Adaptation of Diapause Induction Cue Enables Range Expansion of the Tamarisk Leaf Beetle

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GRADUATE DEGREE PROGRAM IN ECOLOGY
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Evolution in tamarisk biocontrol

Tamarisk

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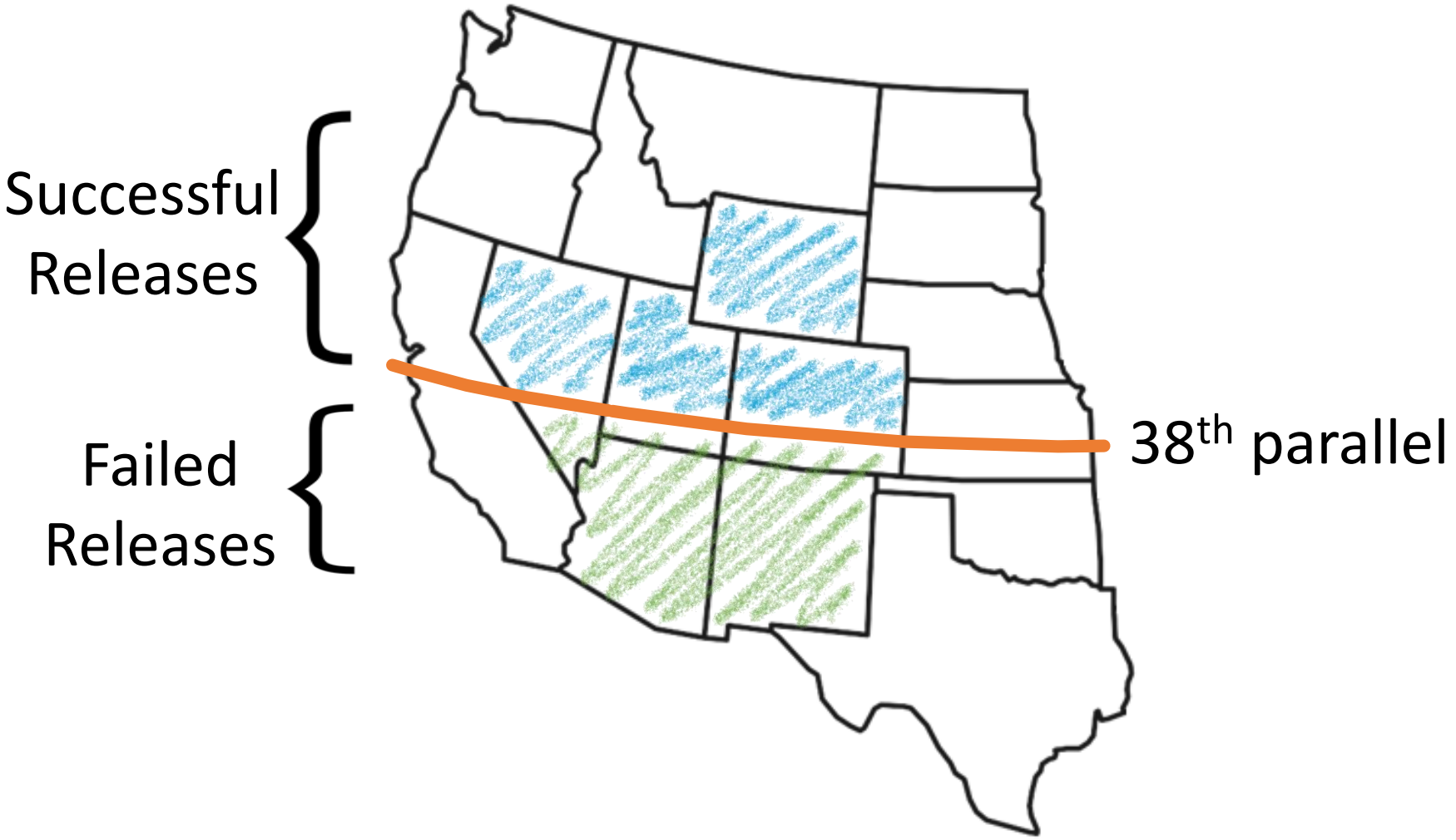
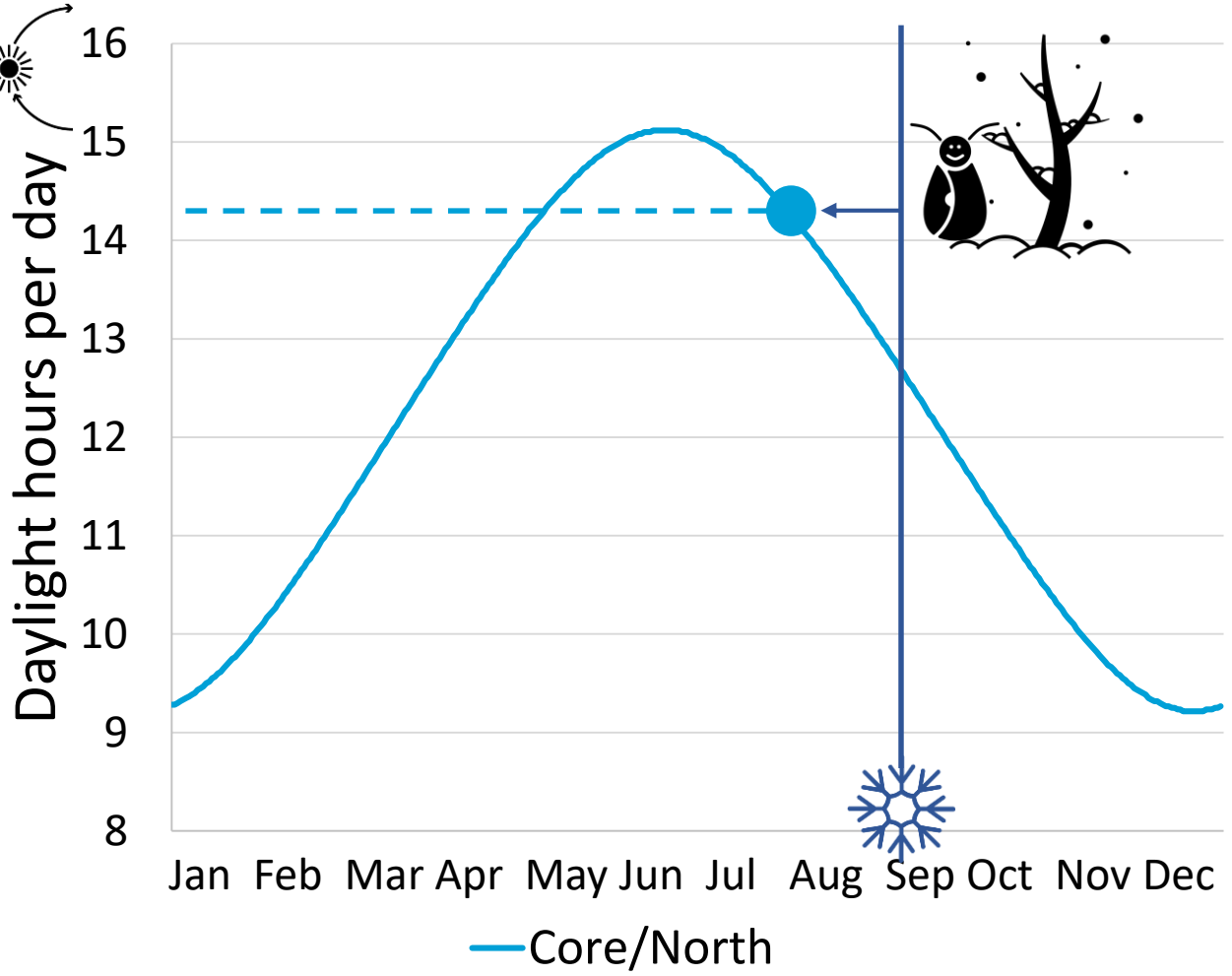
Northern Tamarisk Leaf Beetle
(*Diorhabda carinulata*)

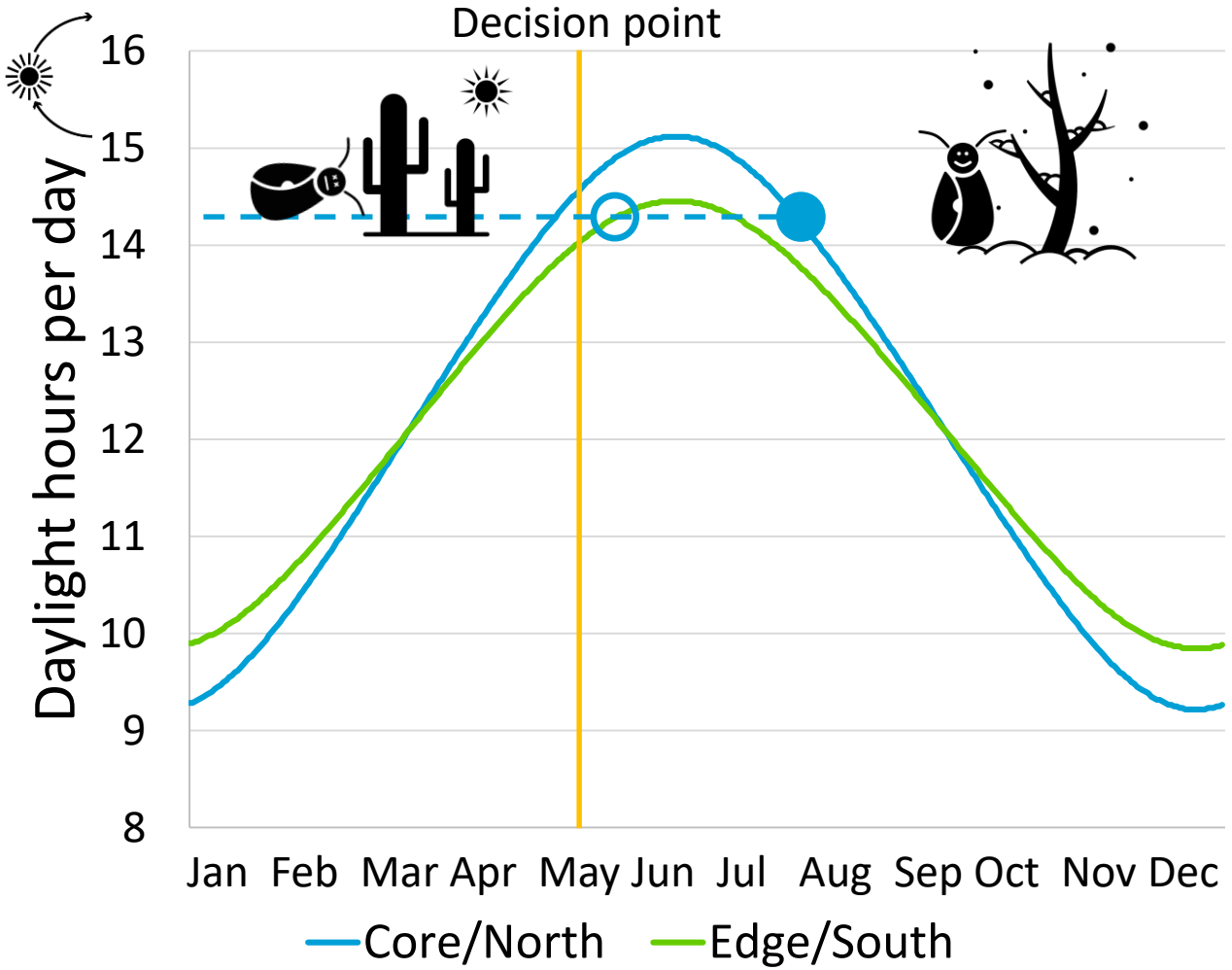
Diorhabda releases - 2001



Daylengths and diapause

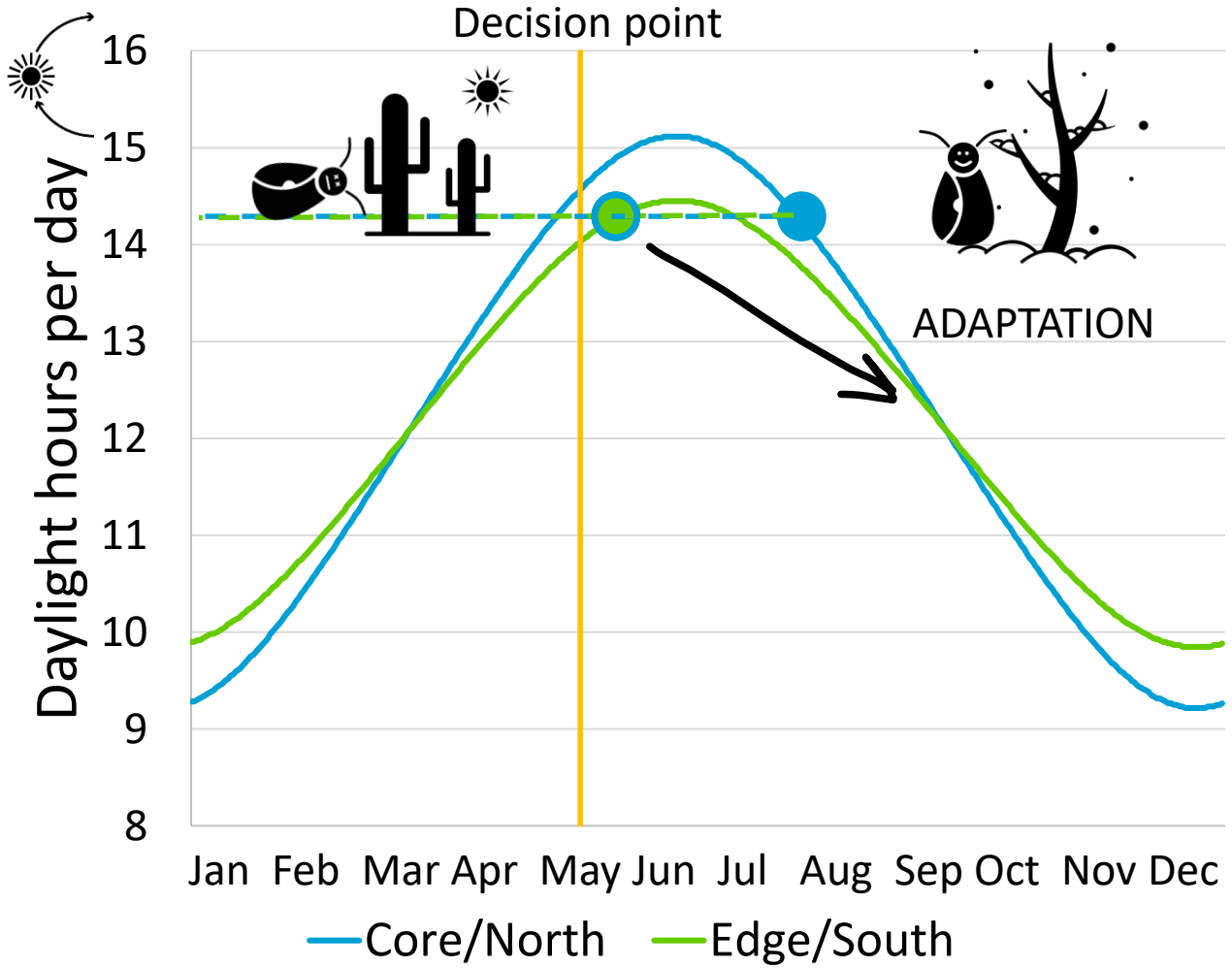


Daylengths and diapause

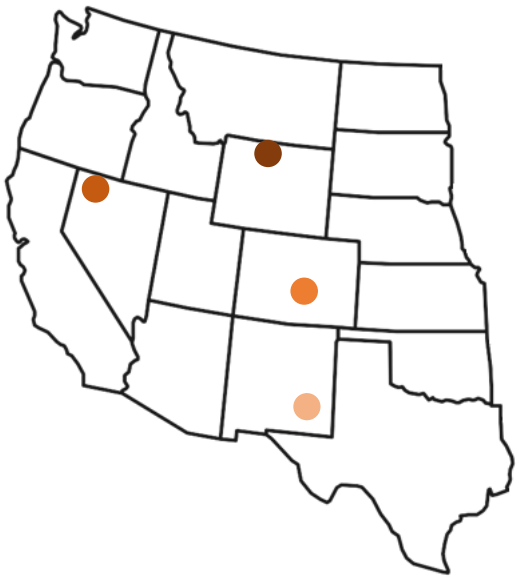


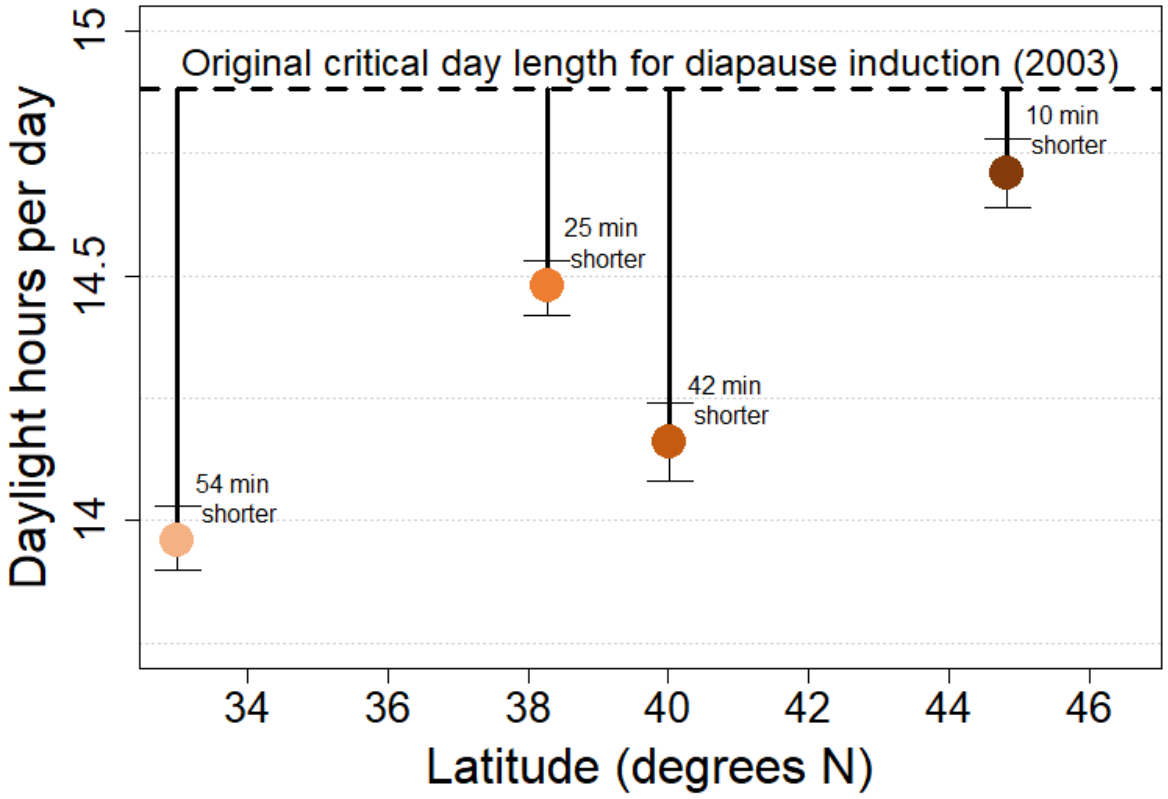
Local adaptation to daylength

1. Match timing of northern populations.
2. Adapt to the southern environment.



Critical day length for a population





Data from Bean, et al. 2012.

A new trait: days until diapause

Population-level measurement

Critical day length:

50% of **population** enters diapause

Individual-level measurement

Days until diapause:

for an **individual** at a day length

Objectives for days until diapause

1. Heritability:
   Is there heritable variation
   for selection to act upon?

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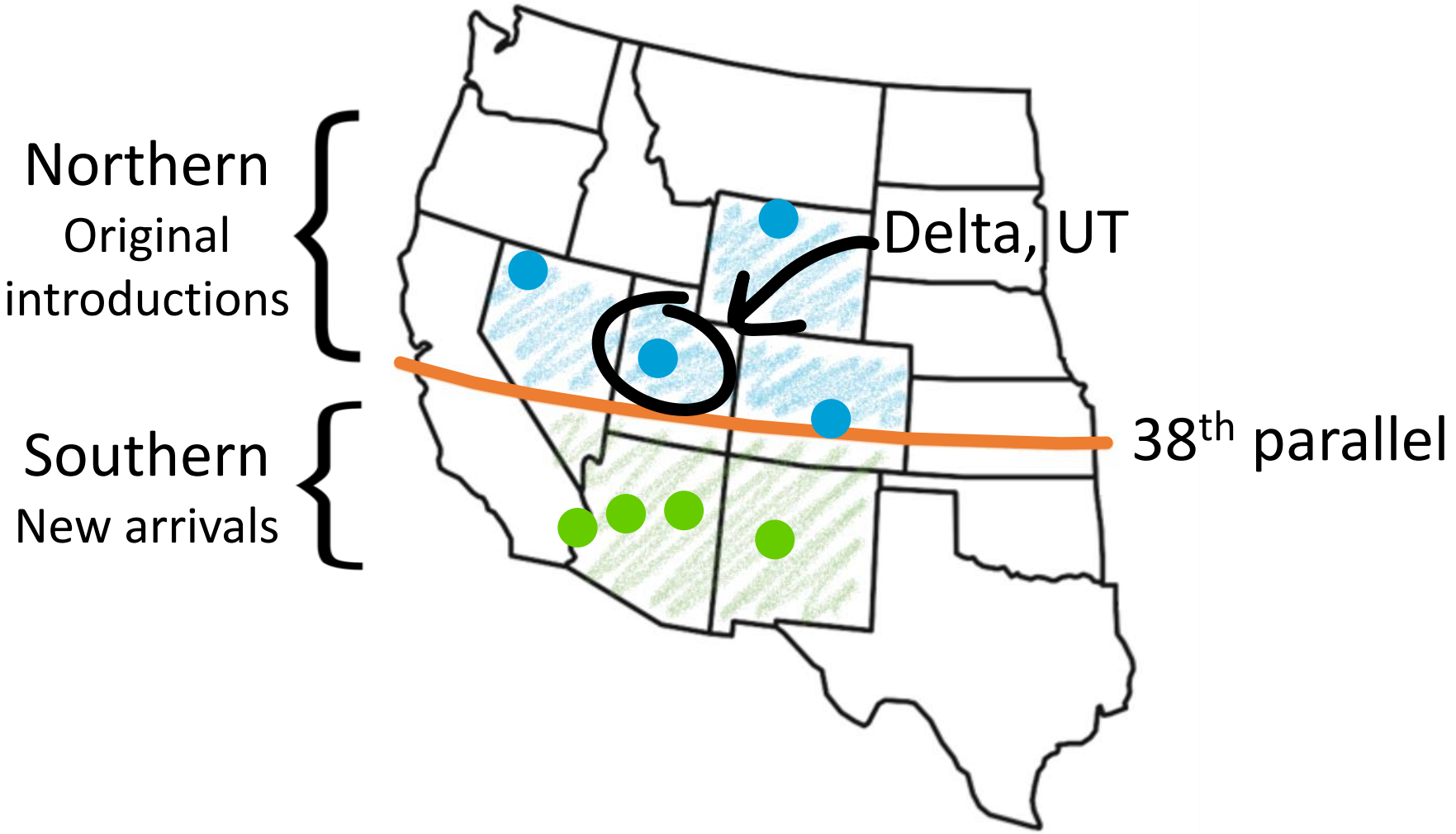
2. Adaptation:
   Are populations locally
   adapted across the range?

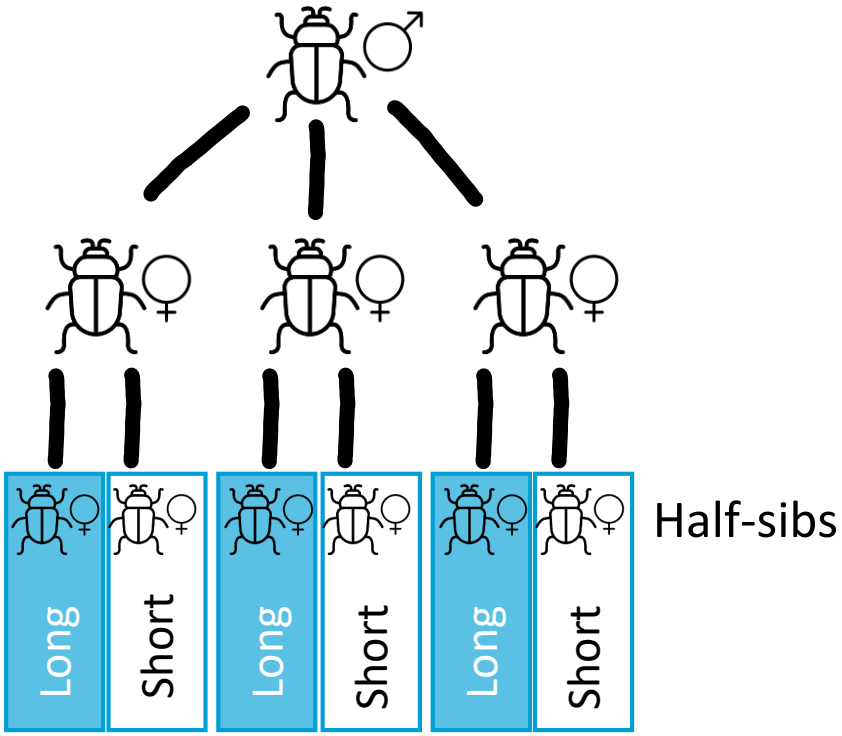
Diorhabda collections - 2017

Diorhabda collections - 2017



Heritability methods

Paternal half-sibling breeding design

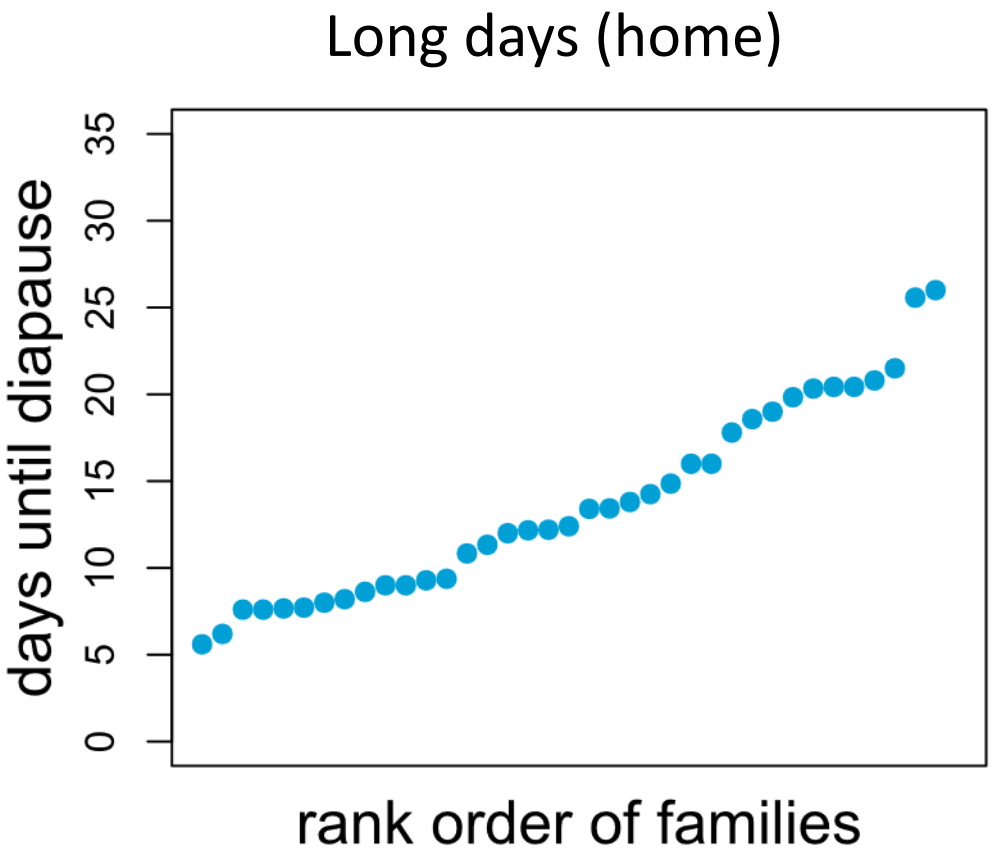


Two environments

Long days (home)
13 hr : 55 min
80% predicted to diapause

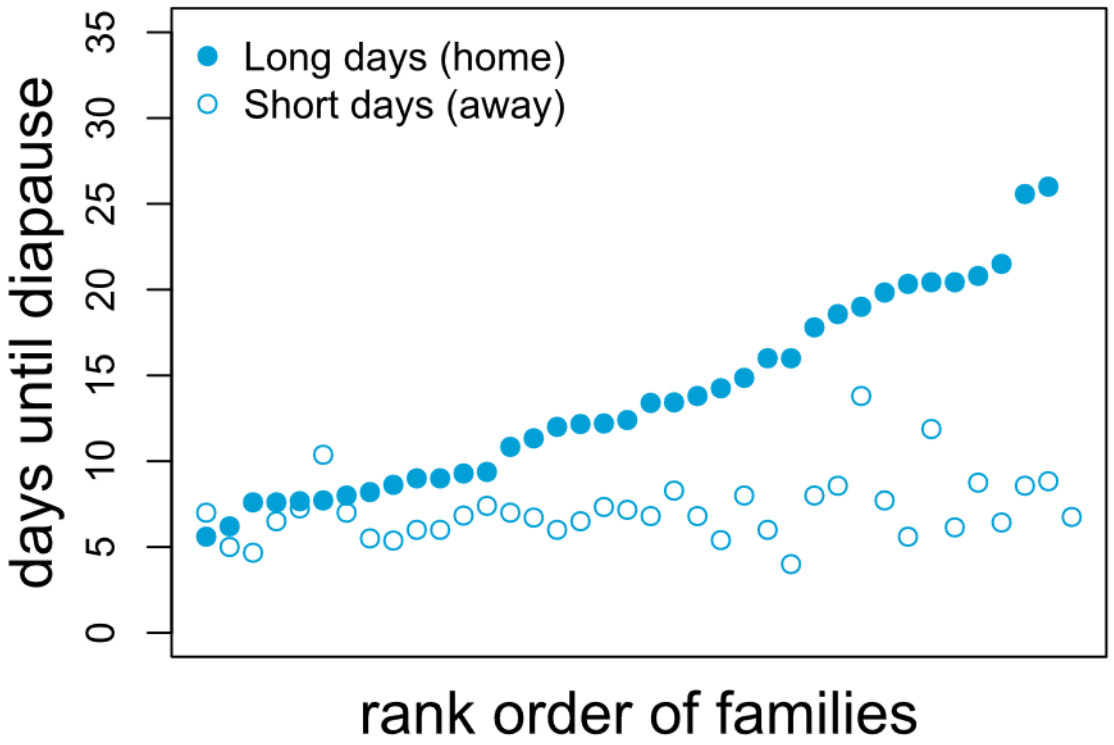
Short days (away)
13 hr : 26 min
99% predicted to diapause

Heritability



$h^2 = 0.7$

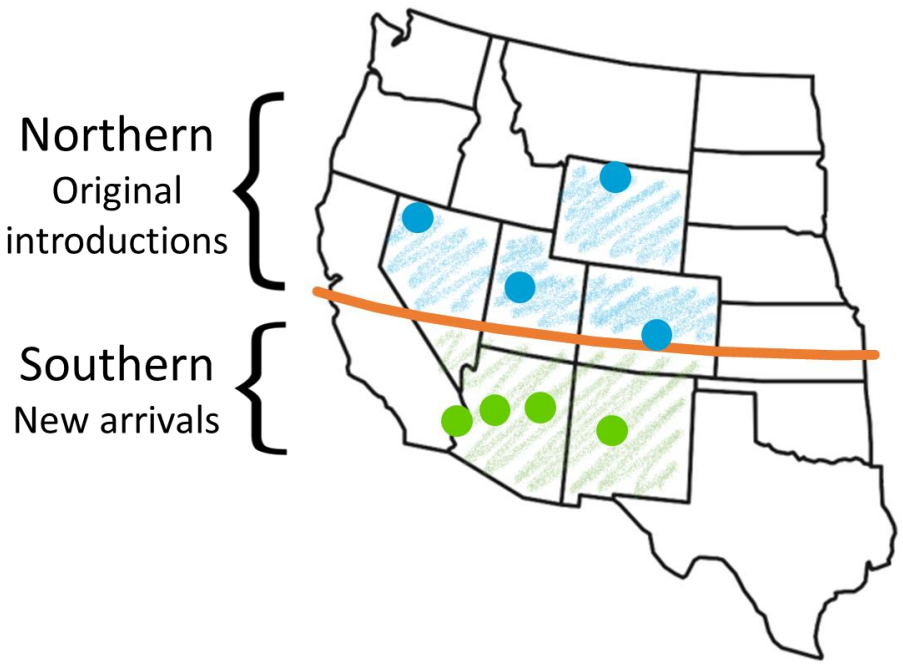
Heritability



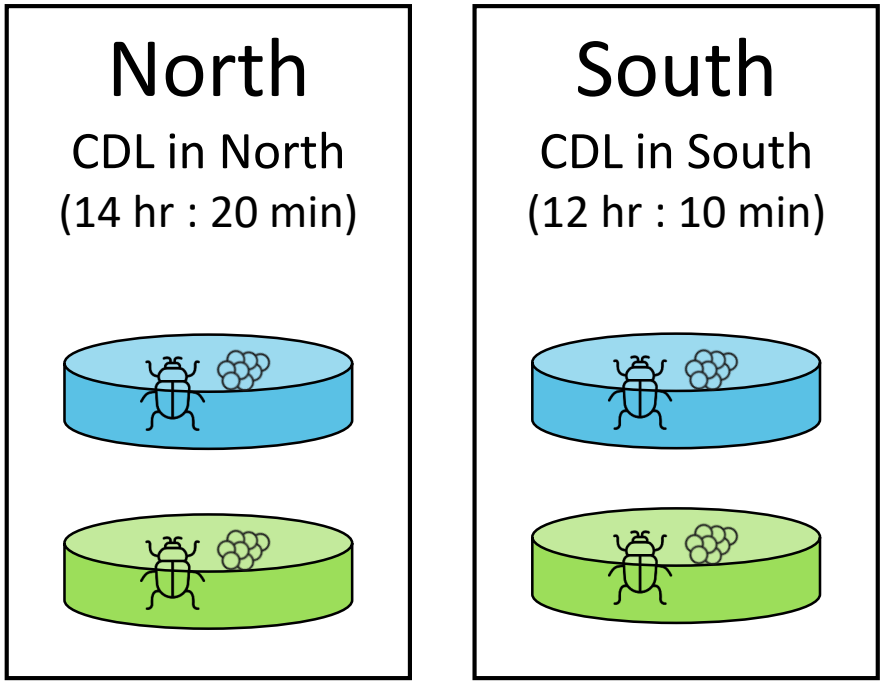
$h^2 = 0.7$

$h^2 \approx 0$

Local adaptation methods

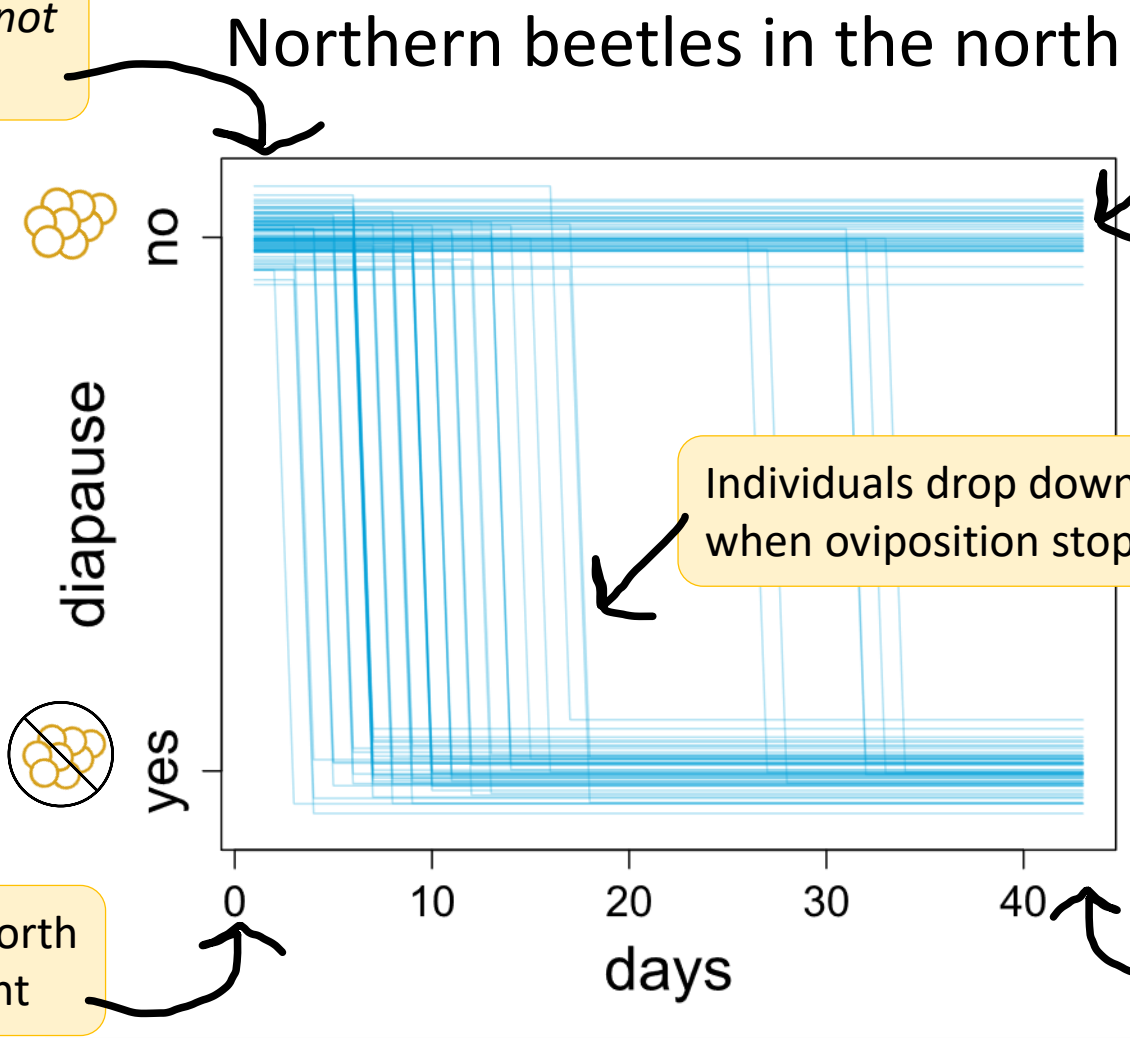


Two environments



Local adaptation

All beetles *not in diapause*



Some never diapause

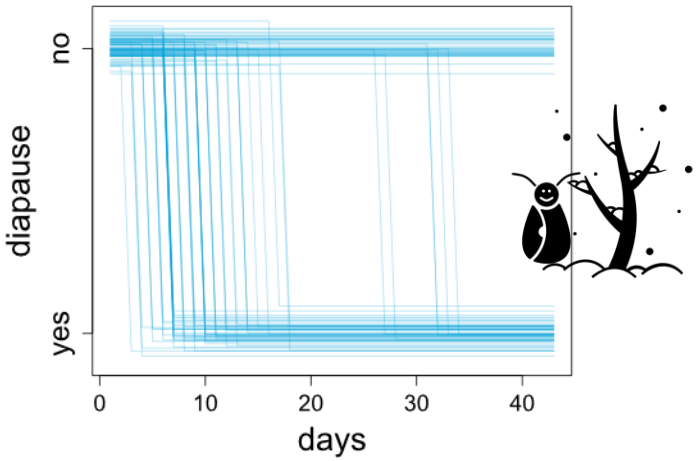
Individuals drop down when oviposition stops

Switch to north environment

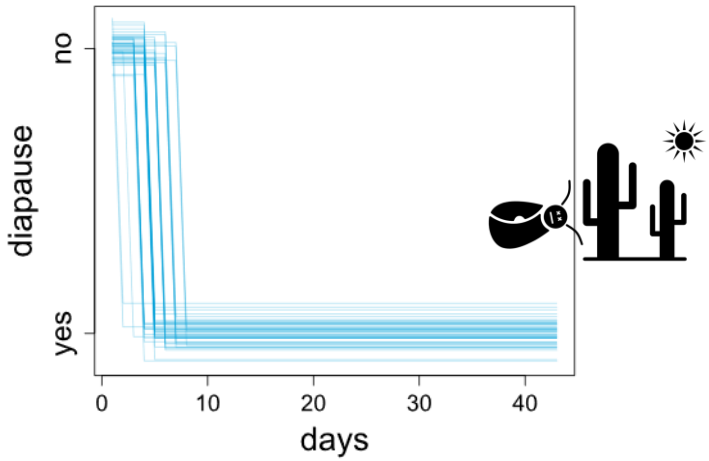
End of experiment

Local adaptation

Northern beetles in **North** = **Adapted**



Northern beetles in **South** = **Mismatched**



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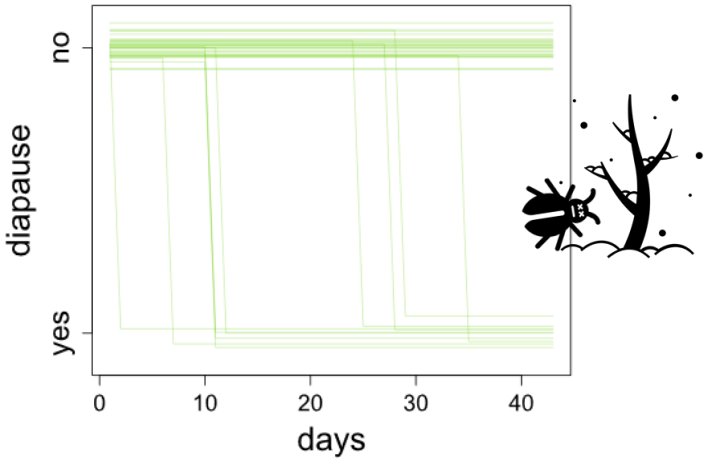

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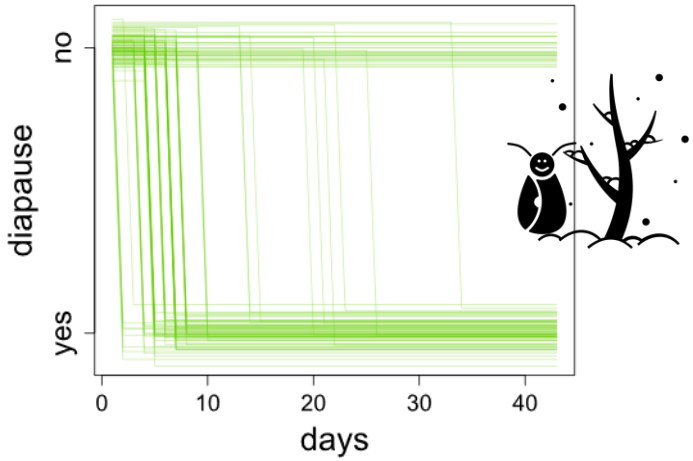

Take-aways

- **Days until diapause** is a new trait to study adaptation to daylength at an individual level
- Selection can act on heritable variation near "home", but not when too far away
  - Beetles moved long distances by humans will not be able to adapt
- Diorhabda is locally adapted to daylength

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