

Structure, Dynamics, and Climate sensitivity of Range-margin Jack Pine forests in central Minnesota

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M.S. Defense Seminar

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Shawn Fraver





What's next?

What's next with today's weather?



NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER WEATHER SAFETY INFORMATION CENTER NEWS SEARCH ABOUT

Local forecast by "City, St" or ZIP code

 [Location Help](#)

Severe weather possible from Upper Midwest across Ohio Valley and into central Appalachians, as well as for parts of Desert Southwest

Scattered severe thunderstorms are expected to develop Thursday afternoon and evening over parts of the Upper Midwest and Ohio Valley and into the central Appalachians. Damaging wind and large hail are the main threats for this area. Meanwhile, storms with large hail and strong winds will also be possible across parts of the Desert Southwest, specifically over the lower Colorado River Valley. [Read More...](#)

HAZARDOUS WEATHER CONDITIONS


[Heat Advisory in effect from August 21, 12:00 PM CDT until August 21, 08:00 PM CDT](#)

[Hazardous Weather Outlook](#)

Current Conditions

[En Español](#)

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Overcast
71°F
22°C

Humidity 96%
Wind Speed SE 10 mph
Barometer 29.79 in (1008.2 mb)
Dewpoint 70°F (21°C)
Visibility 8.00 mi

Last Update on 21 Aug 8:53 am CDT










Current conditions at **Minneapolis-St. Paul International Airport (KMSP)**
Lat: 44.89°N Lon: 93.22°W Elev: 834ft.

[More Local Wx](#) | [3 Day History](#) | [Mobile Weather](#)

Falcon Heights MN

7 Day Forecast

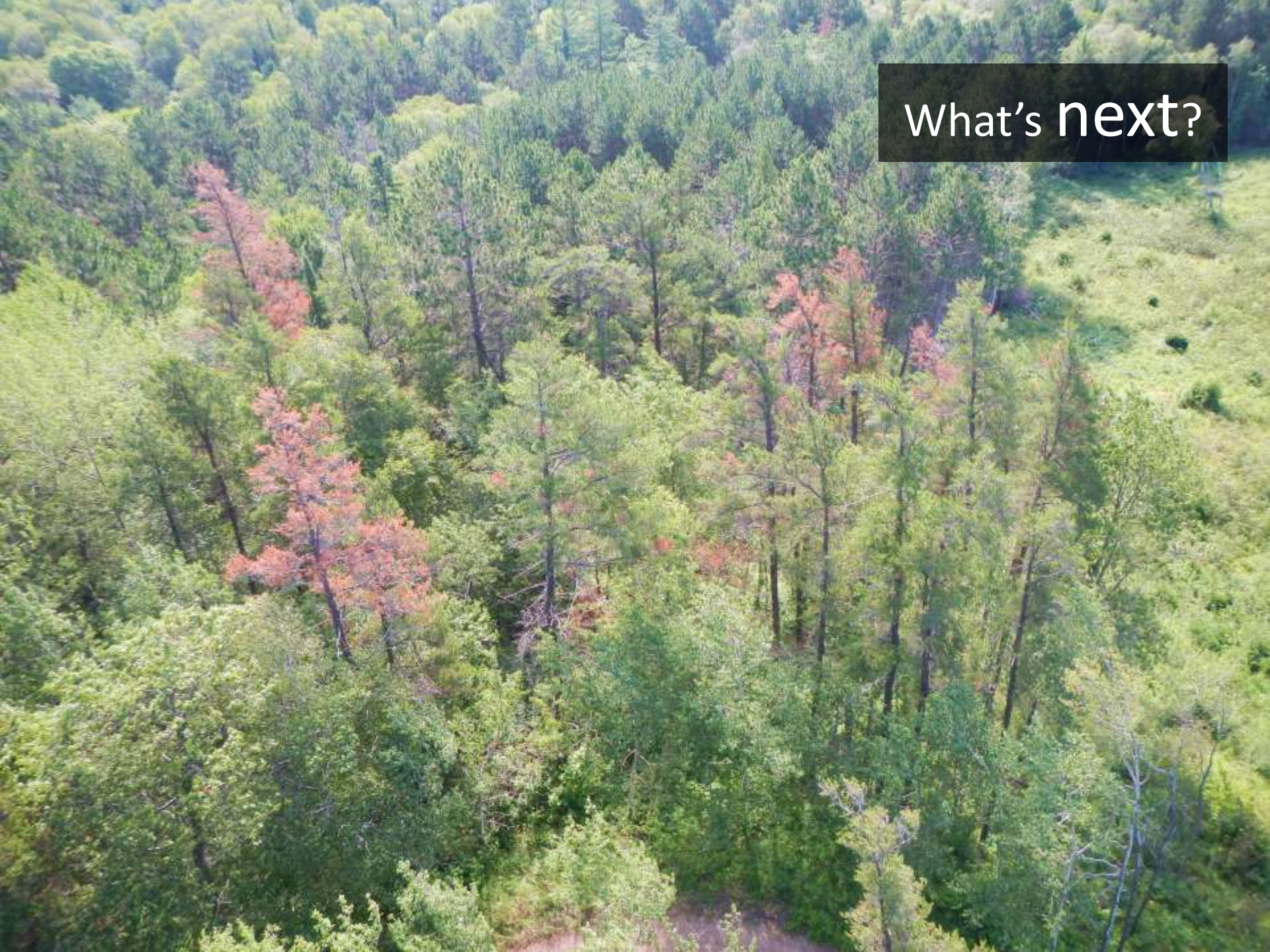
For More Weather Information:
[Twin Cities/Chanhassen, MN Local Forecast Office](#)

TODAY	TONIGHT	FRIDAY	FRIDAY NIGHT	SATURDAY	SATURDAY NIGHT	SUNDAY	SUNDAY NIGHT	MONDAY
 <p>20%</p>	 <p>30%</p>		 <p>20%</p>	 <p>60%</p>	 <p>50%</p>	 <p>40%</p>	 <p>40%</p>	

What's **next** with climate change?



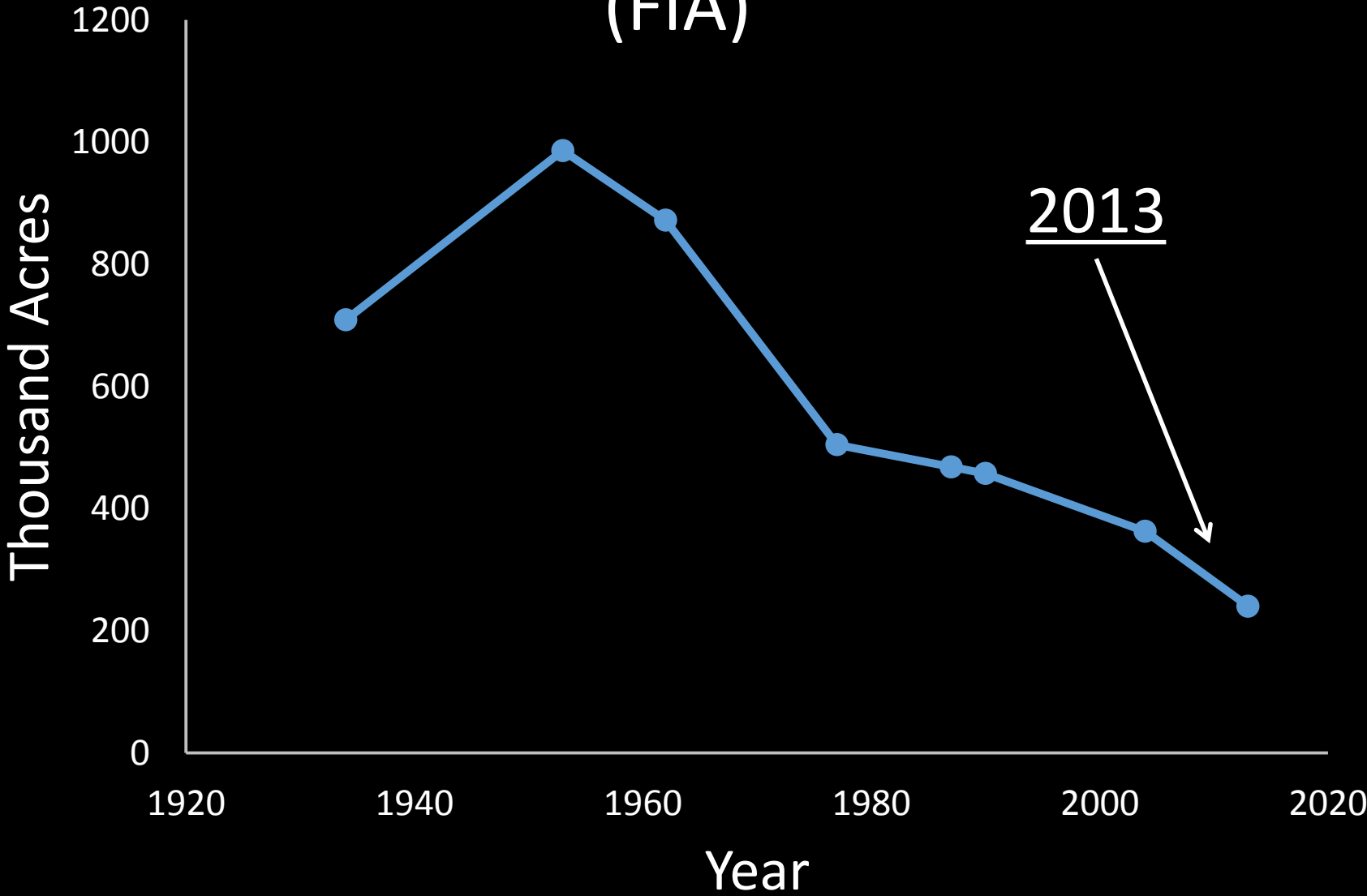
Always uncertainty... be prepared

An aerial photograph of a dense forest. The majority of the trees are green, but several trees in the middle-left and middle-right sections have turned a vibrant reddish-orange, indicating the start of autumn. The forest is situated on a hillside, and a small, light-colored clearing or path is visible in the lower center. The overall scene is lush and vibrant.

What's next?

Jack Pine Timberland Change in Minnesota

(FIA)





- Diseased planting stock
- Drought
- Increased deer herbivory

what's causing the Decline?

Dynamics

Climate

Dynamics_{expected}

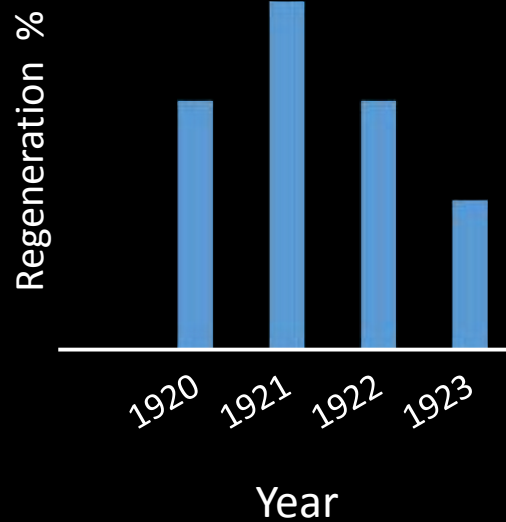


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EVEN AGED



Dynamics_{central MN}



+ ? =

Regeneration %

?

1920 1930 1940 1950

Year

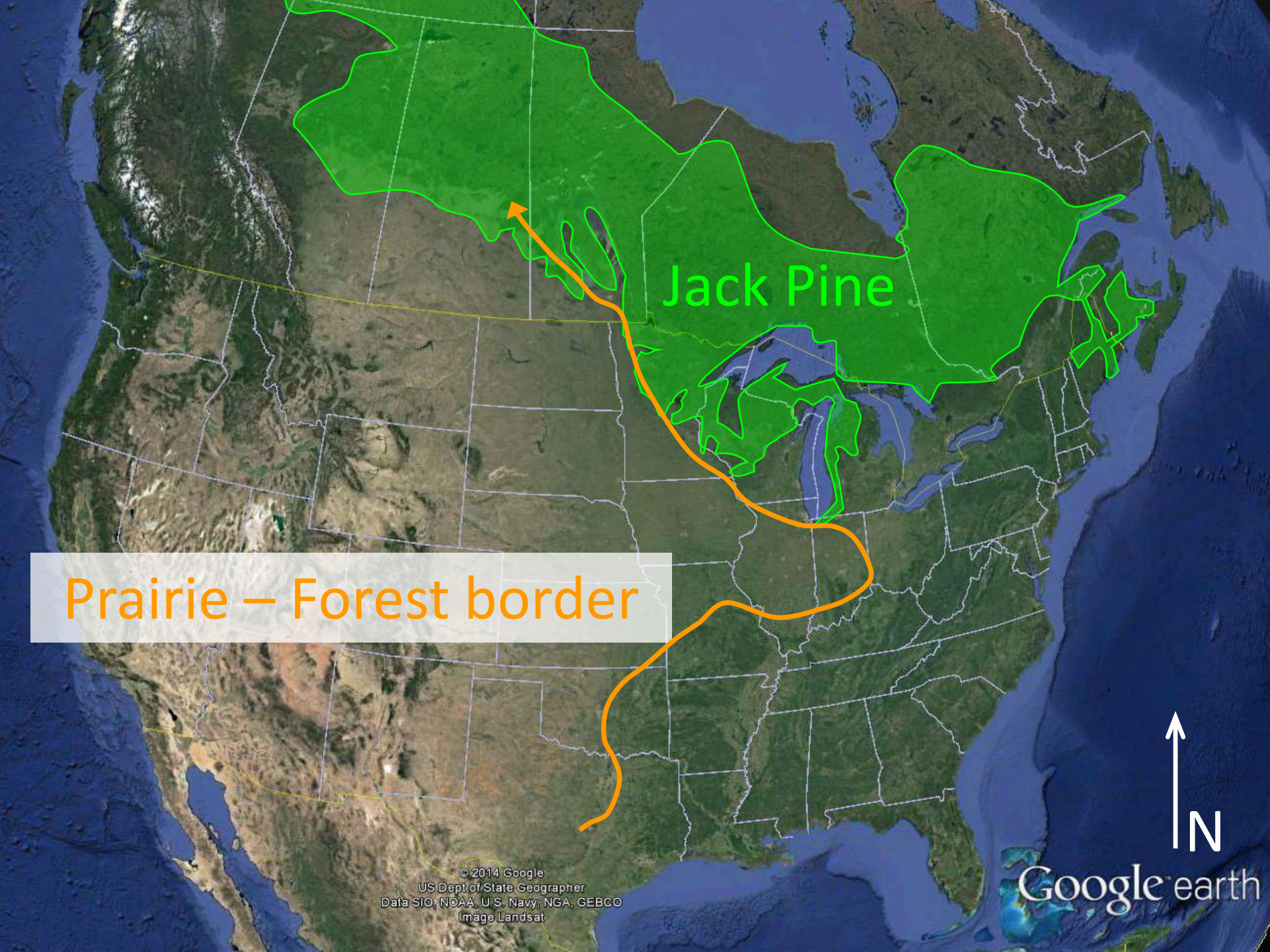
Project objectives - 1:

Dynamics —

Quantify historic range of variability

Jack Pine

Prairie – Forest border



Jack Pine

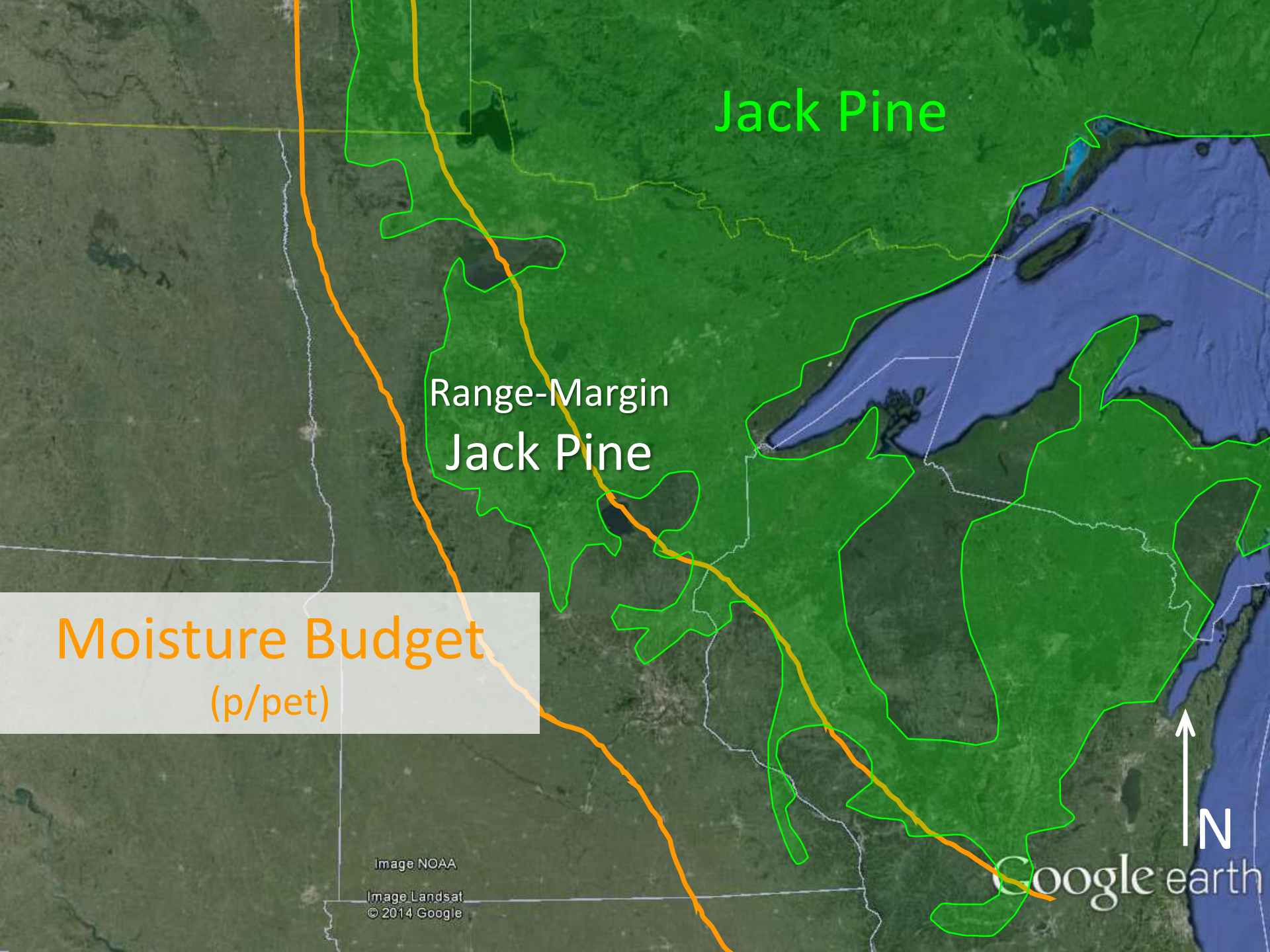
Range-Margin
Jack Pine

Moisture Budget
(p/pet)

Image NOAA

Image Landsat
© 2014 Google

↑ N
Google earth



Project objectives - 2:

Quantify relationships

- climate : recruitment
- climate : growth

Project objectives:

Dynamics : historic range of variability

Climate : recruitment & growth

Jack Pine

Range-Margin
Jack Pine

Native Plant
Communities

FDc24, FDc23,
FDc12, FDn12

Image NOAA

Image Landsat
© 2014 Google

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N
Google earth

range-margin
Jack Pine
10 study sites

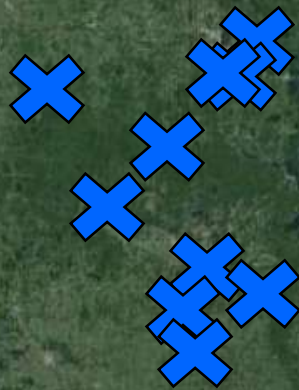


Image NOAA
© 2014 Google
Image Landsat

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N
Google earth

range-margin
Jack Pine
study plots

50 m



50 m

range-margin Jack Pine
-understory components



range-margin Jack Pine
-coarse woody debris



range-margin Jack Pine
- stem locations

50 m



50 m

range-margin Jack Pine
- composition and structure



range-margin Jack Pine
- increment cores







increment cores

- sand
- age
- measure
- cross-date

Recruitment / Regeneration





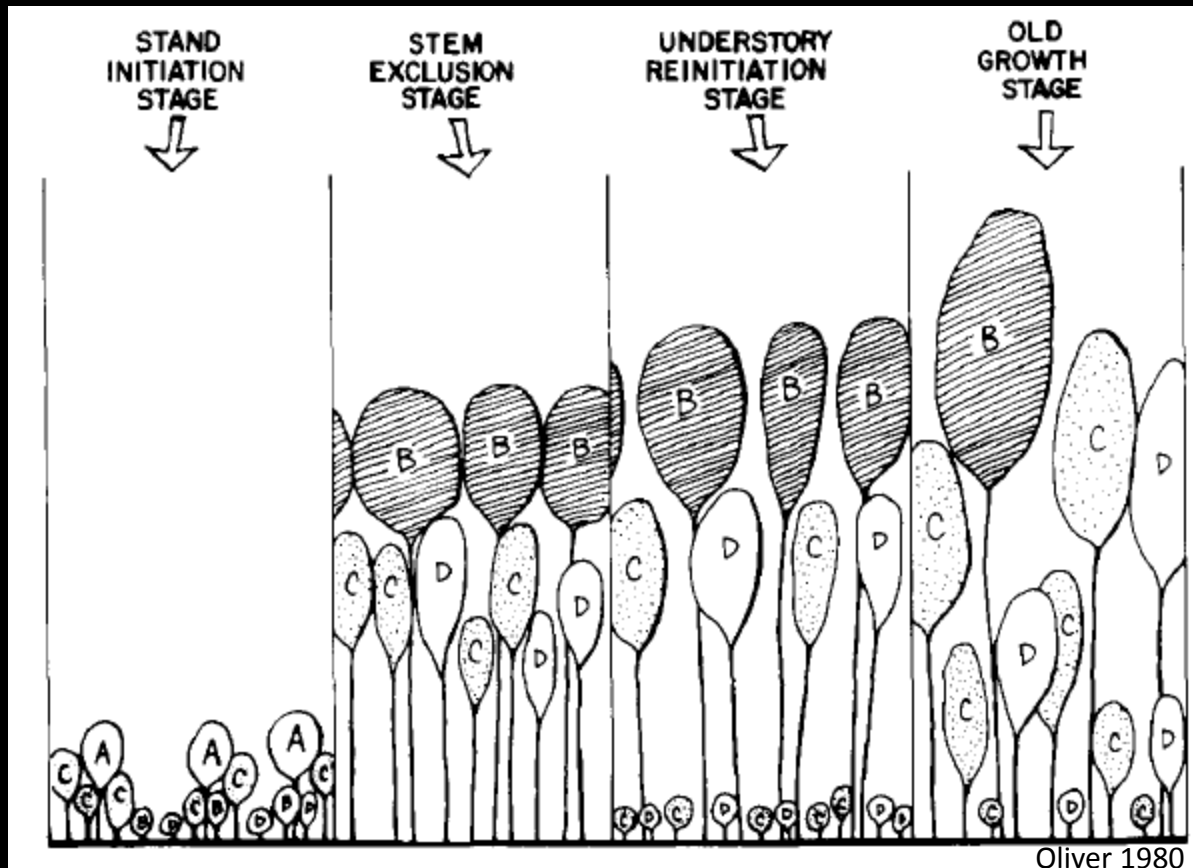
Stand Structure

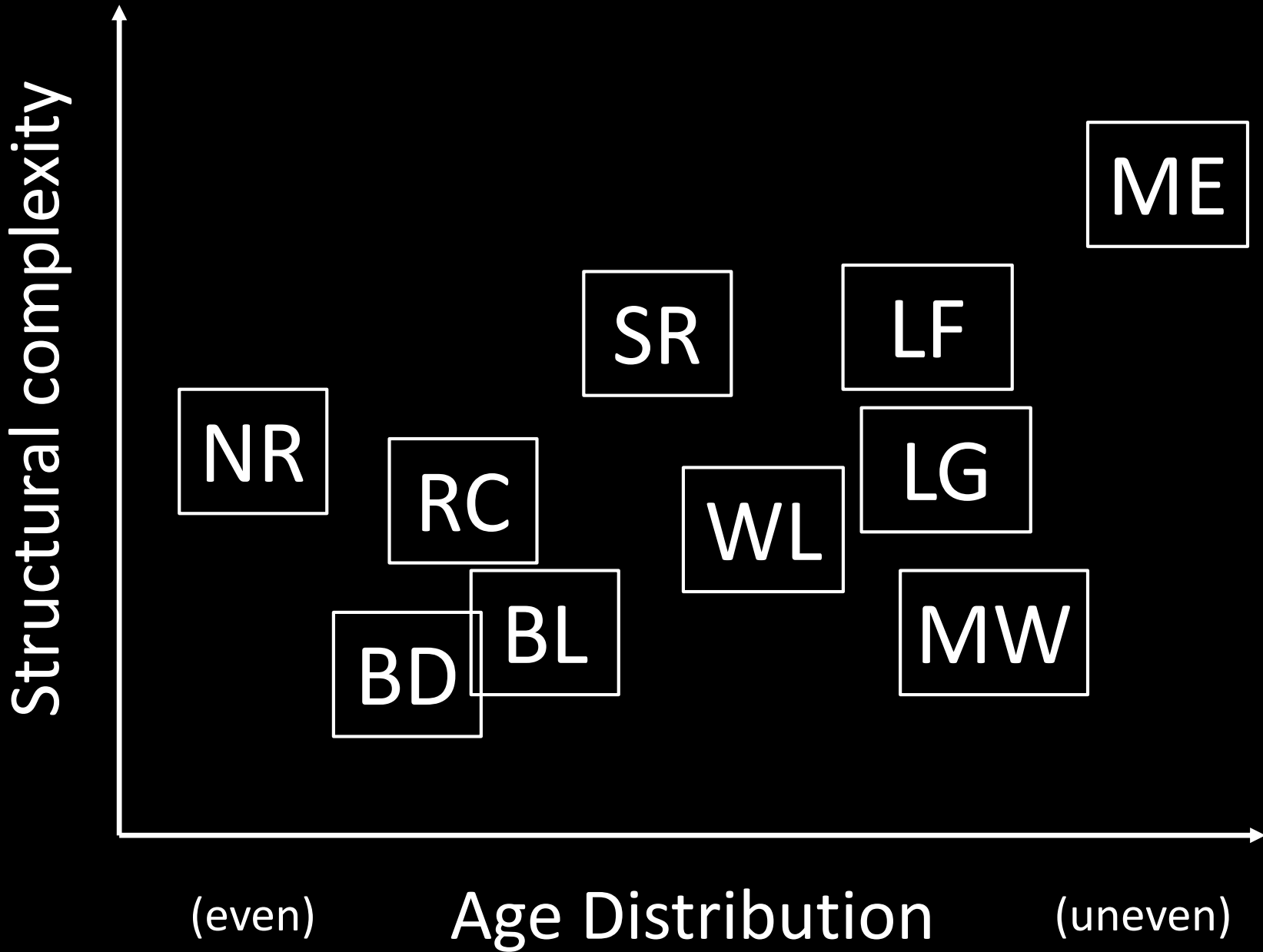
size, age, density, arrangement,
volume, etc.



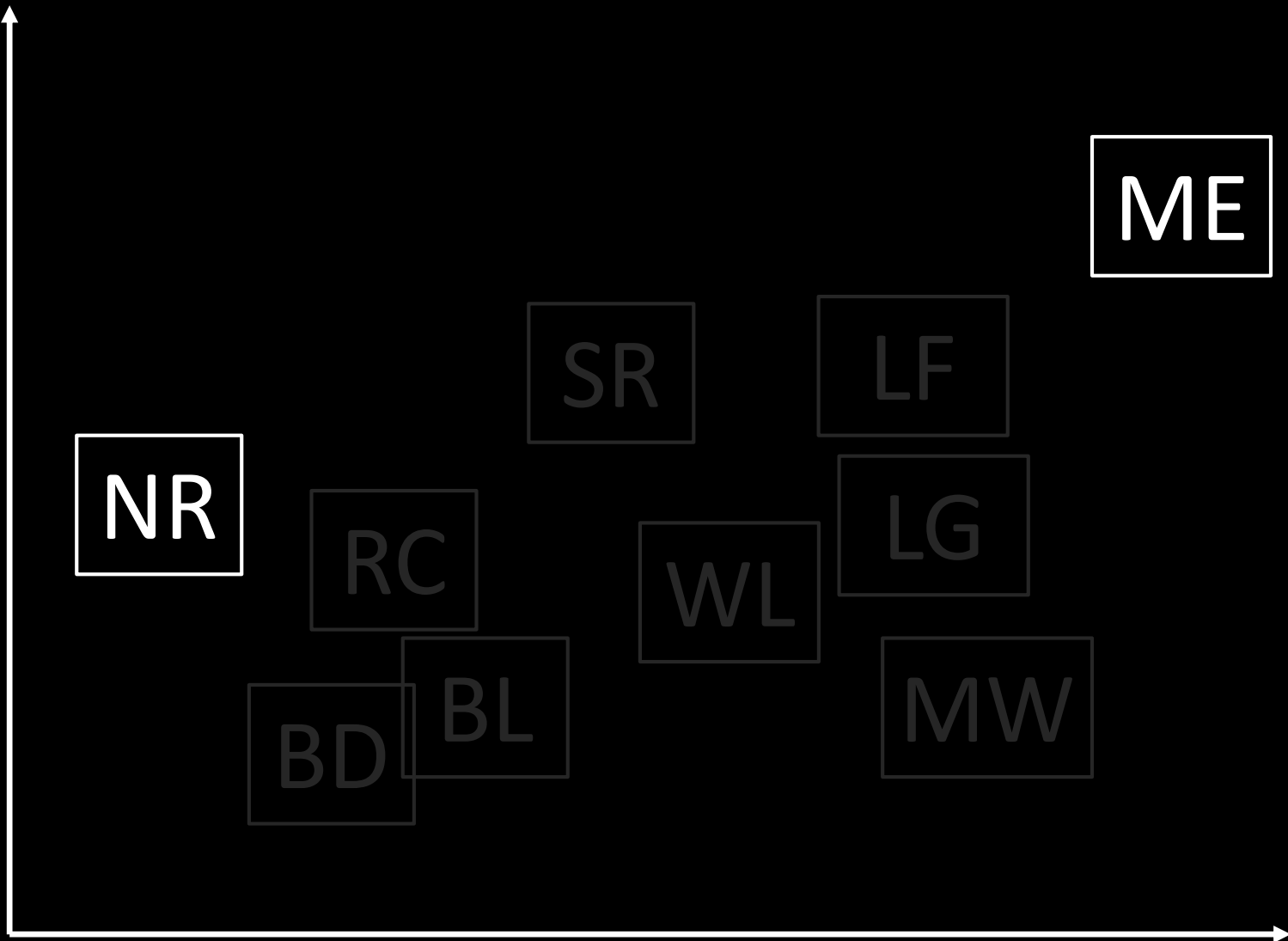
Stand Development

Structural change over time





Structural Complexity

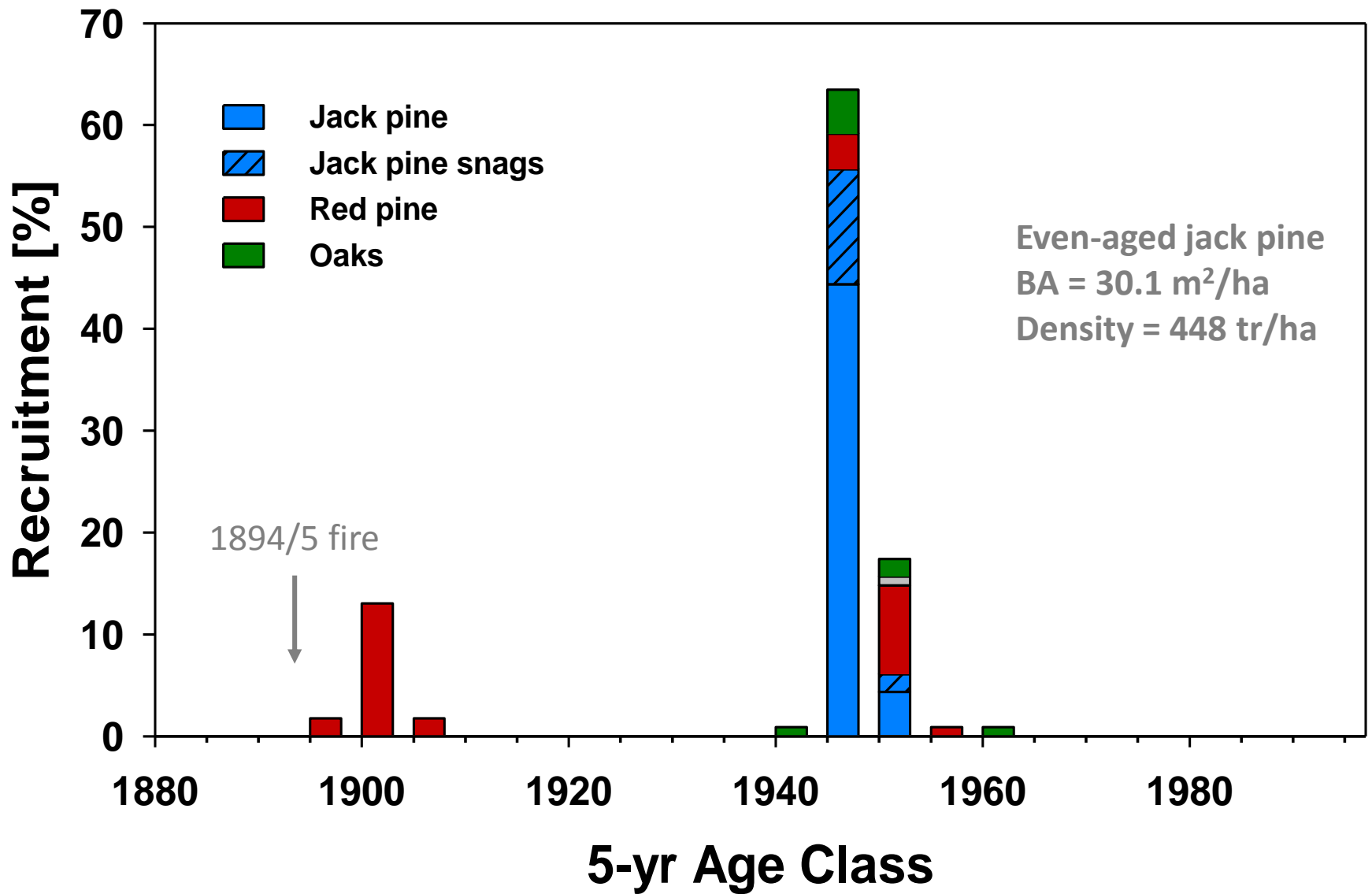


(even)

Age Distribution

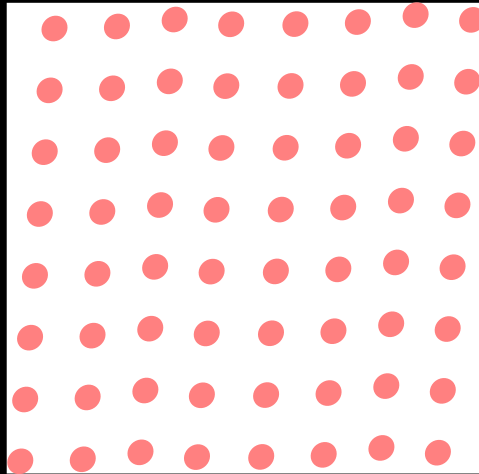
(uneven)

age Distribution – Nimrod Range

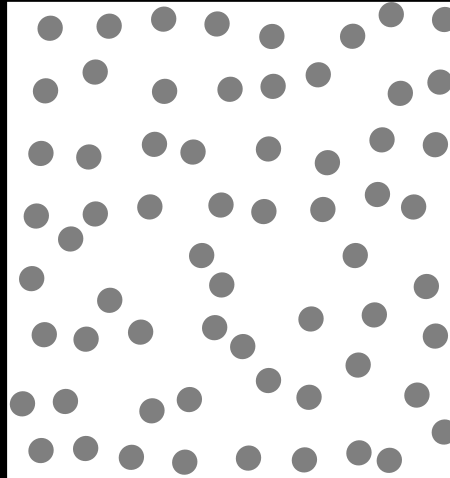


Spatial arrangement – Ripley's K

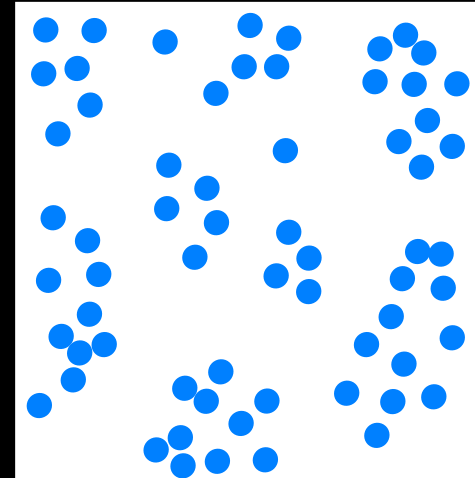
Uniform



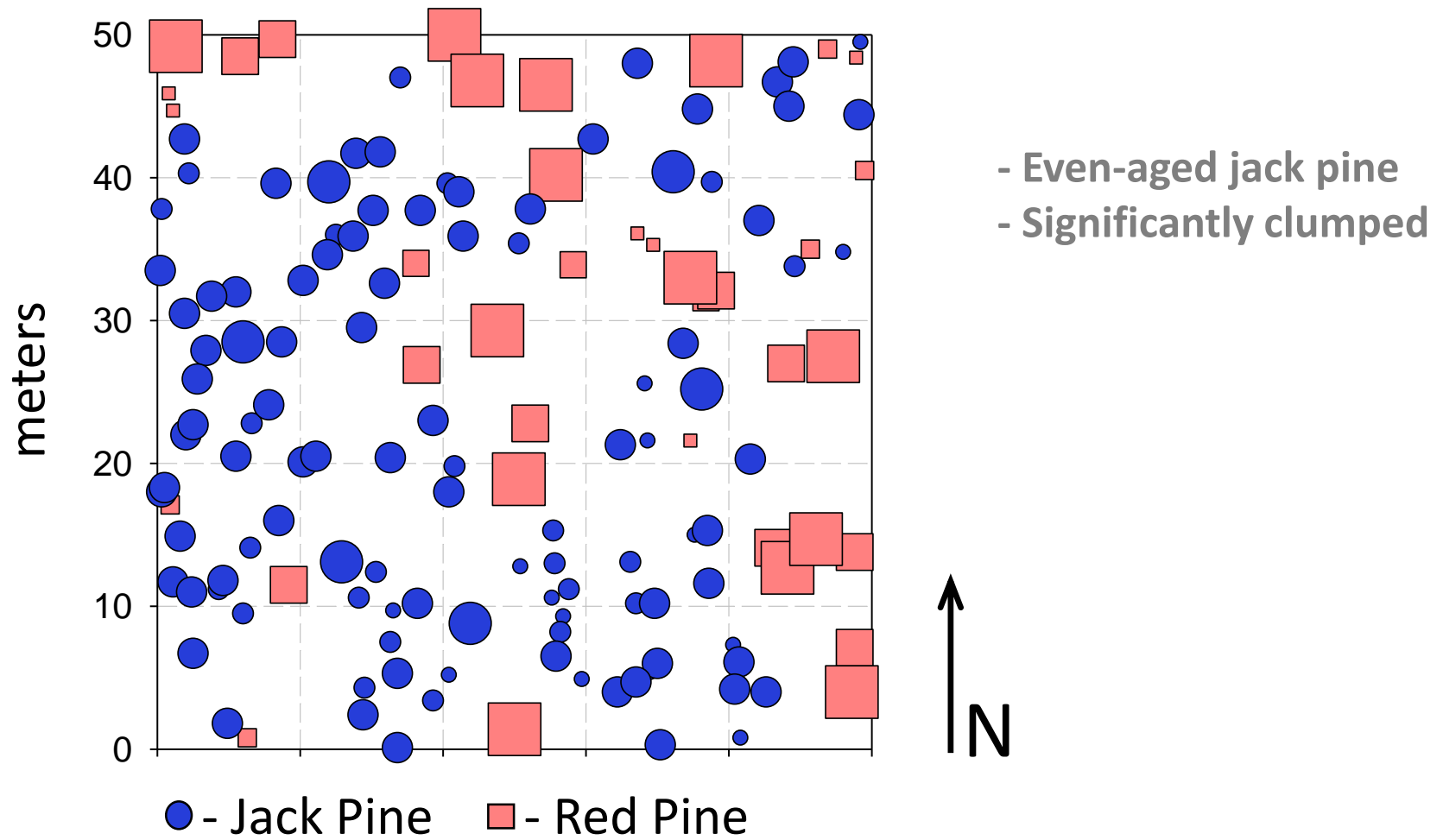
Random



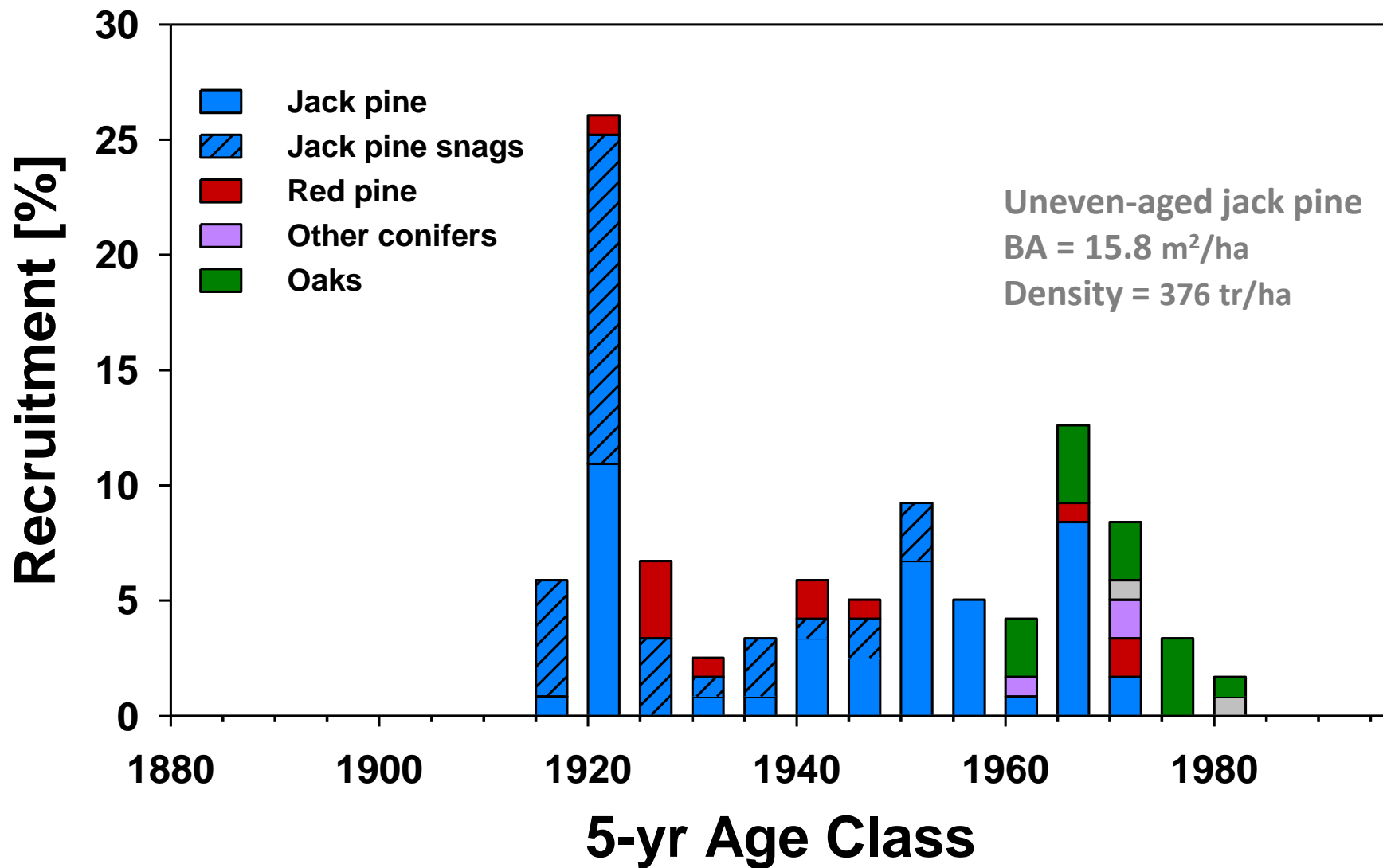
Clumped



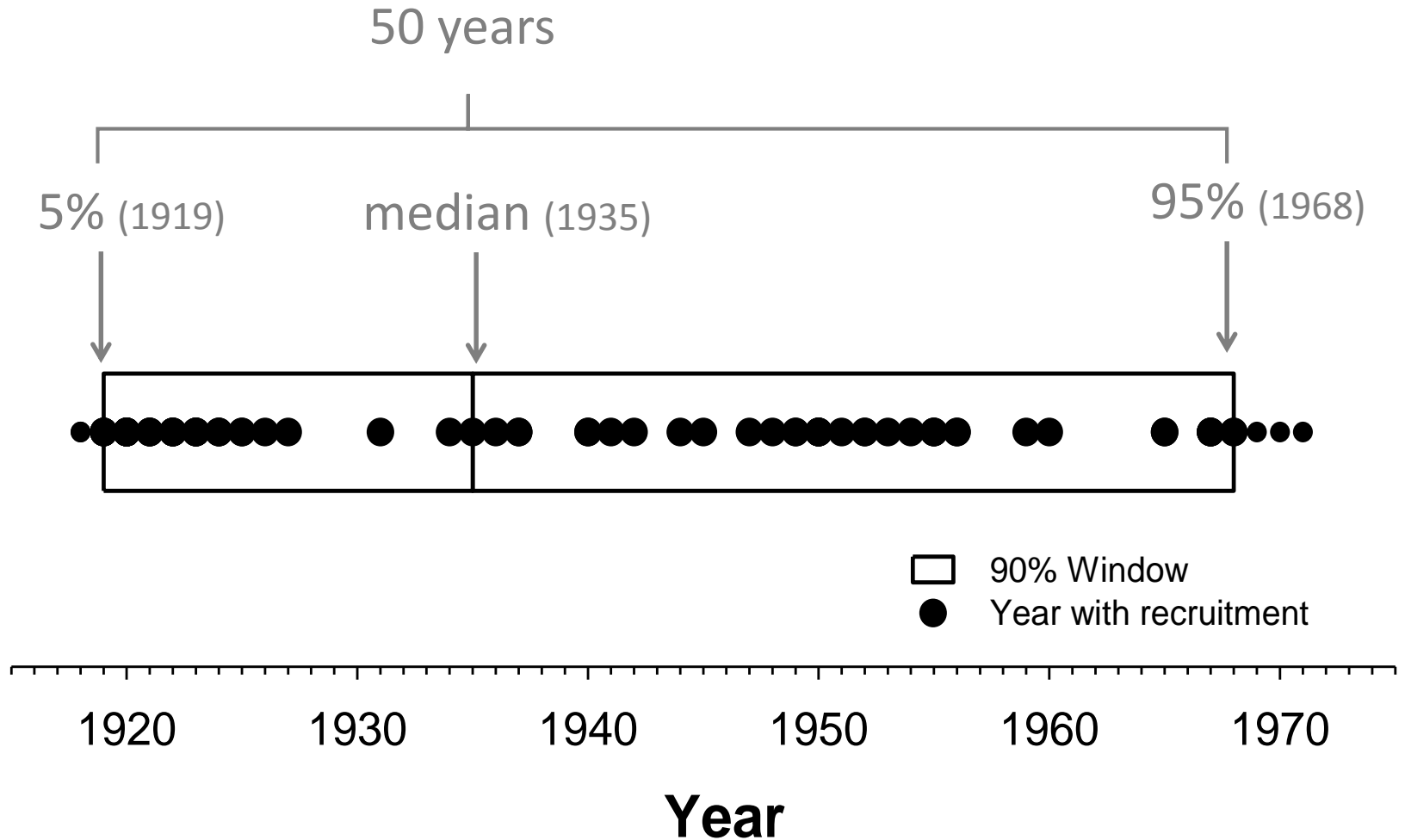
stem map – Nimrod Range



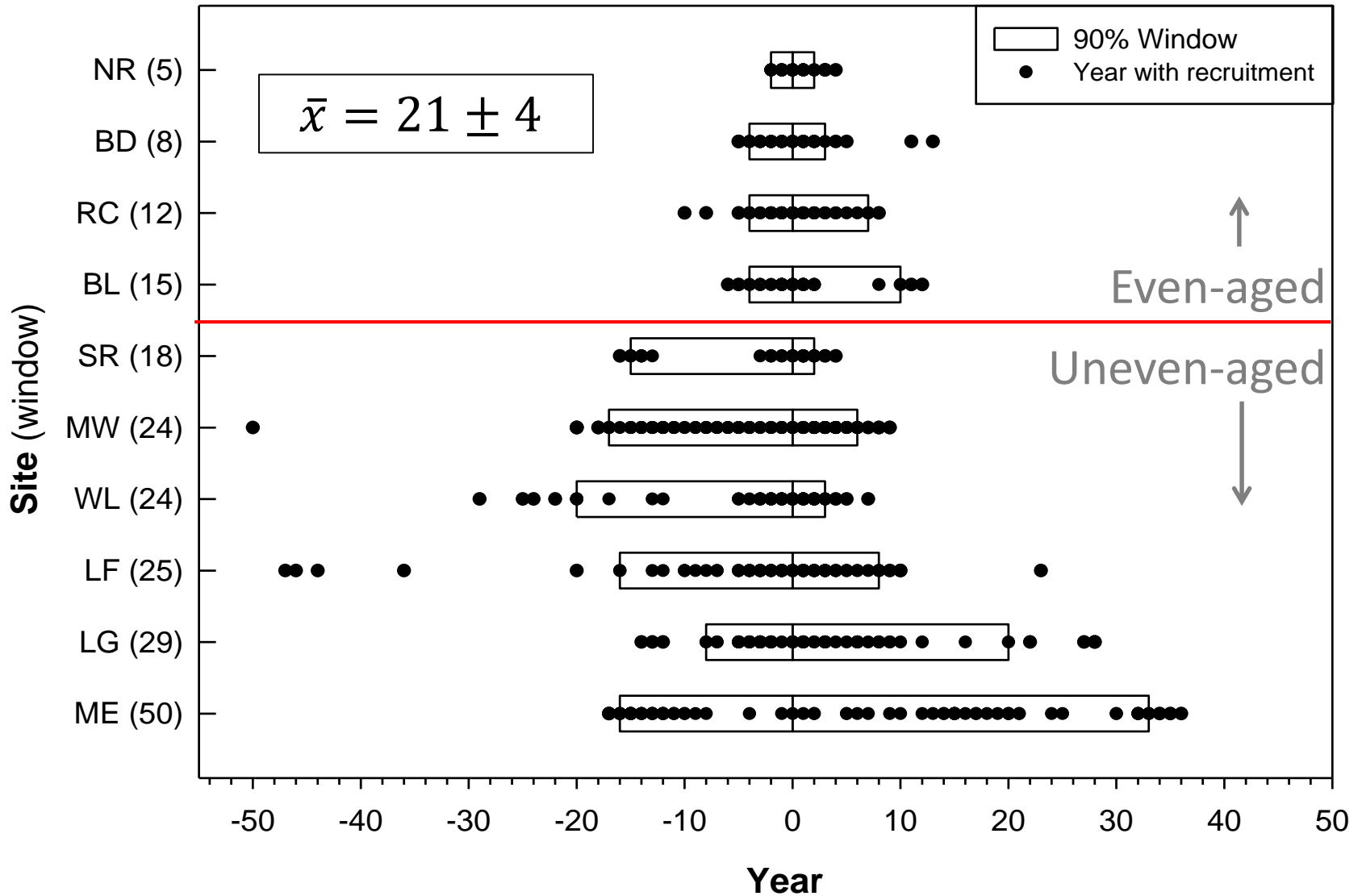
Age Distribution – Midge Lake East



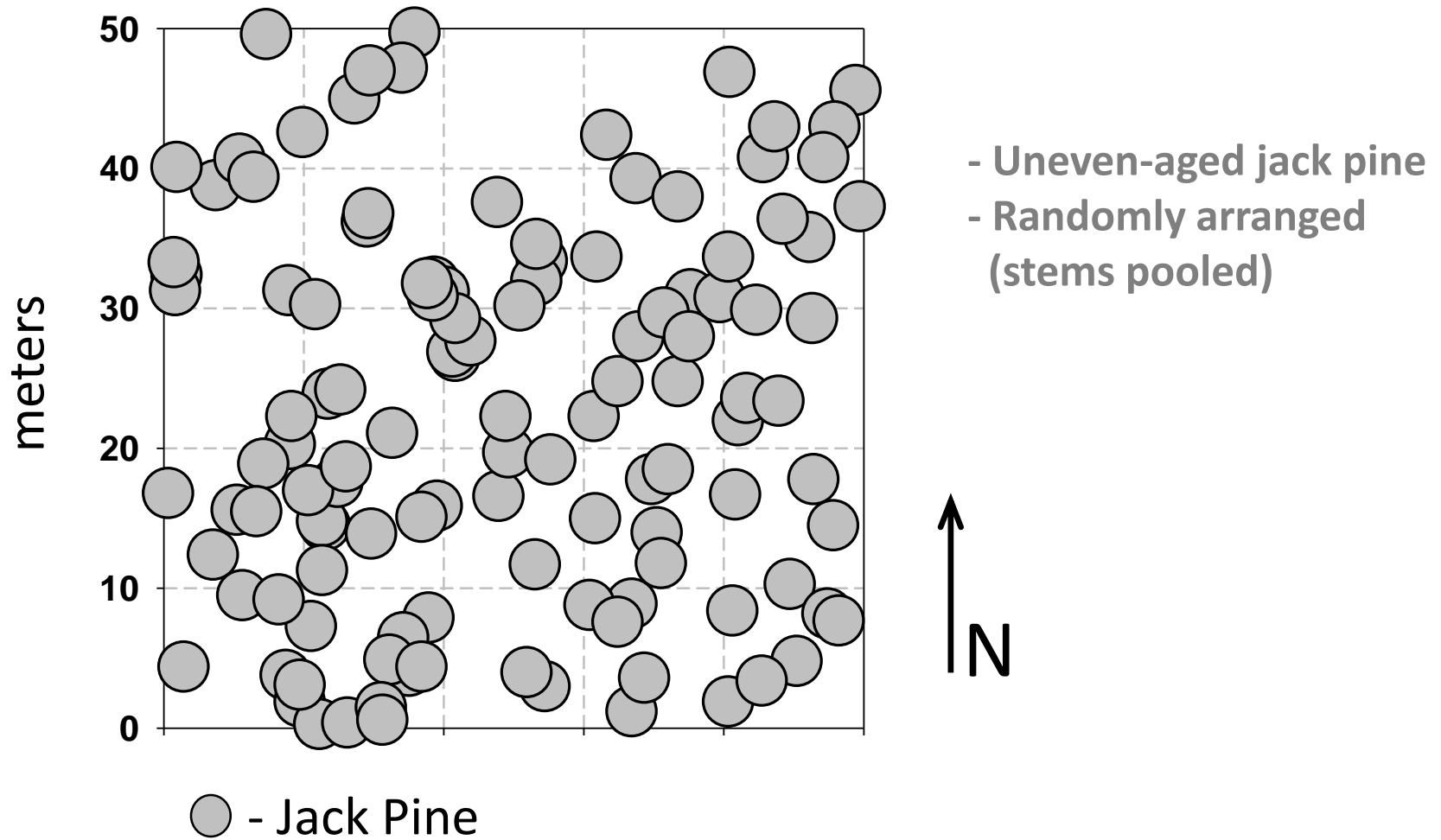
recruitment window – Midge Lake East



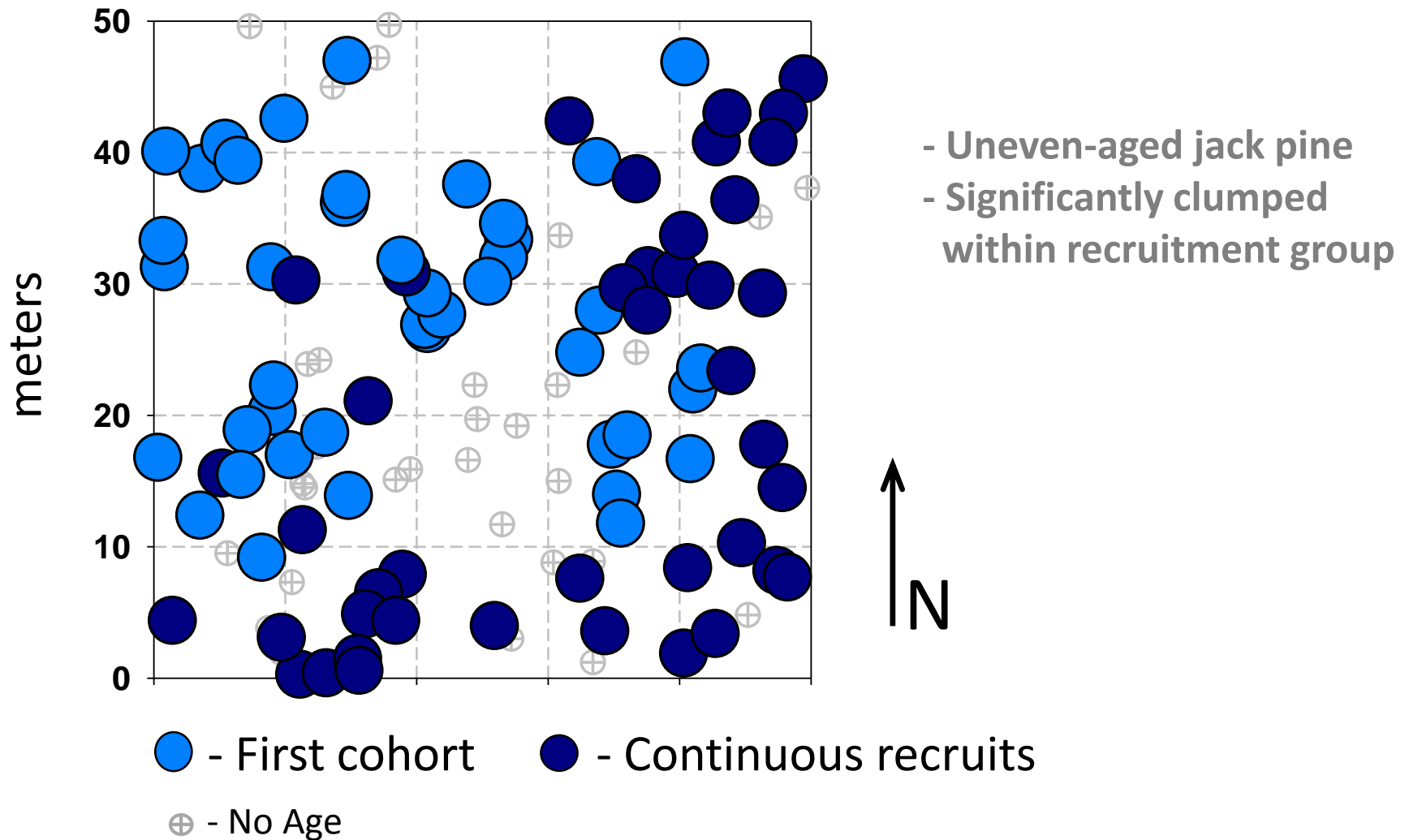
recruitment window – All sites



stem map – Midge Lake East



Stem Map with Age – Midge Lake East



Role of disturbance?





demographic transition

dynamics observed :

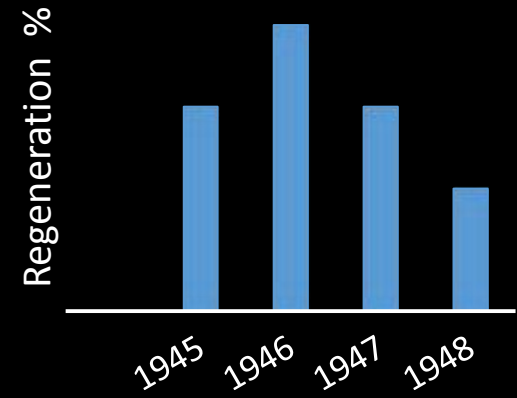


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EVEN-AGED

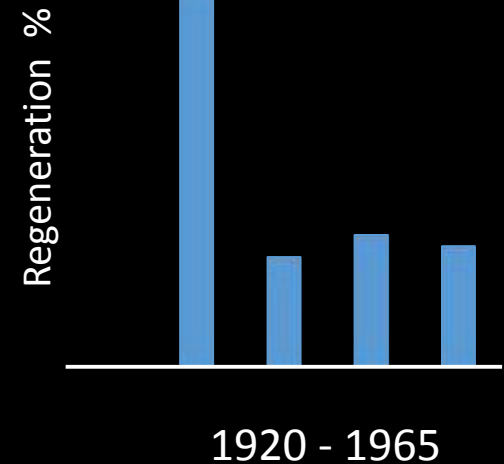


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UNEVEN-AGED



Project objectives:

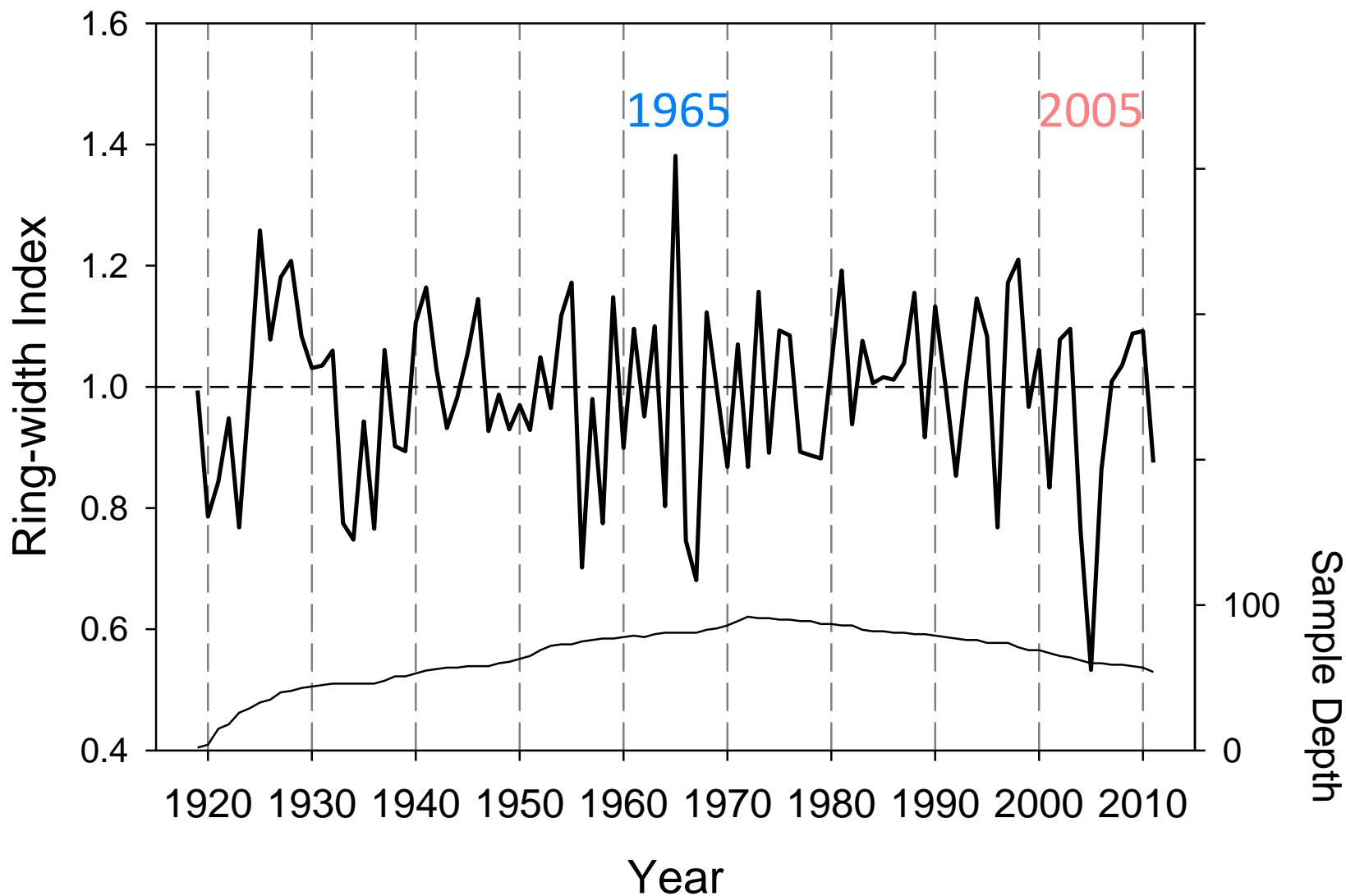
Climate : growth & recruitment

Monthly climate Variables:

- Average temperature
- Precipitation
- Moisture budget (p/pet)

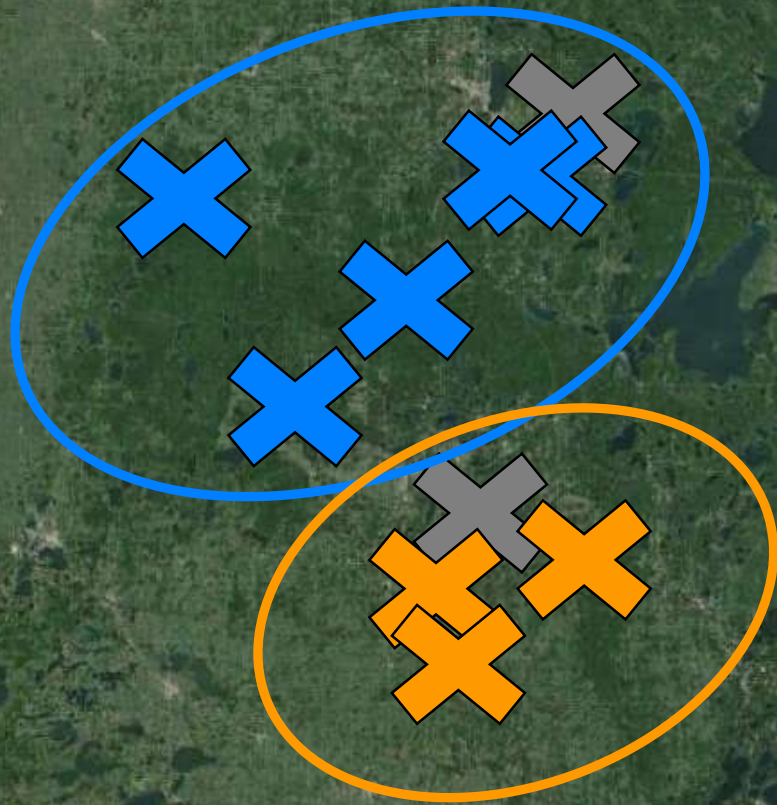


Master Chronology vs. Year

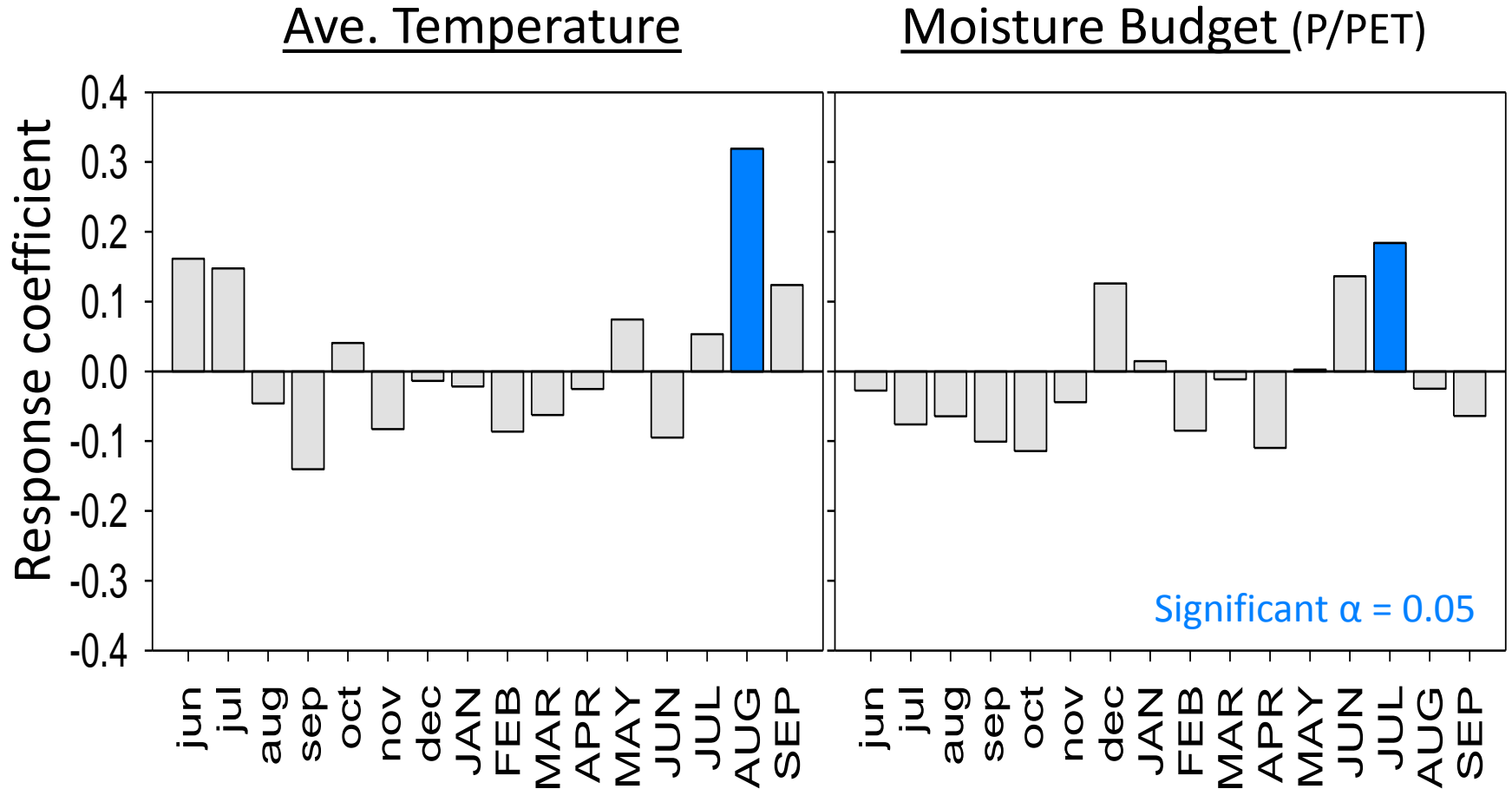


climate : growth – Two Groups

climate : growth – Two Groups

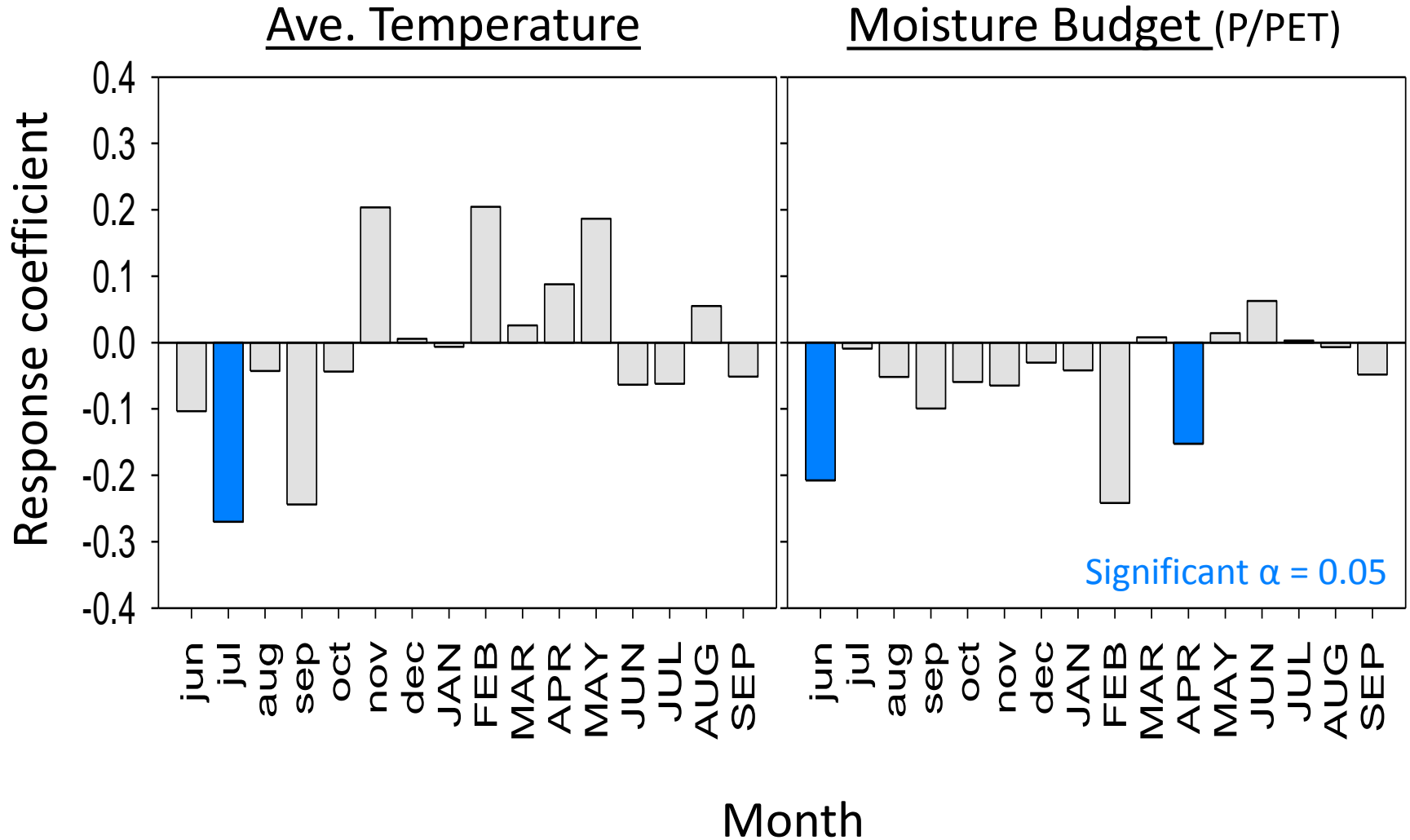


climate : growth – North



16-Month analysis window

climate : growth – South



climate : recruitment – region

T	P	P/PET
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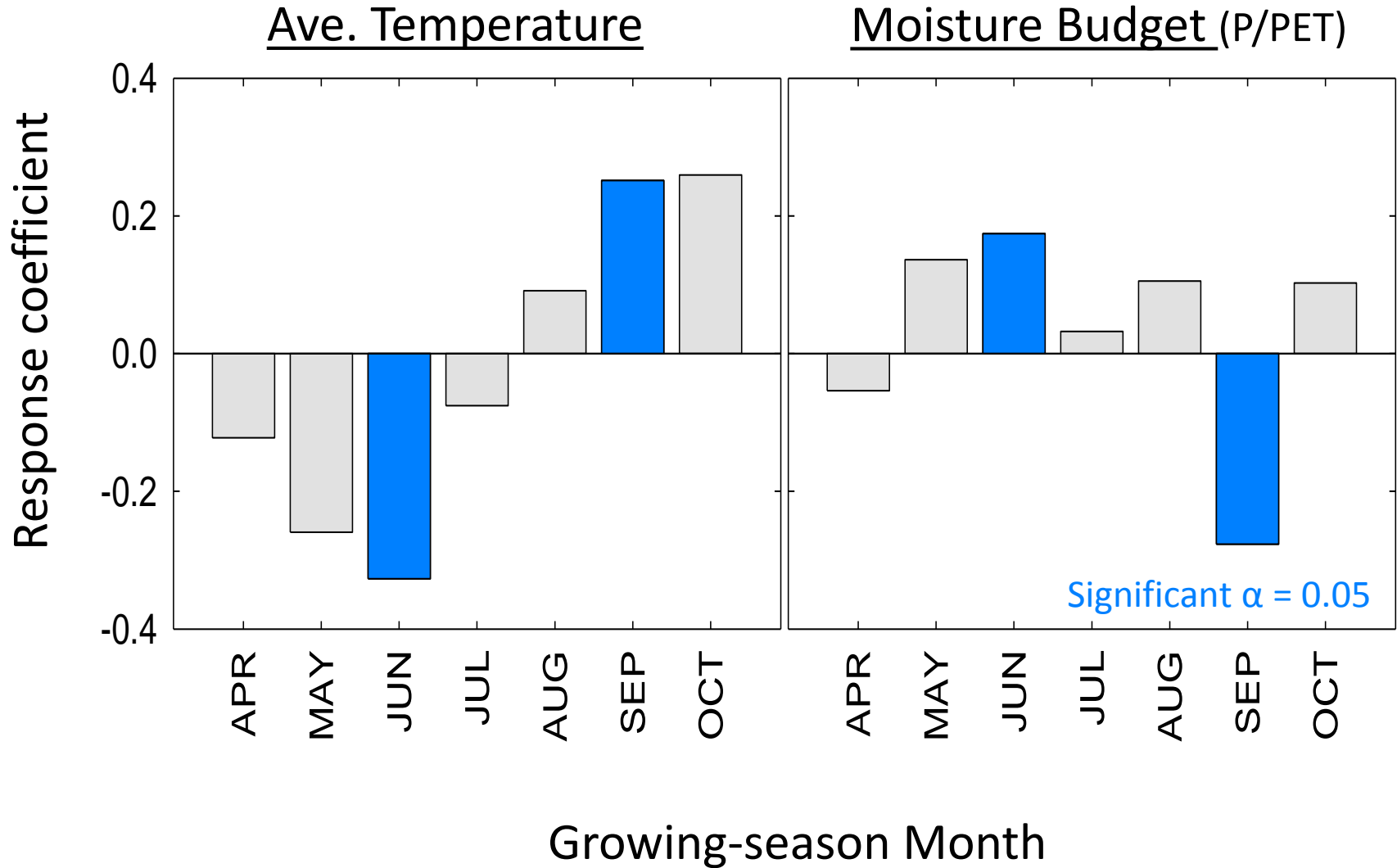
-0.01

0.28

0.27

Pearson's correlation coefficients, $\alpha = 0.05$

climate : recruitment – region



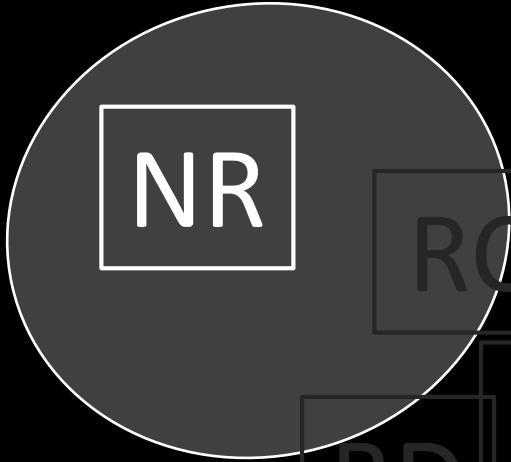


- Succulent stage
- Need cold-hardening
- Within-season variable response

what's causing the Decline?

Dynamics

Climate



RC

BD

BL

SR

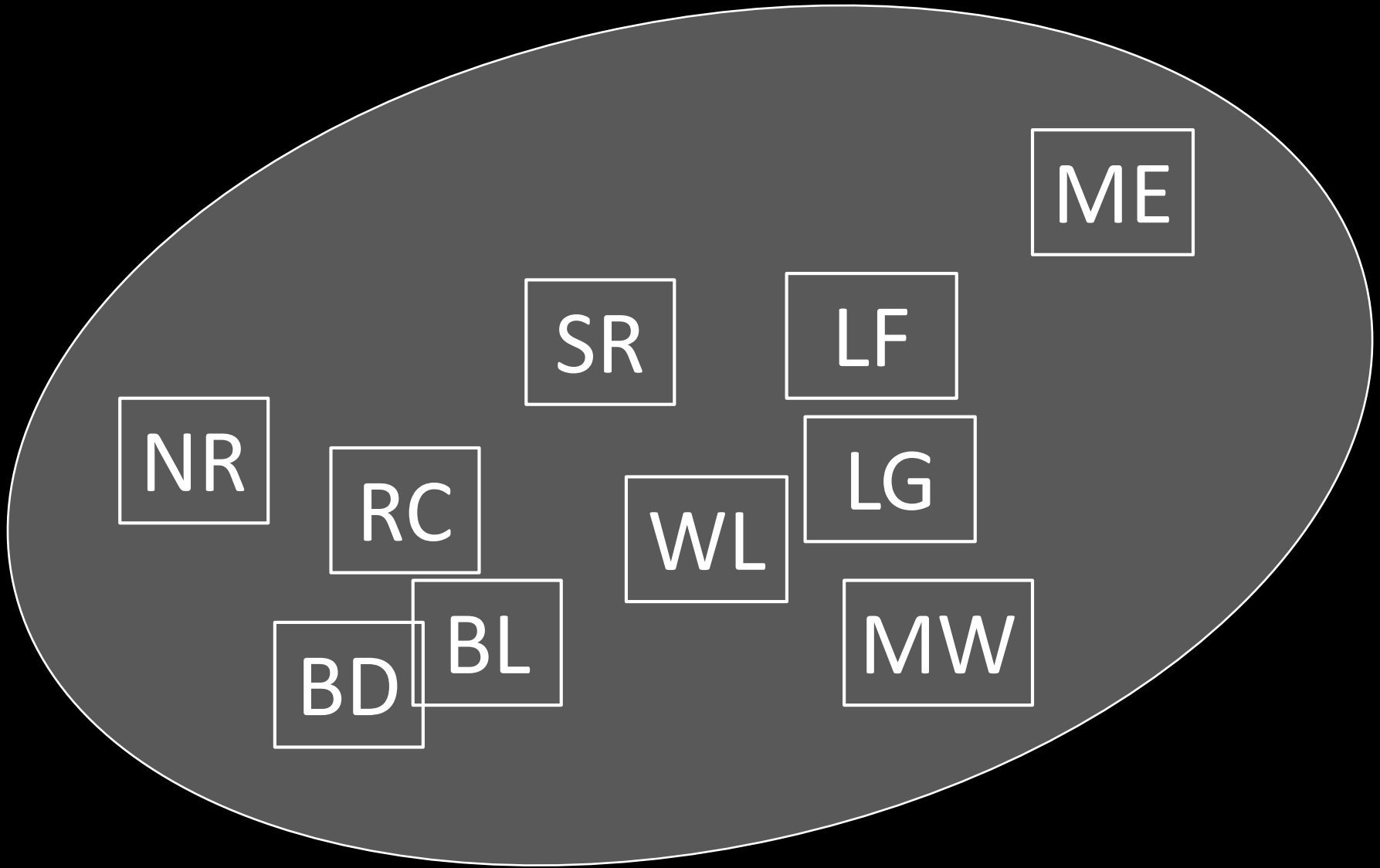
WL

LF

LG

MW

ME



NR

RC

BD

BL

SR

WL

LF

LG

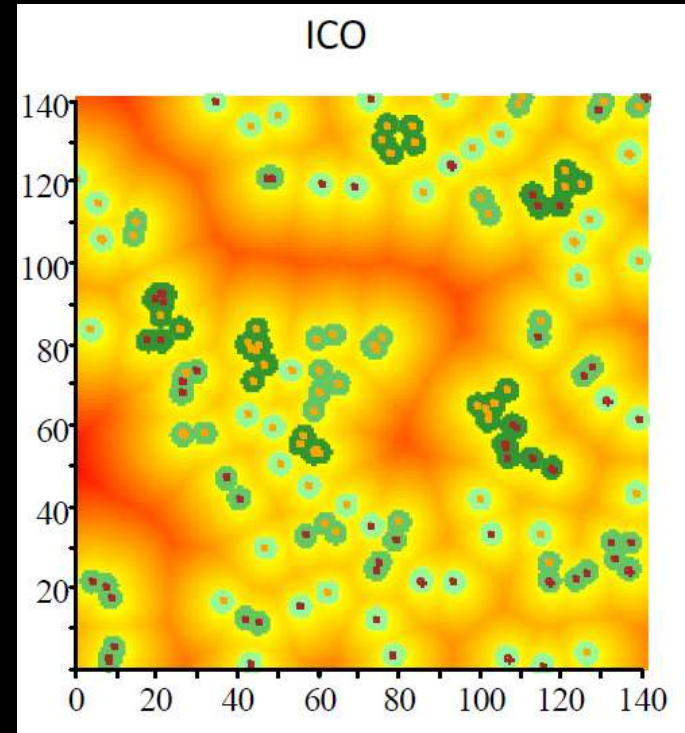
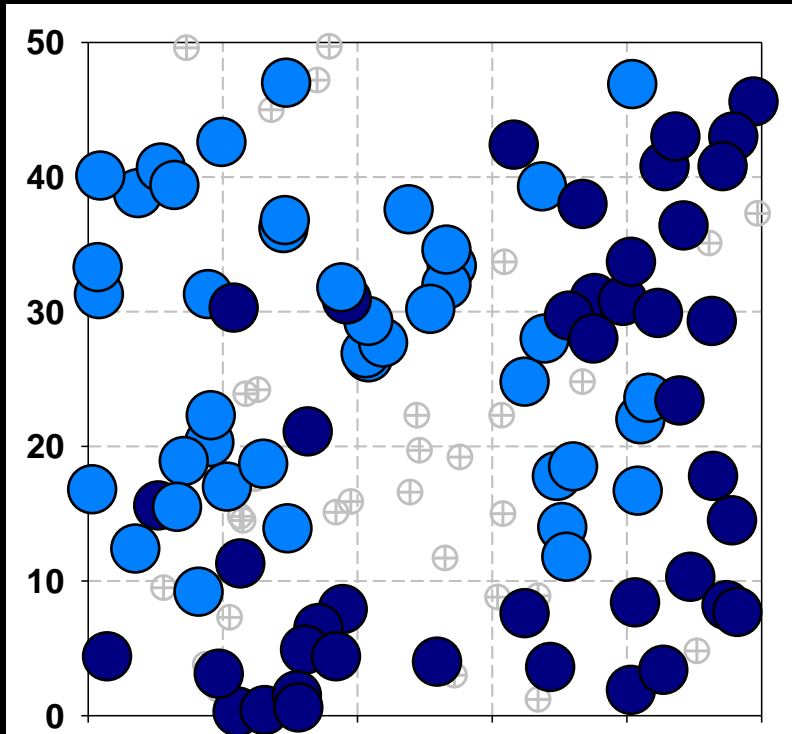
MW

ME

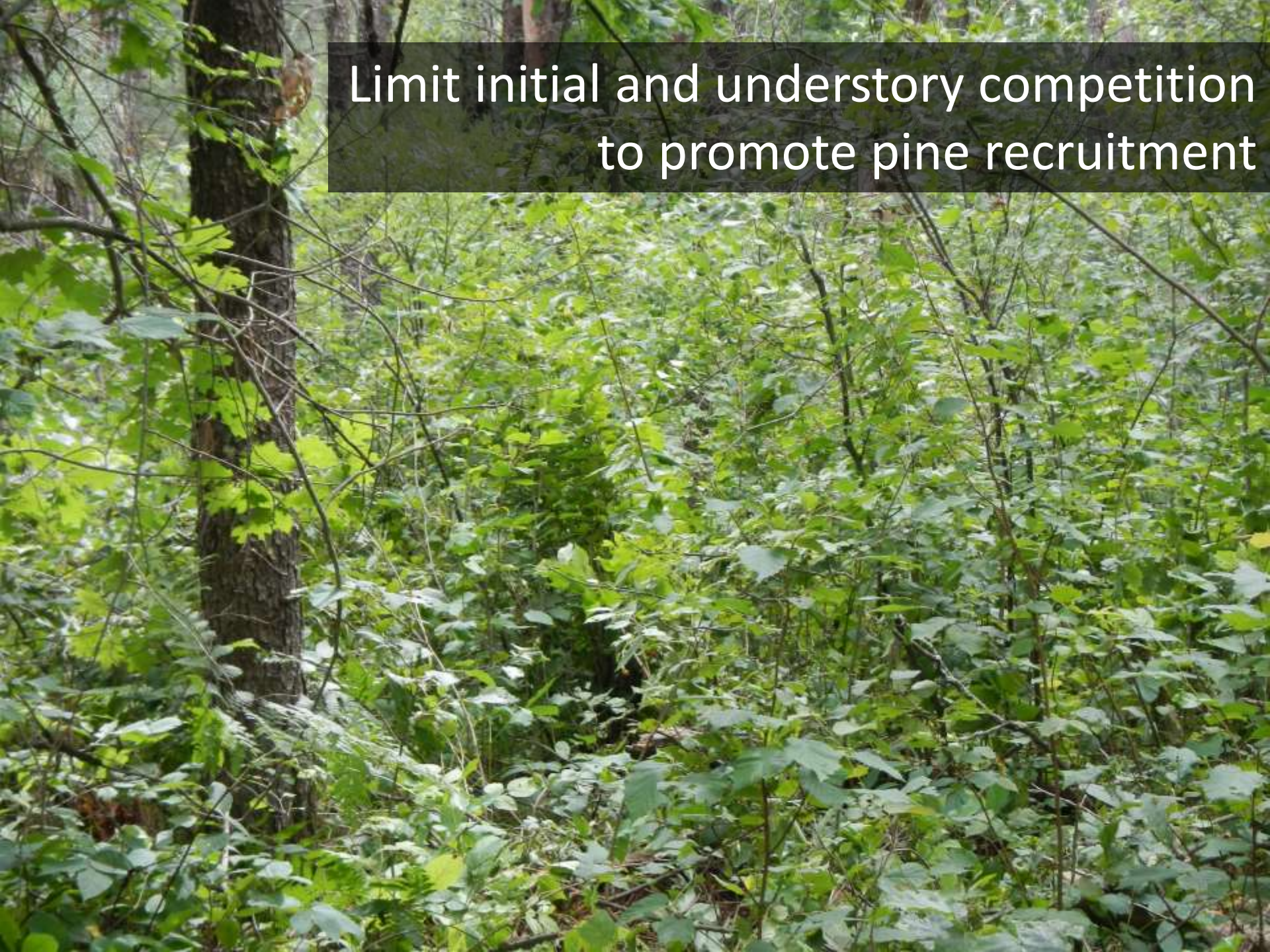
Promote structural complexity



Variable density management – “skips and gaps”



Limit initial and understory competition
to promote pine recruitment



Limit herbivory



What's next?

Always uncertainty...
be prepared to adapt



Questions ?

Acknowledgements

Committee: Tony D'Amato, Shawn Fraver,
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Linda Nagel

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Photo/Figure credits: Serotinous cones – en.Wikipedia.org; Crown fire – wildlandfirefighter.ca; Surface fire - NPS.gov;
Stand development – Oliver 1980 Forest Ecology and Management; Jack pine seedling – nswildflora.ca; ICO graphic -
http://faculty.washington.edu/jlutz/Publications/ICO_Manager_Guide.pdf



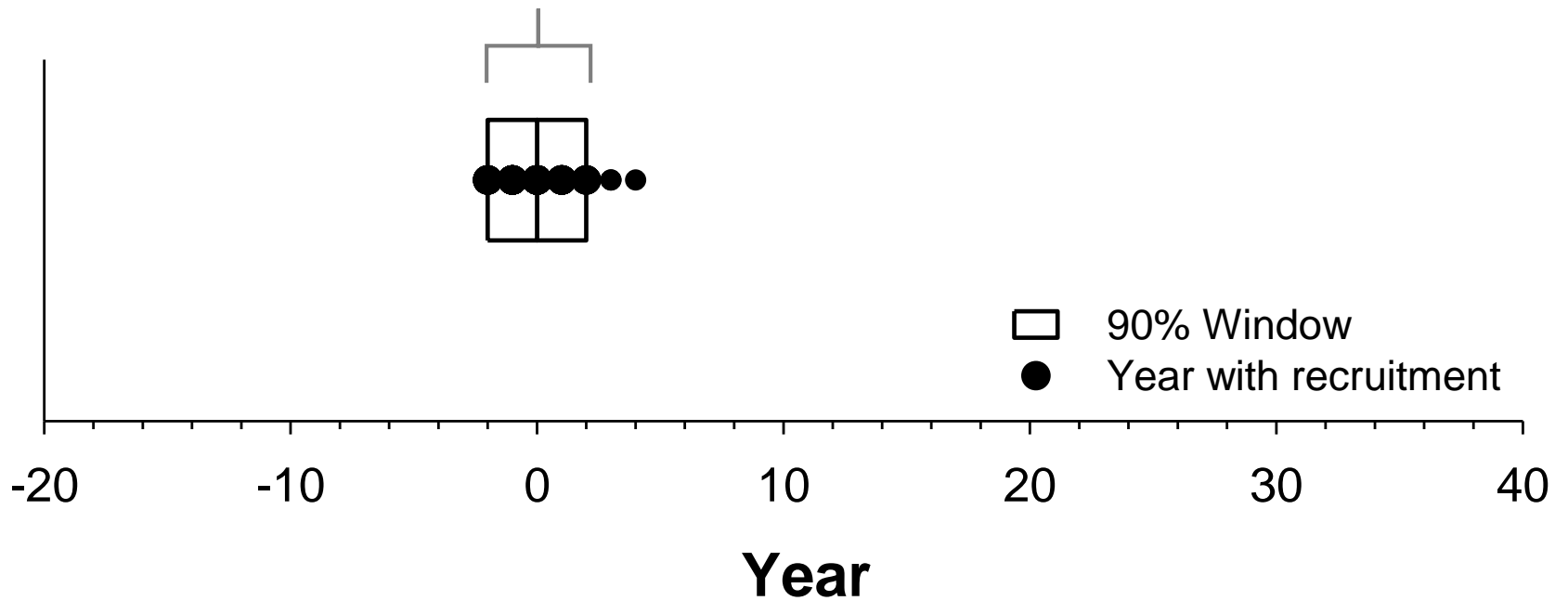
How did **THIS:**

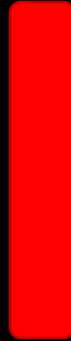
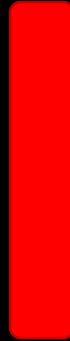
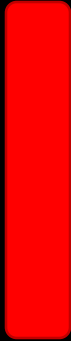
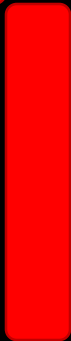
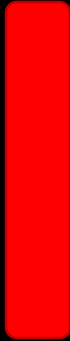
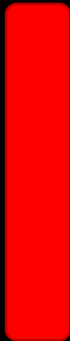
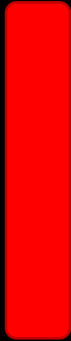
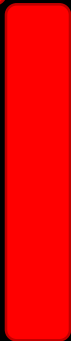


happen?

recruitment window – Nimrod Range

5 years (1946 – 1950)





what's causing the Decline?

D C

