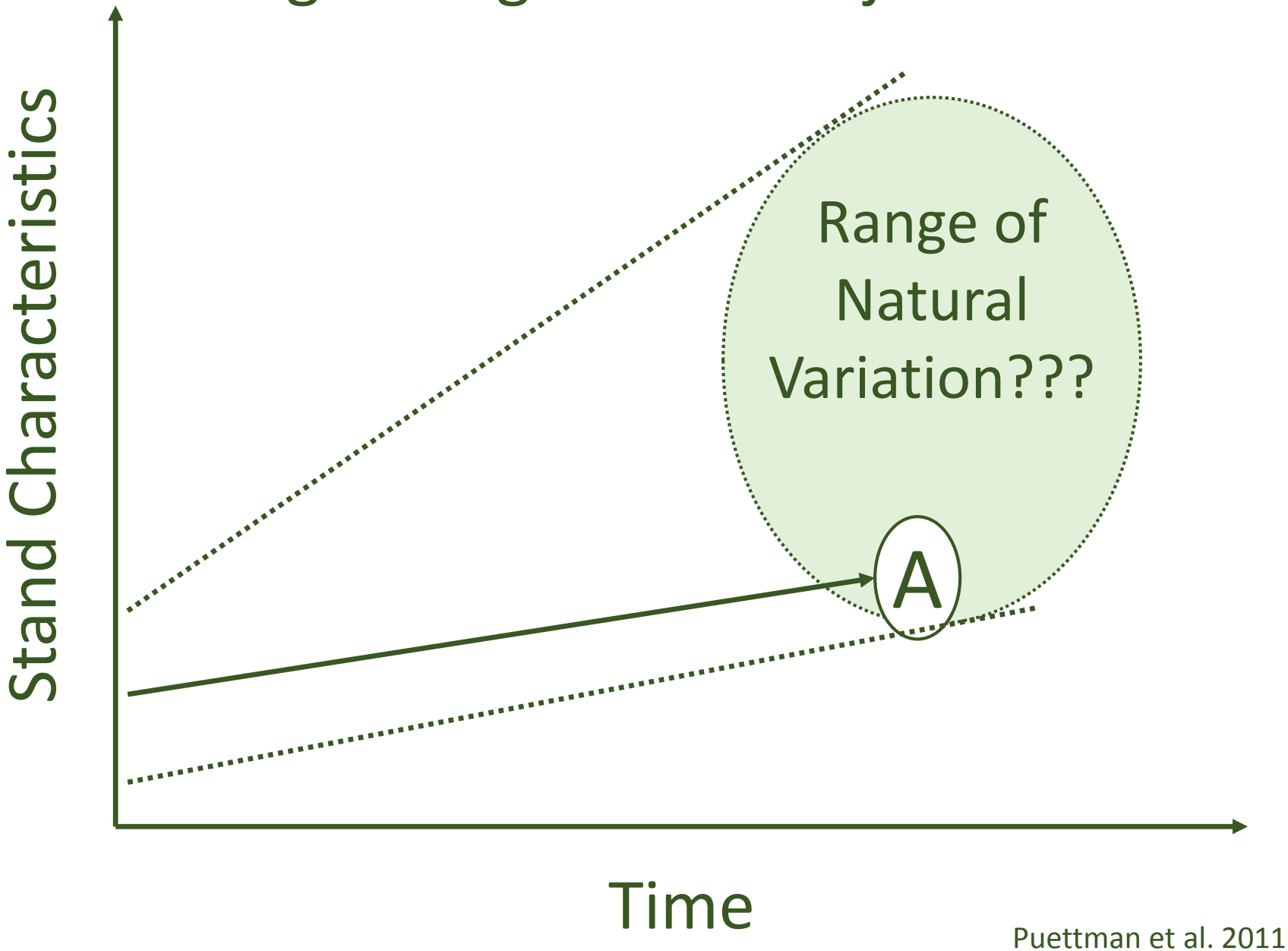
NECSC Northeast Climate Science Center

Range-margin Populations

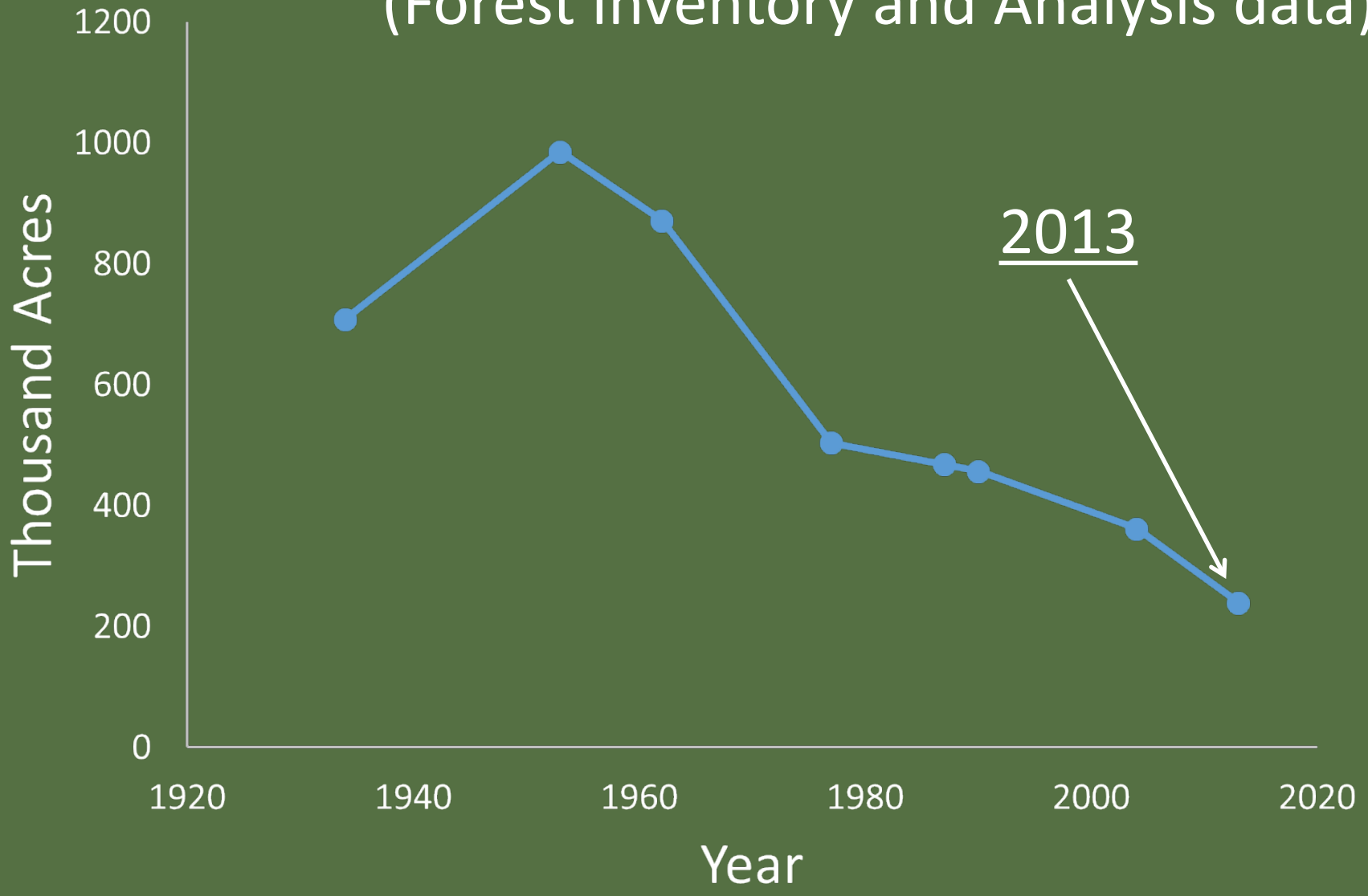
- Persistent through or adapted to marginal conditions
- Bellwethers of range shifts

Range-margin stand trajectories?



Puettman et al. 2011

Jack Pine Timberland in Minnesota
(Forest Inventory and Analysis data)



Dynamics - assumed

Serotinous

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Stand-replacing

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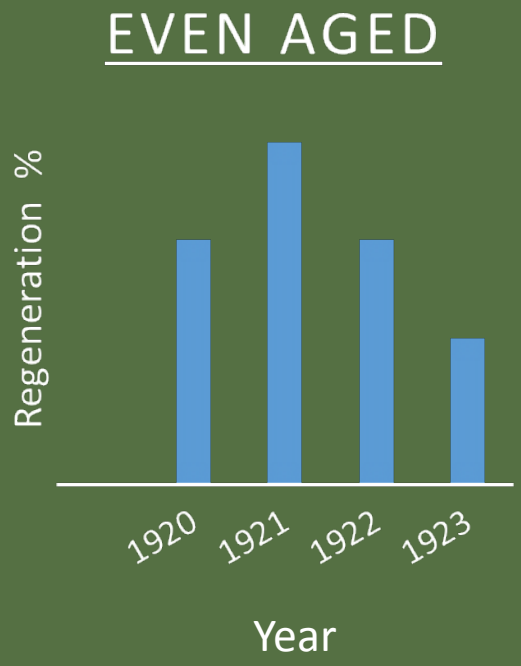


Heinselman 1973

Dynamics – xeric islands – Quebec

Non-serotinous

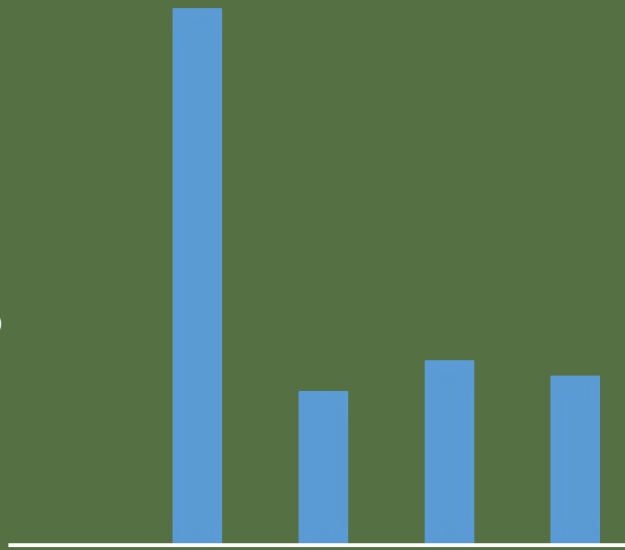
+

Non-lethal

Open-period

=

UNEVEN-AGED



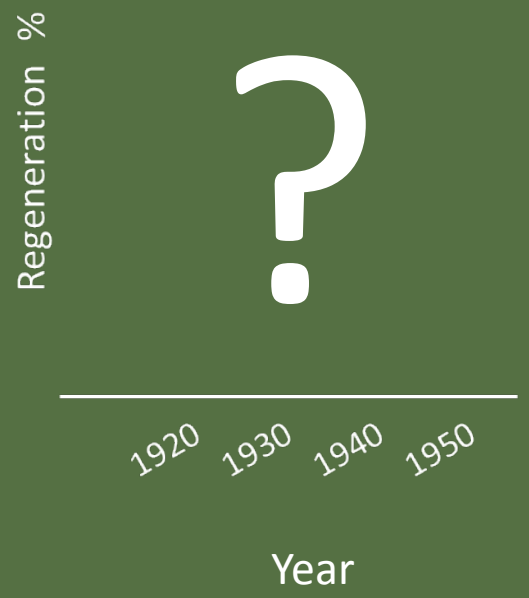
Gauthier, Gagnon, and Bergeron 1993

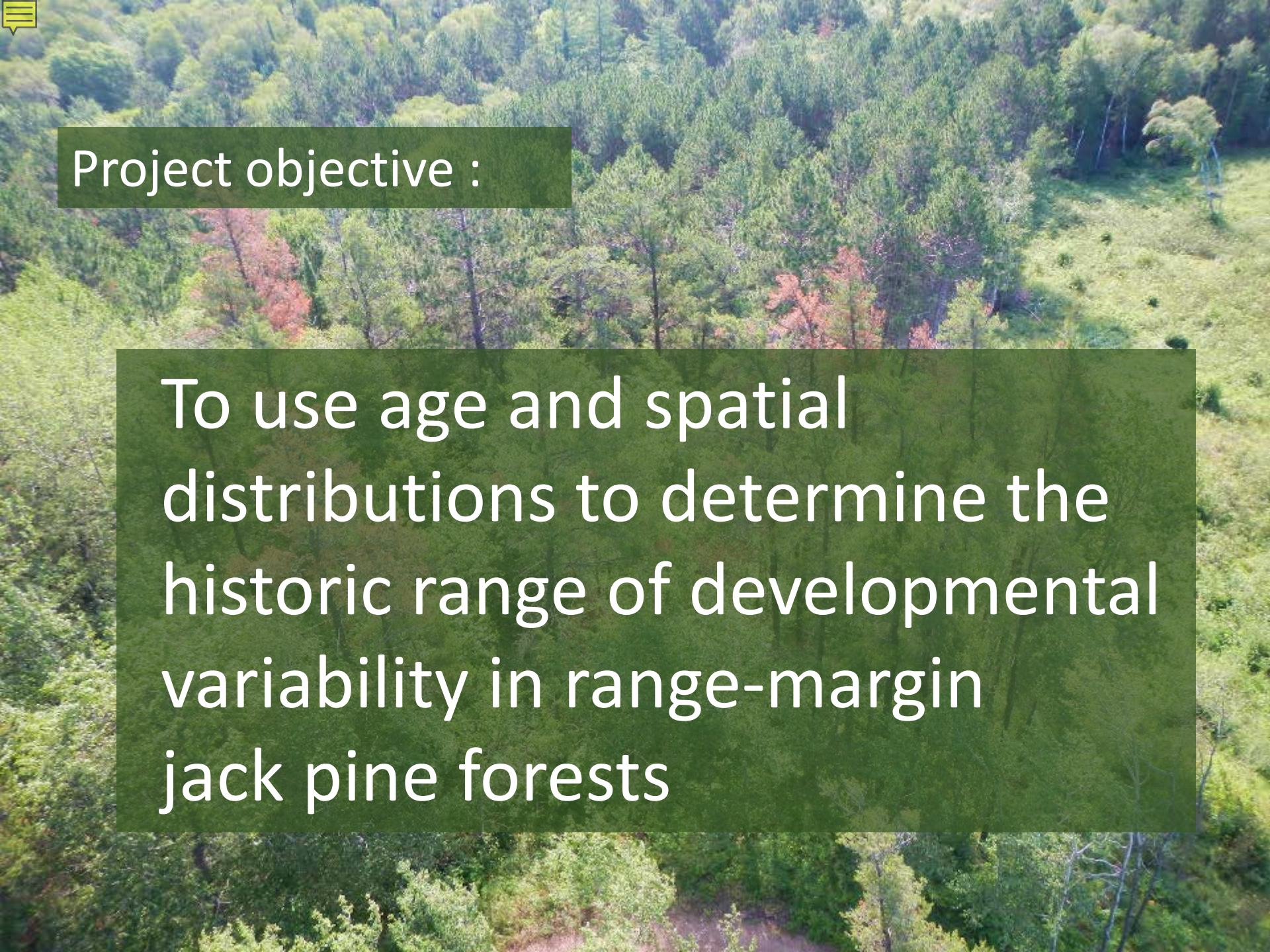
Gauthier, Bergeron, and Simon 1996

Dynamics – central Minnesota

Non-serotinous

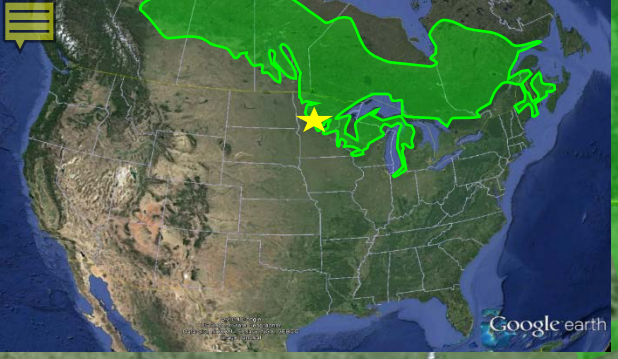
+ ? =





Project objective :

To use age and spatial distributions to determine the historic range of developmental variability in range-margin jack pine forests



Range-margin jack pine

10 research sites

Study Area

Study area features

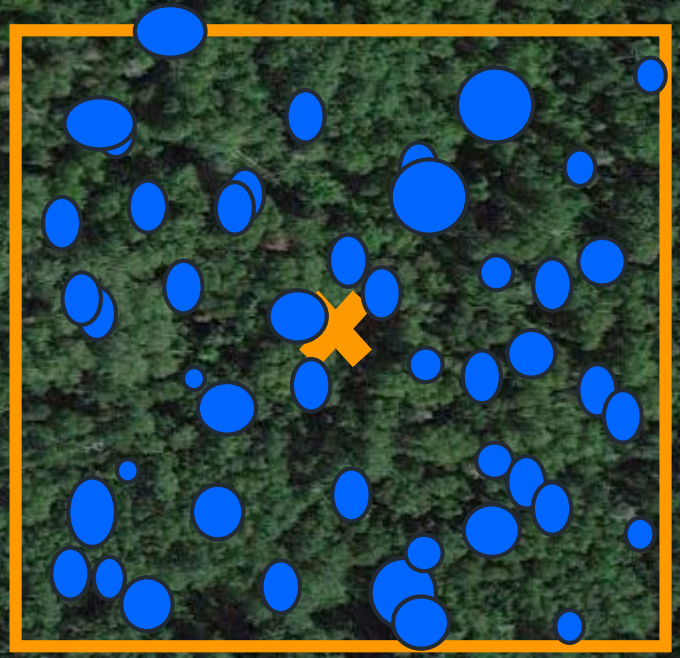
- Non-serotinous cones
- Sandy outwash soils
- Prairie associates

N

Google earth

At each site:

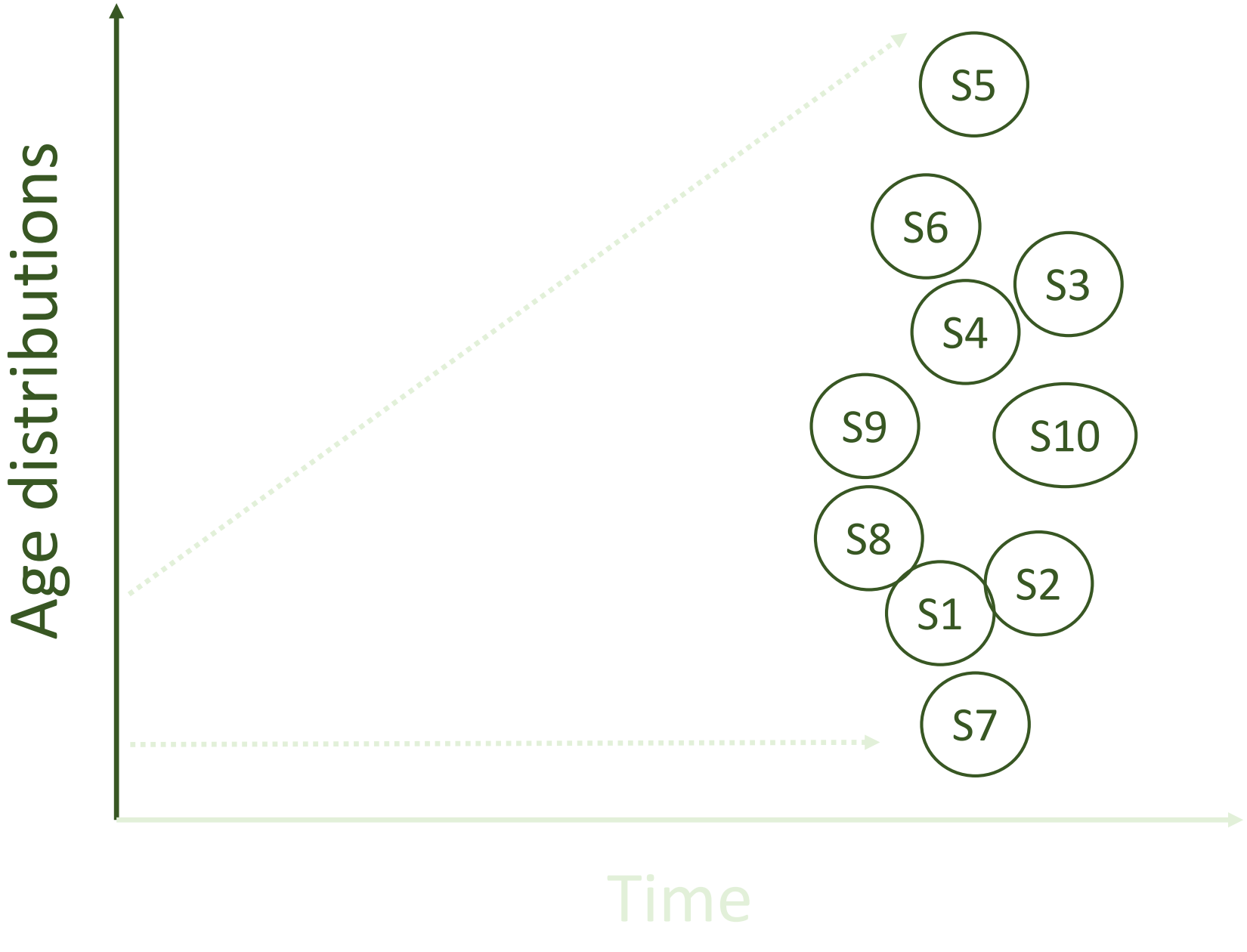
- One 0.25 ha plot
- Trees ≥ 10cm
  - Mapped stem locations
  - Species, DBH, crown class, mortality class
  - Increment core



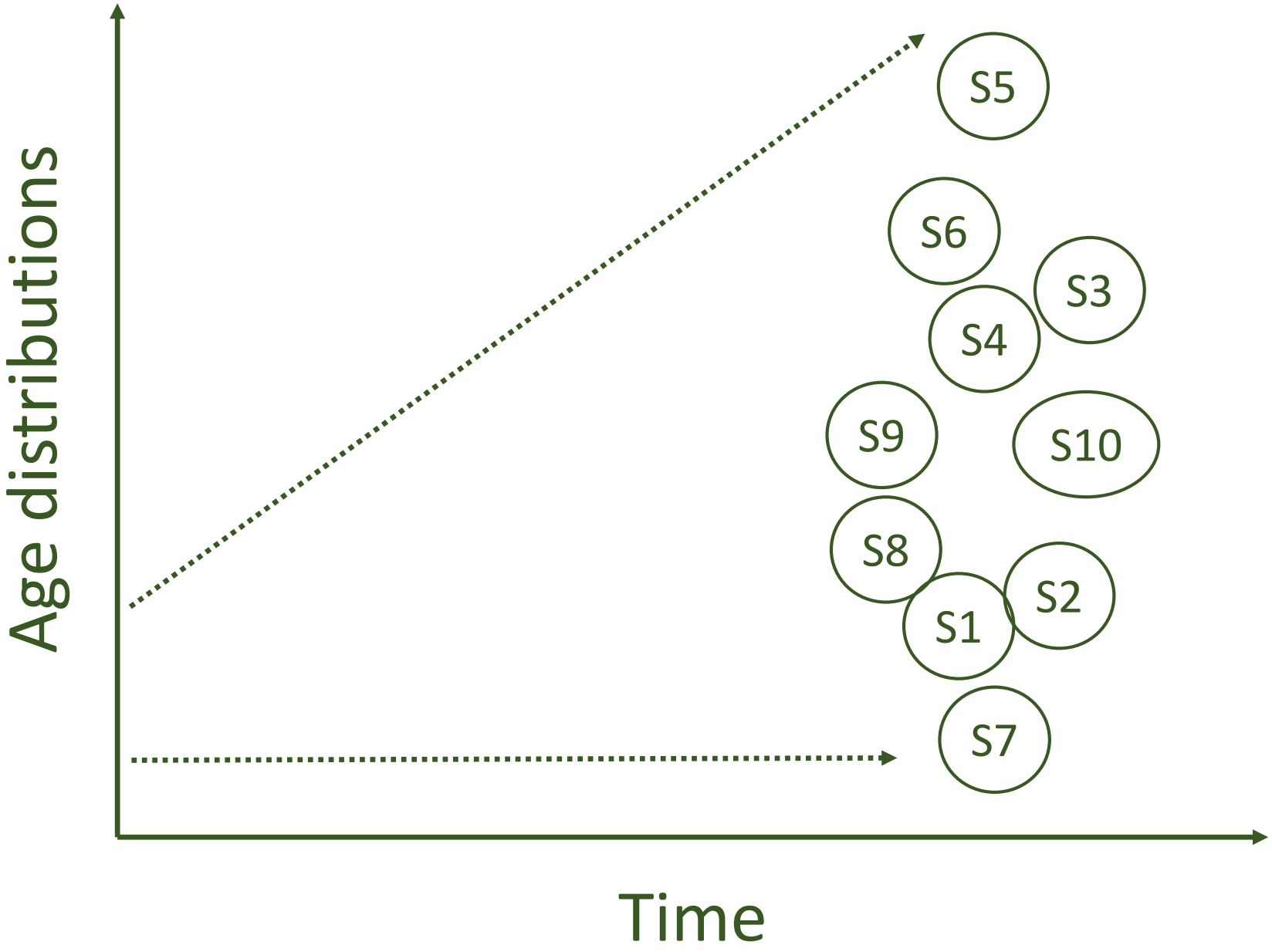
Dendroecology reconstruction

- Increment cores from all living trees and jack pine snags in each plot (*N* = 1676)
- Fire scarred trees in or nearby plots (*N* = 6)
- Standard processing
- Age distributions for all species at each site (*n* = 1562)
- Jack pine recruitment windows (*n* = 875)

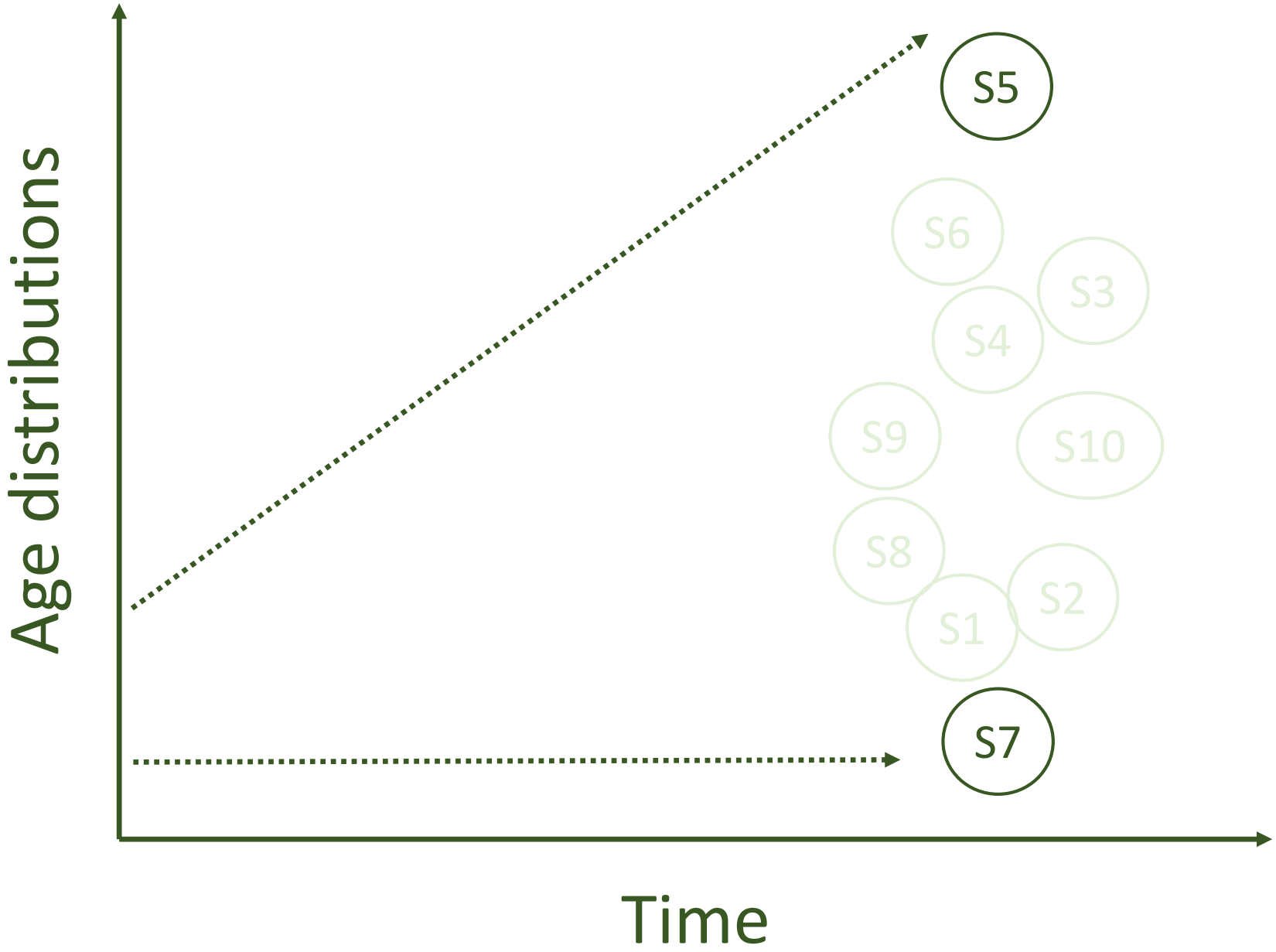
Results – All Stands



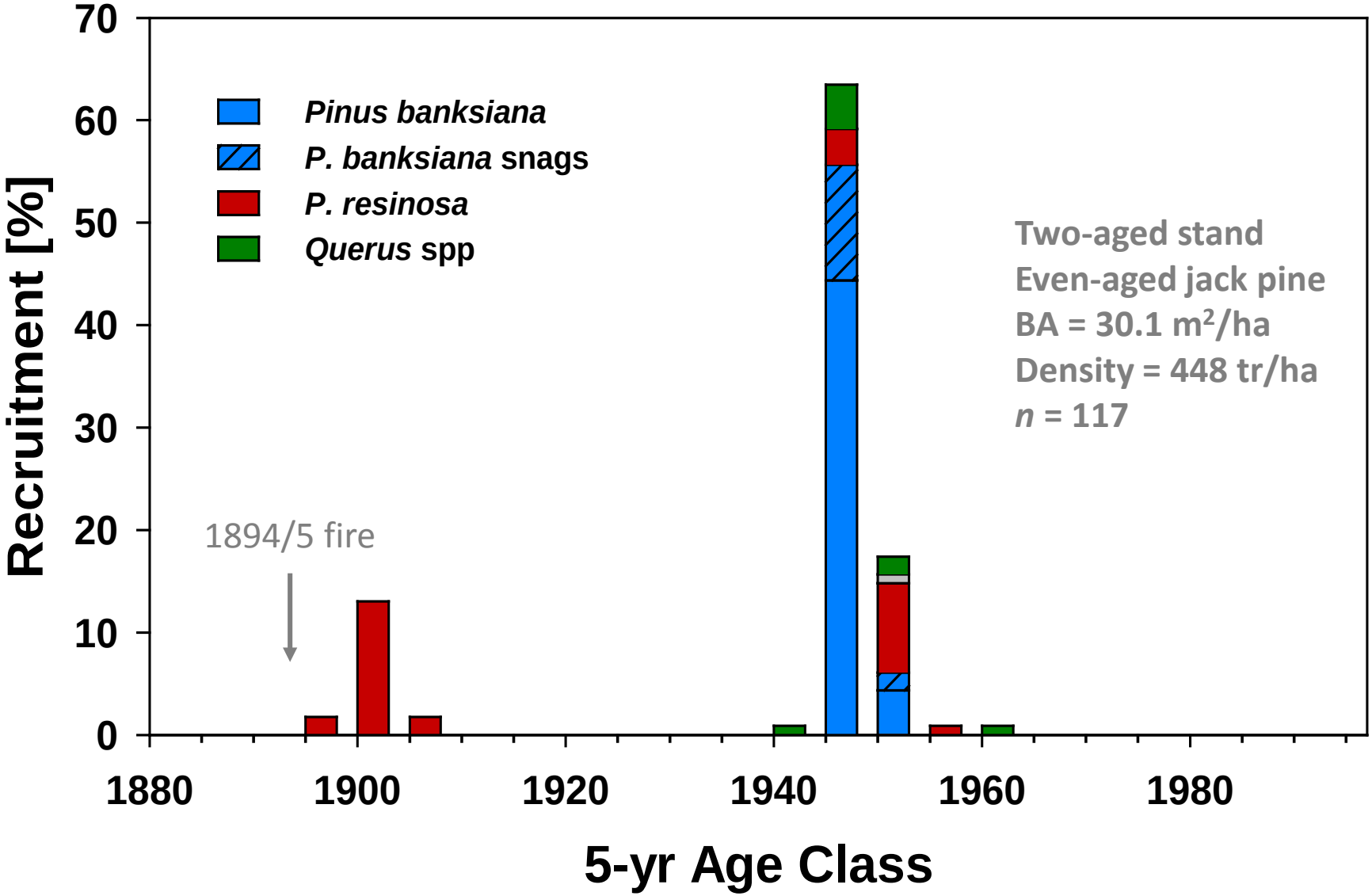
Results – All Stands



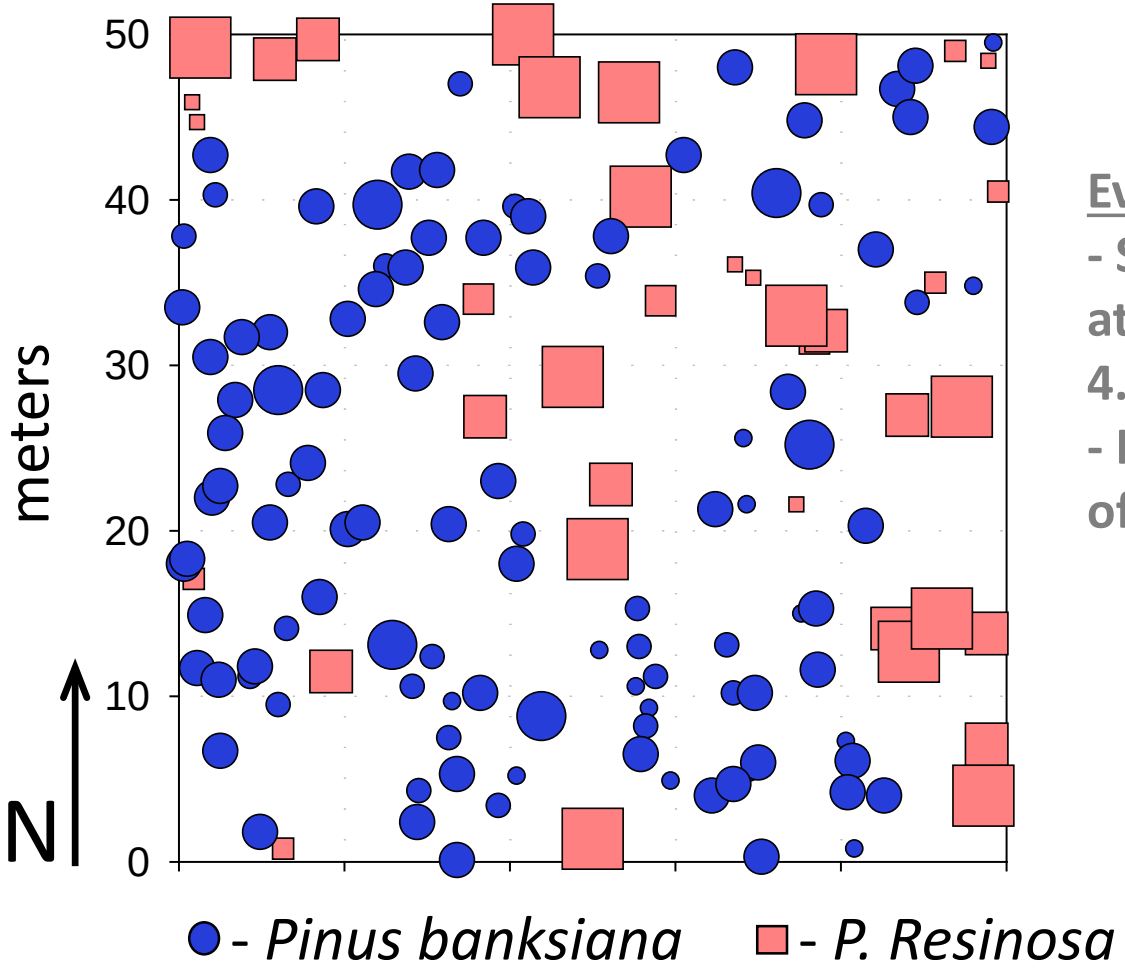
Results – Focal stands



Age distribution – S7 – ‘Nimrod Range’



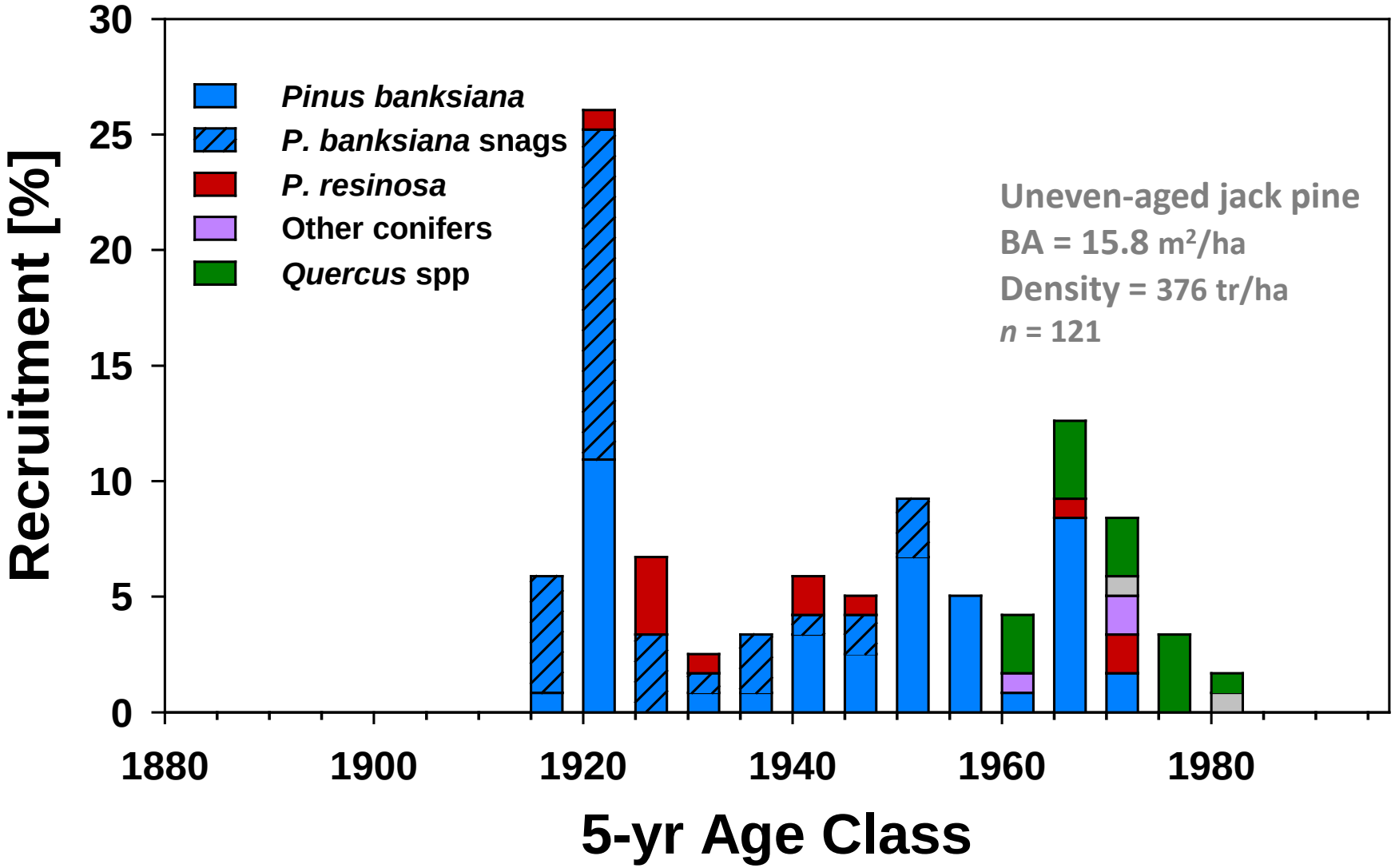
Spatial distribution – Nimrod Range



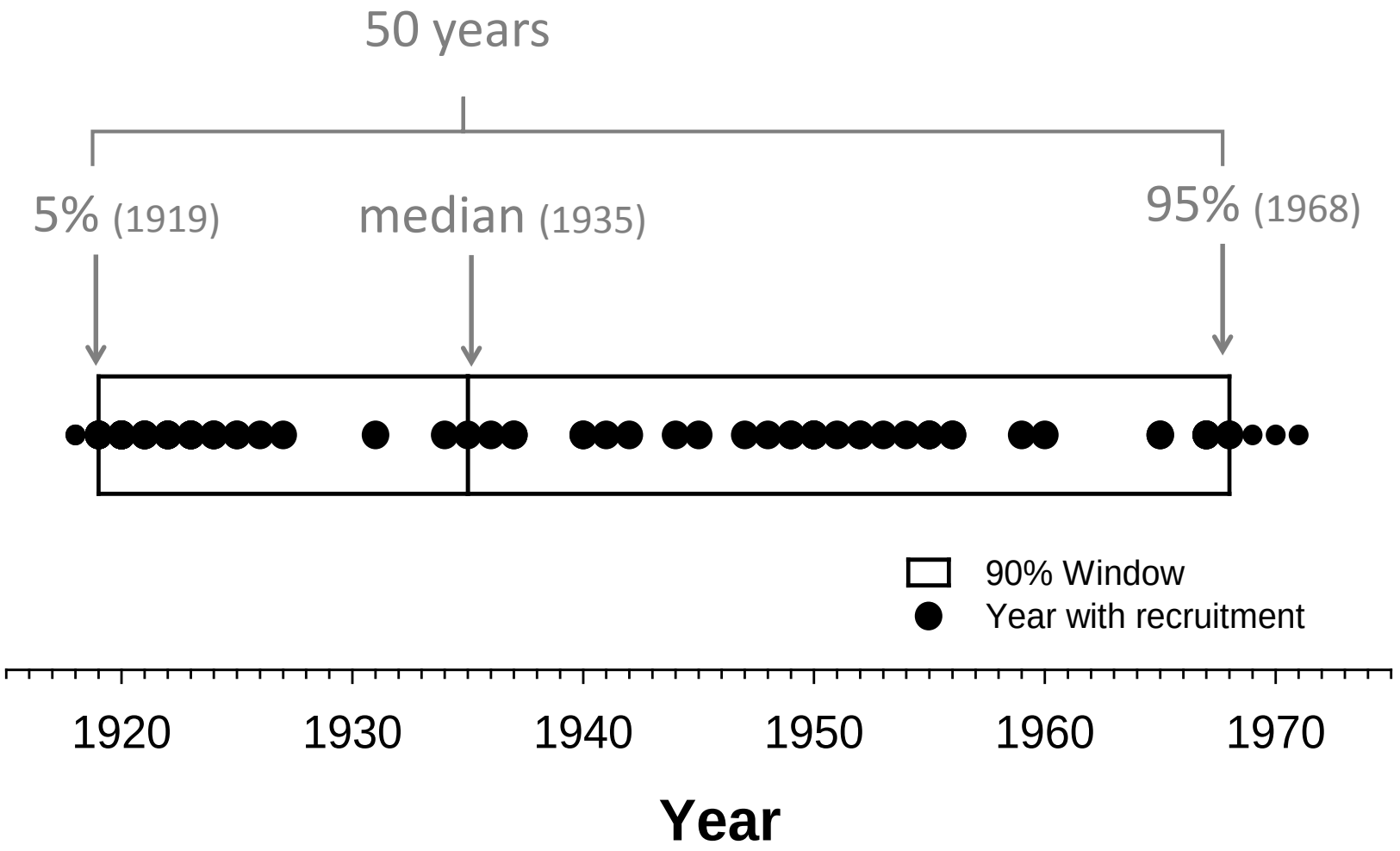
Even-aged jack pine

- Significantly clumped at distances between 4.5 - 6.5 m (*n* = 111)
- In gaps within older cohort of *Pinus resinosa* (*n* = 39)

Age distribution – S5 – Midge Lake East

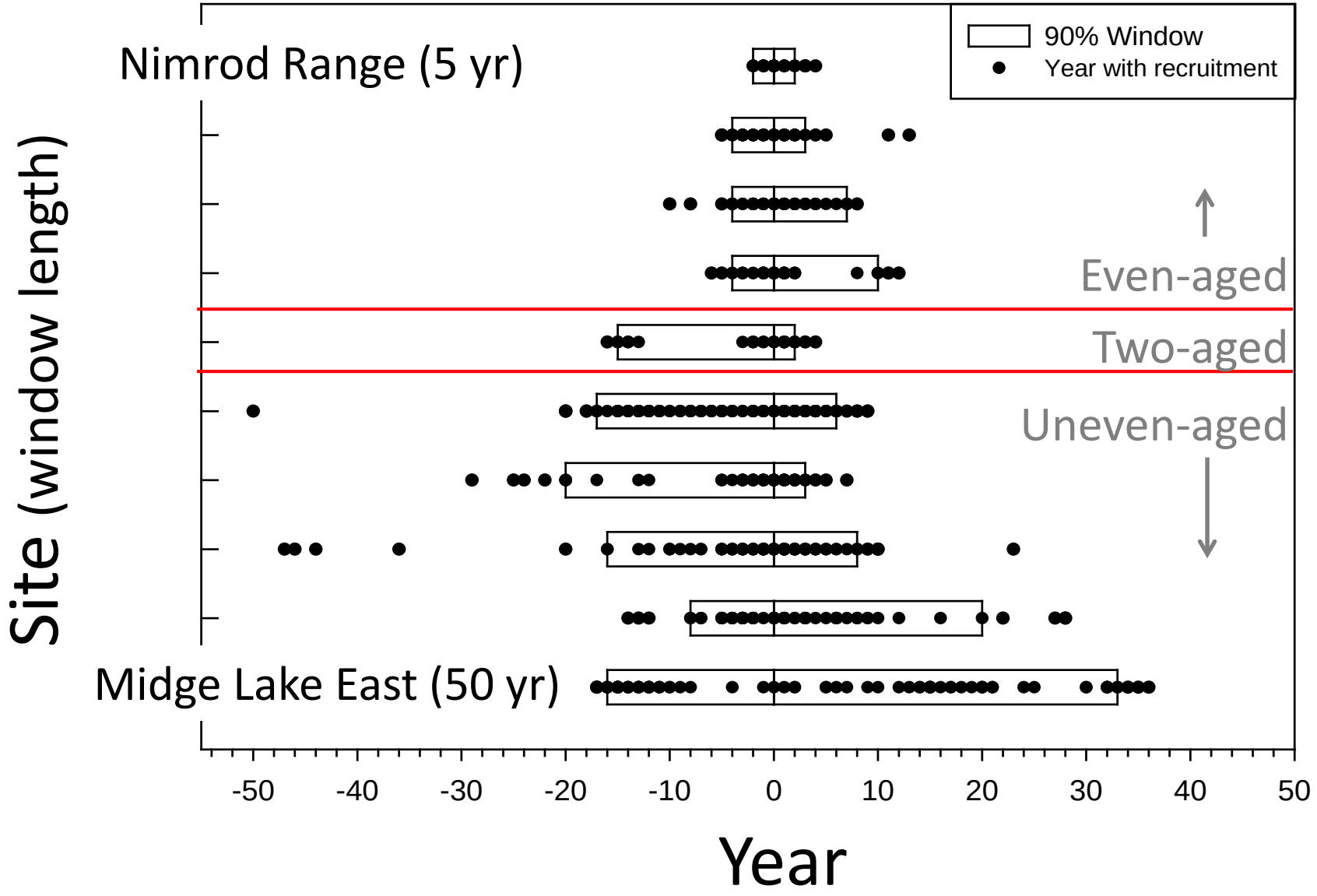


Recruitment window – Midge Lake East

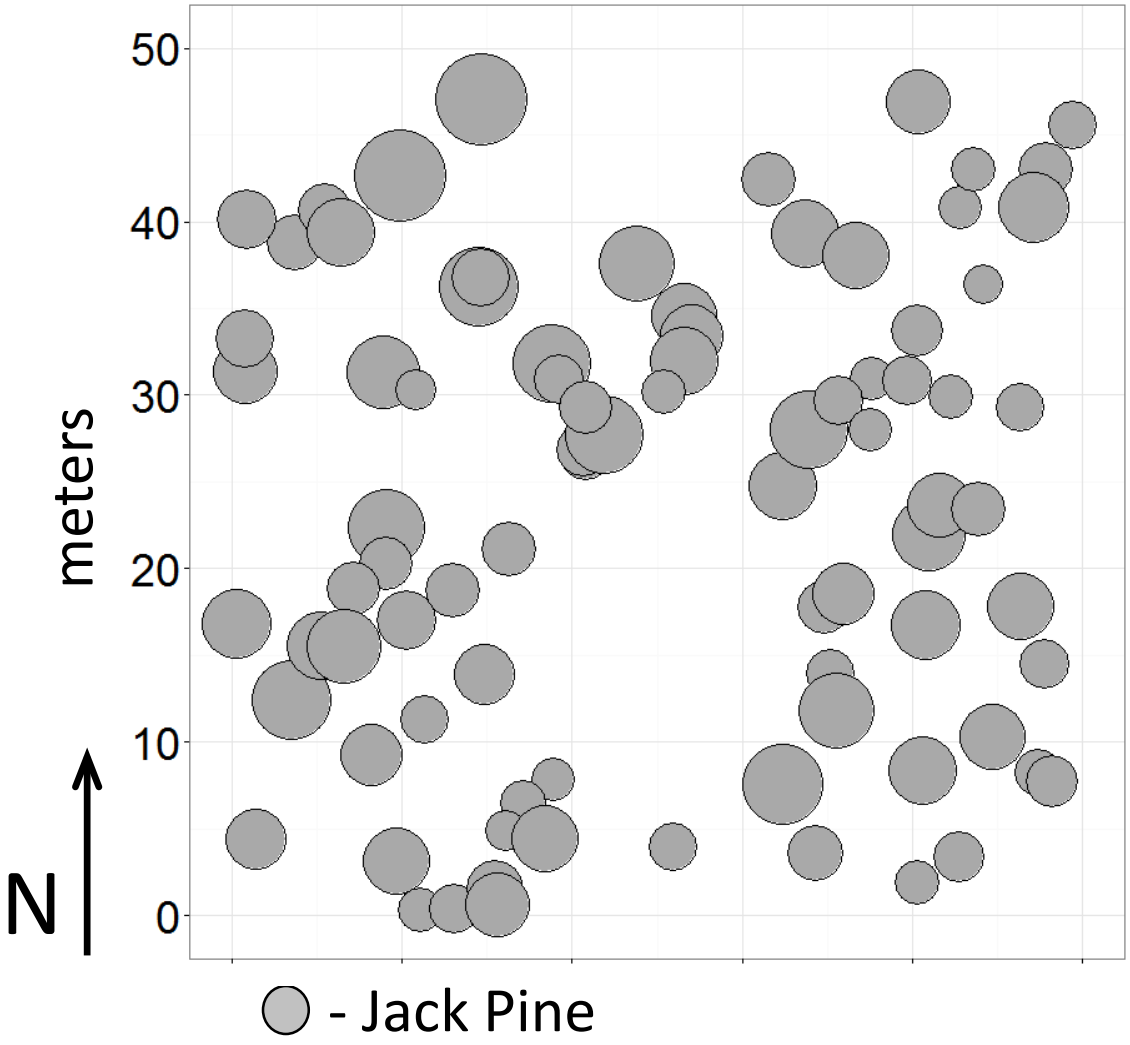


Recruitment window – All sites

Median = 21yr

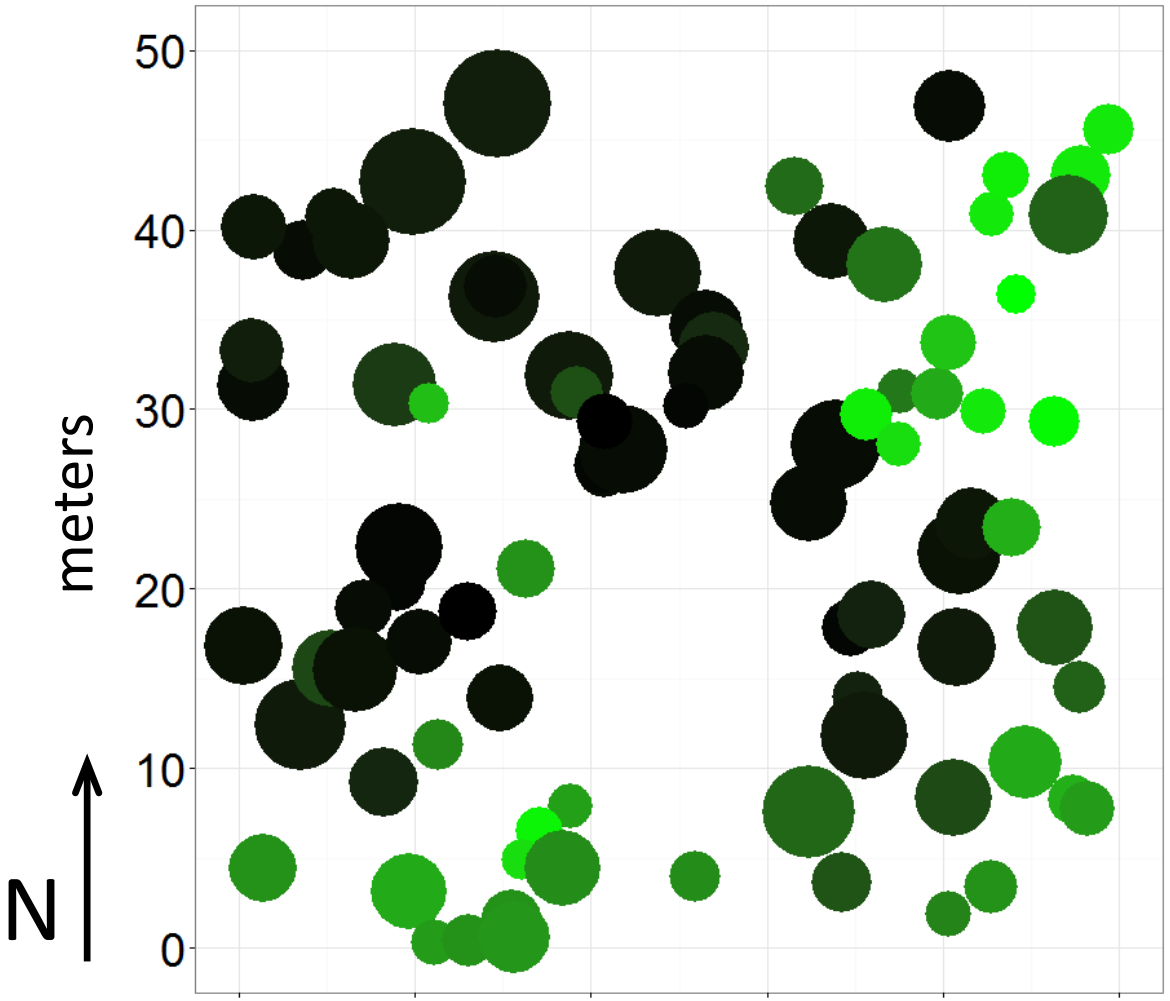


Spatial distribution – Midge Lake East



- Uneven-aged jack pine
- Pooled stems no different from random (*n* = 84)

Spatial distribution by Age – Midge Lake East



Significantly clumped within recruitment groups

95% (1968)

50% (1935)

5% (1919)

First 50% (*n* = 42)

1.5 – 2.5 m and 8 – 10 m

Second 50% (*n* = 42)

2 – 8 m


Post-disturbance open period
Tappeiner et al. 1997
Franklin et al. 2002
Donato et al. 2012
Pinno et al. 2013

dynamics reconstructed :

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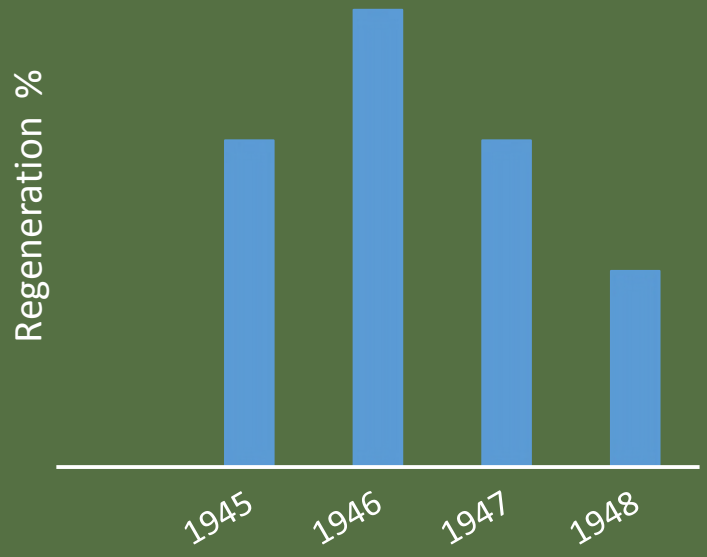
EVEN-AGED



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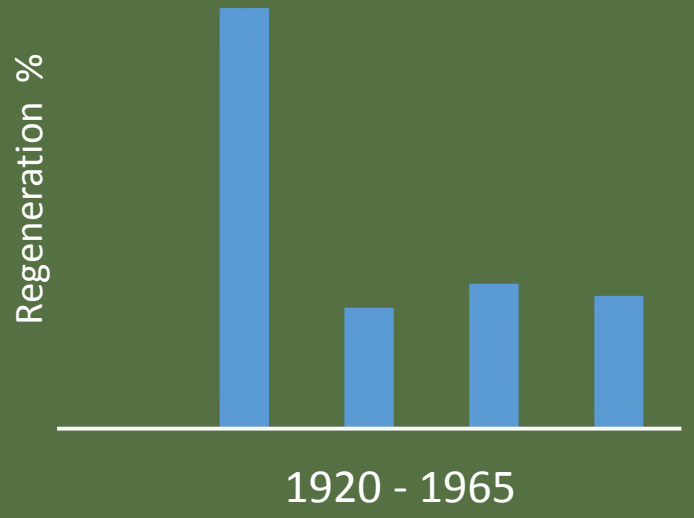
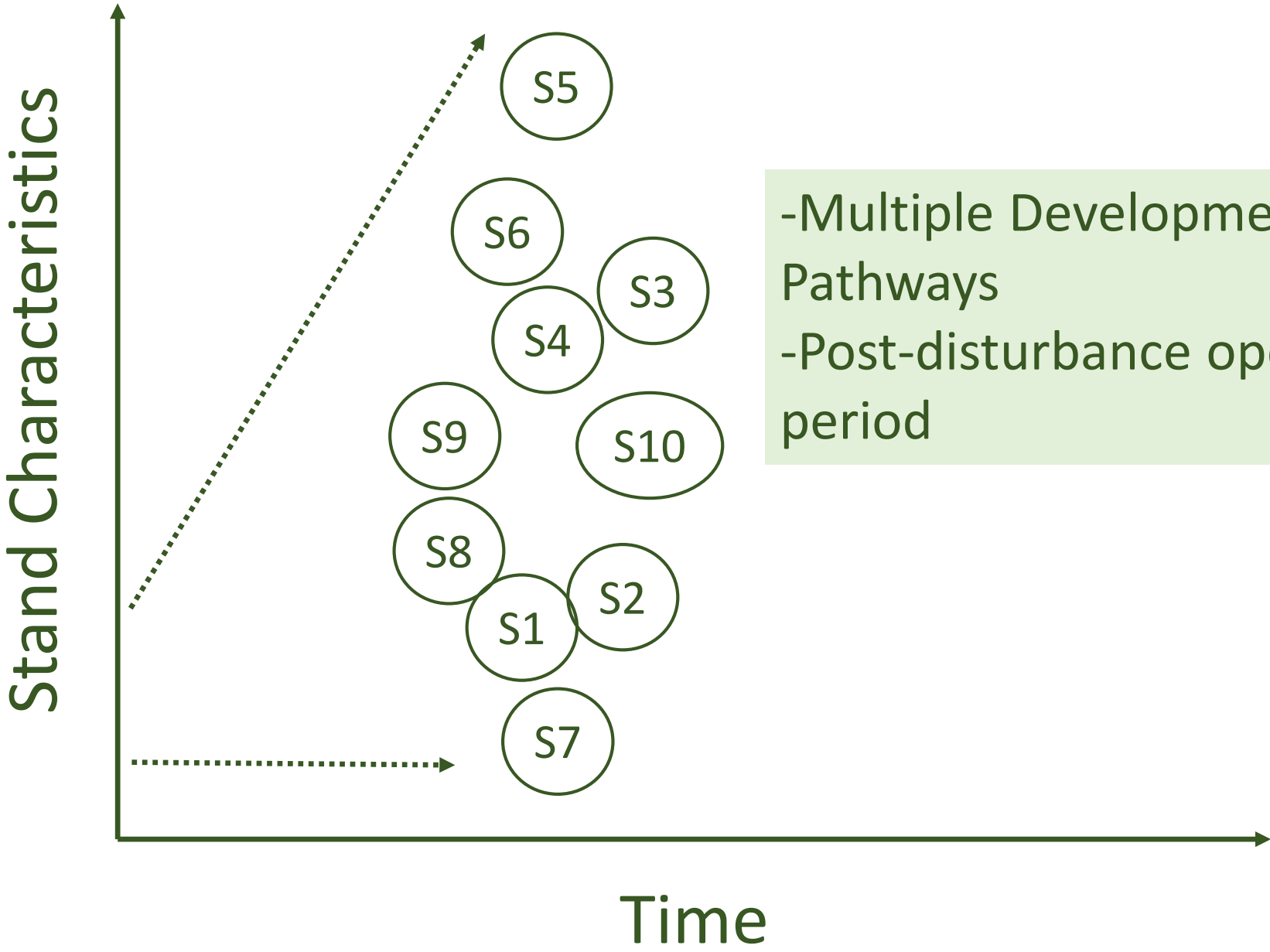
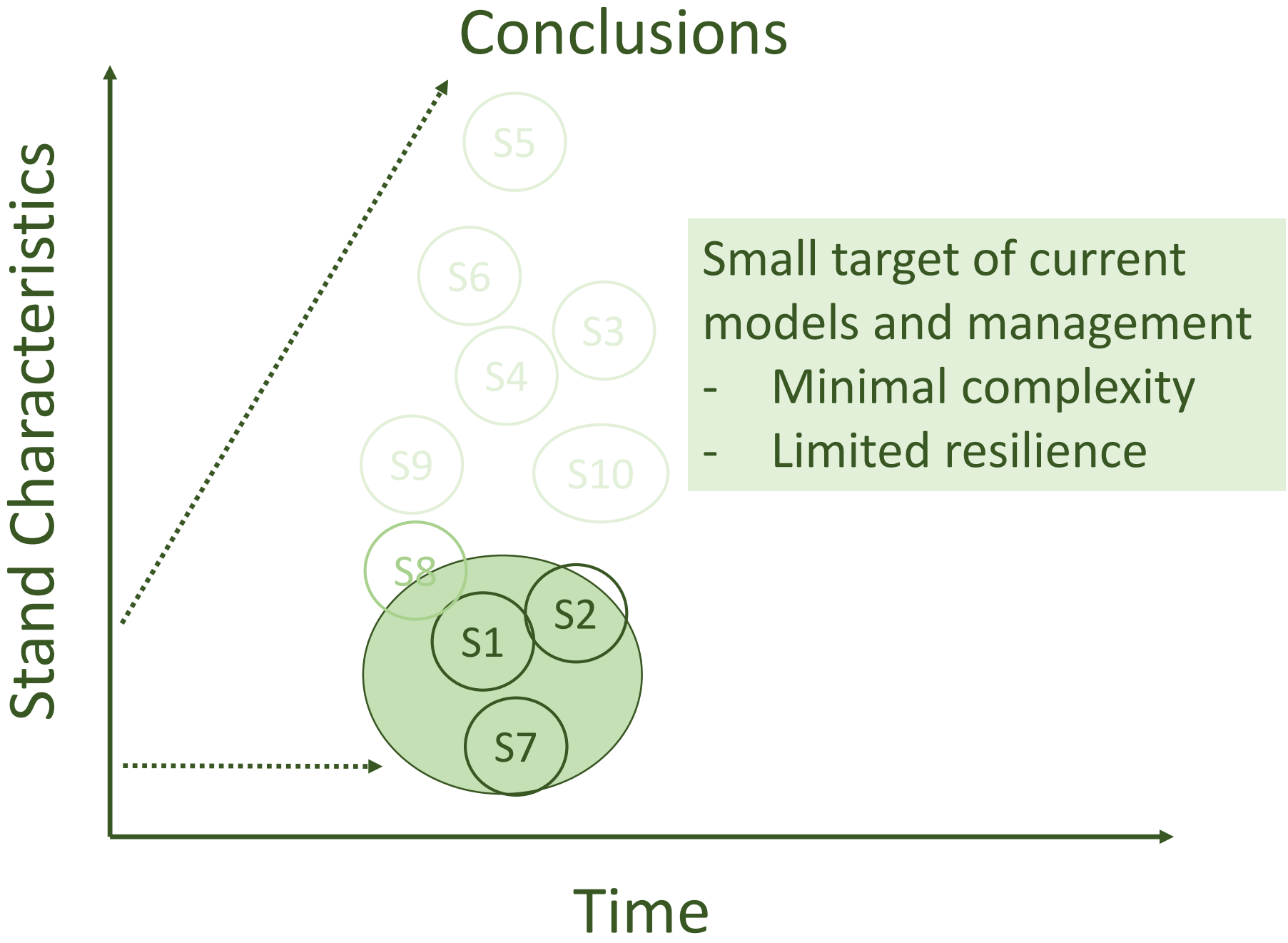
UNEVEN-AGED



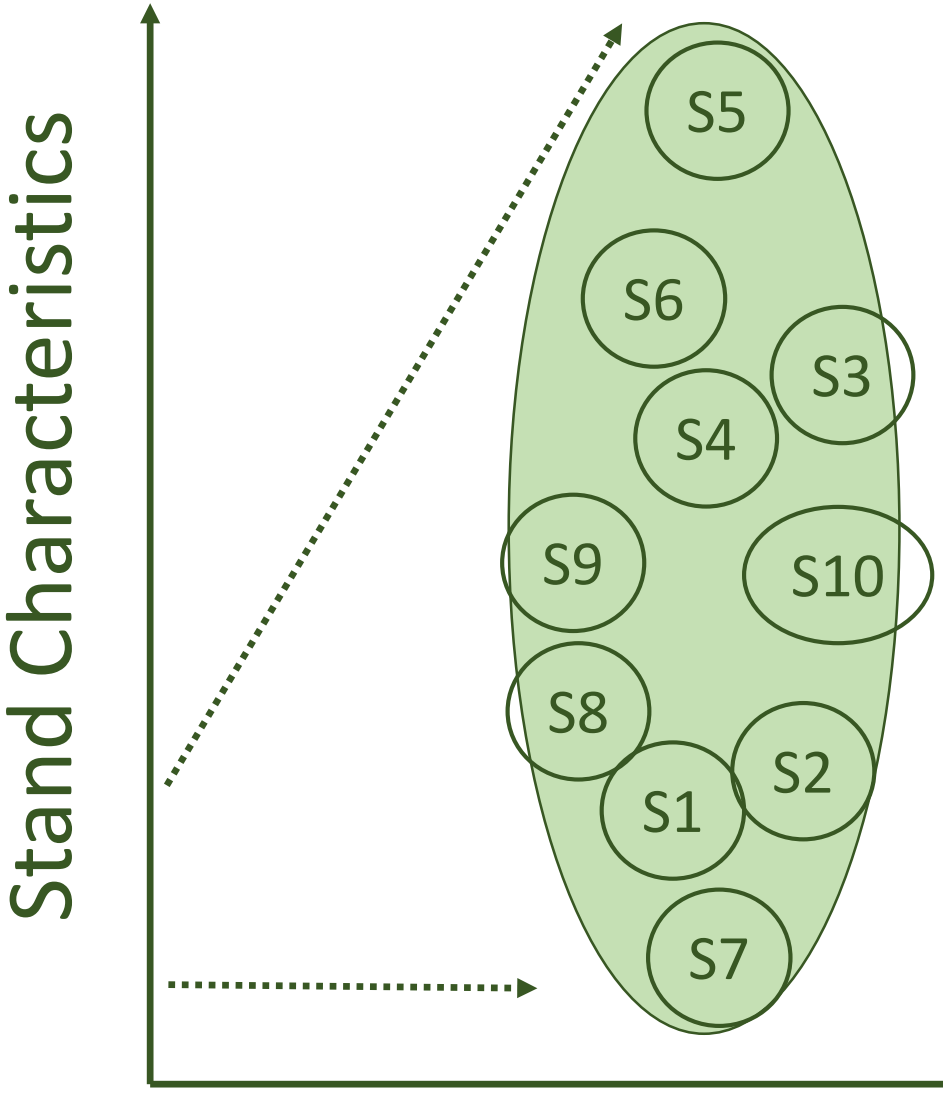
Conclusions



-Multiple Developmental Pathways
-Post-disturbance open period


Conclusions
Stand Characteristics
Time
S5
S6
S3
S4
S9
S10
S8
S2
S1
S7
Small target of current models and management
- Minimal complexity
- Limited resilience

Conclusions

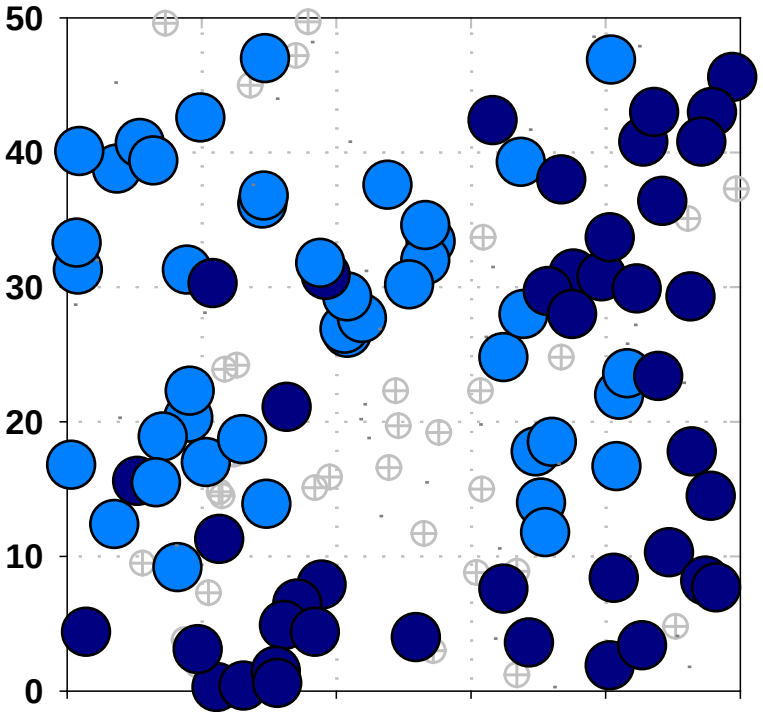


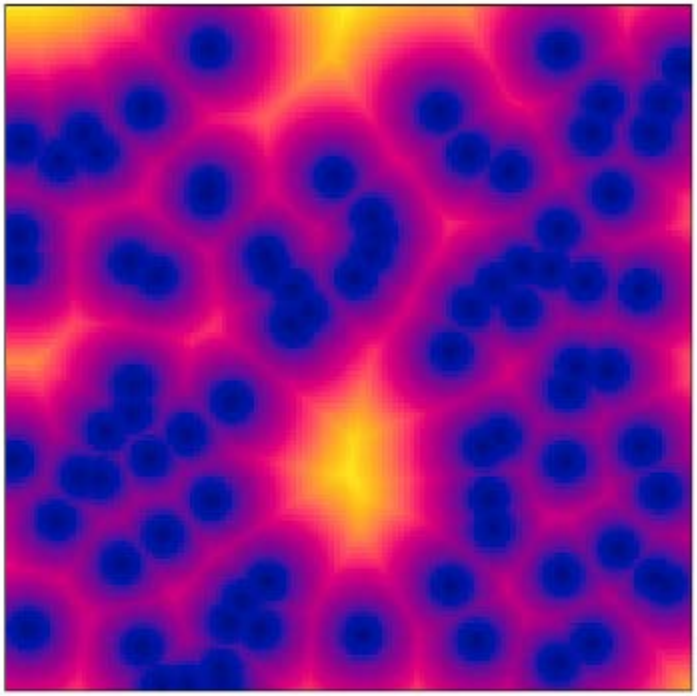
Stand complexity:

- Diversified options
- Increased resilience and adaptability?

Management implications:

- Multiple potential regeneration methods
- Live tree retention & ecological legacies
- Allow for post-harvest open-periods
- Variable density harvests





Franklin et al. 1997, Franklin, Mitchell, and Palik 2007
D'Amato et al. 2011, Churchill et al. 2013

Acknowledgements

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Questions
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