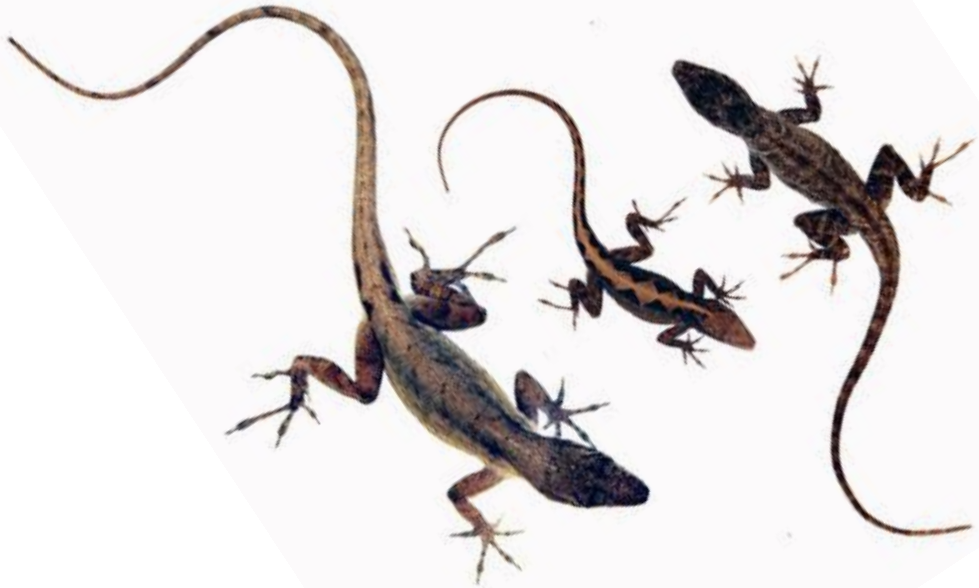
Does season-dependent reproductive value of offspring drive the evolution of life-history traits in *Anolis* lizards?



Joshua M. Hall, Timothy S. Mitchell, Sarin Tiatragul, Phillip R. Pearson, Daniel A. Warner

Department of Biological Sciences
Auburn University

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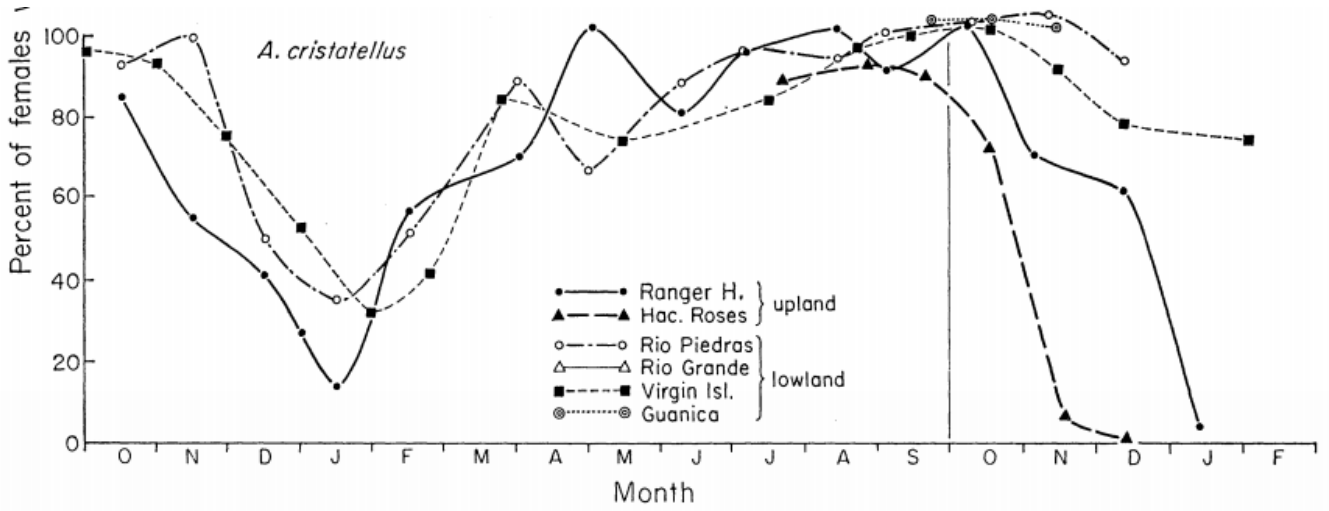
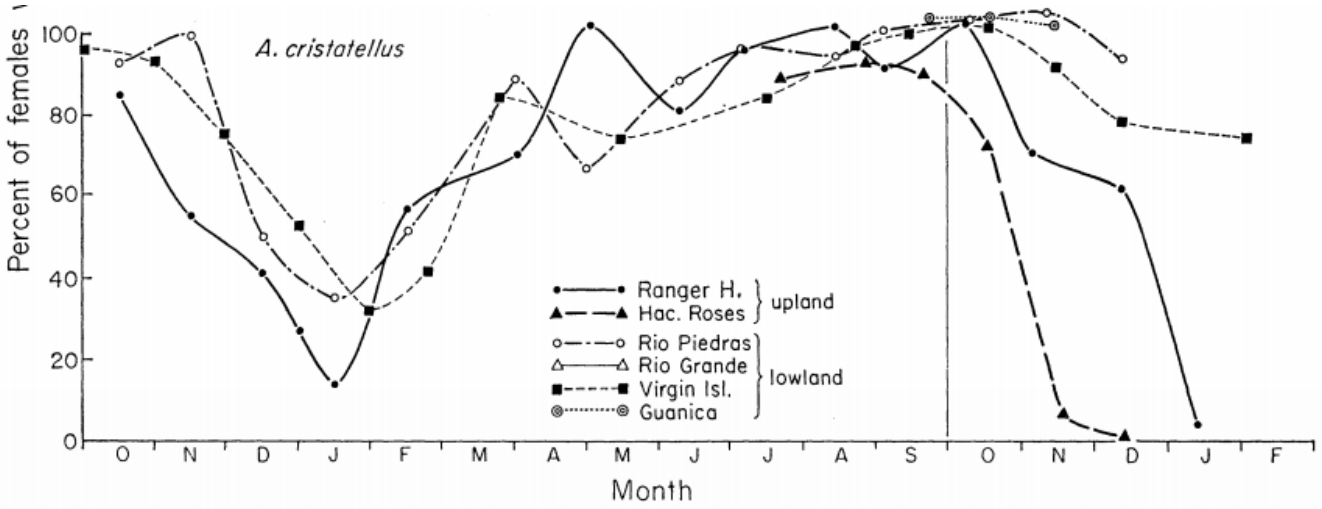


Gorman & Licht 1974

Does season-dependent reproductive value of offspring drive the evolution of life-history traits in *Anolis* lizards?

- In seasonal environments the value of offspring can change through the year
- Aspects of reproduction may shift seasonally as well



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1.) Is reproductive value of offspring season-dependent?
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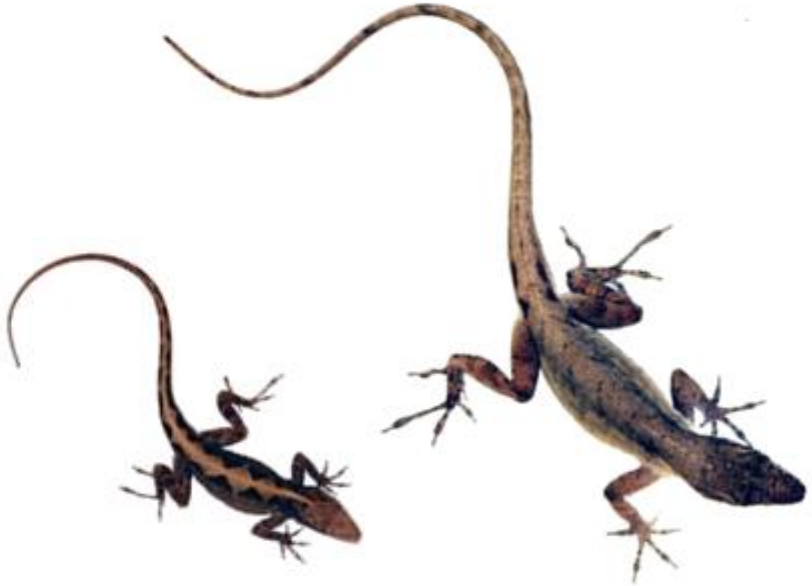
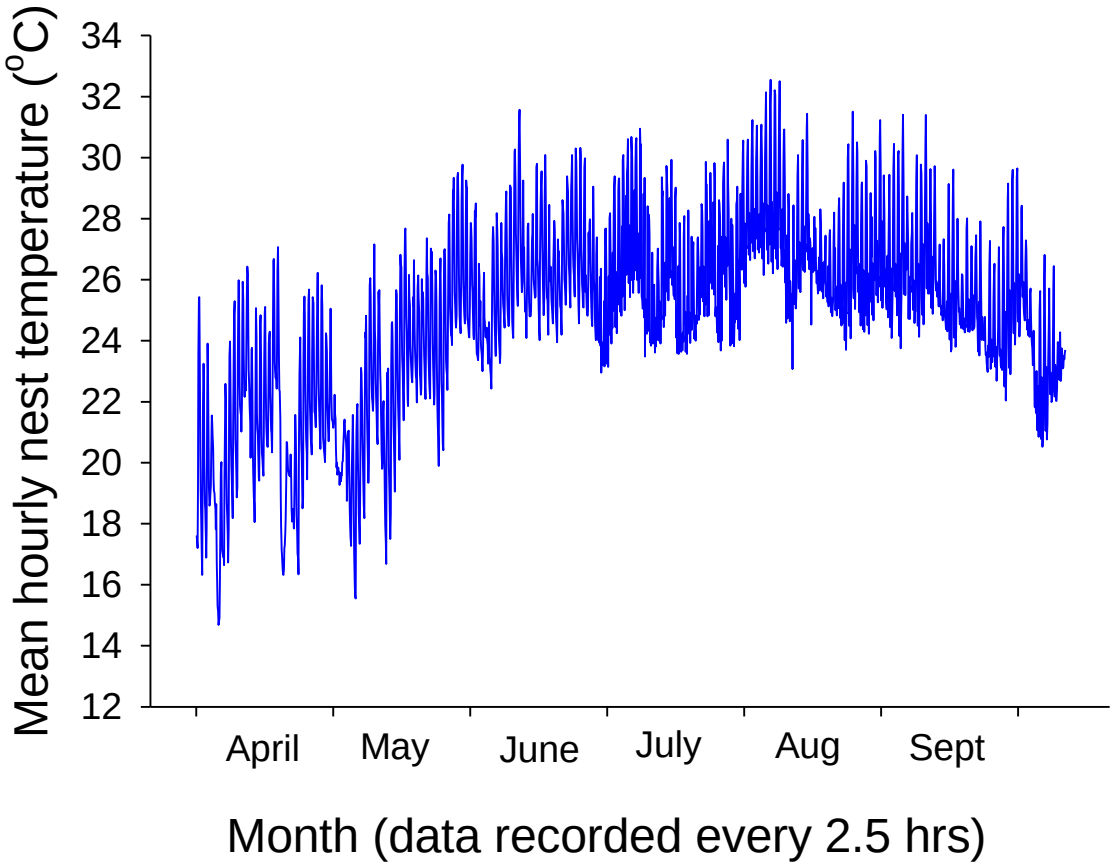
Such a study system would be quite useful:

1.) trade-offs in life-history traits (e.g. offspring size vs number)
2.) annual routines
3.) testing predictions from life-history theory

The brown anole (*A. sagrei*)



Do seasonal changes in nest temperature have season-specific fitness consequences?



Pearson & Warner; Proc Royal Soc B; In Press

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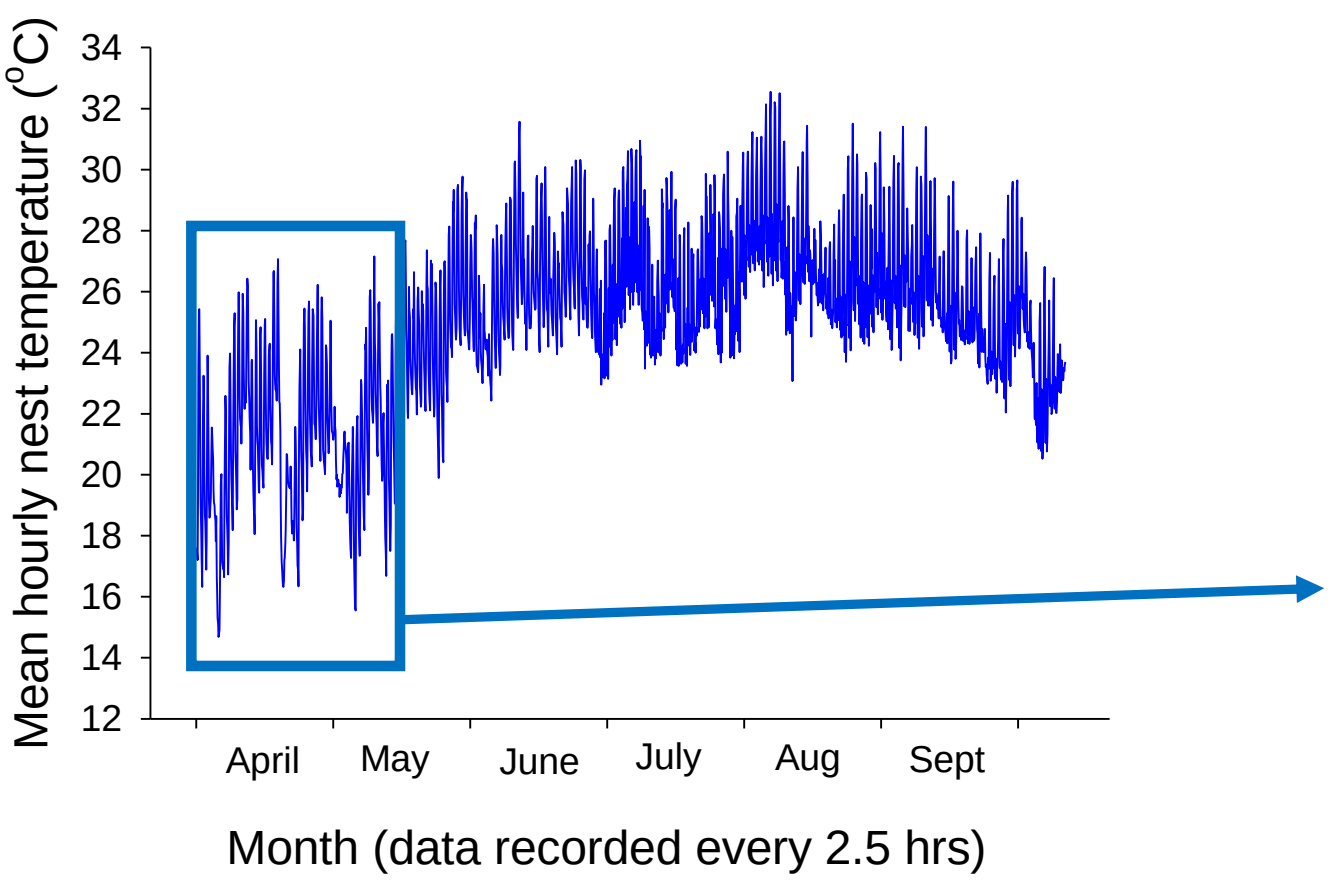

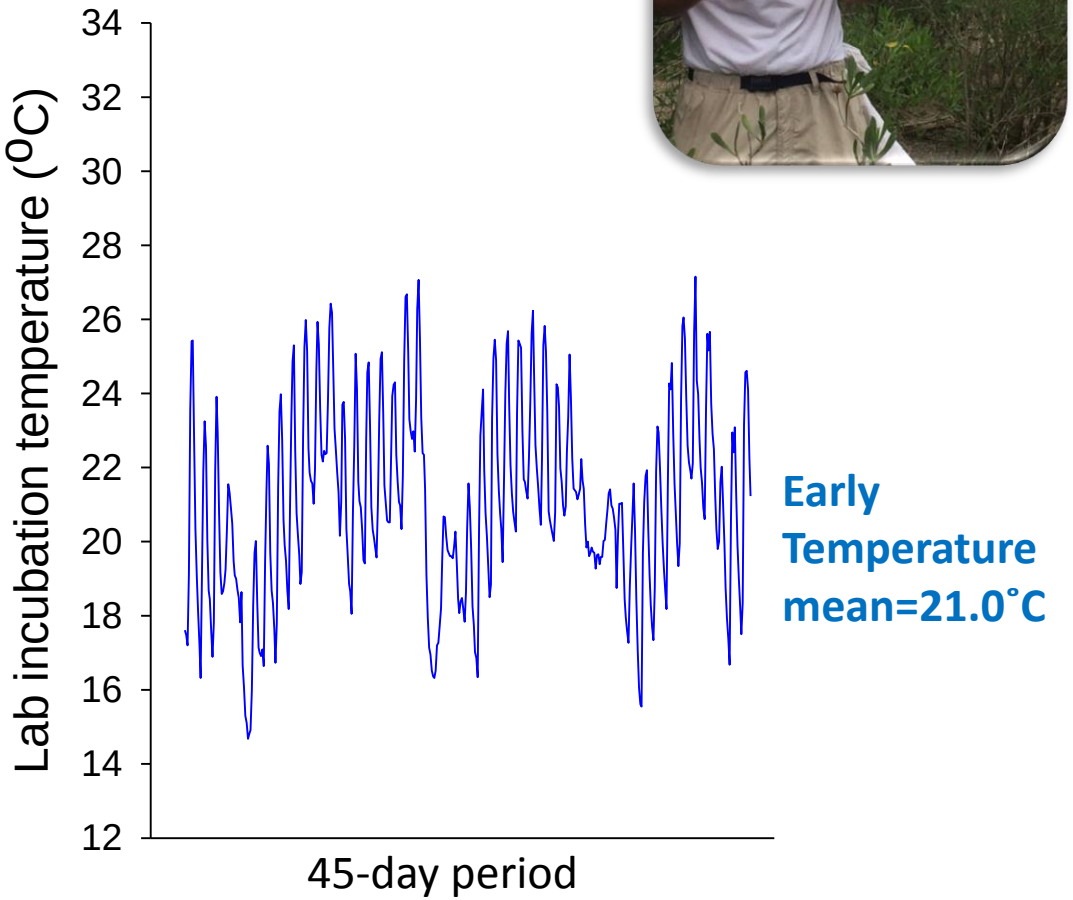

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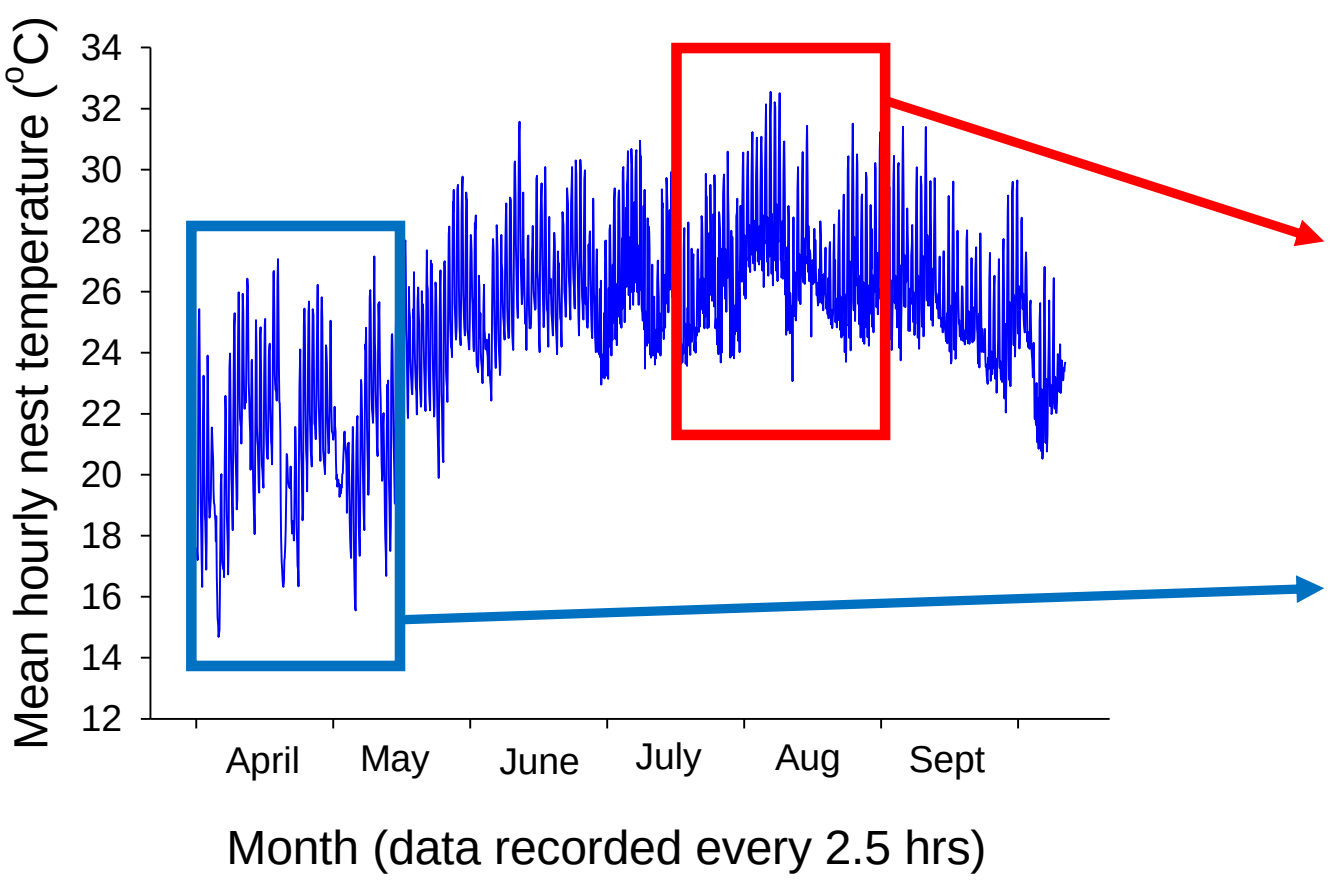

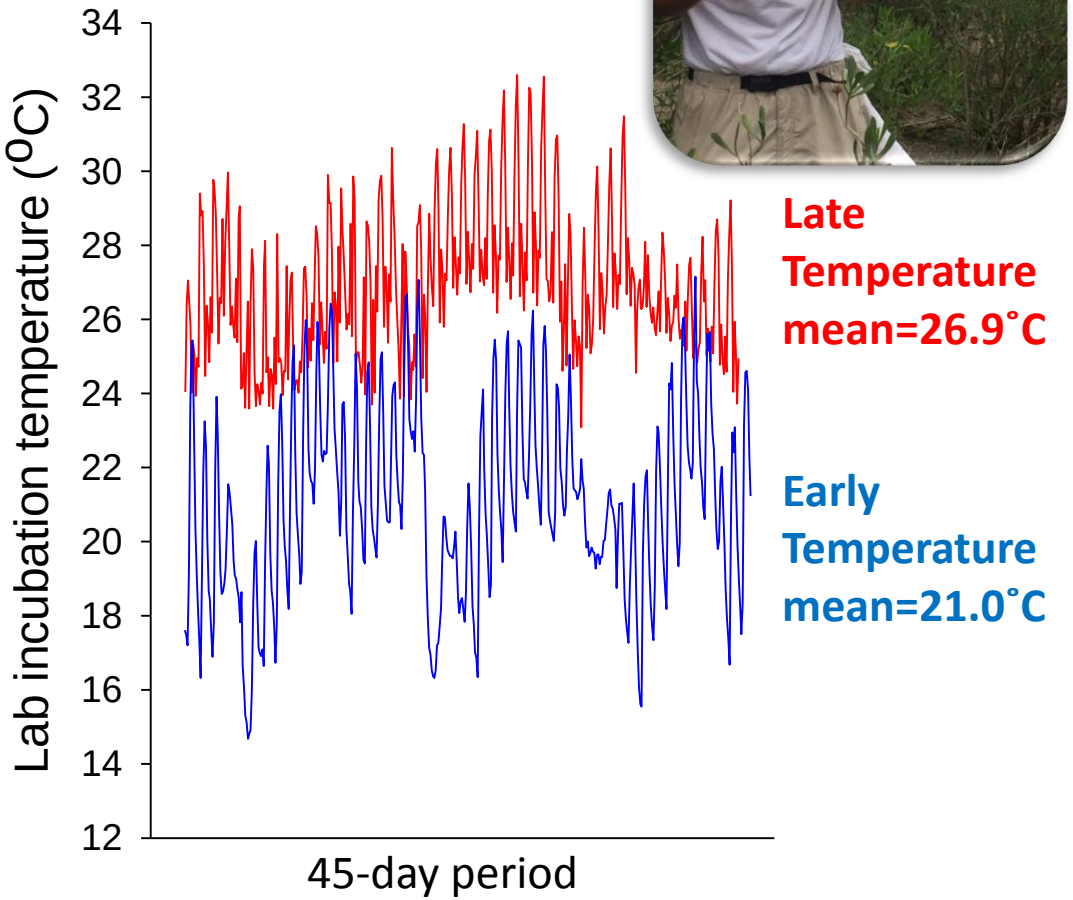

Pearson & Warner; Proc Royal Soc B; In Press

Experimental design

Early vs. late cohorts of lizards (80 females in each cohort)

- Early cohort collected in mid-February, 2015
- Late cohort collected in early July, 2015

Pearson & Warner; Proc Royal Soc B; In Press

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Early vs. late incubation regimes

- Early Temperatures (April 1 – May 15)
- Late Temperatures (July 15 – August 28)

Pearson & Warner; Proc Royal Soc B; In Press

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Cohort	Early Temperatures	Late Temperature
Early Season Cohort	**Early-Early** (*n*=242)	**Early-Late** (*n*=252)
Late Season Cohort	**Late-Early** (*n*=266)	**Late-Late** (*n*=267)

Pearson & Warner; Proc Royal Soc B; In Press

Offspring fitness in the field

Methods

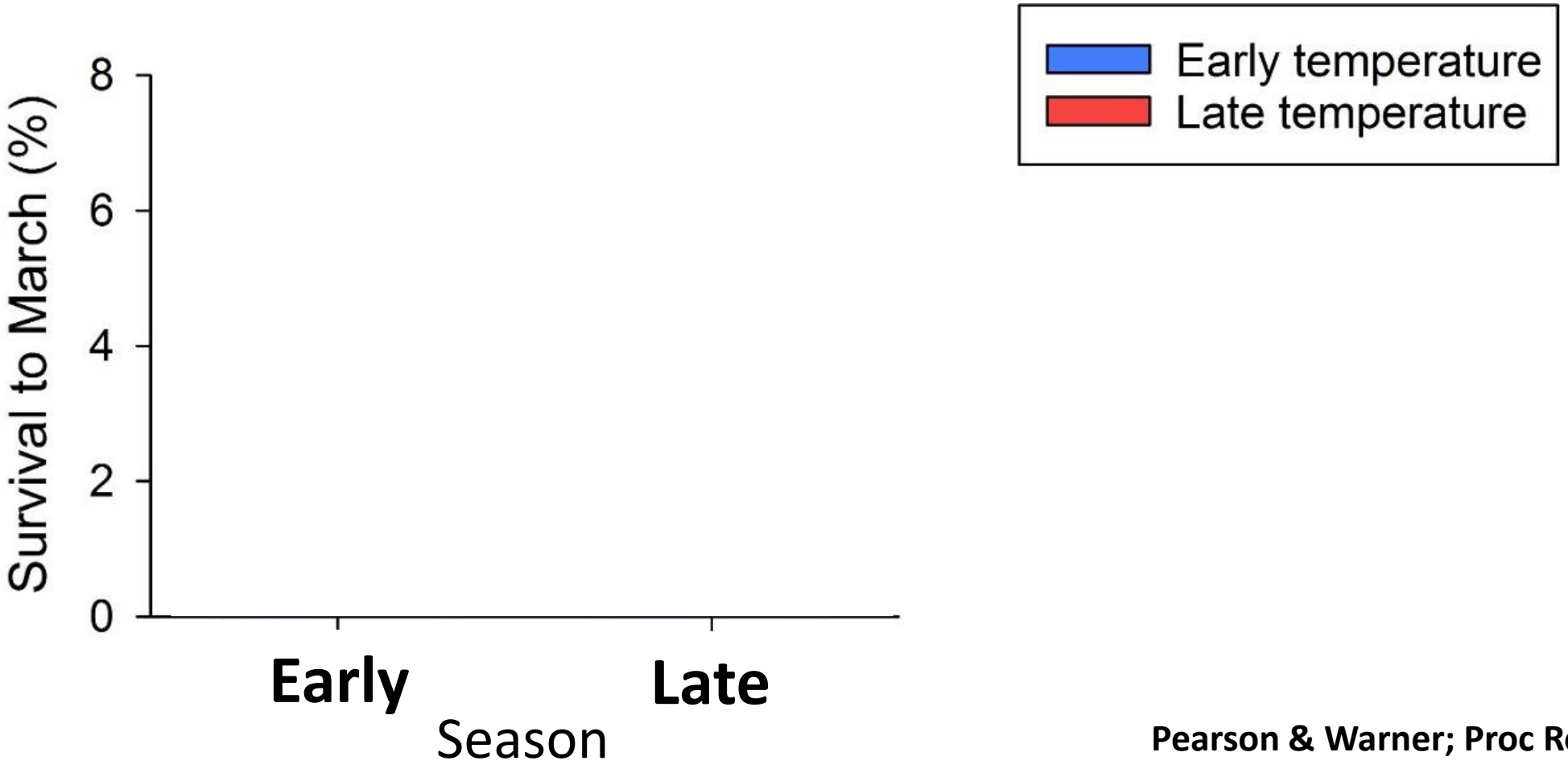
- All offspring uniquely marked
- Released onto island in Matanzas River, Florida

Spring recapture effort

- March 2016

Pearson & Warner; Proc Royal Soc B; In Press

Results – survival



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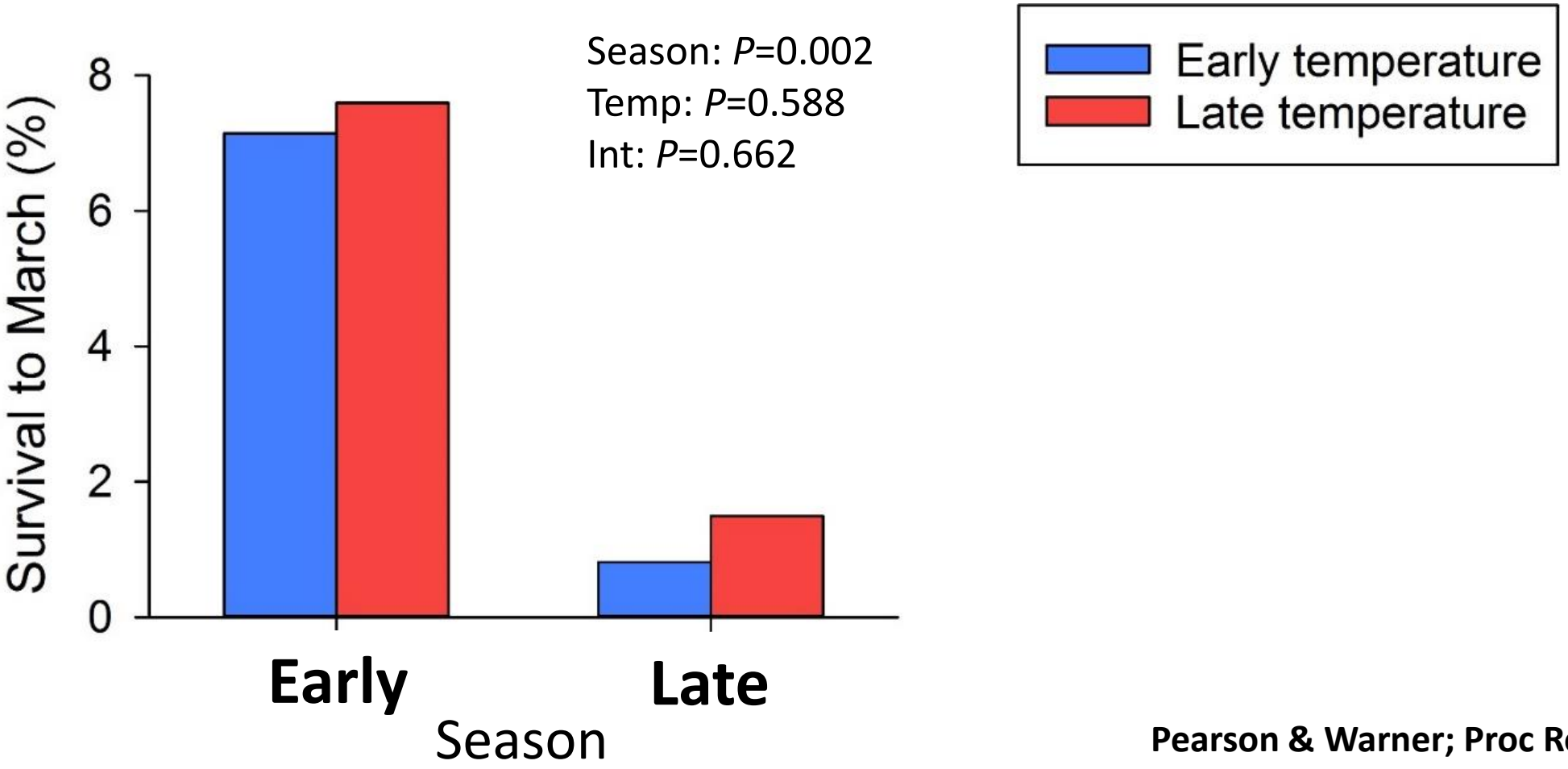

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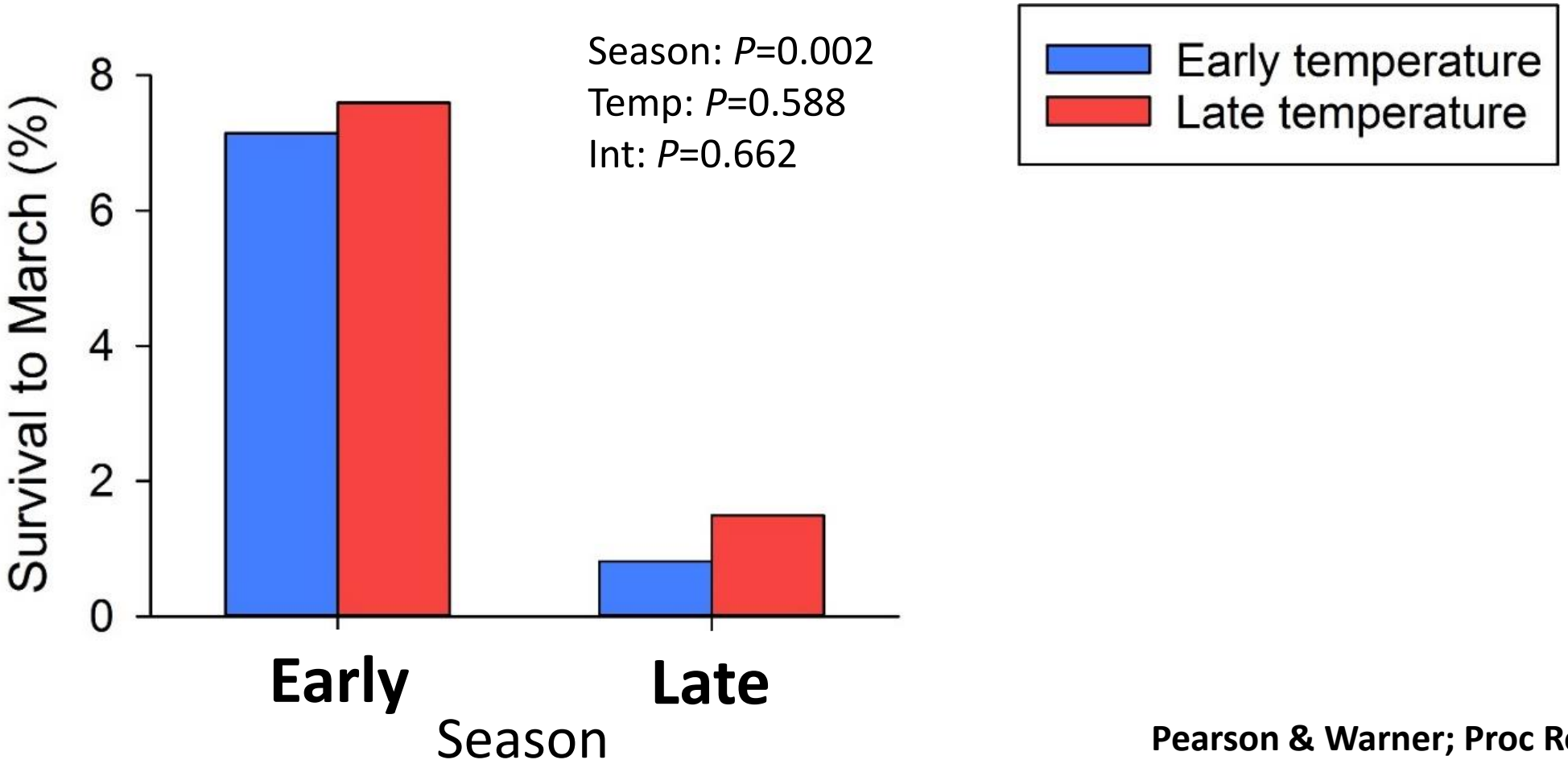
Season-dependent reproductive Value of offspring



Pearson & Warner; Proc Royal Soc B; In Press

Does adult density impact seasonal changes in offspring survival?

March April June August October

breeding starts

hatching starts

breeding ends

Mitchell et al In Prep

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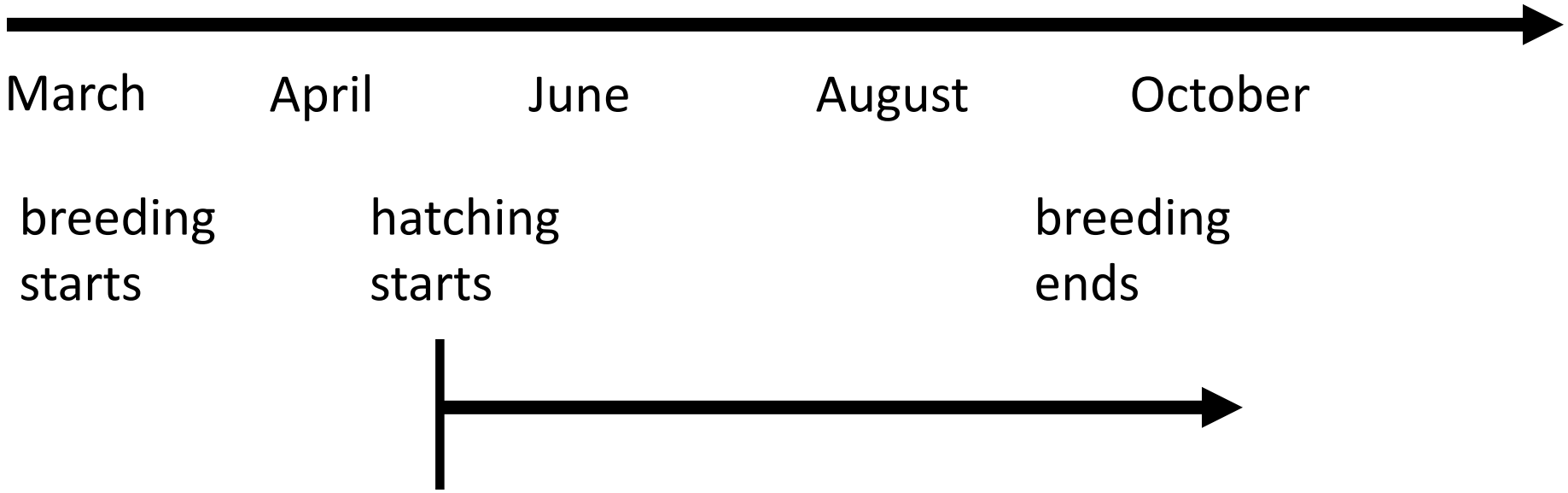

Mitchell et al In Prep

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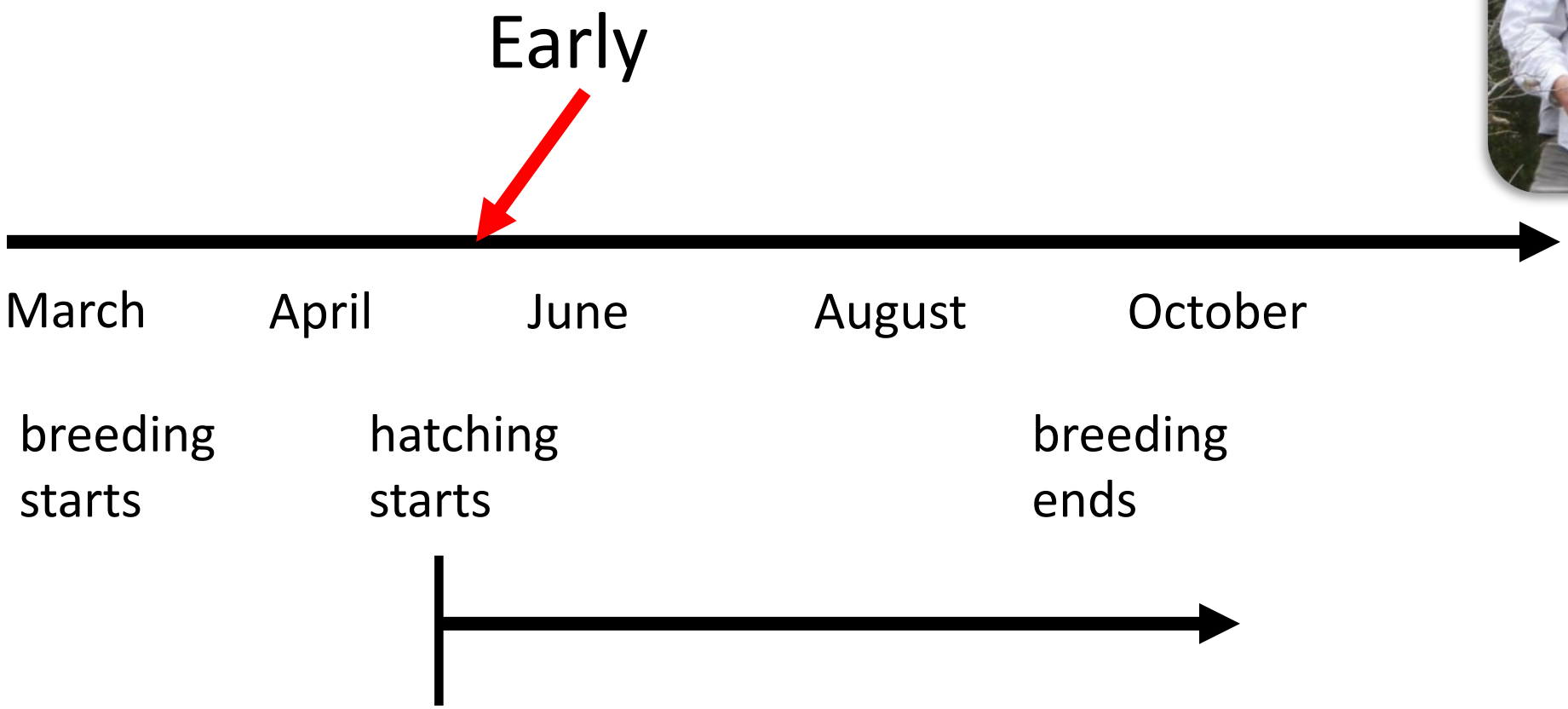

Mitchell et al In Prep

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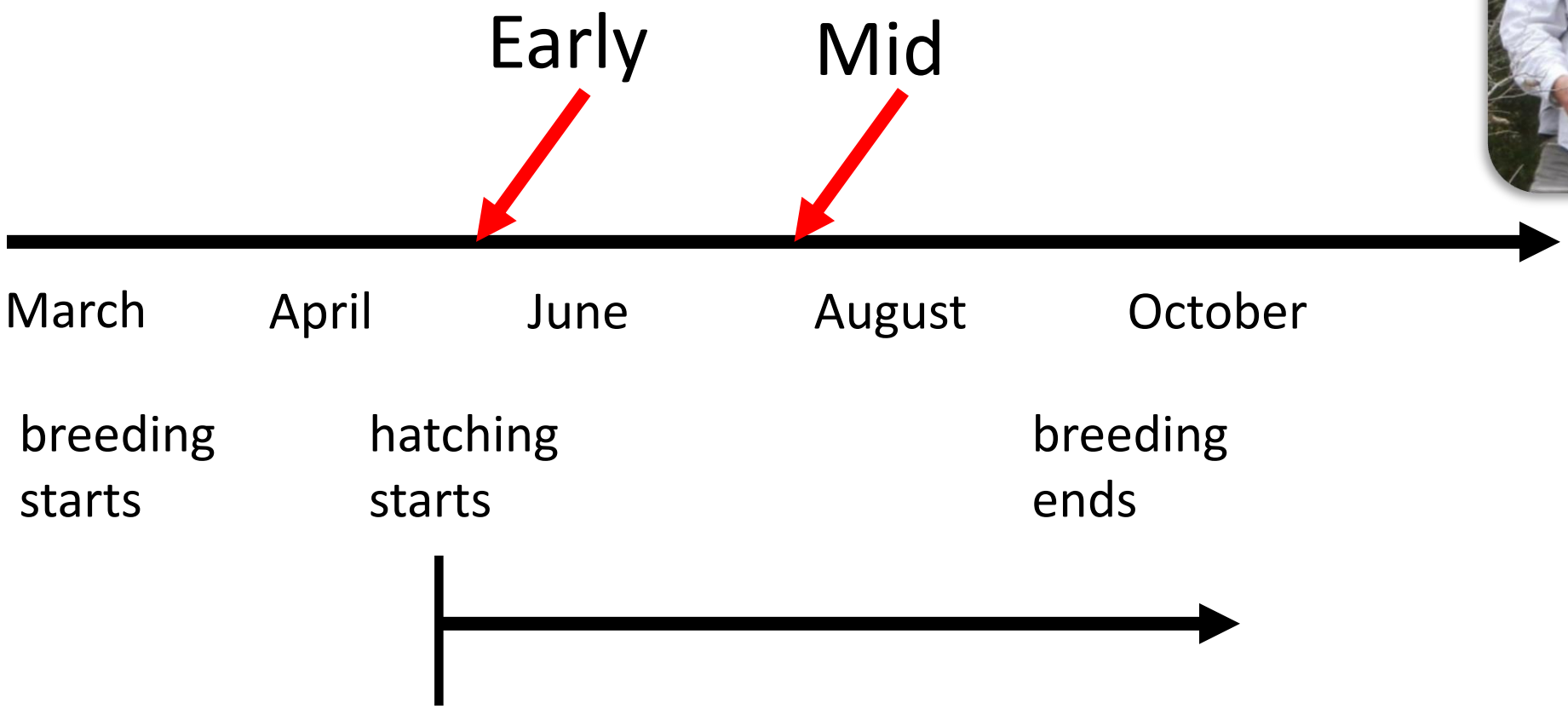

Mitchell et al In Prep

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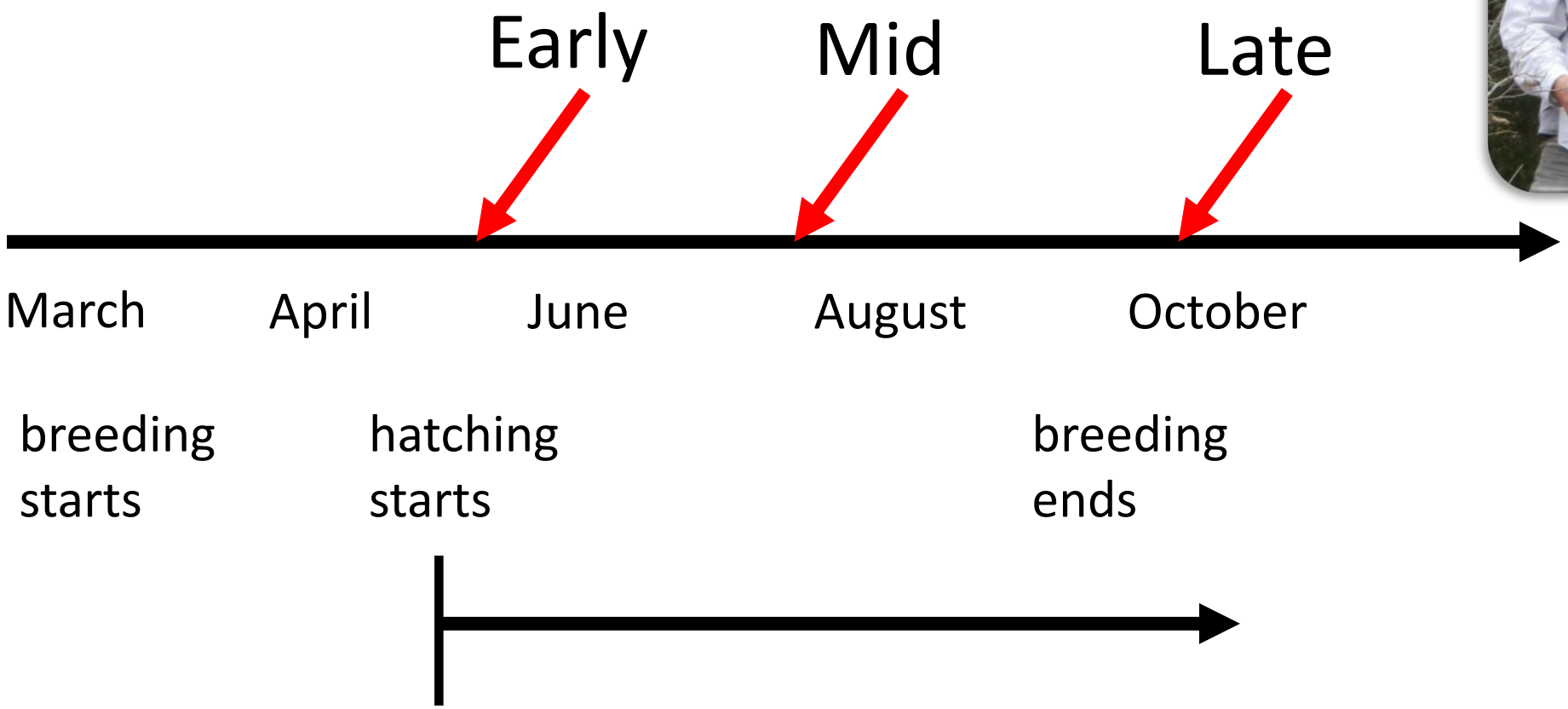


Mitchell et al In Prep

Experimental design

Whole-island manipulation

Mitchell et al In Prep

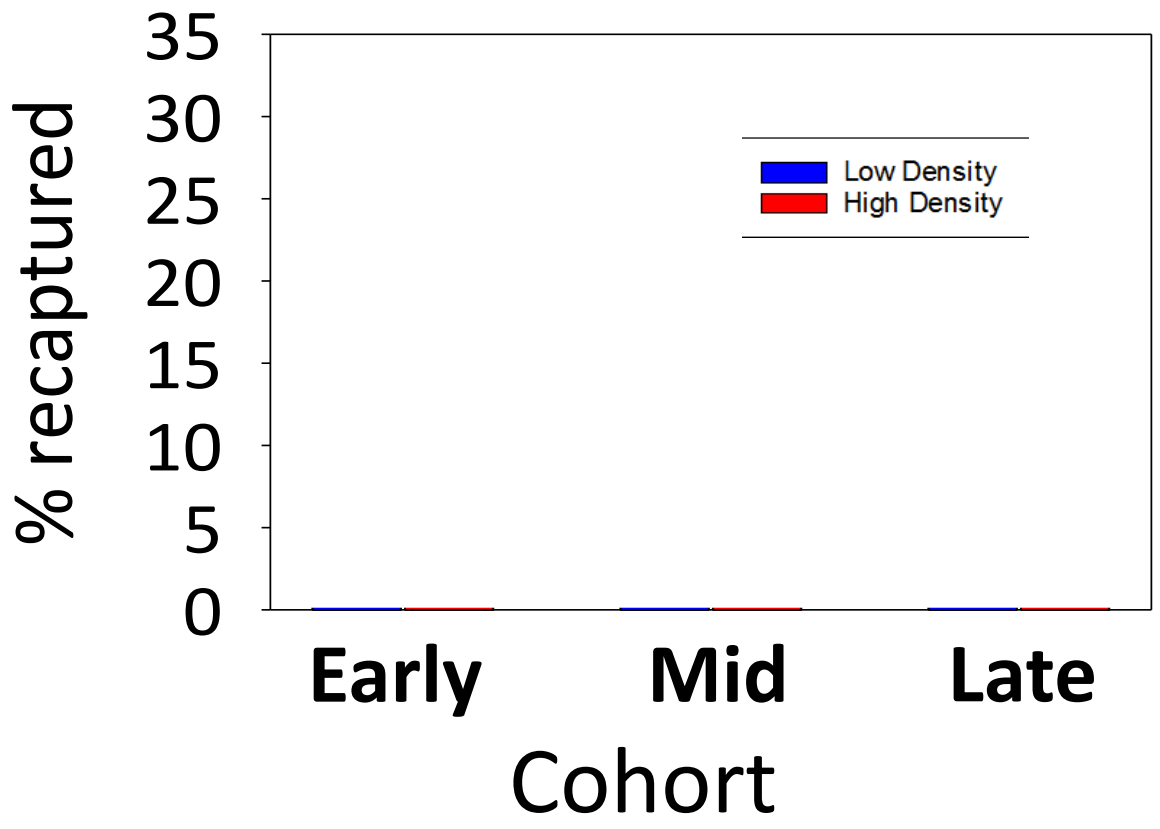
Experimental design

- Bred three cohorts of field caught adults in lab- early, mid, late
- Released marked hatchlings from three cohorts
- Recapture the following spring

Whole-island manipulation

Mitchell et al In Prep

Field results



Mitchell et al. in prep

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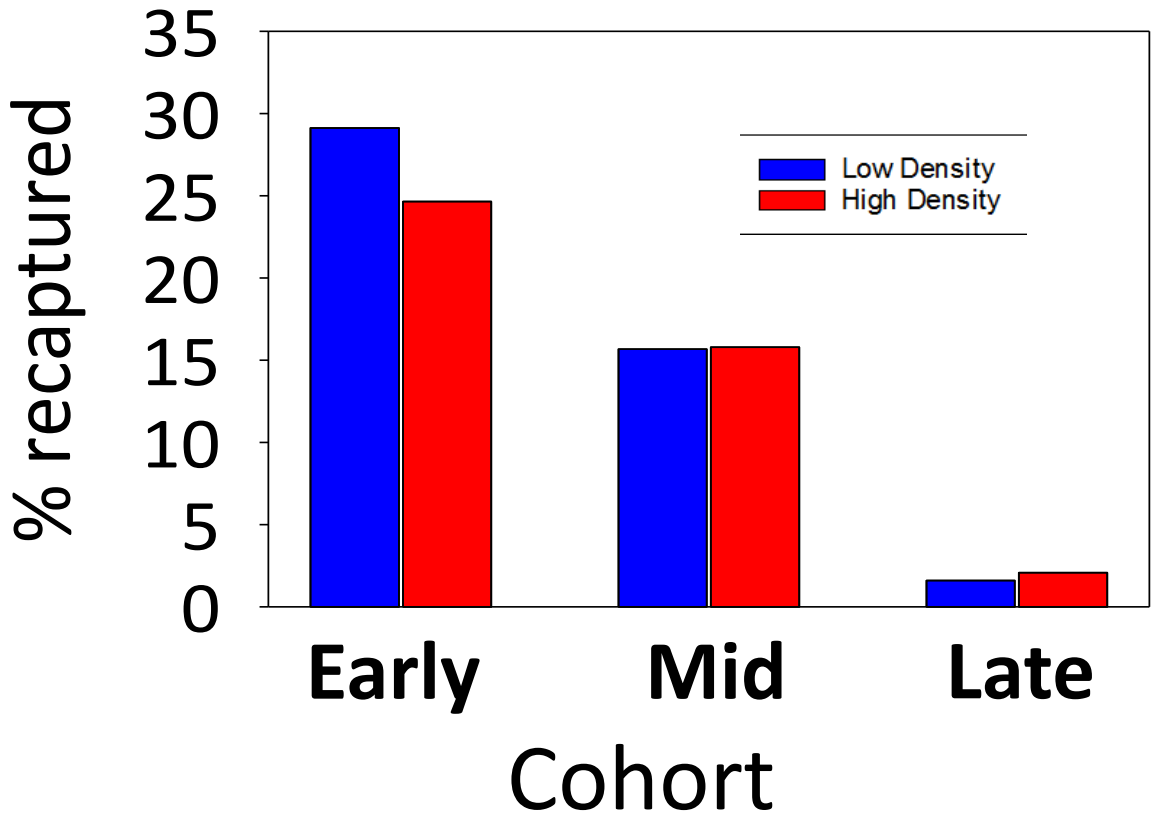

Mitchell et al. in prep

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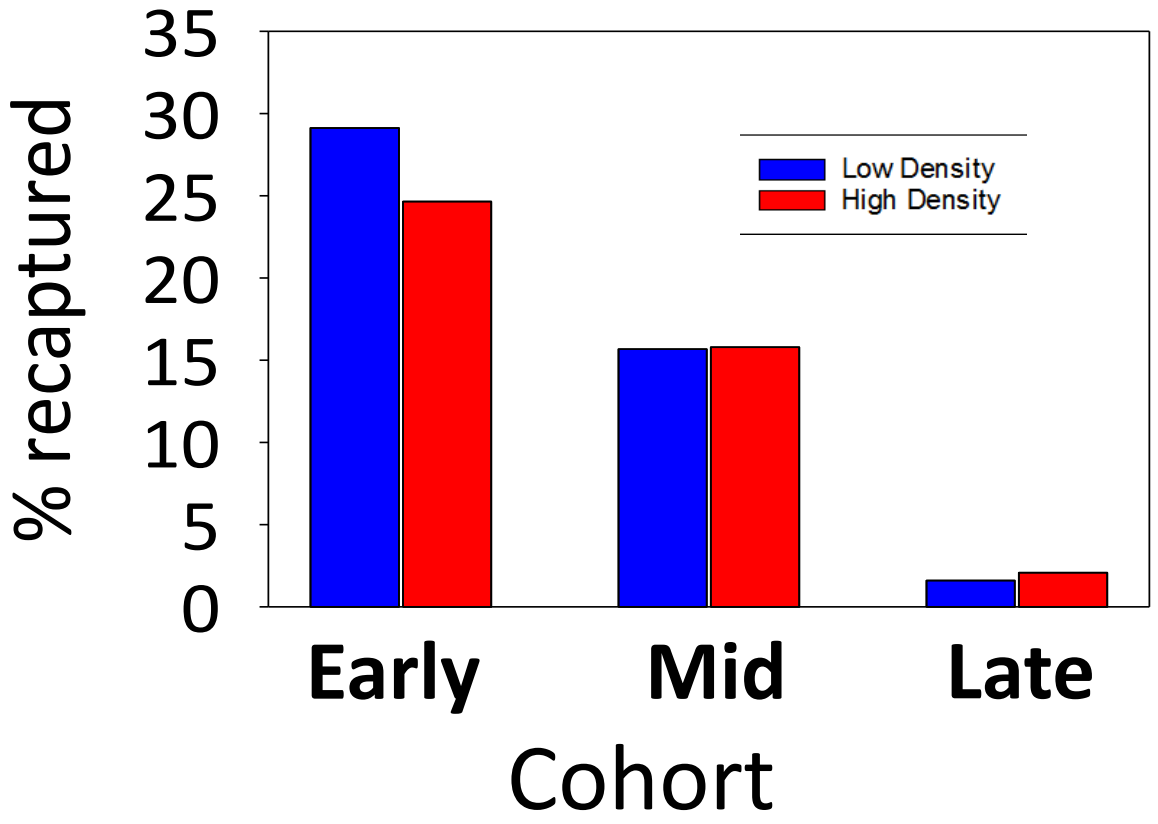
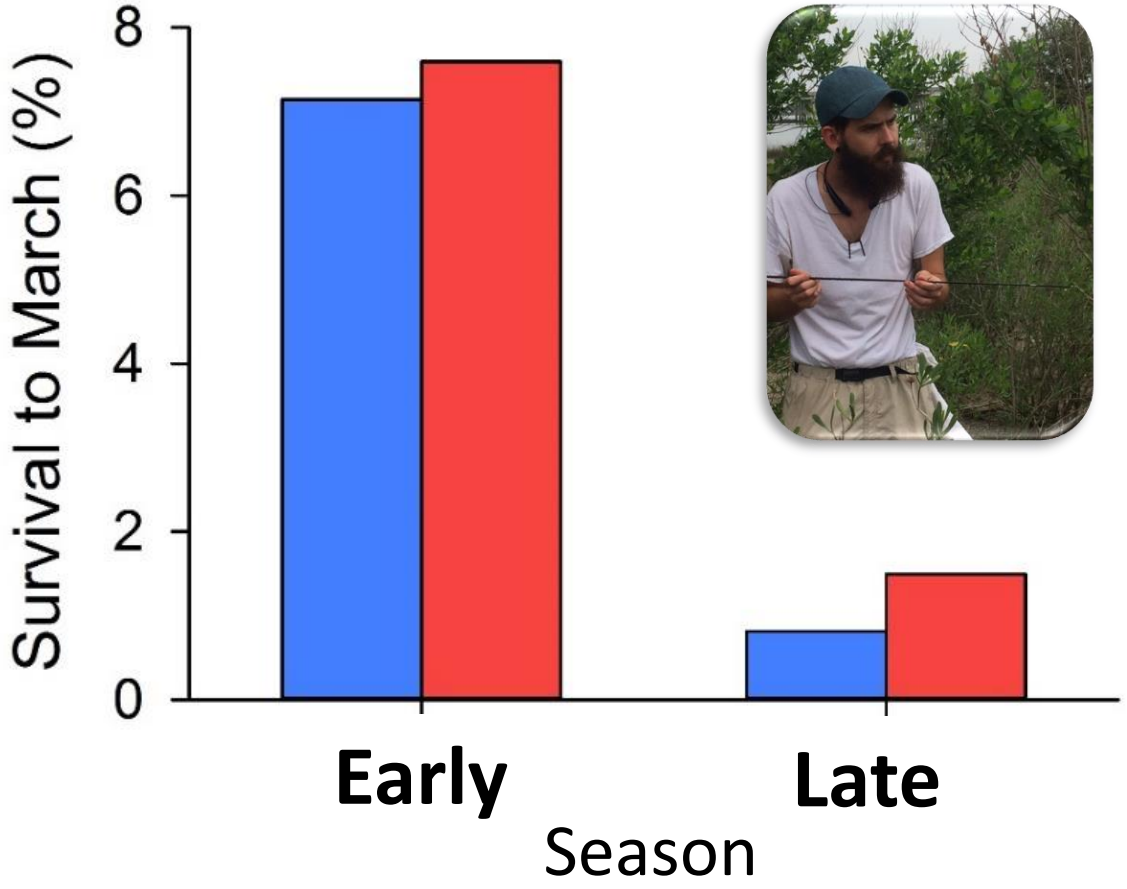
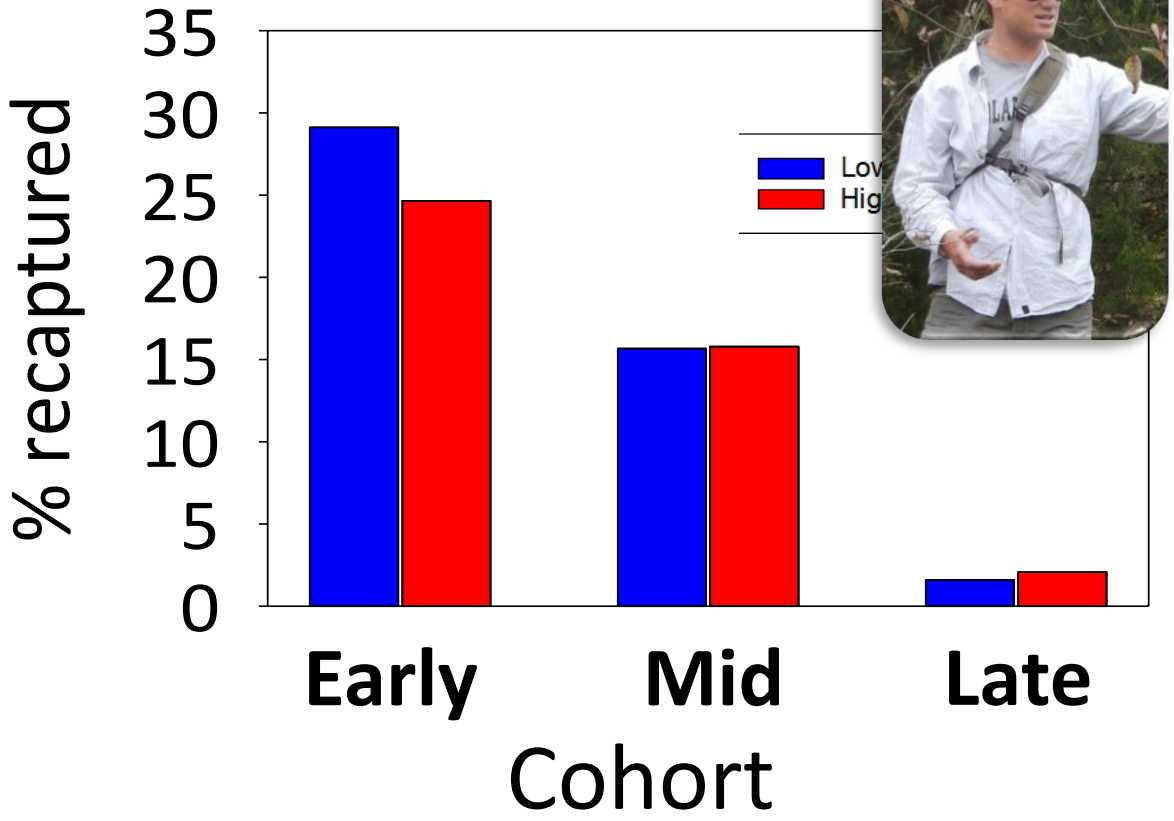


Season-dependent reproductive Value of offspring

Mitchell et al. in prep

- Two experiments asking different questions
- Same answer – hatching earlier is better





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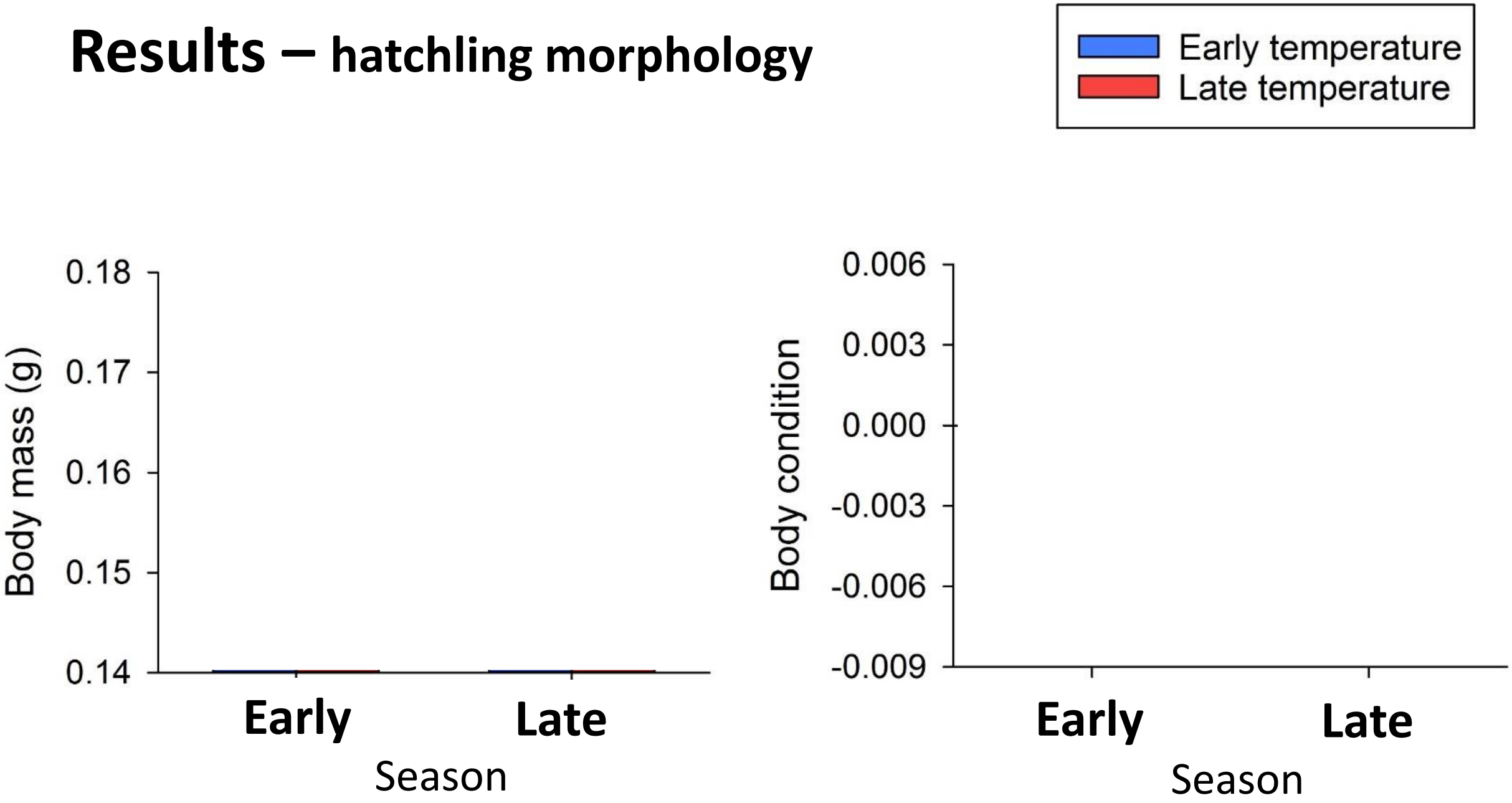
Results – hatchling morphology



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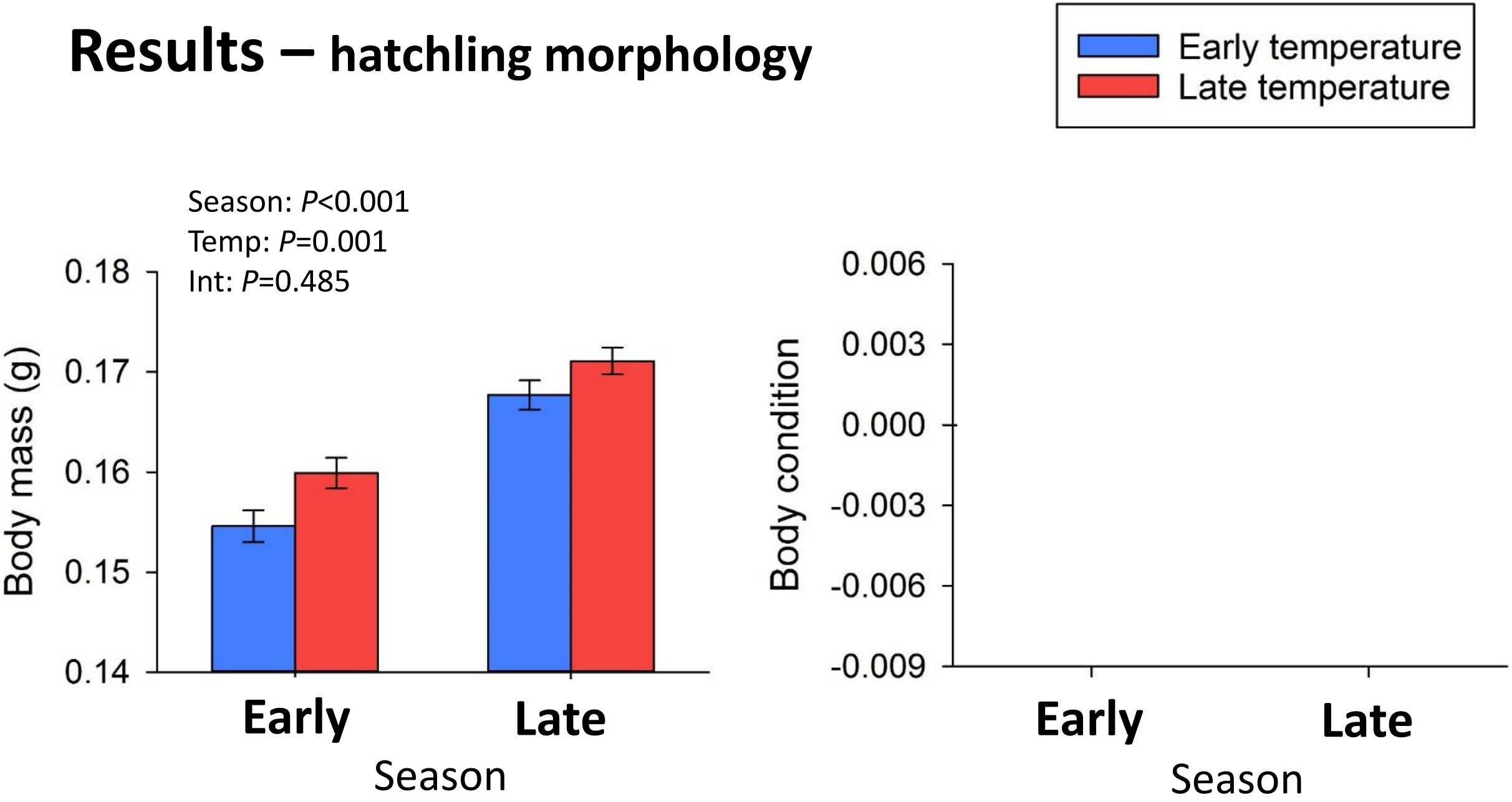

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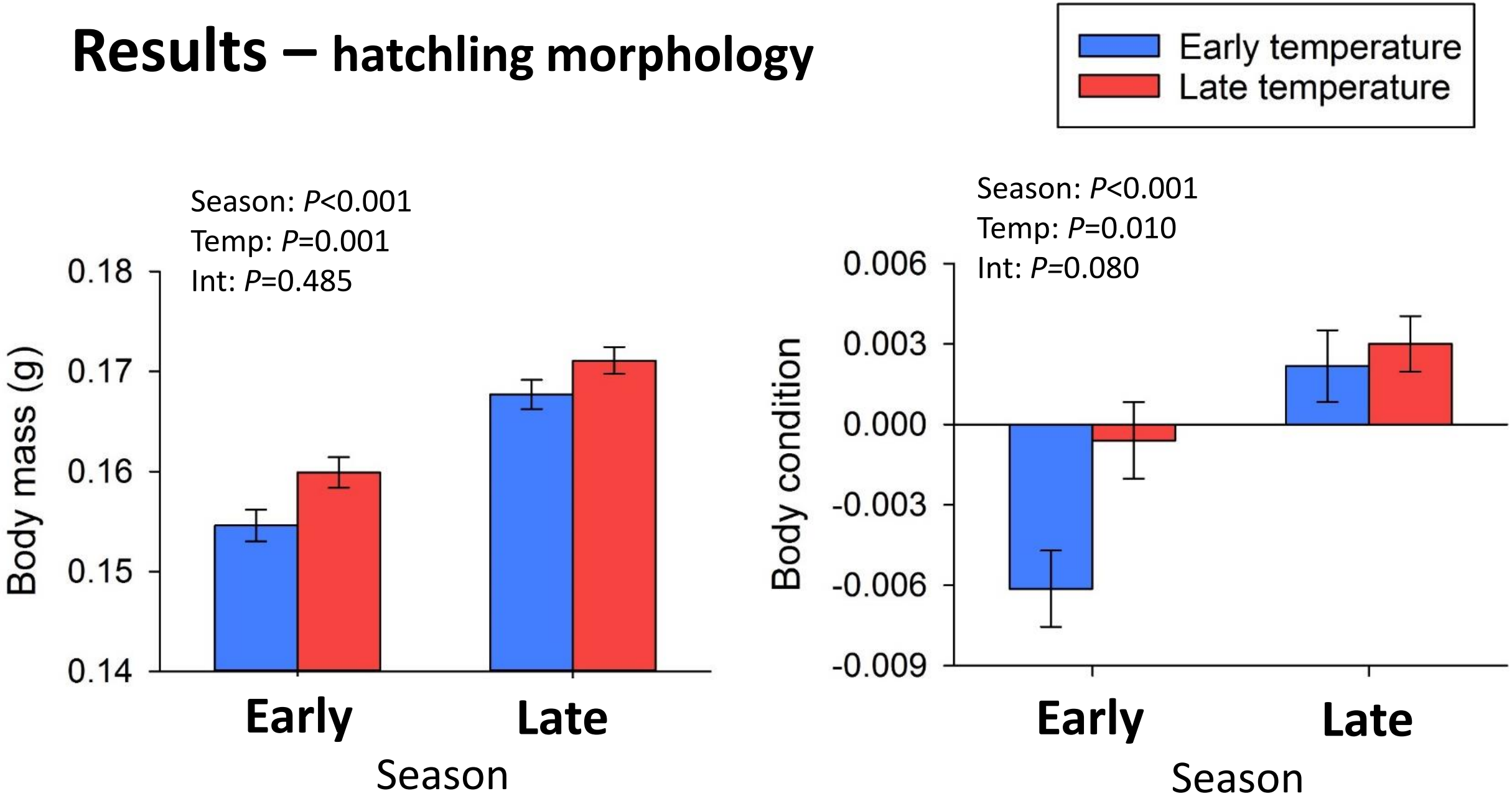

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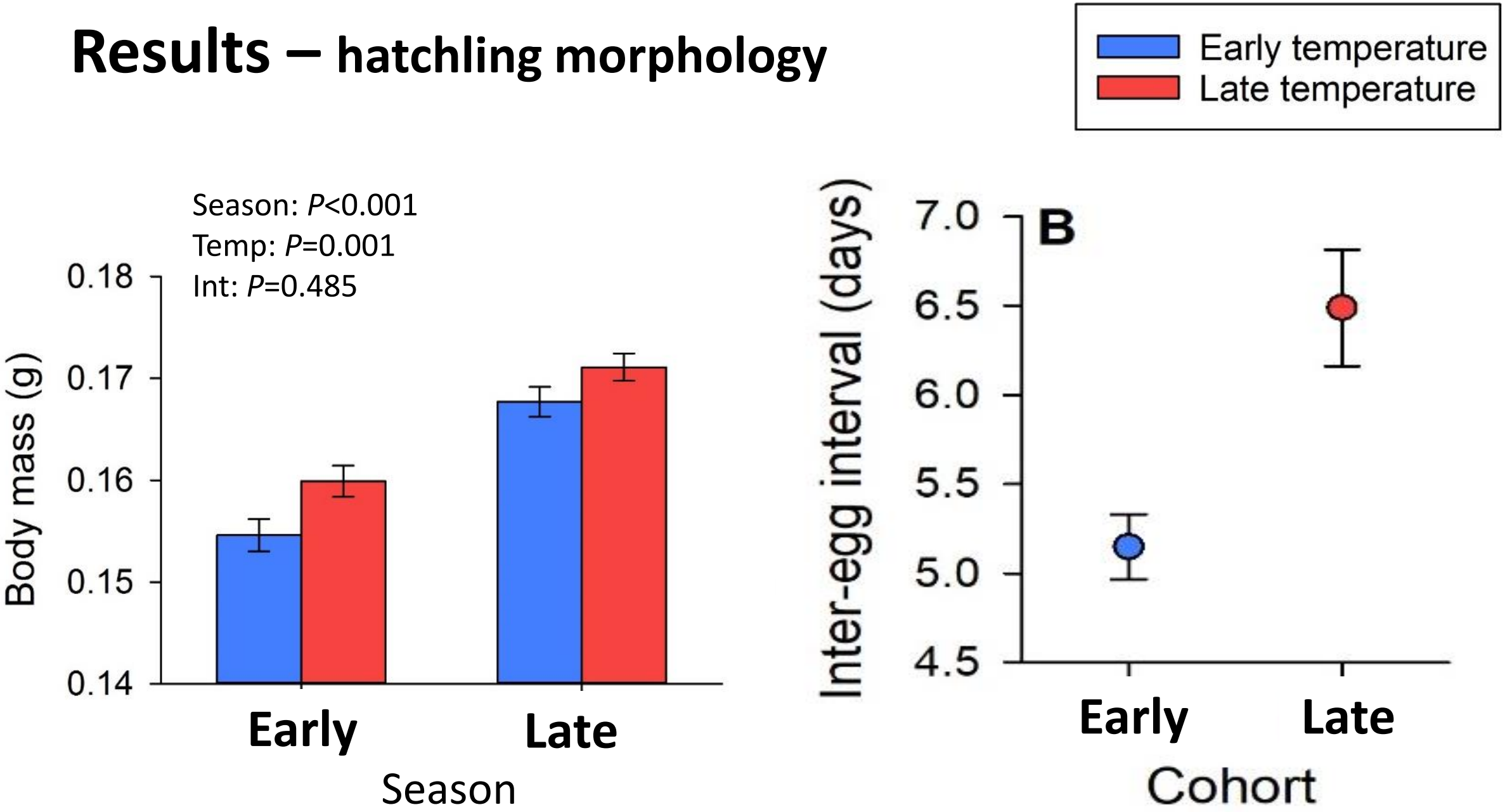

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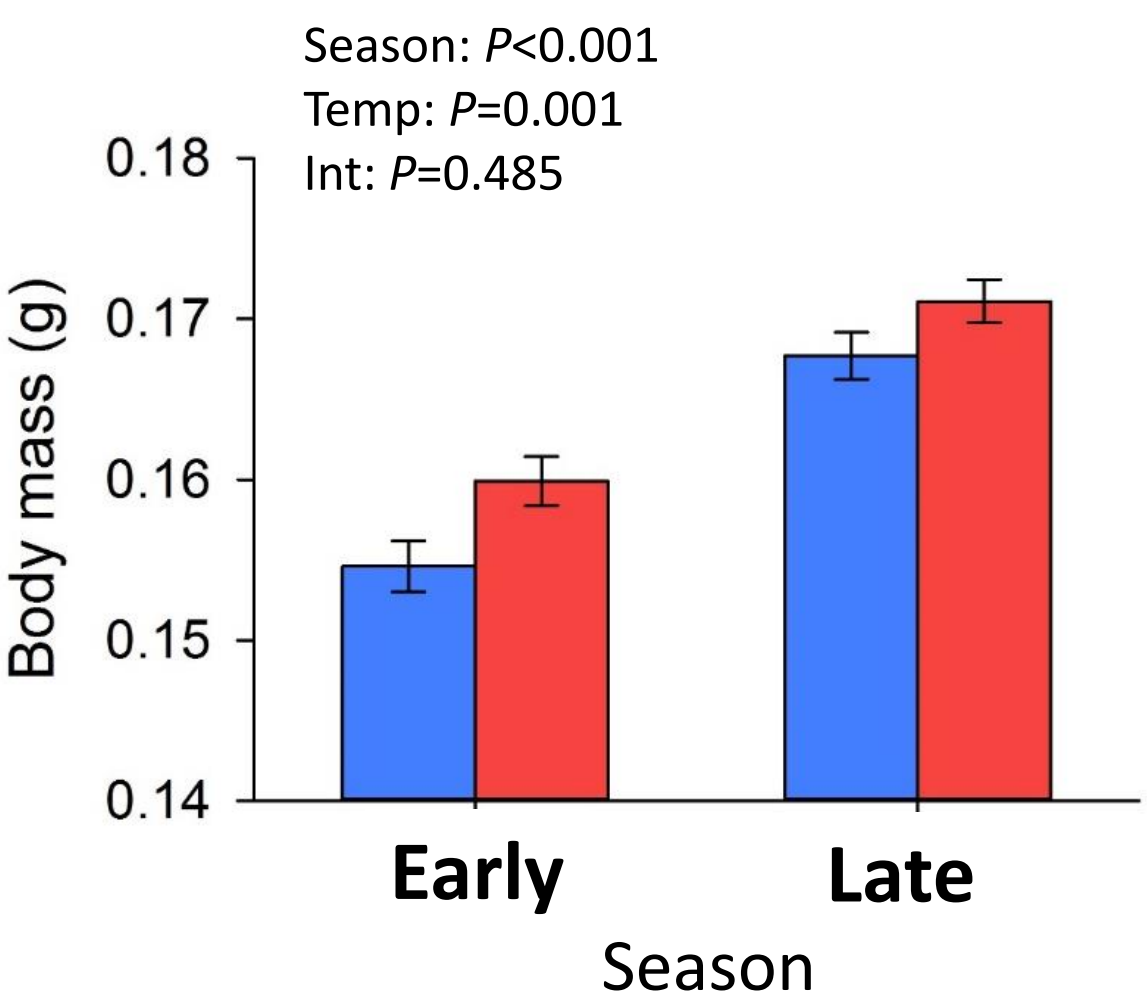
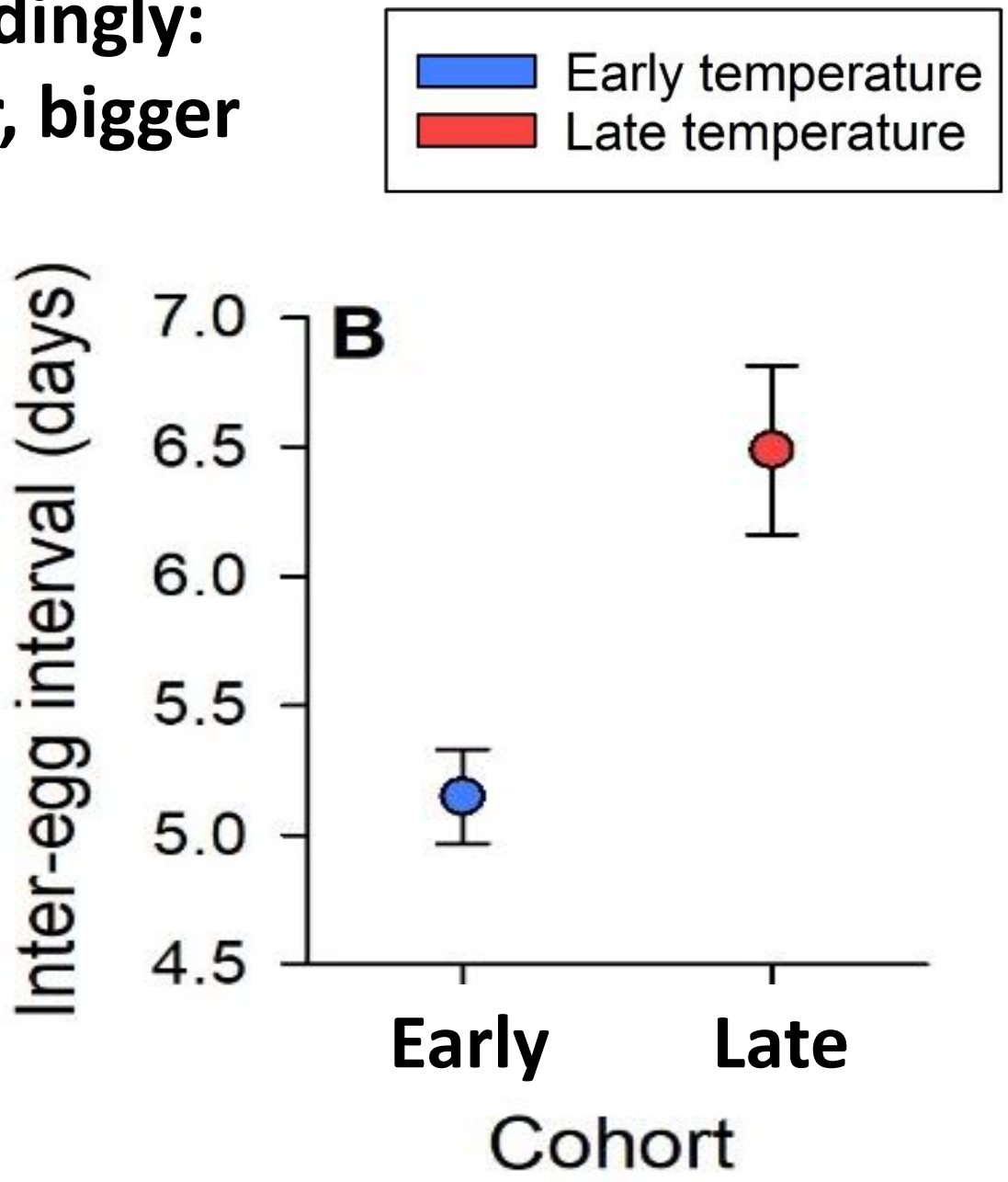
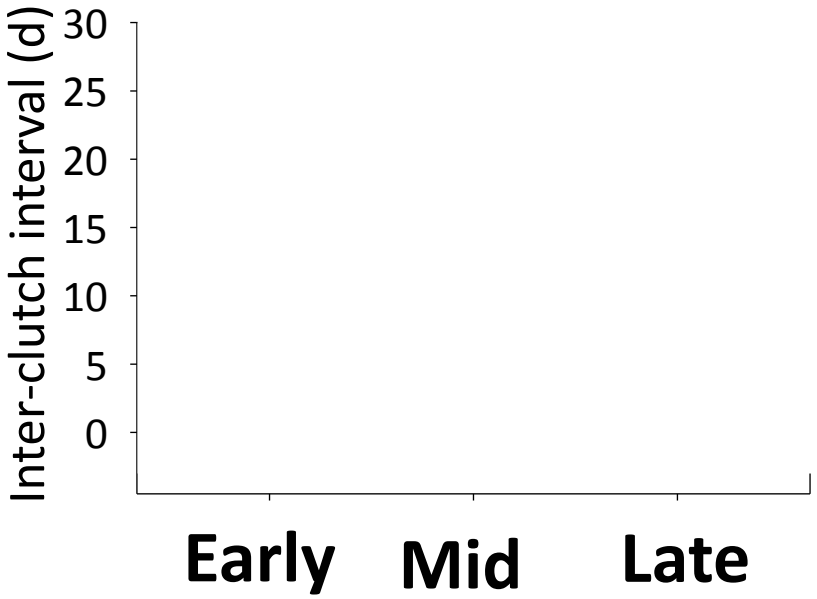
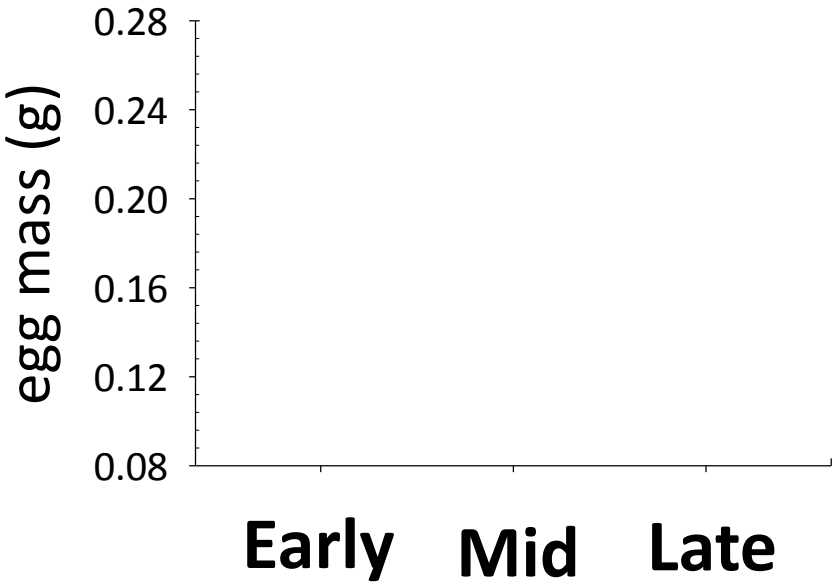
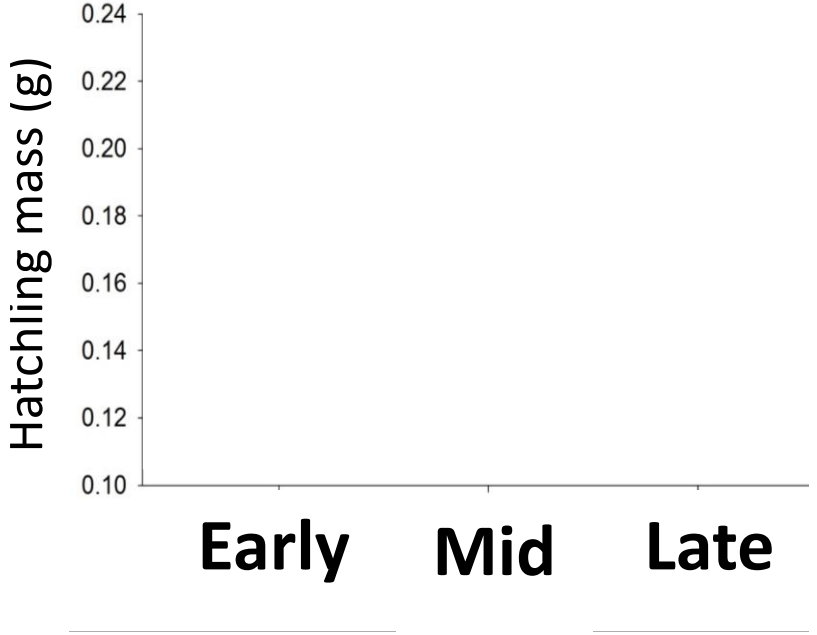




Lab breeding results (adult density)







Mitchell, Hall, Warner in revision

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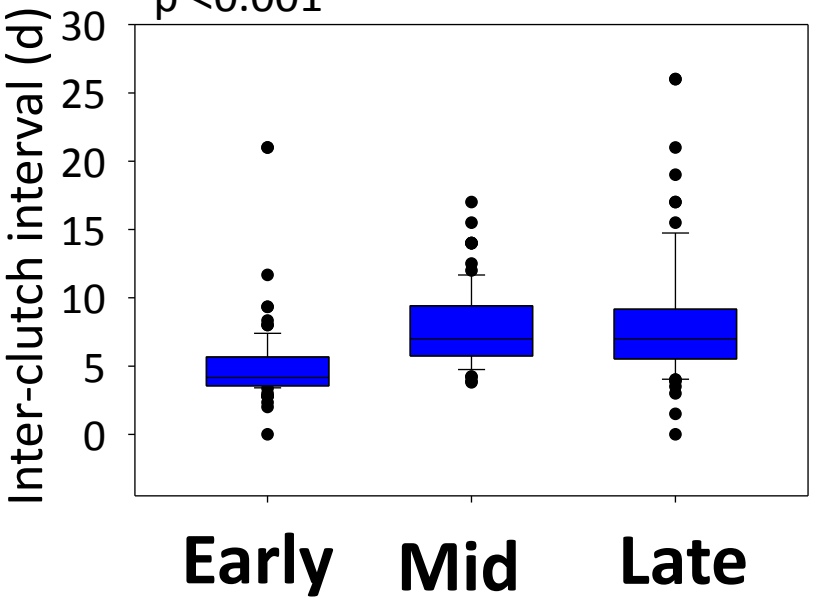
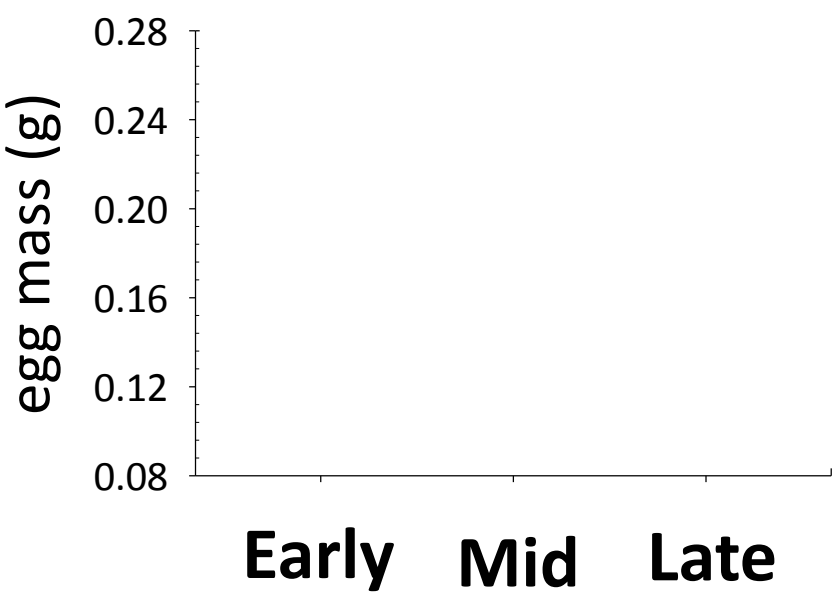
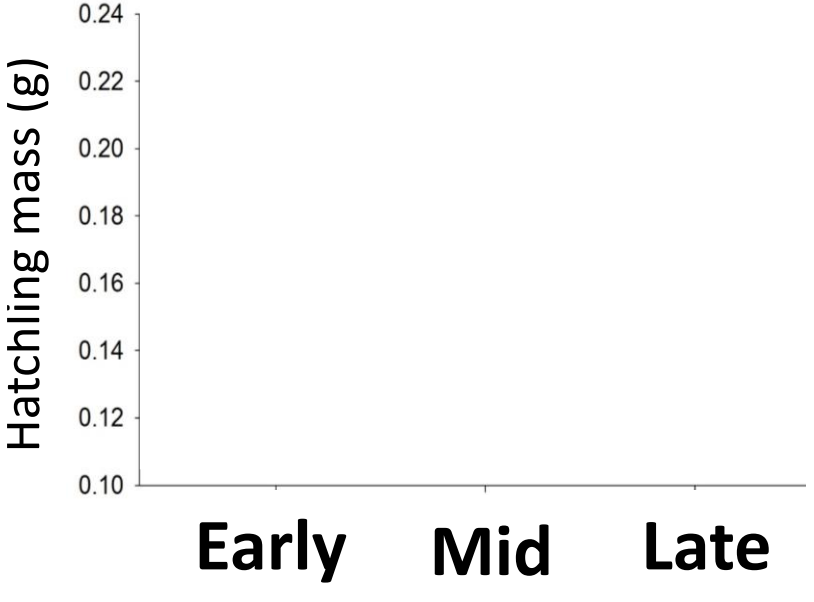
Cohort: $F_{2,189}$=18.94
p <0.001







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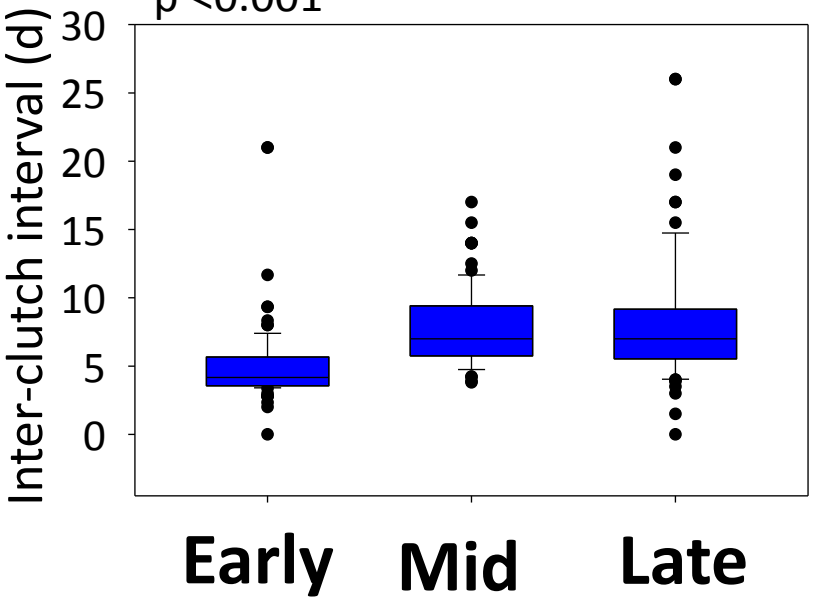

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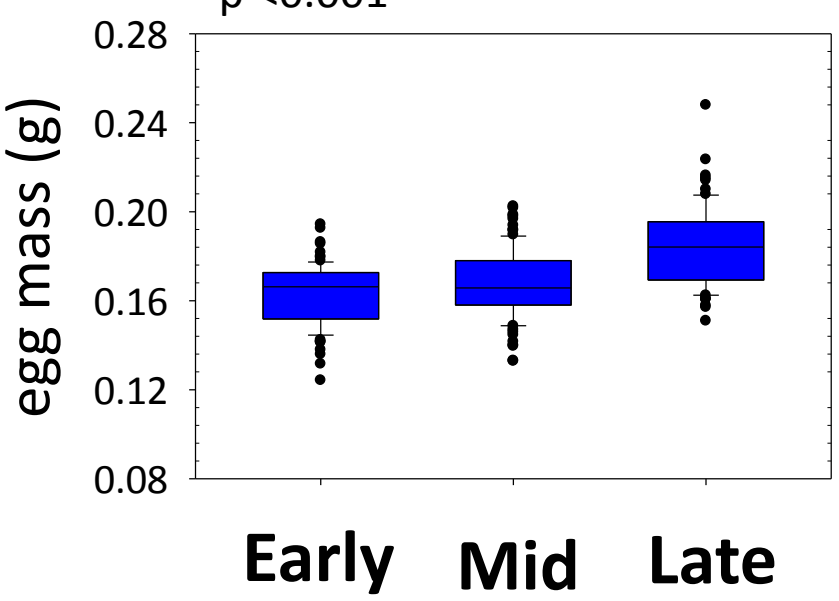

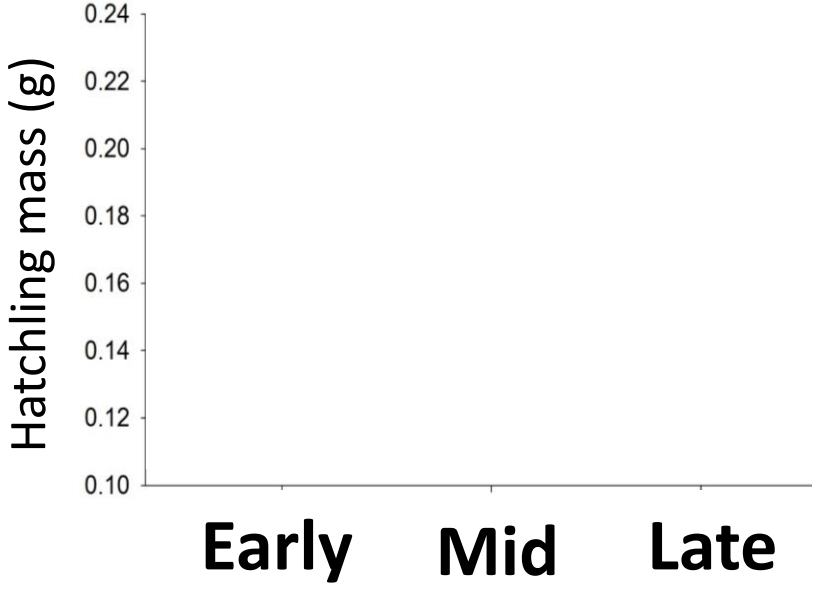

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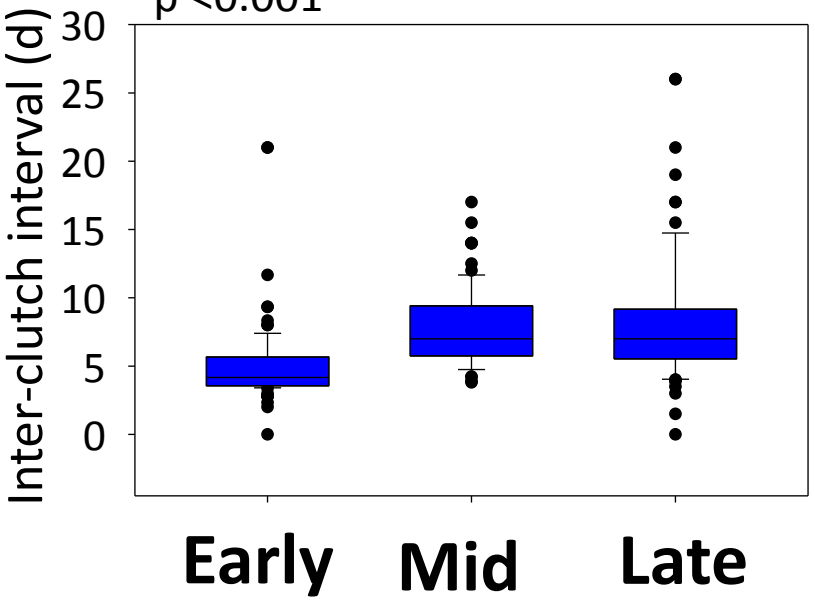

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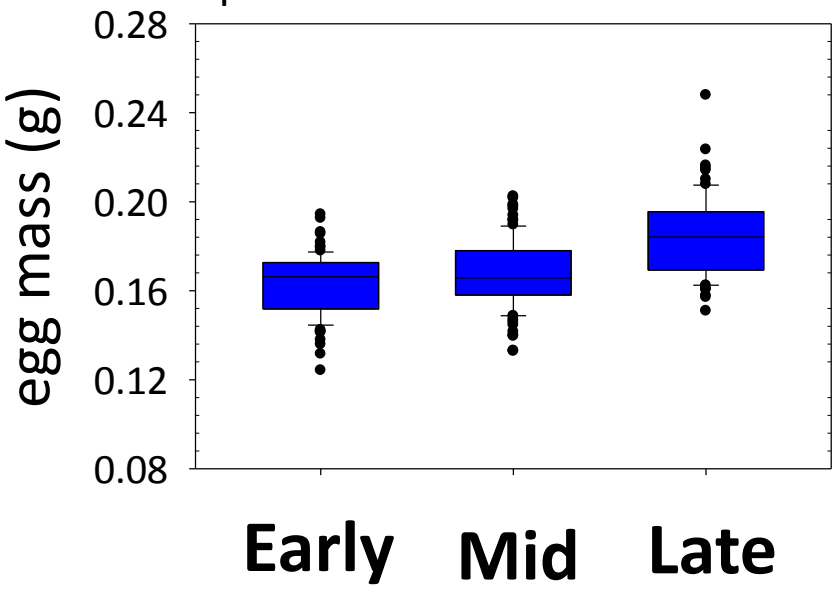

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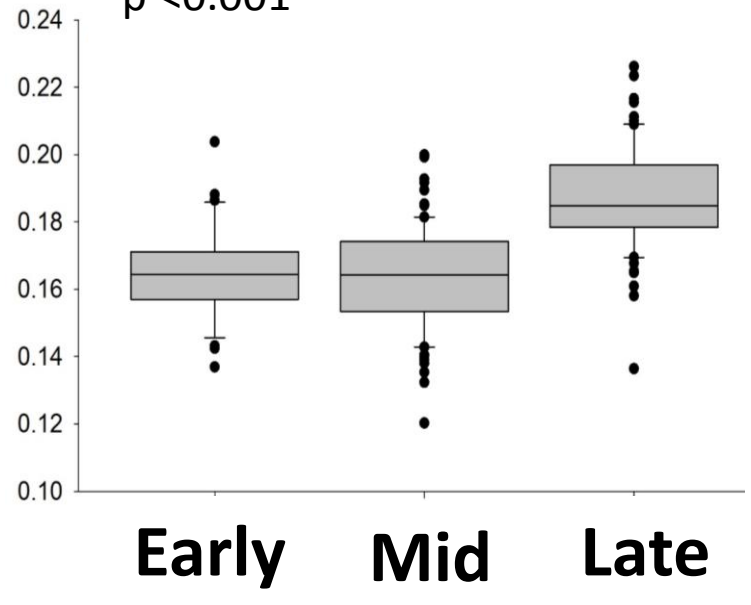

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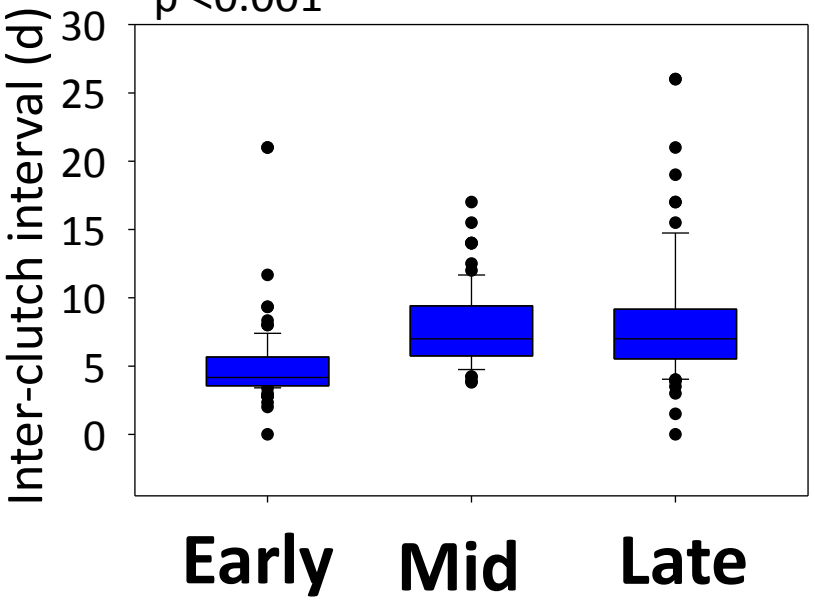

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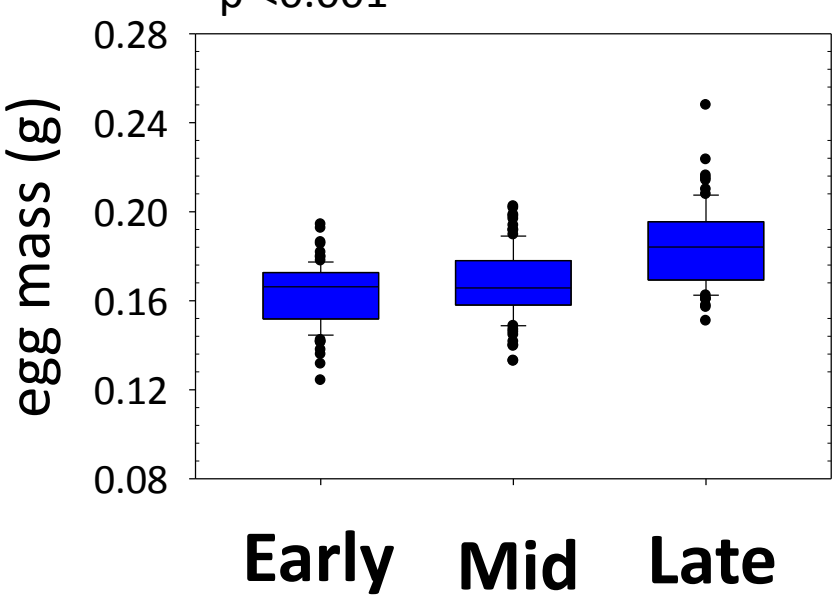

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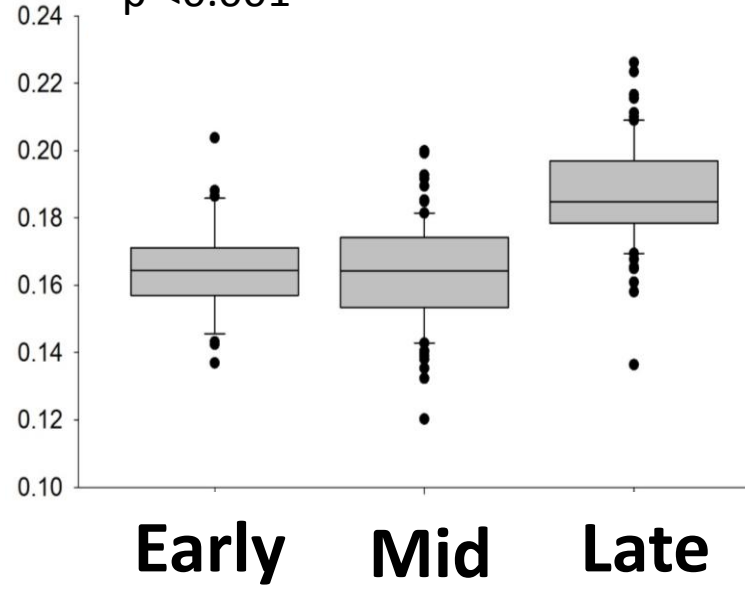

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Mitchell, Hall, Warner in revision

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Do seasonal shifts in reproductive effort persist in the lab?

March April June August October

Hall, Mitchell, Warner In Prep

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Collect lizards

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Hall, Mitchell, Warner In Prep

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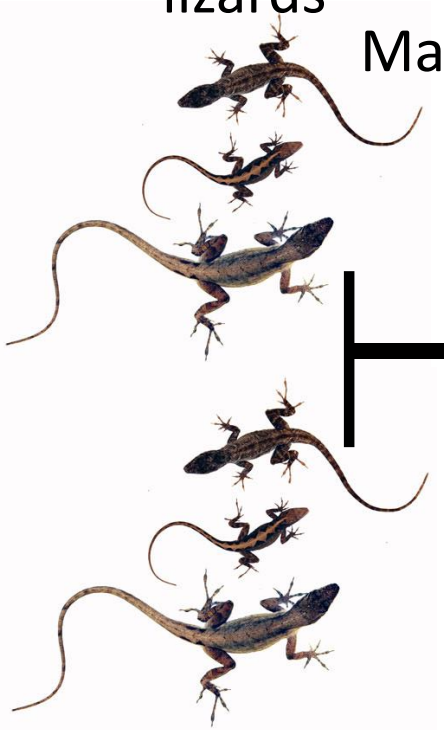


Breed a single cohort in lab for the full season

Hall, Mitchell, Warner In Prep

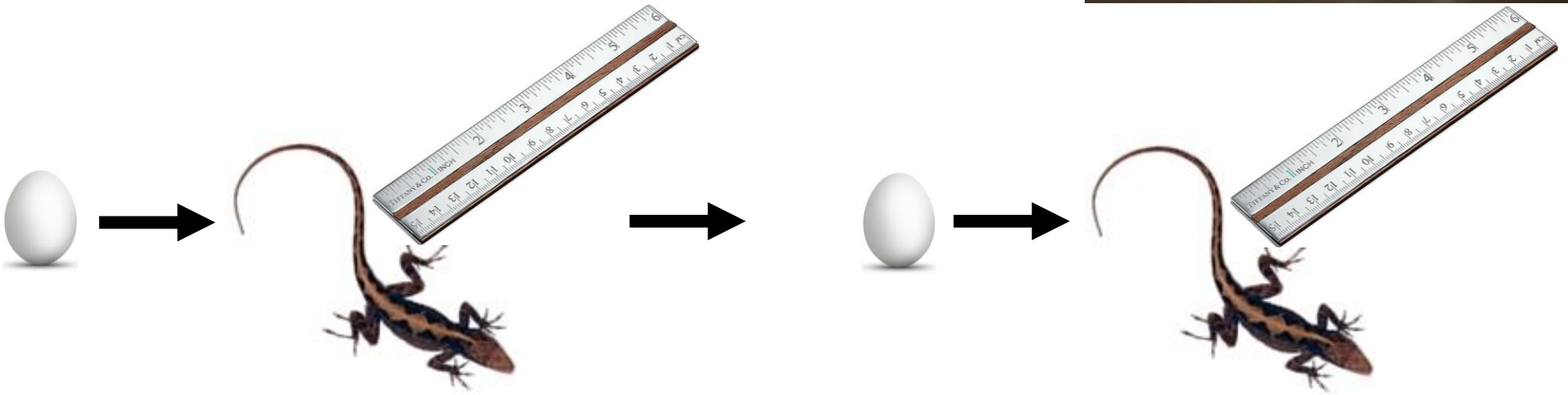
Experimental design

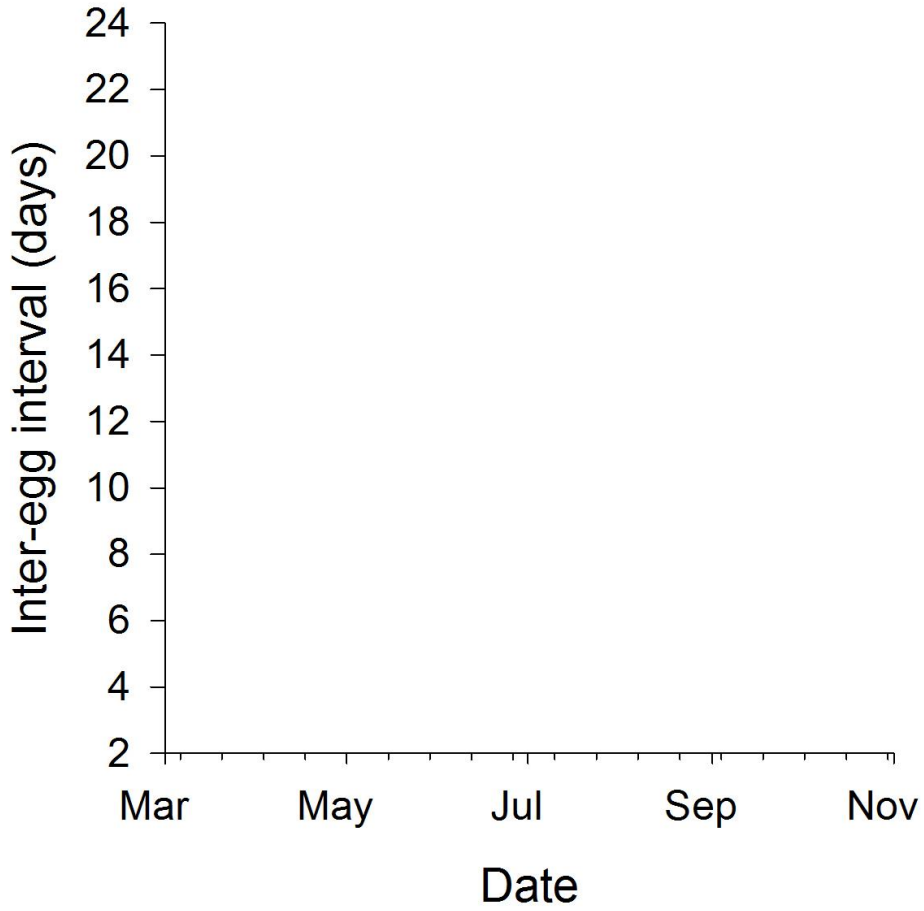
Experimental design

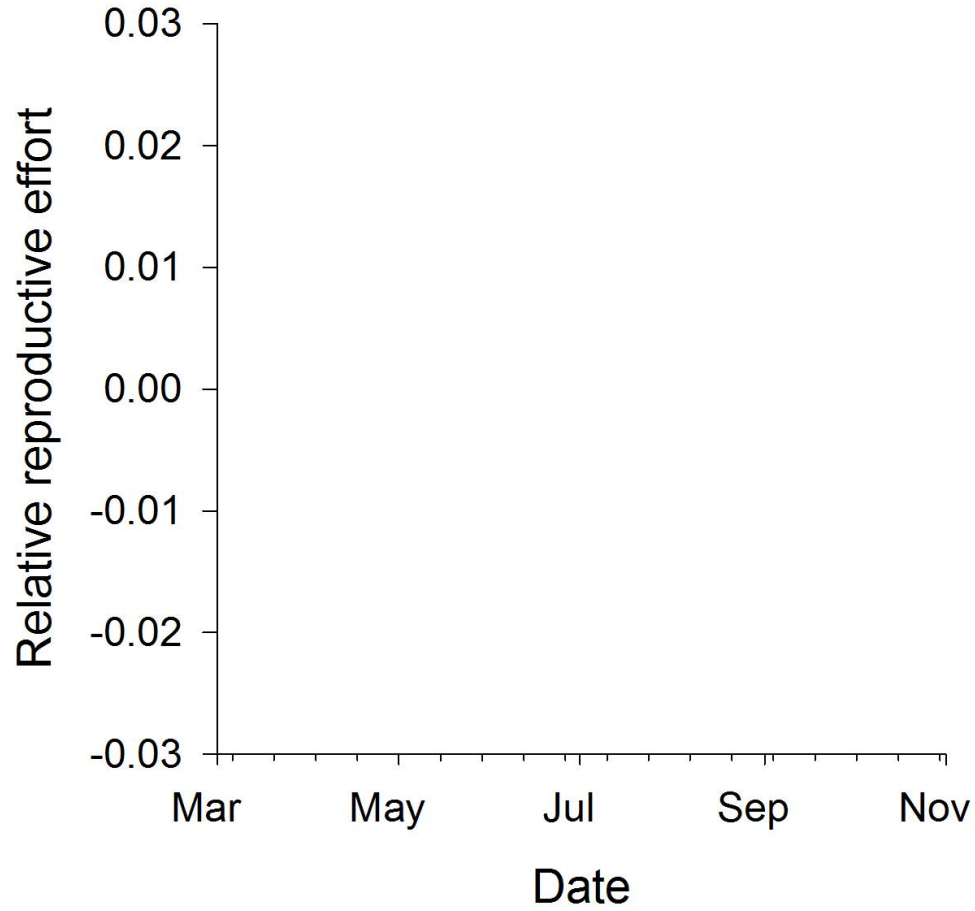
- Measured reproductive traits
- Measure mass and SVL of each female immediately after each clutch is laid

Experimental design

- Measured reproductive traits
- Measure mass and SVL of each female <u>immediately after</u> each clutch is laid

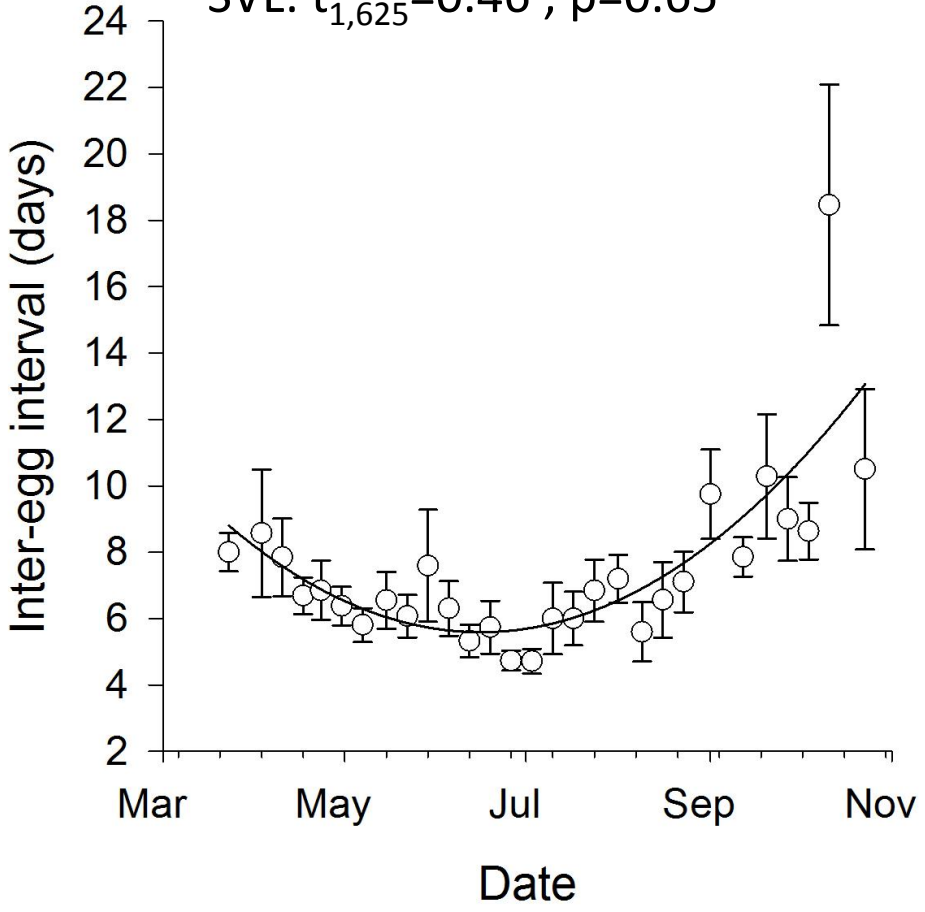


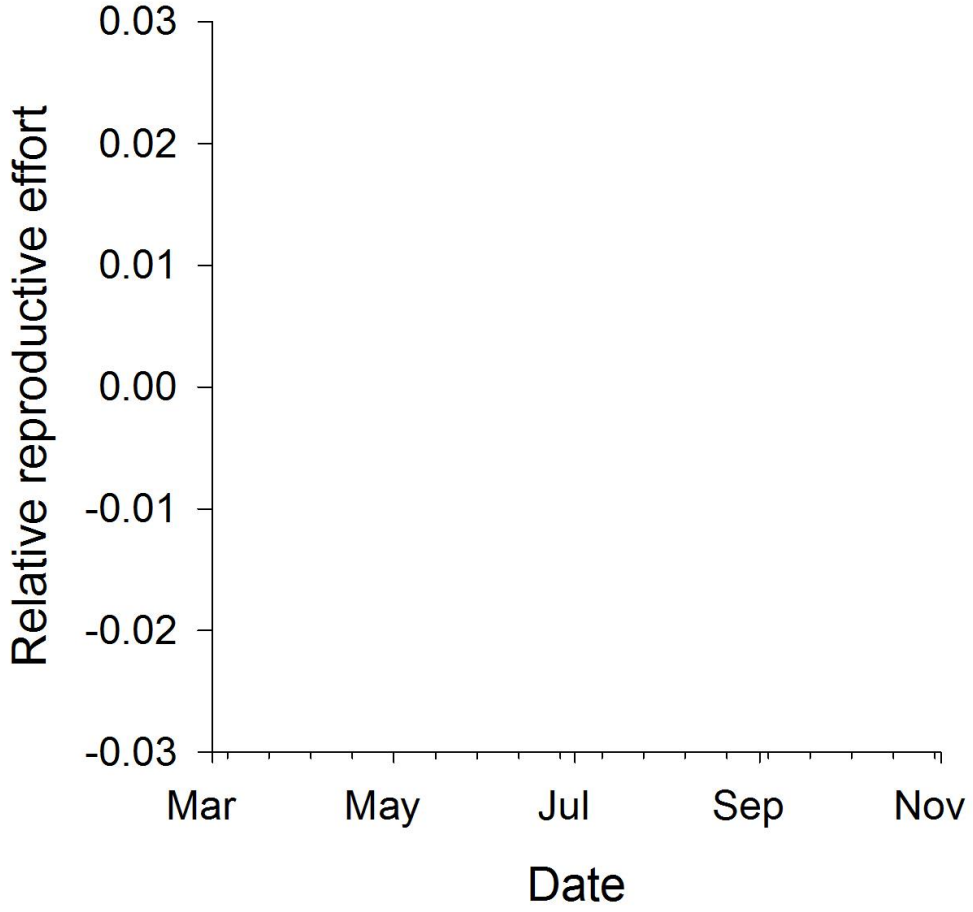

Inter-egg interval (days)
24
22
20
18
16
14
12
10
8
6
4
2
Mar
May
Jul
Sep
Nov
Date


Relative reproductive effort
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
Mar
May
Jul
Sep
Nov
Date

Time: $t_{1,625}$=3.93 ; p <0.001

SVL: $t_{1,625}$=0.46 ; p=0.65





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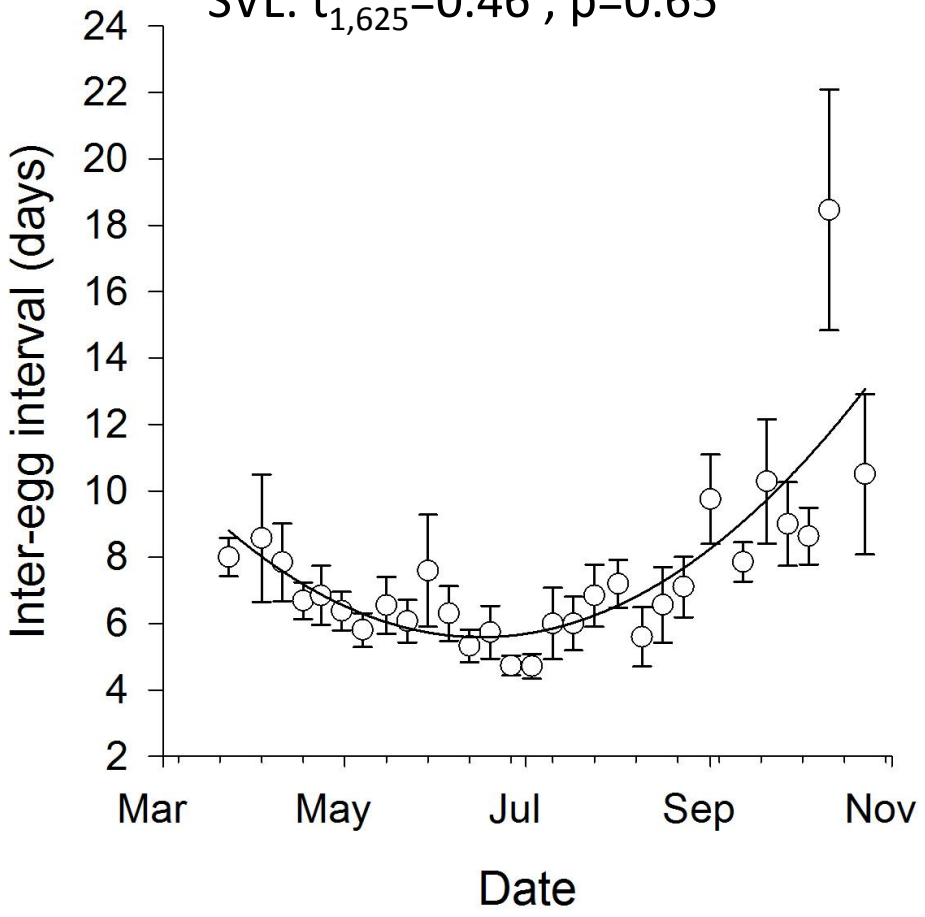
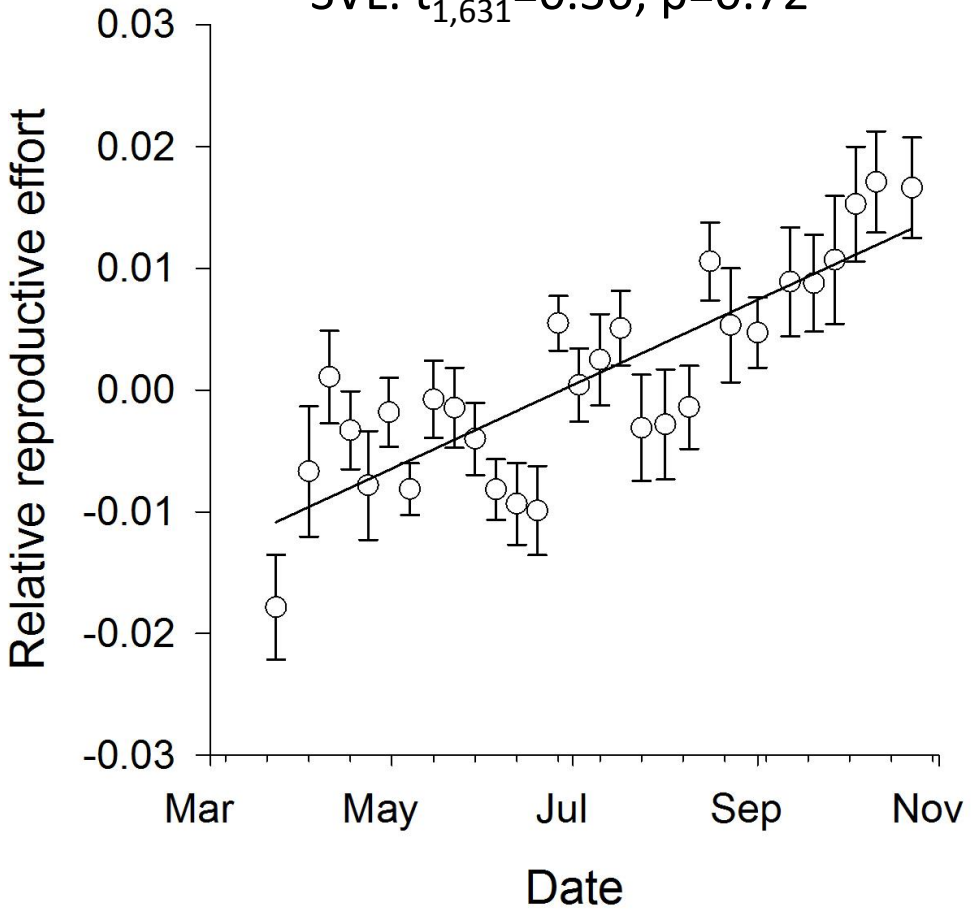


Time: $t_{1,631}$=3.49; p=0.005
SVL: $t_{1,631}$=0.36; p=0.72



Results – shifts apparent in ‘real time’

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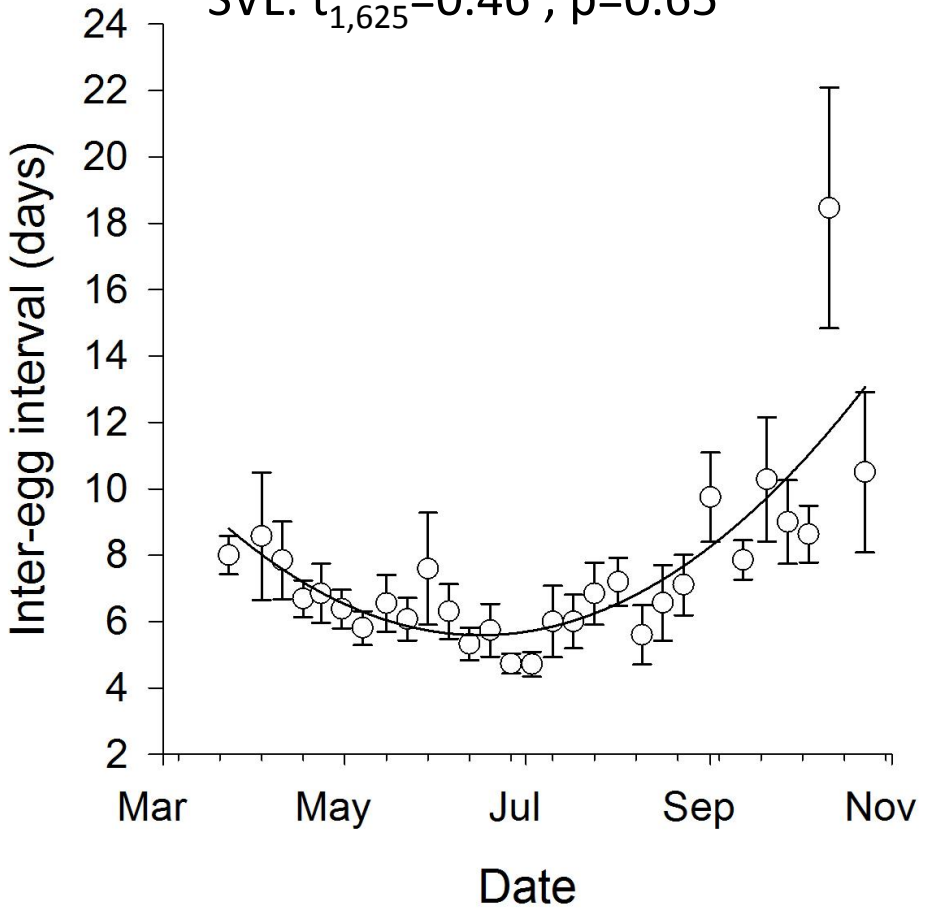
SVL: $t_{1,625}$=0.46 ; p=0.65



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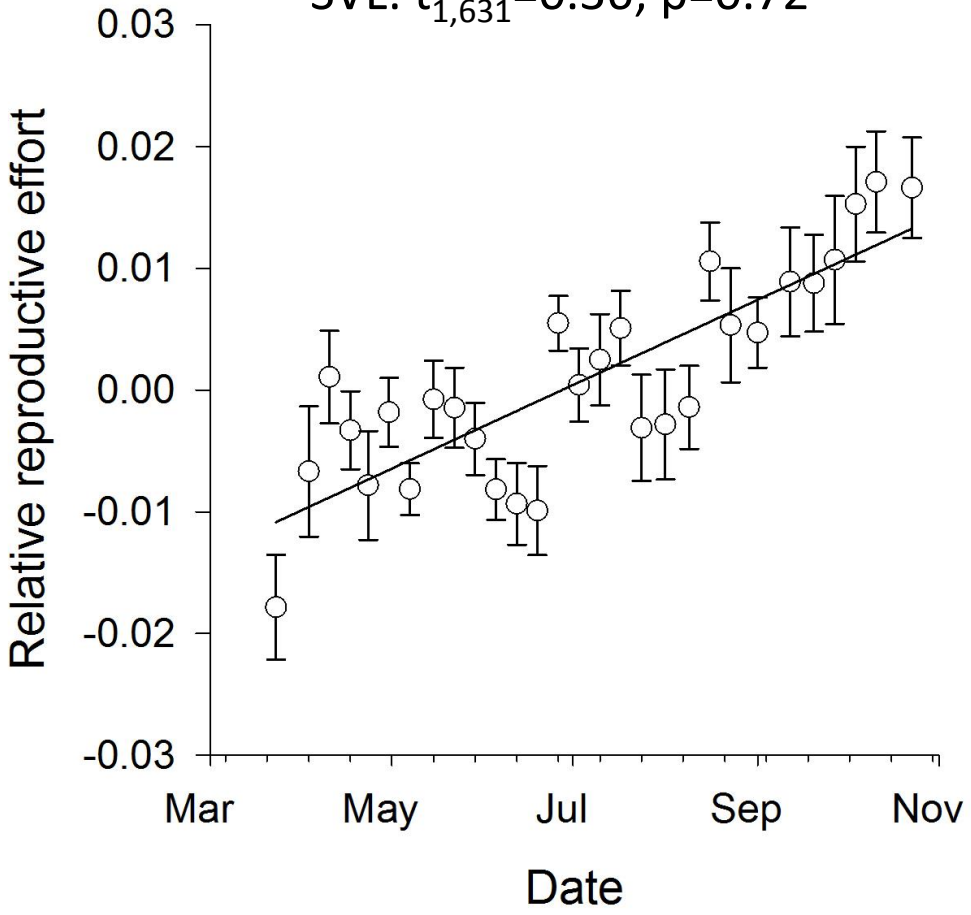
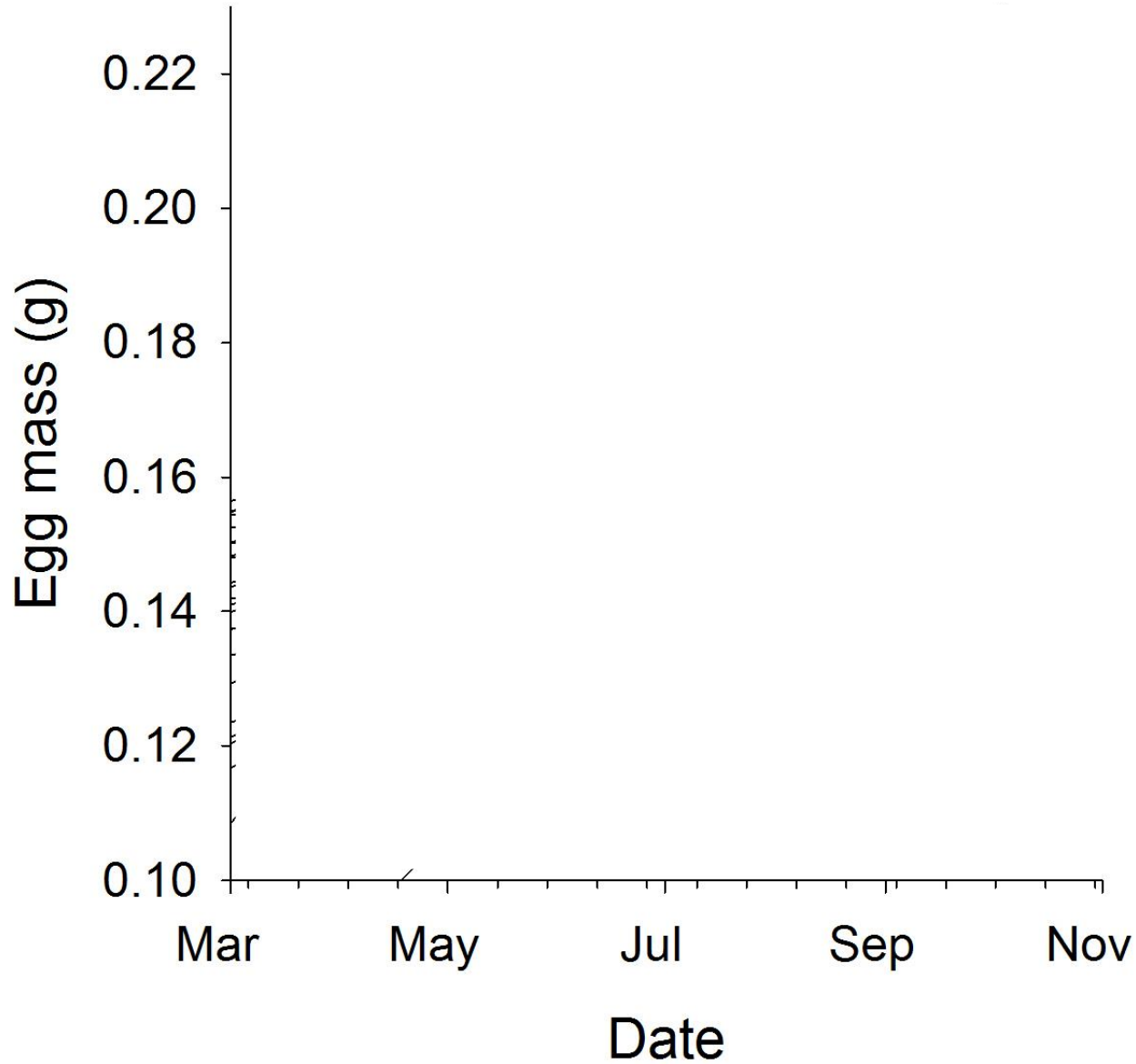
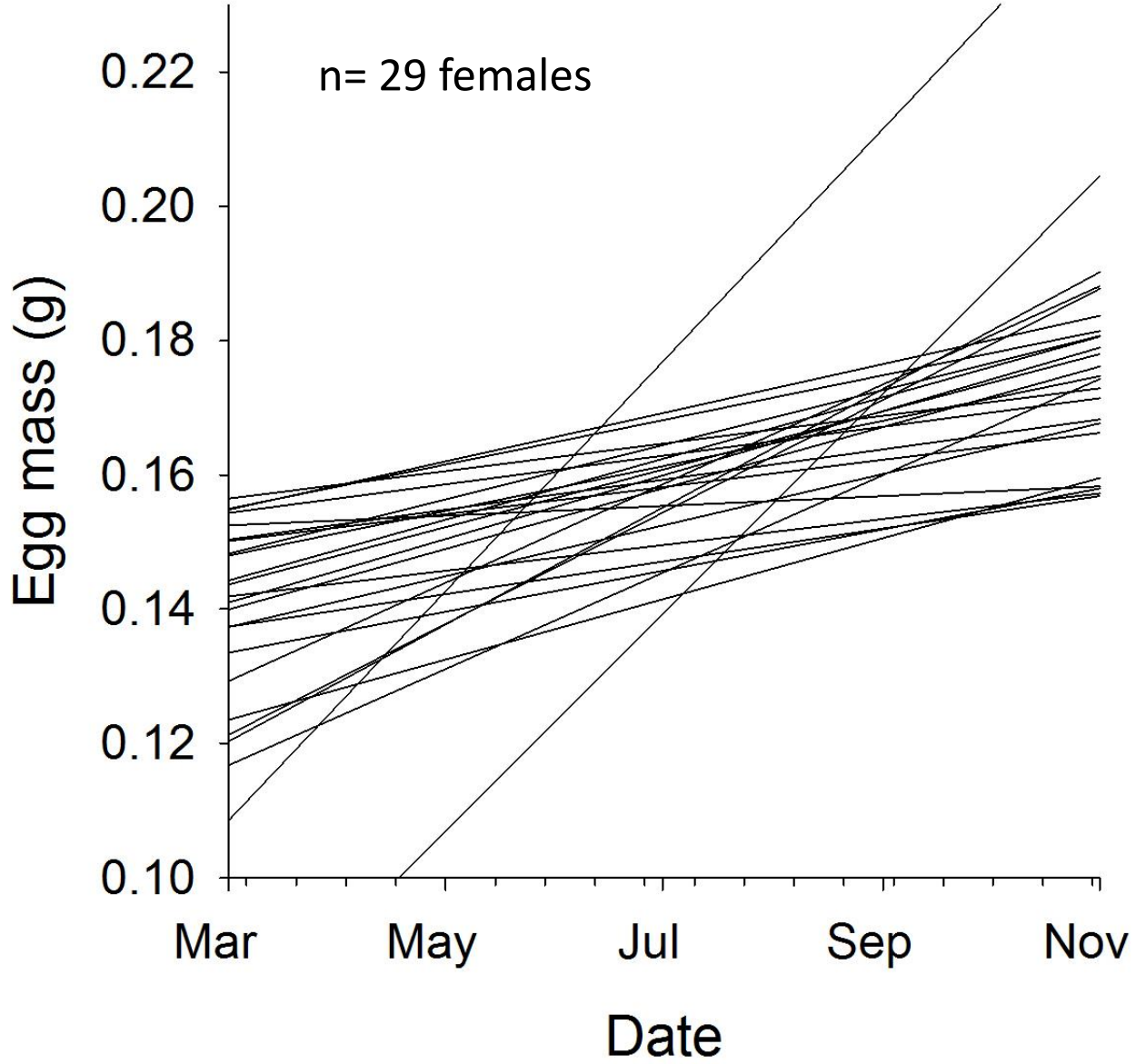



0.22
0.20
0.18
0.16
0.14
0.12
0.10
Egg mass (g)
Mar
May
Jul
Sep
Nov
Date

Results – variation among females



Does season-dependent reproductive value of offspring drive the evolution of life-history traits in *Anolis* lizards?

1.) Is reproductive value of offspring season-dependent? **Yes**
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How does food availability constrain seasonal shifts in reproduction?

Hall et al. submitted

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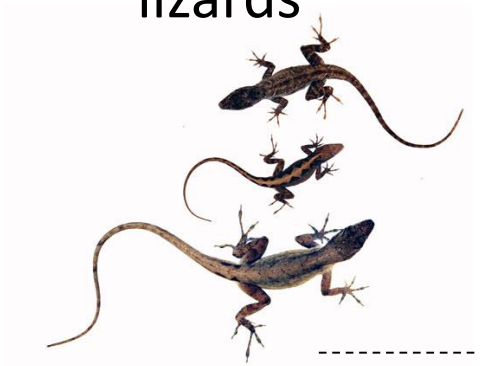
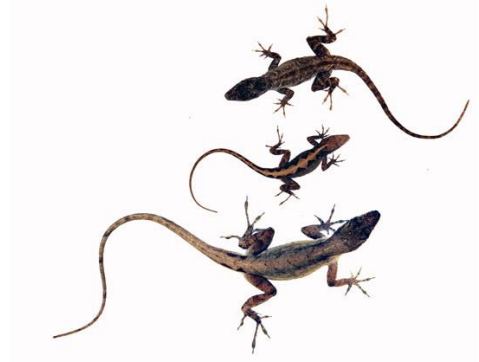


High prey diet



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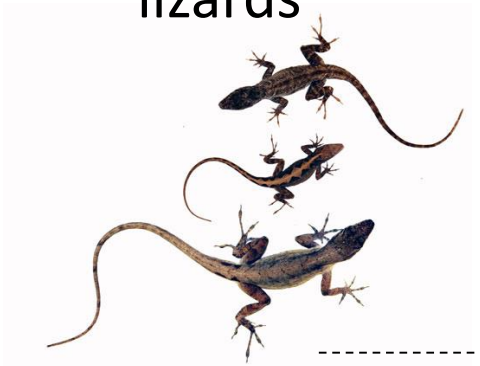

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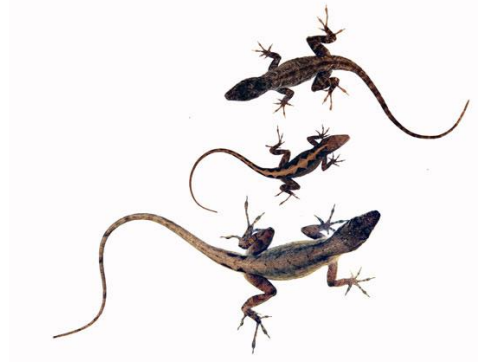

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Low prey diet

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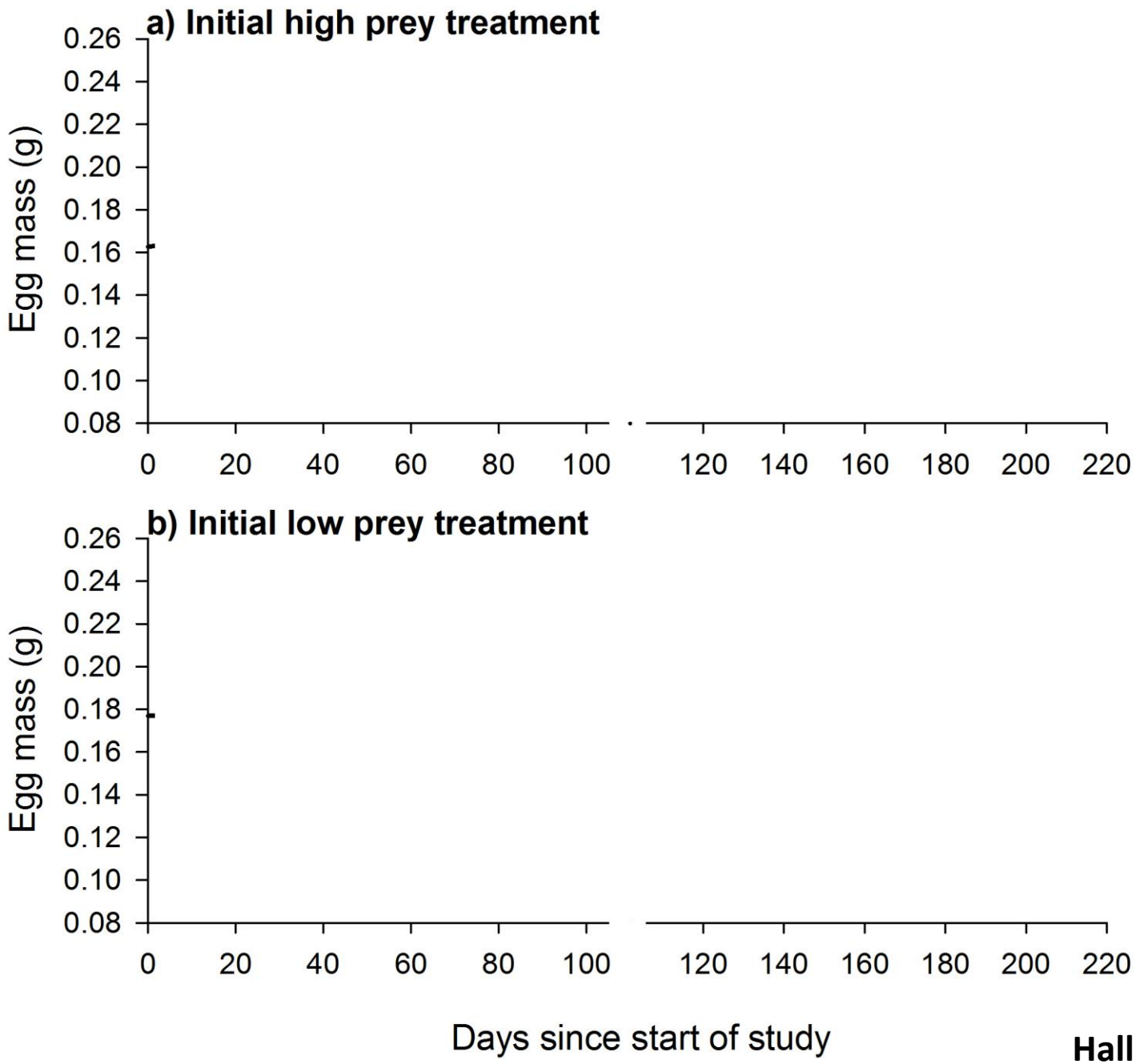
● High Prey

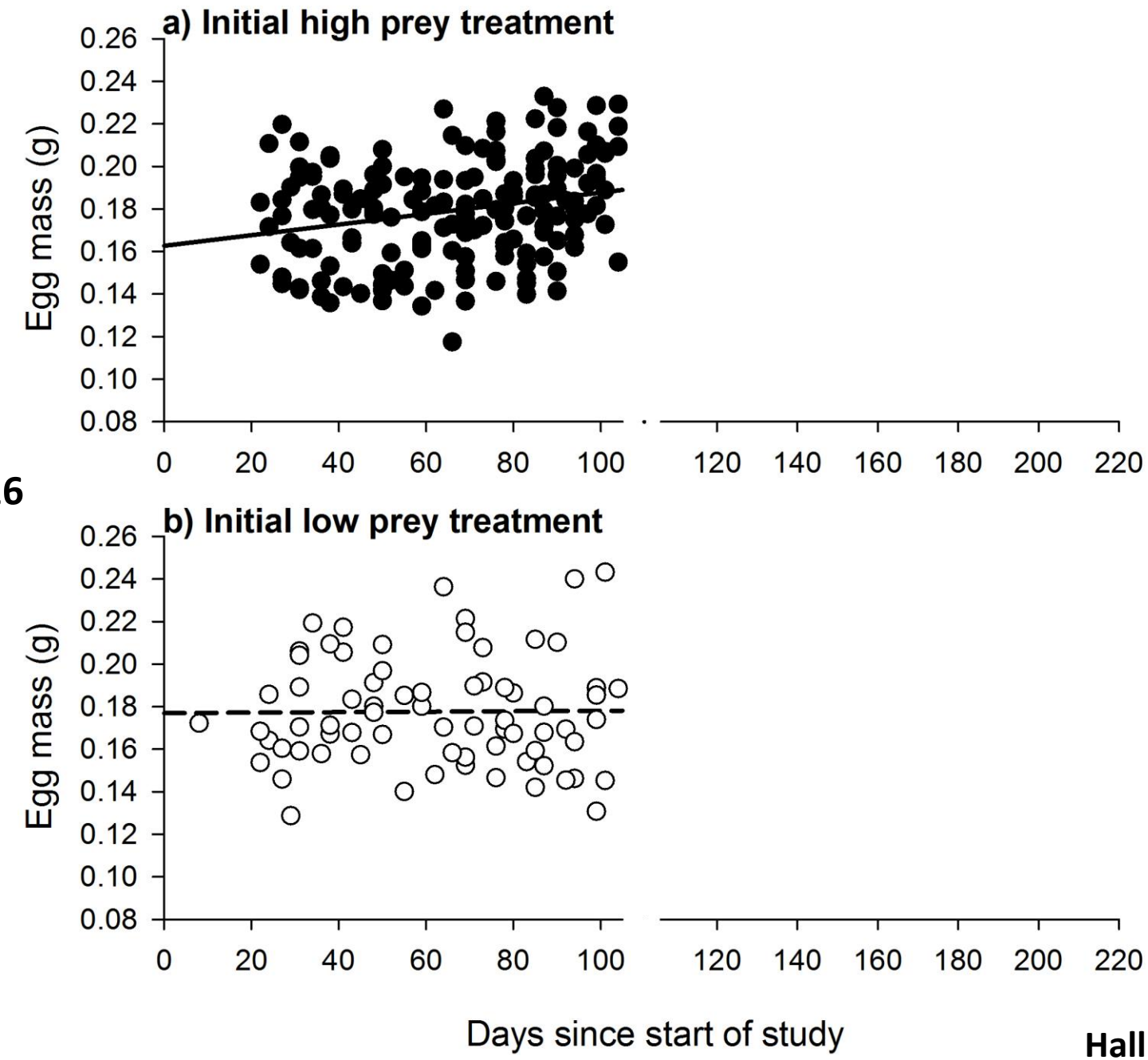
○ Low Prey



Hall et al. submitted

● High Prey

○ Low Prey



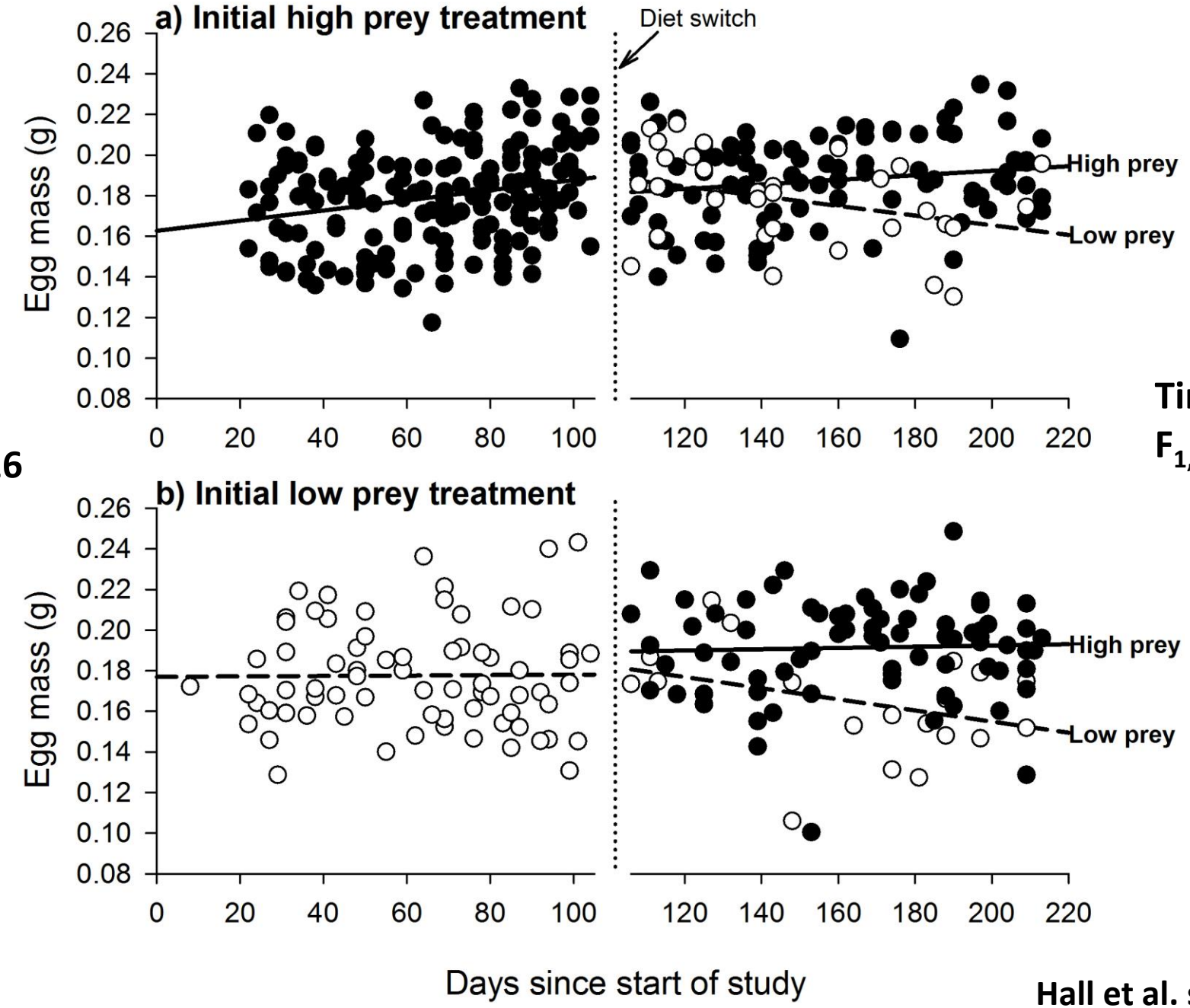
Time x Treat Int:

$F_{1,203}$ =5.04; p=0.026

Hall et al. submitted

● High Prey

○ Low Prey



Time x Treat Int:
$F_{1,203}$ =5.04; p=0.026

Time x Treat Int:
$F_{1,187}$=4.66; p=0.032

Hall et al. submitted

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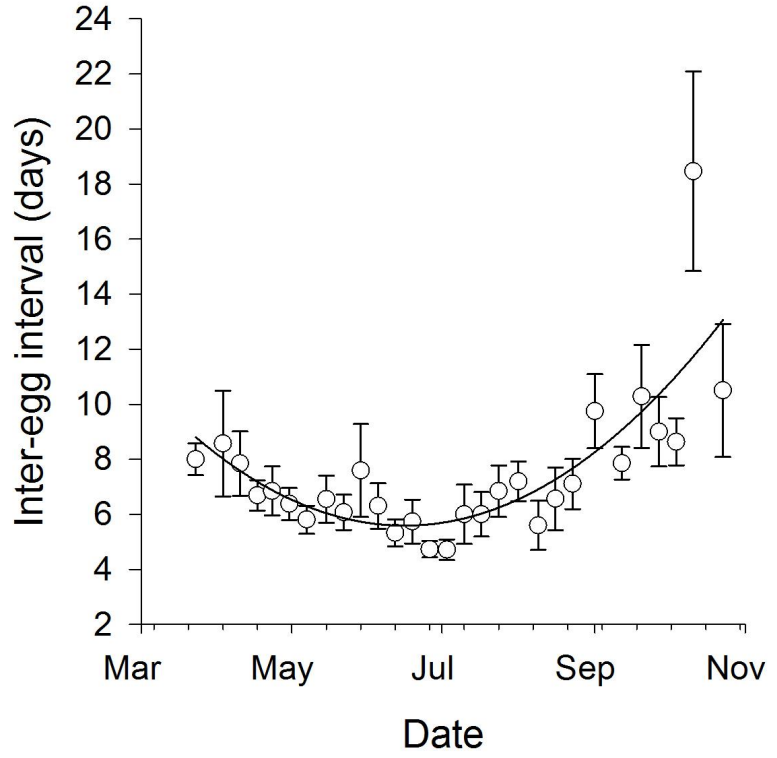

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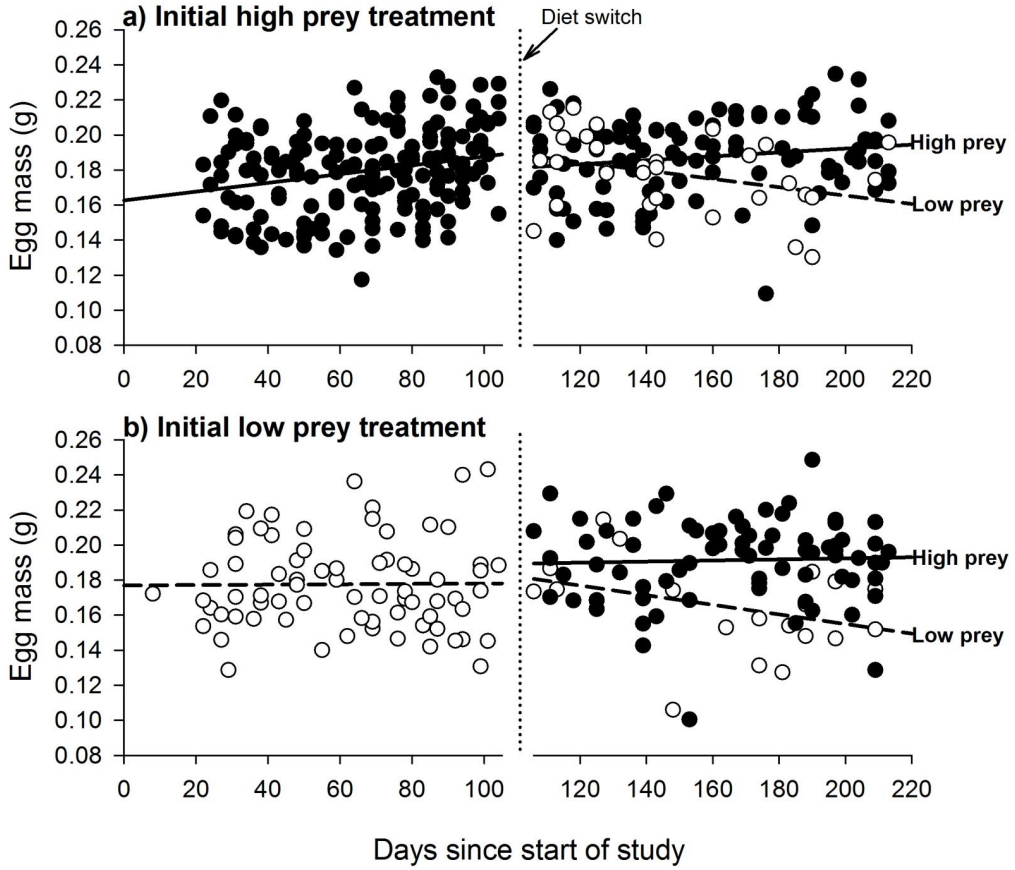
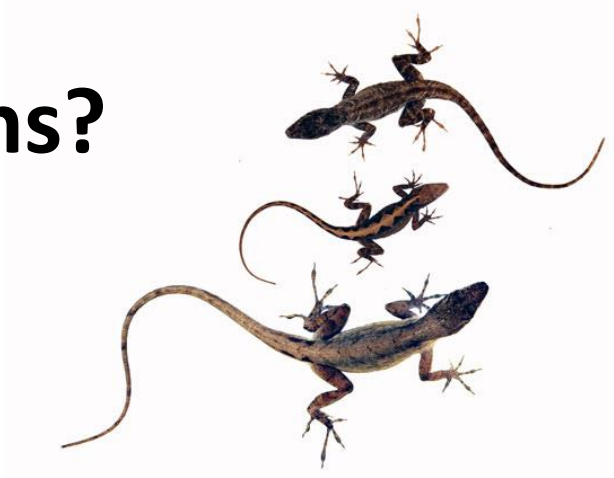


Future Questions?



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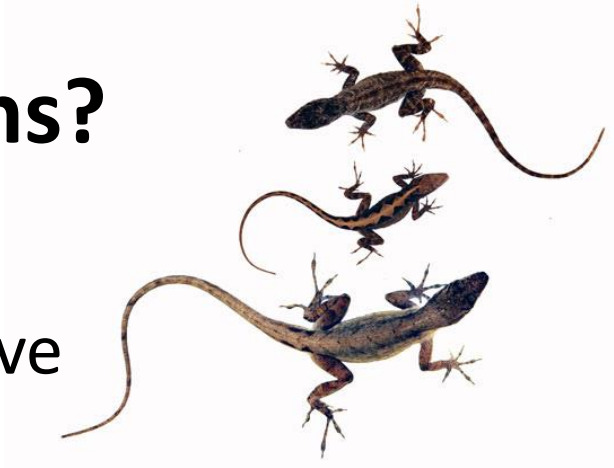

- How does selection operate on reproductive shifts across different environments? (mainland vs island anoles)

- How might seasonal changes in offspring value influence trade-offs among lifespan, age at maturity, reproductive traits?

Acknowledgements

- Warner Lab members
  - Particularly undergrads
- J. Kolbe, J. Stroud, M. Wolak