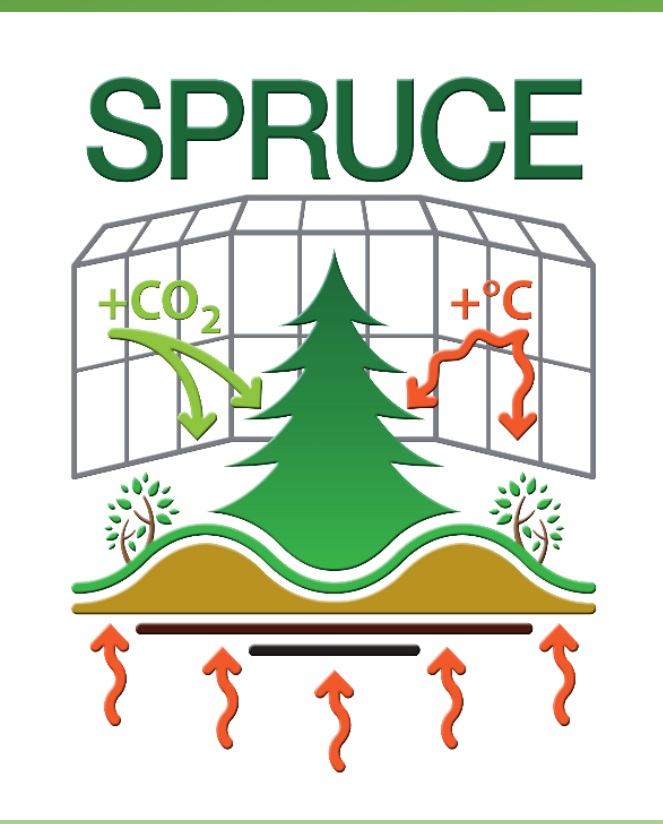


Woody Ecophysiology and Water Relations

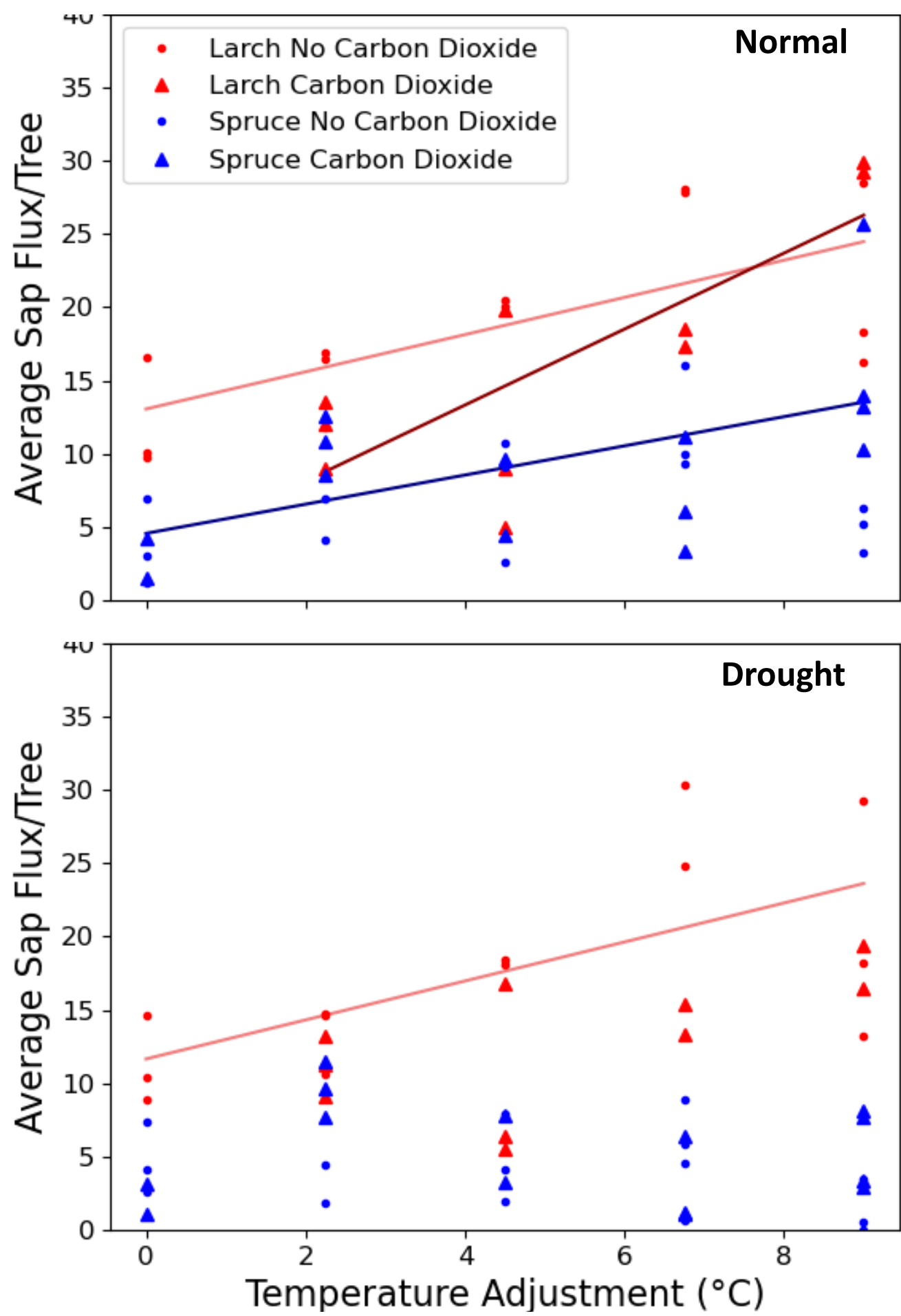


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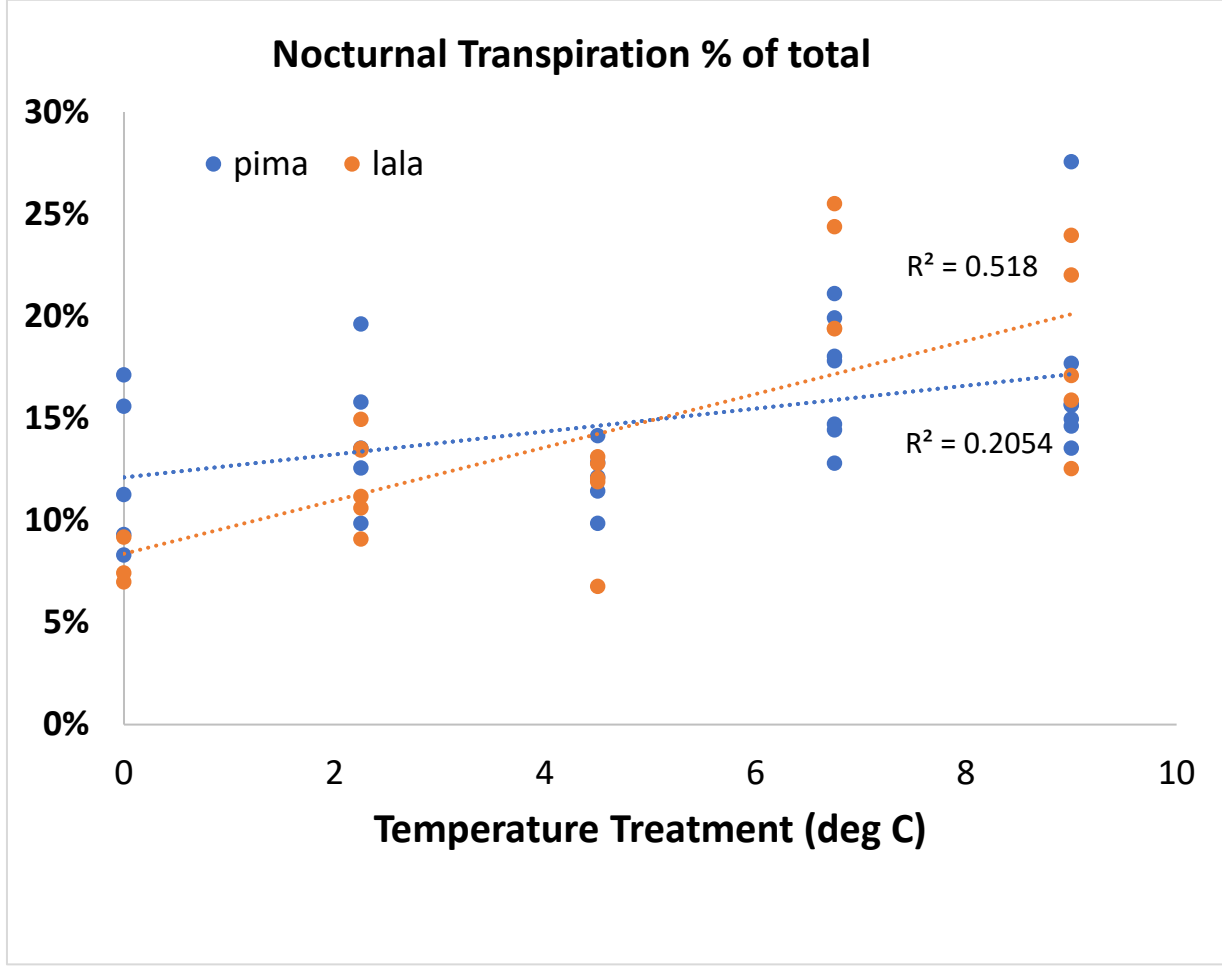
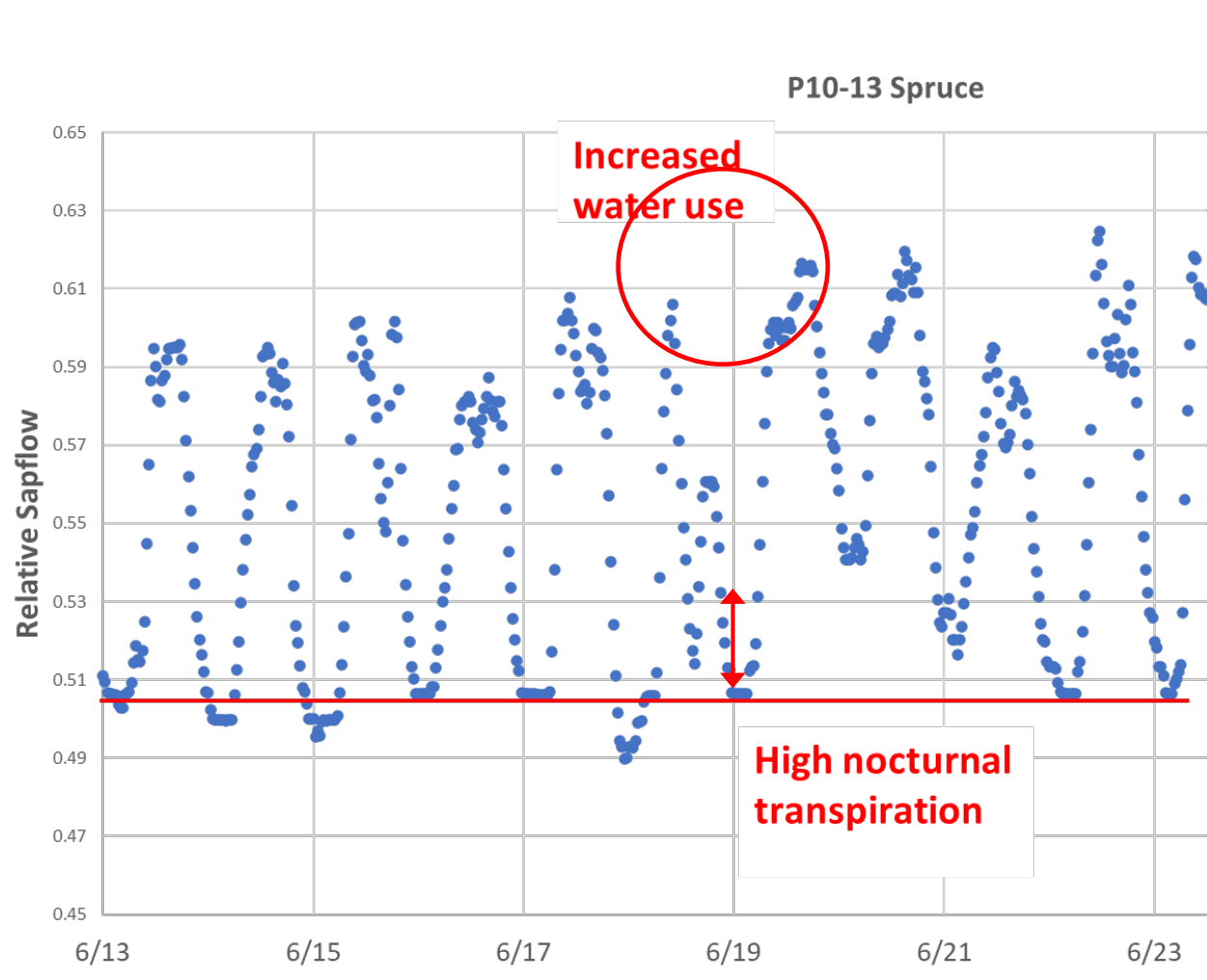
¹Oak Ridge National Laboratory, ²UTK, ³UTRGV, ⁴Cornell

Sap flow

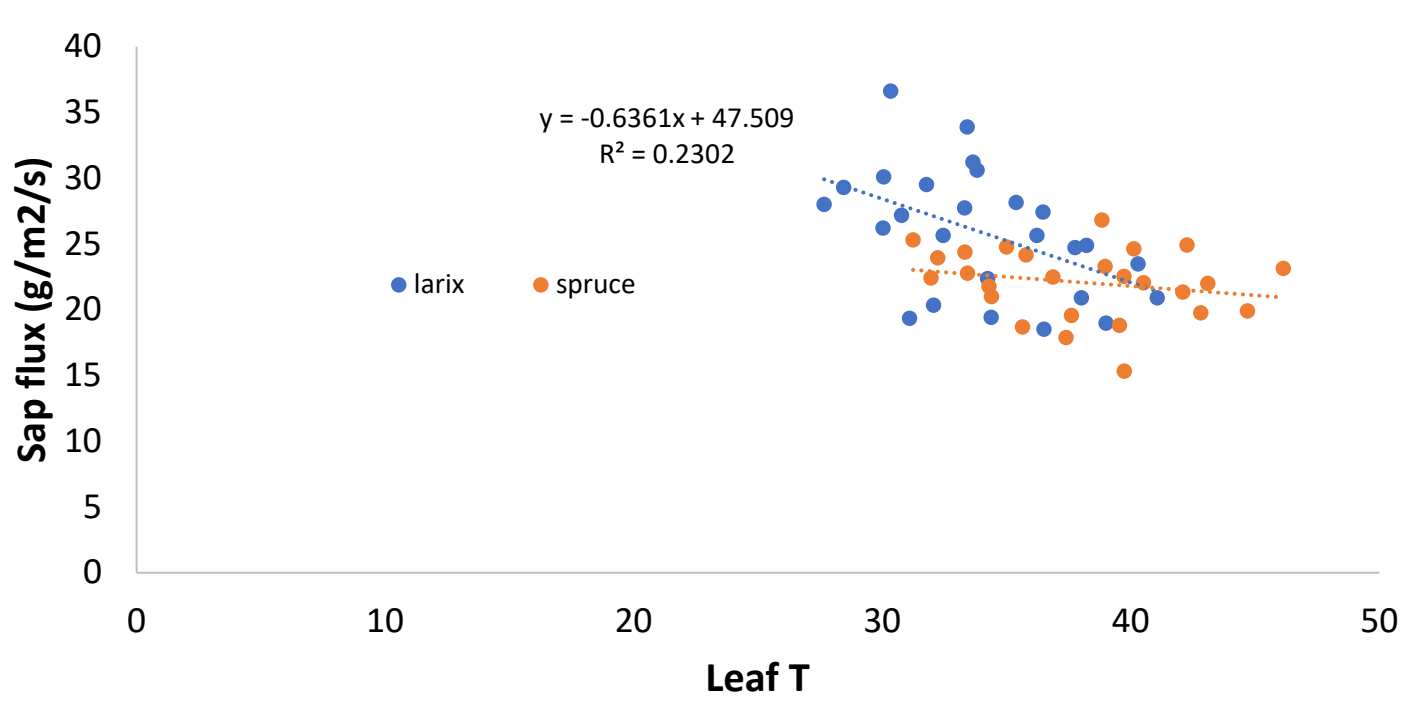
- Warming increases water use
- 2X greater sap flow in larch
- Drought x Warming reduces sap flow for spruce
- Drought x Warming x CO₂ reduces sap flow for larch



Nocturnal Transpiration

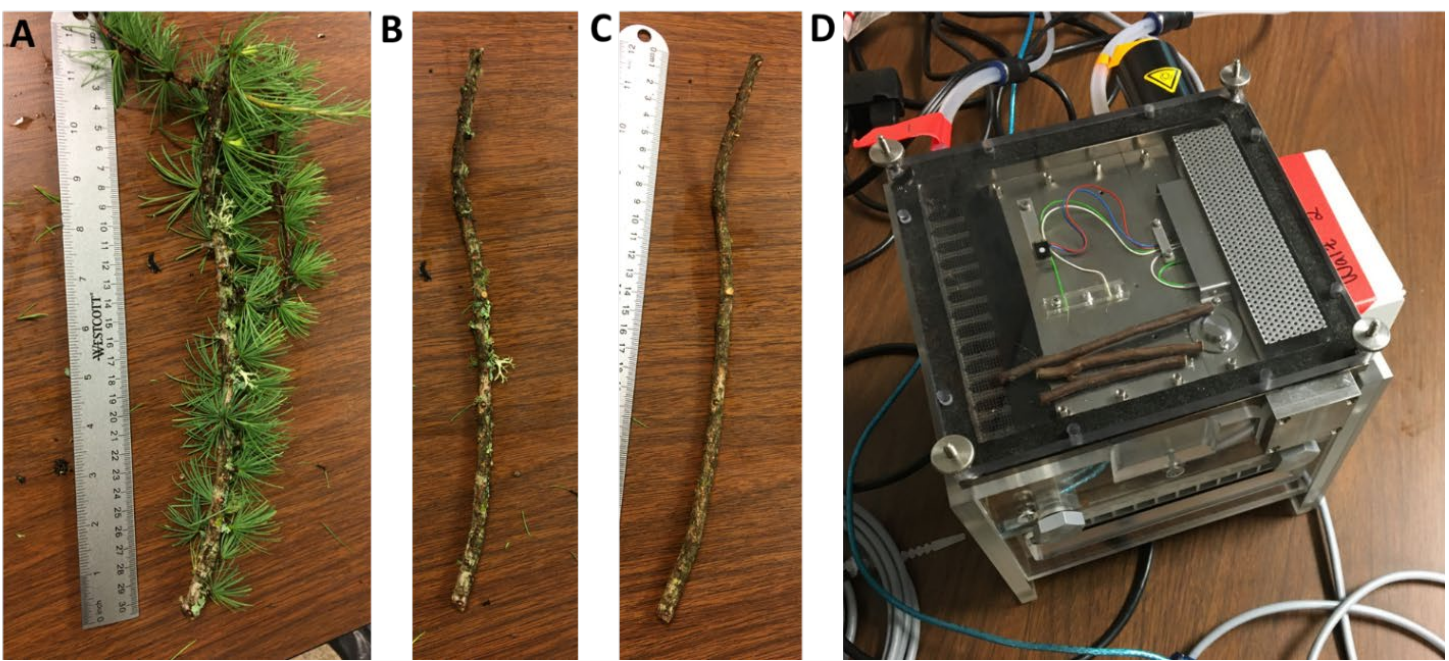


Sap flow reaches a maximum at T increases.
Is there a threshold T when sap flow declines?



Woody Respiration

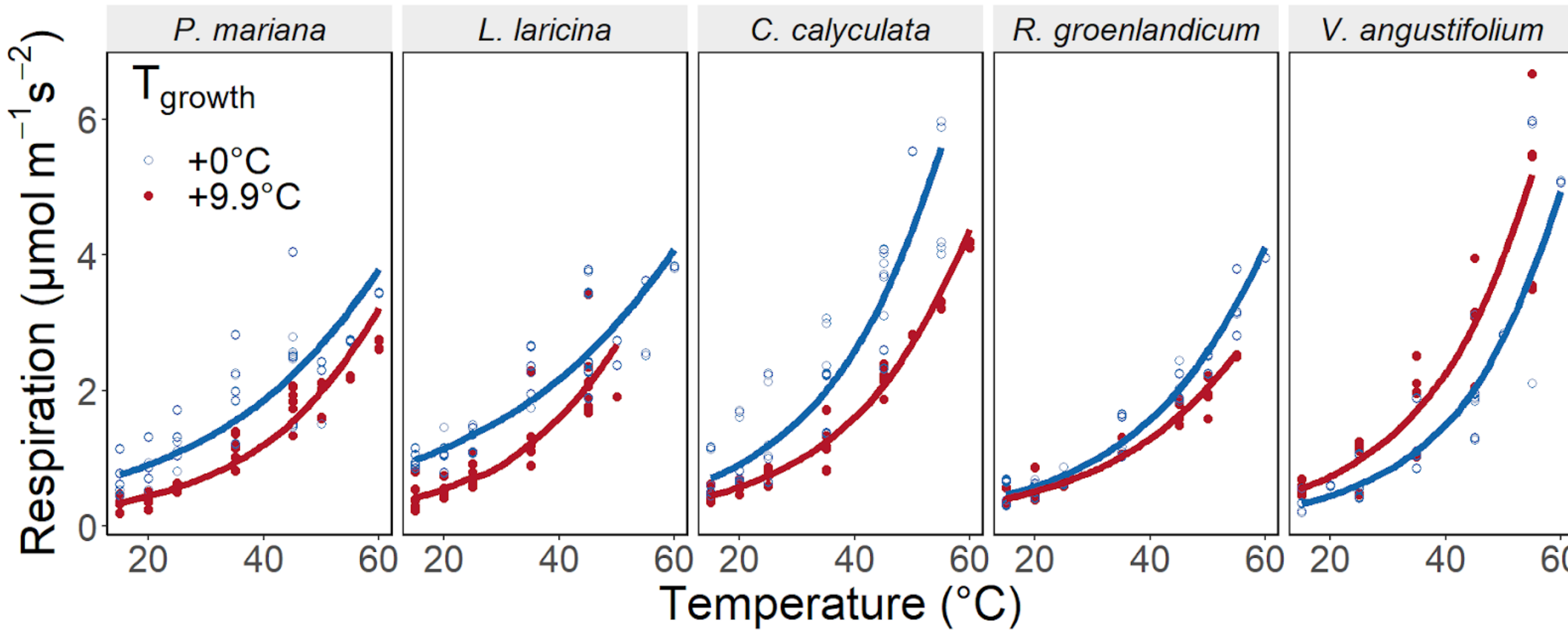
- At the SPRUCE whole ecosystem warming experiment in Minnesota woody respiration rates were measured at 15, 25, 35, 45, 55 and 60 °C
- Species included black spruce, tamarack, blueberry, leatherleaf Labrador tea from woody plants growing in ambient and +9 °C plots
- Licor LI-6800 retrofitted to temperature-controlled cuvette



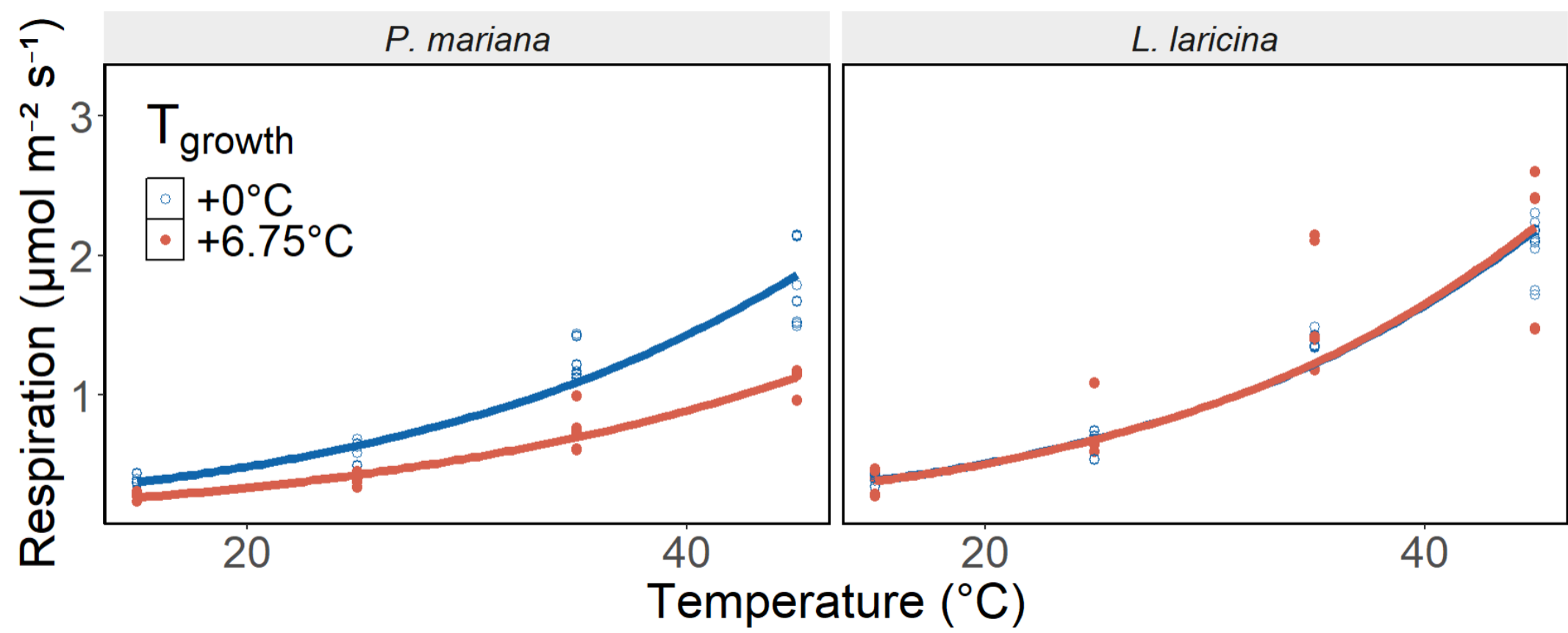
A) freshly cut *Larix* branch
B) foliage removed
C) lichen removed
D) *Chamaedaphne* branch

Woody Respiration

- In June 2023 - Strong thermal acclimation of woody respiration in spruce, tamarack and two shrubs.
- Highly active blueberry (*V. angustifolium*) had no acclimation.



- Acclimation may depend on phenology? – growth vs. maintenance respiration
- Measurements conducted in late June 2023 - active growth period
- Remeasured acclimation response of trees in mid August 2024 (below)

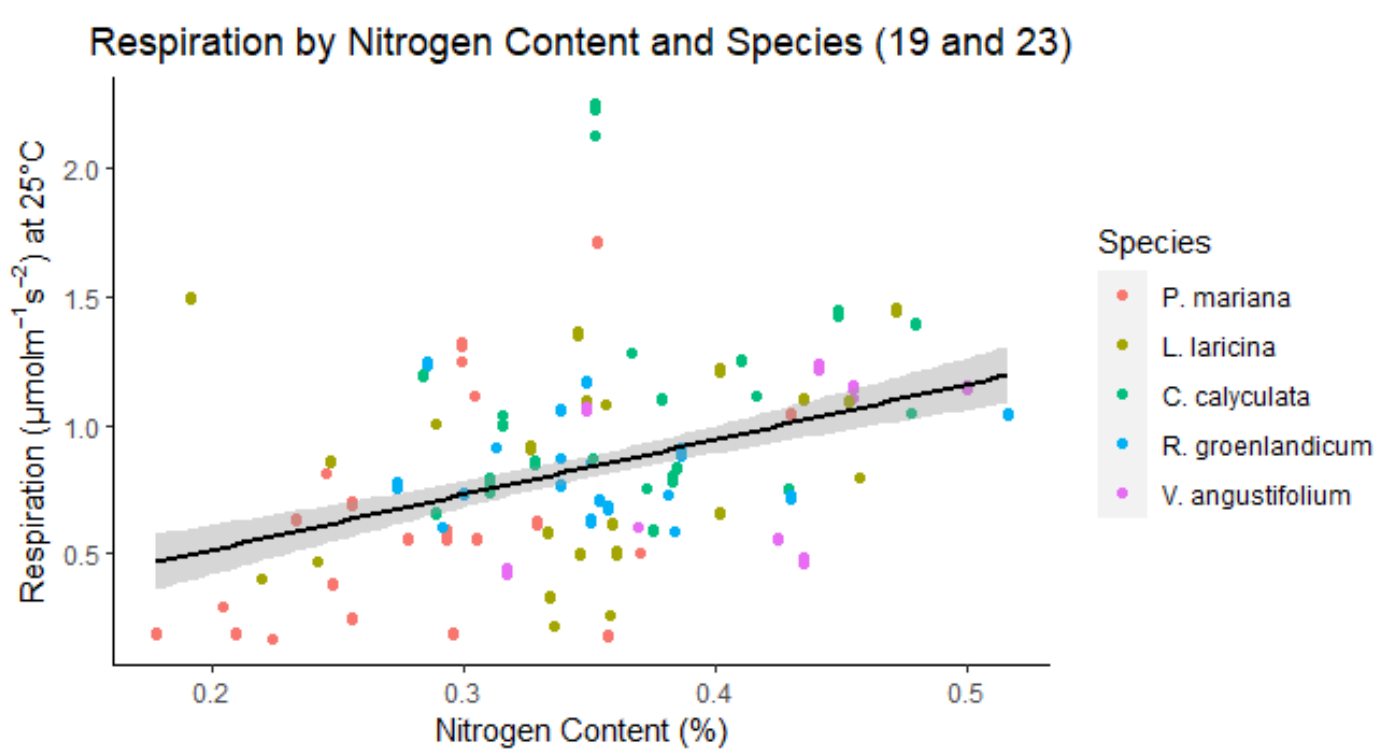


- In August 2024 - Full acclimation of spruce - no acclimation of tamarack

Species	Growth Temperature Treatment			
	+0°C		+9°C	
	Average Crash Temperature (°C)	St error	Average Crash Temperature (°C)	St error
<i>V. angustifolium</i>	51.25	3.75	52.5	2.5
<i>C. calyculata</i>	51.25	2.39	52.5	3.23
<i>R. groenlandicum</i>	55	2.04	51.25	1.25
<i>P. mariana</i>	51	2.92	52	3.39
<i>L. laricina</i>	50	3.16	45.83	0.83

Woody respiration crashed at high temperature, leading to irreversible damage

Respiration increased with stem nitrogen content across species and treatments



Final Measures

- Gas exchange
 - A-Ci x T response
 - Rd x T response, NSC diurnal
 - Rubisco, Chl, stomata, etc...
- Leaf Temp x Sap flow
- WP – predawn & midday
- Hydraulics
 - Root/branch PLC, Hyd Con
- Other ???



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