Environmental Temperature Influences Eastern Bluebird Breeding Behavior

Will Kirkpatrick

PhD Student, DuRant Lab

University of Arkansas

About Me

- 4th Year PhD Student in Sarah DuRant's Lab
- Bachelor's Degree – University of Tennessee
  - Sheldon Lab – Behavioral Ecology in the Rainbow Scarab Dung Beetle
  - Certification – Secondary Education
- Doctoral Academy Fellow at the University of Arkansas
- NSF Graduate Student Fellowship Recepient
- 2021 Bella Vista Bluebird Society Research Grant Recepient

THE UNIVERSITY OF TENNESSEE KNOXVILLE

UNIVERSITY OF ARKANSAS

Research articles

Experimental increases in temperature mean and variance alter reproductive behaviours in the dung beetle *Phanaeus vindex*

William H. Kirkpatrick and Kimberly S. Sheldon

Published: 06 July 2022 | https://doi.org/10.1098/rsbl.2022.0109

Bella Vista Bluebird Society

Est. 1980

www.bvbluebirds.com

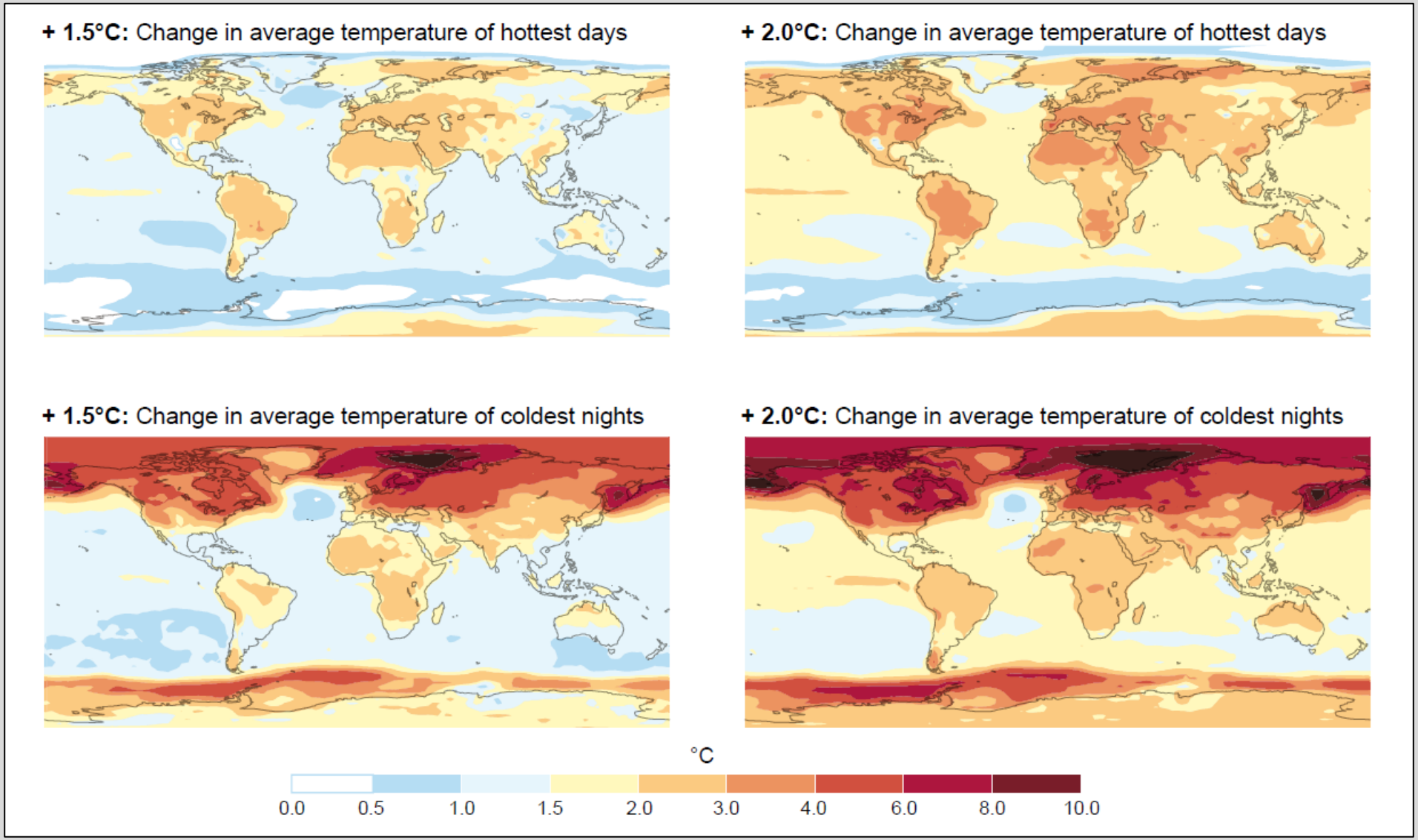
NSF

About Me

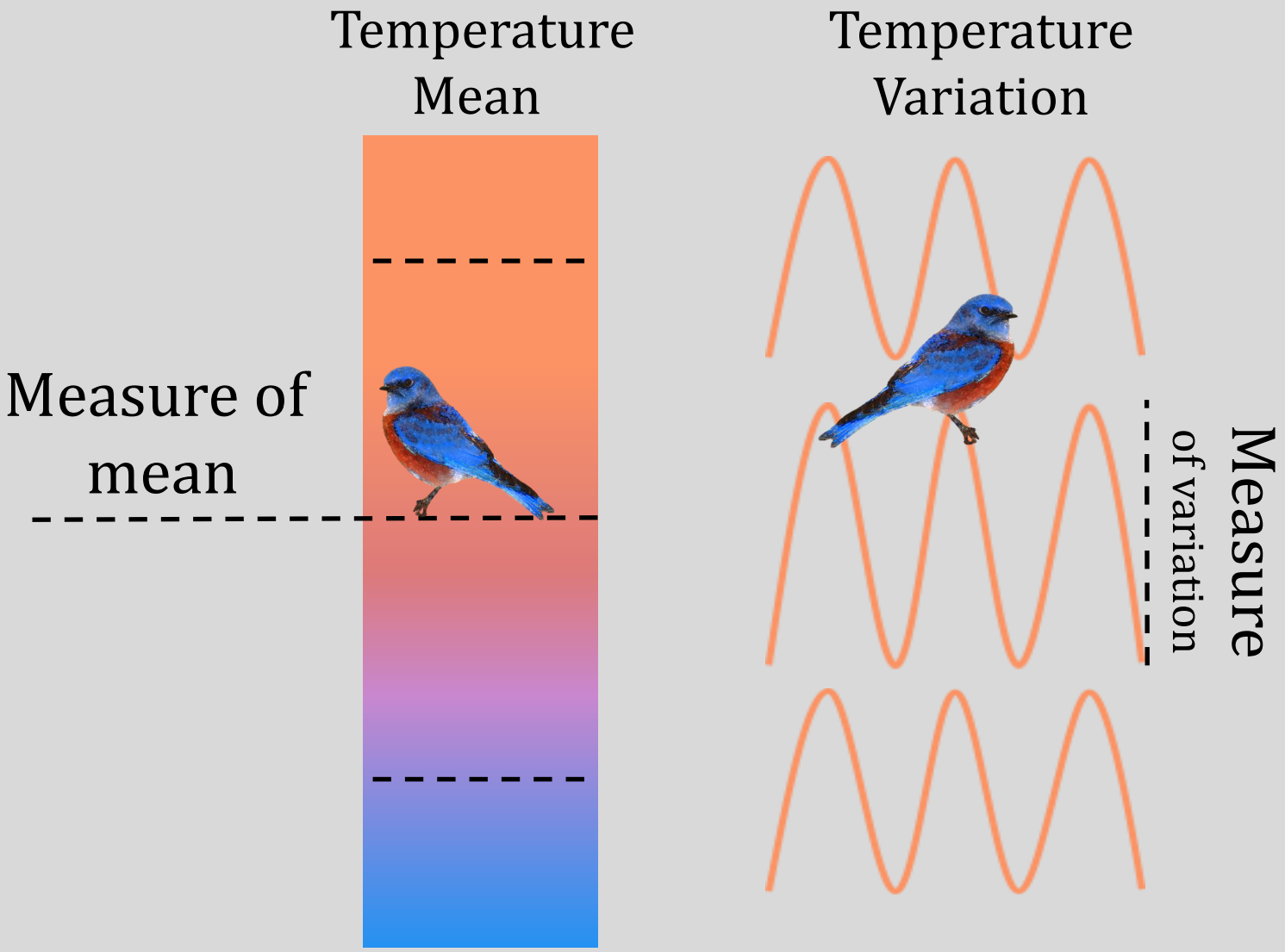
- Research Interests
  - Thermal Ecology – how environmental temperature influences natural systems
  - Organismal Behavior – individual variations in behavior in response to environmental stimuli
    - Behavioral plasticity
  - Physiological Ecology – how the environment shapes organismal outcomes (ex. growth rate)

The Thermal Environment

The Thermal Environment



The Thermal Environment



My Research

Central Idea: environmental temperature variability is an important driver of adult breeding behavior in altricial birds, and their behavior dictates the thermal environment of the nest, shaping offspring physiology.

Hypotheses

- Hypothesis 1
    - Thermal variability affects adult breeding behavior and egg temperatures.
- Hypothesis 2
    - Thermal variability of the nest drives offspring phenotypes.
- Hypothesis 3
    - Experimentally increased temperature mean and variation will influence the duration of off-bouts and the thermal environment of the egg.

Field Sites

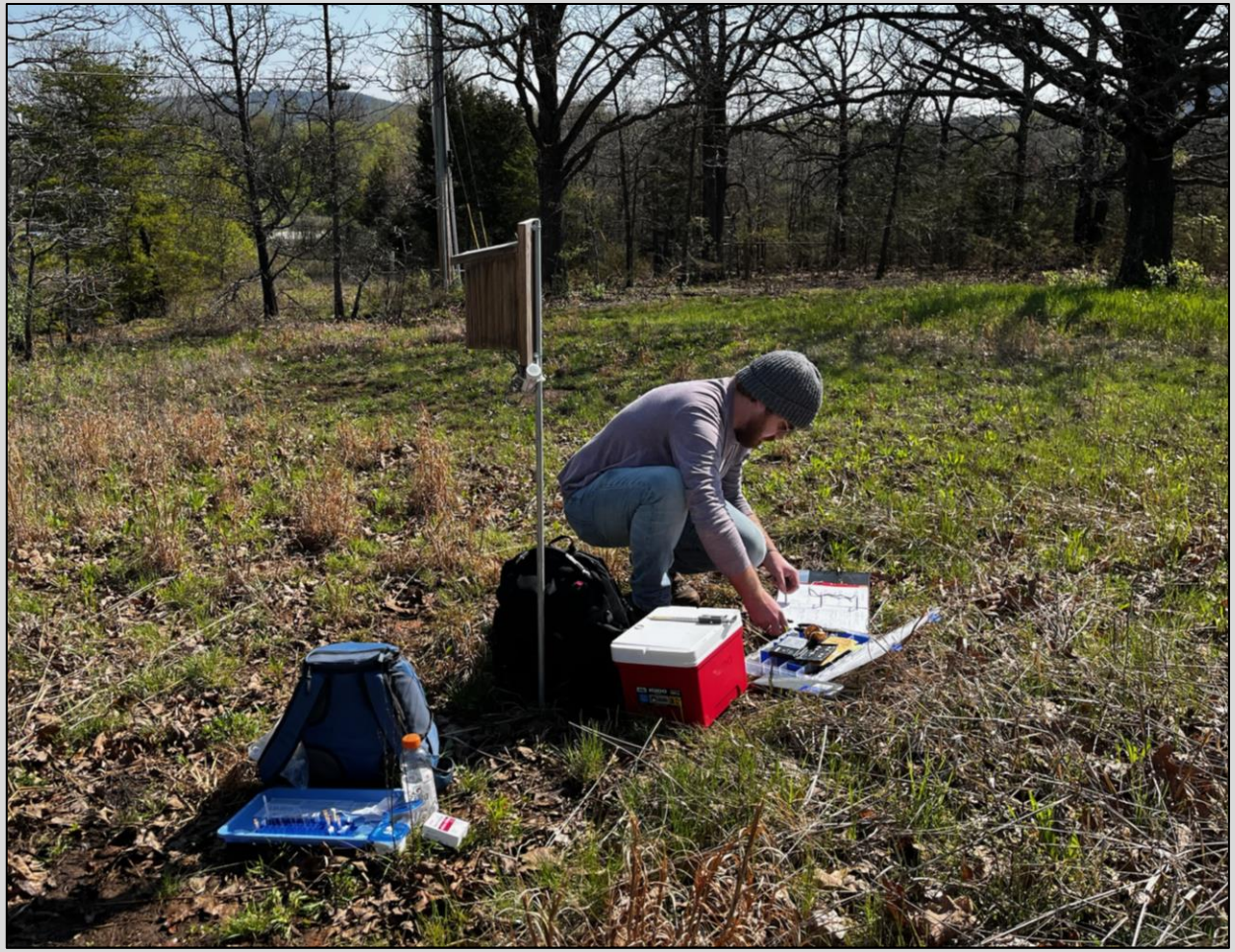
We have expanded from 3 to 6 field sites since Fall 2020.

- Original 3
  - Ag Farm
  - Woolsey Prairie
  - Wilson Springs
- New Sites
  - Westside Prairie
  - Cato Springs
  - Callie's Prairie

Total of 208 boxes

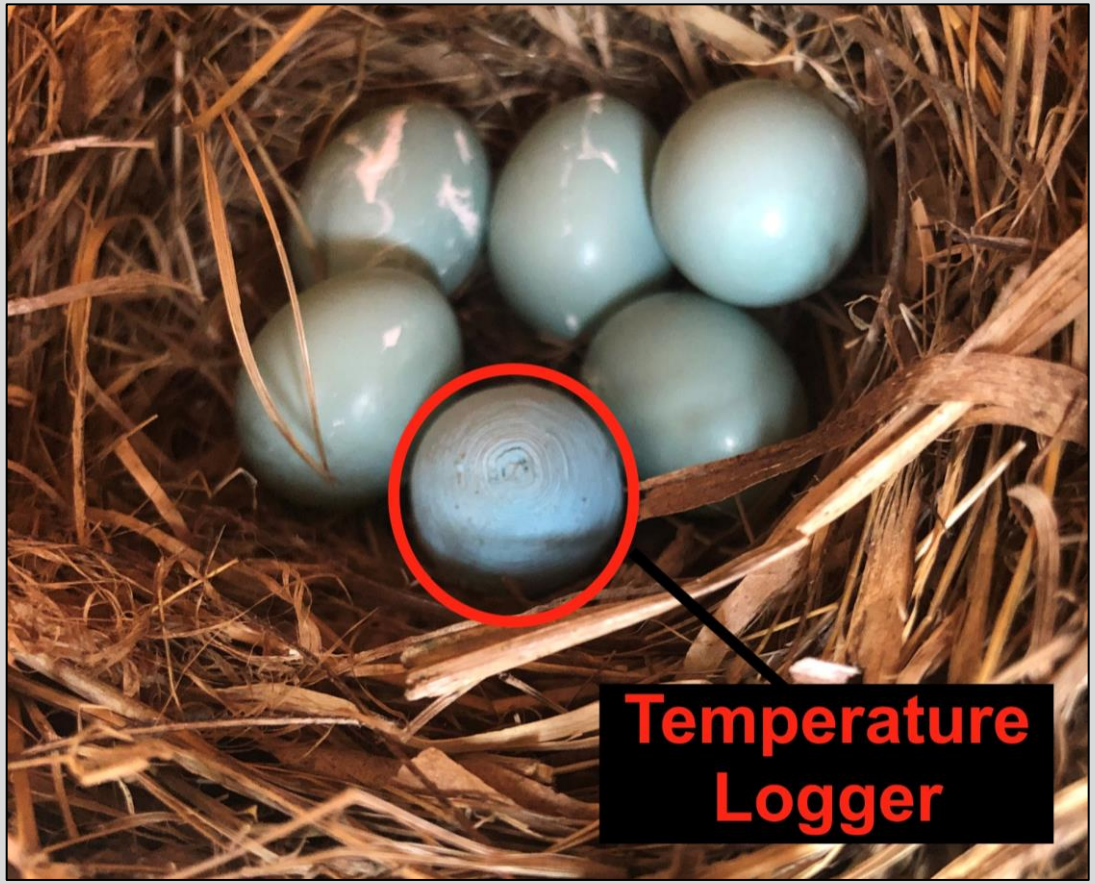
Methodology

- Mass, tarsus, beak lengths on days 1, 5, 10, 13
- Blood samples on day 5 and 10
- Mouth swabs on day 10



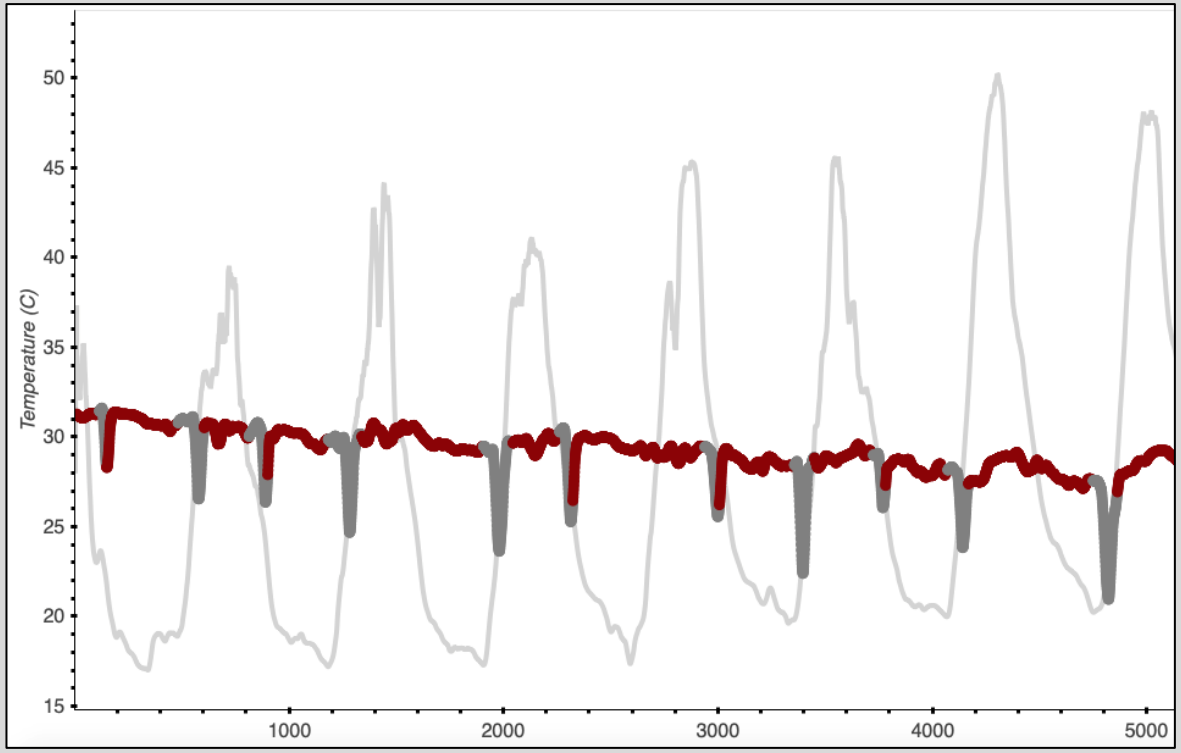
Methodology

- Mass, tarsus, beak lengths on days 1, 5, 10, 13
- Blood samples on day 5 and 10
- Mouth swabs on day 10
- 2 Channel Hobologger in each nest on the day of the 4^{th} laid egg
    - One probe in the nest and one out
- This allows me to track incubation behaviors using NestIQ

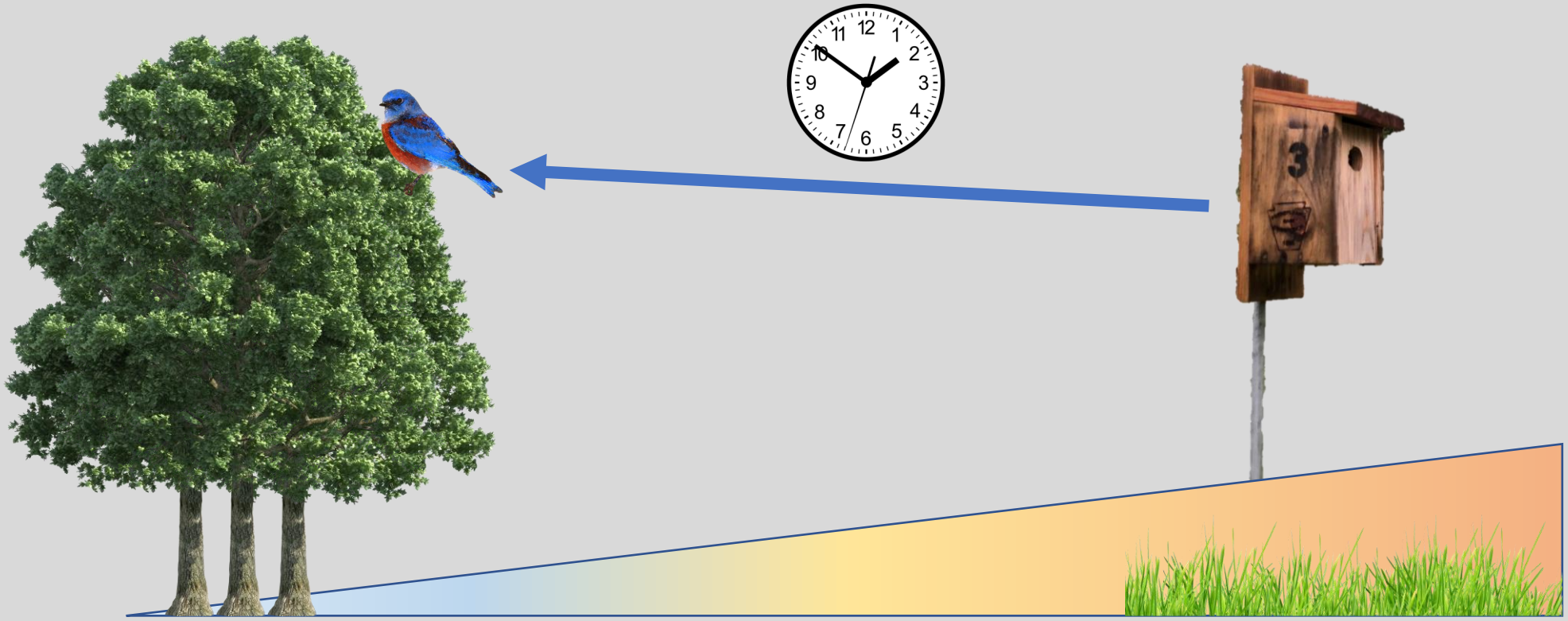


Methodology

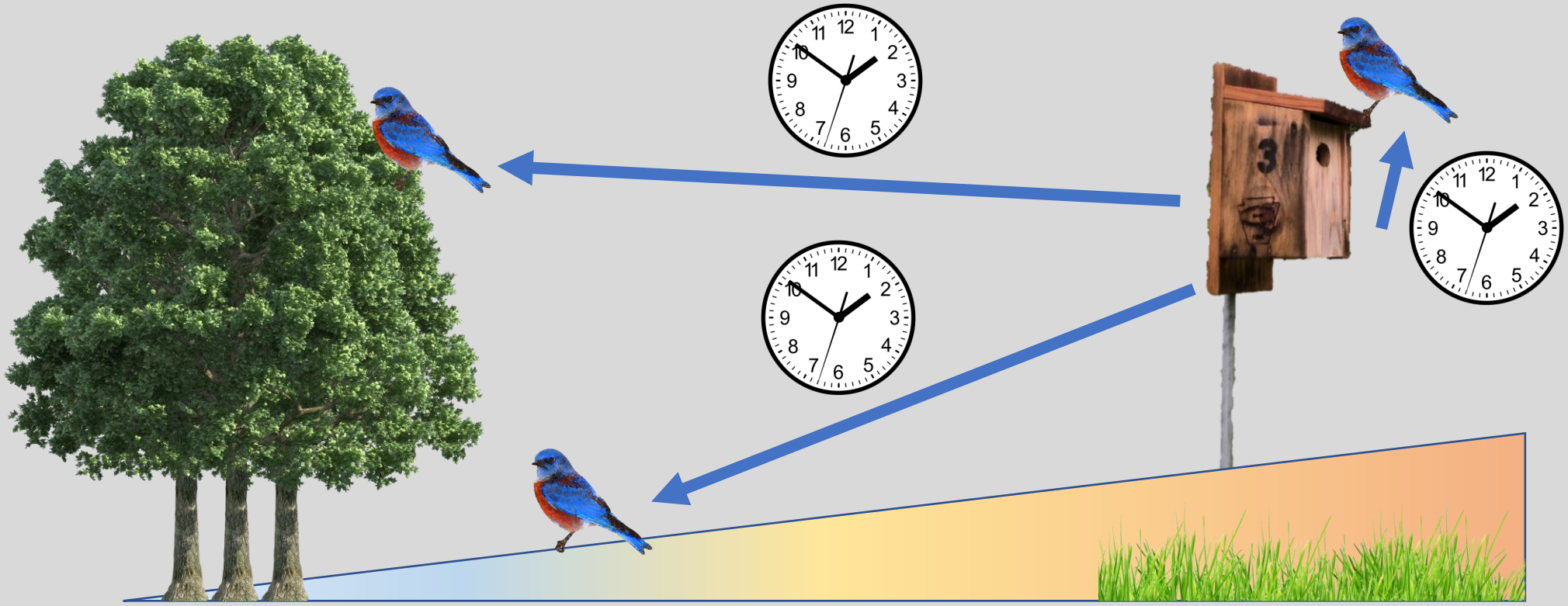
- Mass, tarsus, beak lengths on days 1, 5, 10, 13
- Blood samples on day 5 and 10
- Mouth swabs on day 10
- 2 Channel Hobologger in each nest on the day of the 4th laid egg
    - One probe in the nest and one out
- This allows me to track incubation behaviors using NestIQ



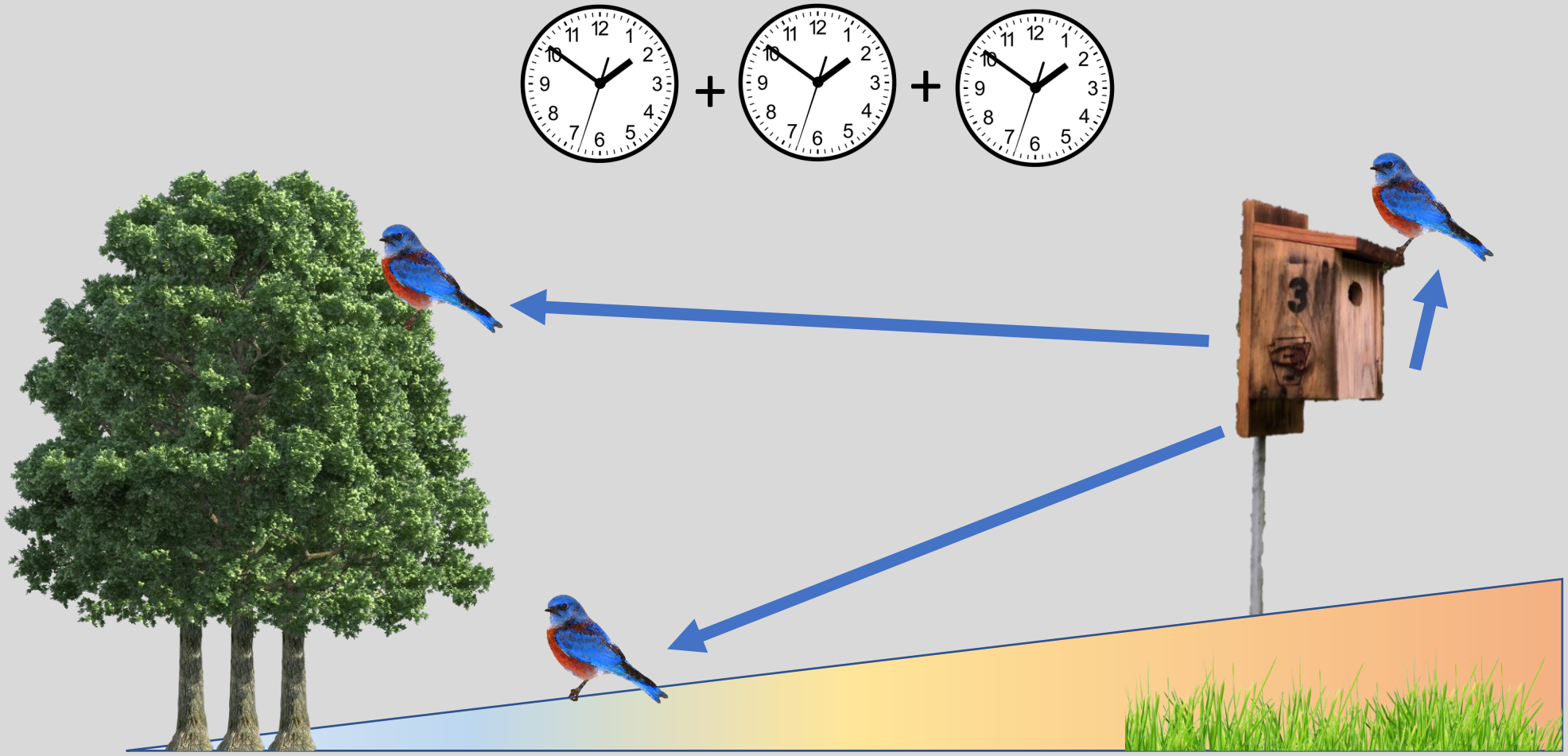
Behavioral Measurements – the off-bout



Behavioral Measurements – Individual Off-bout



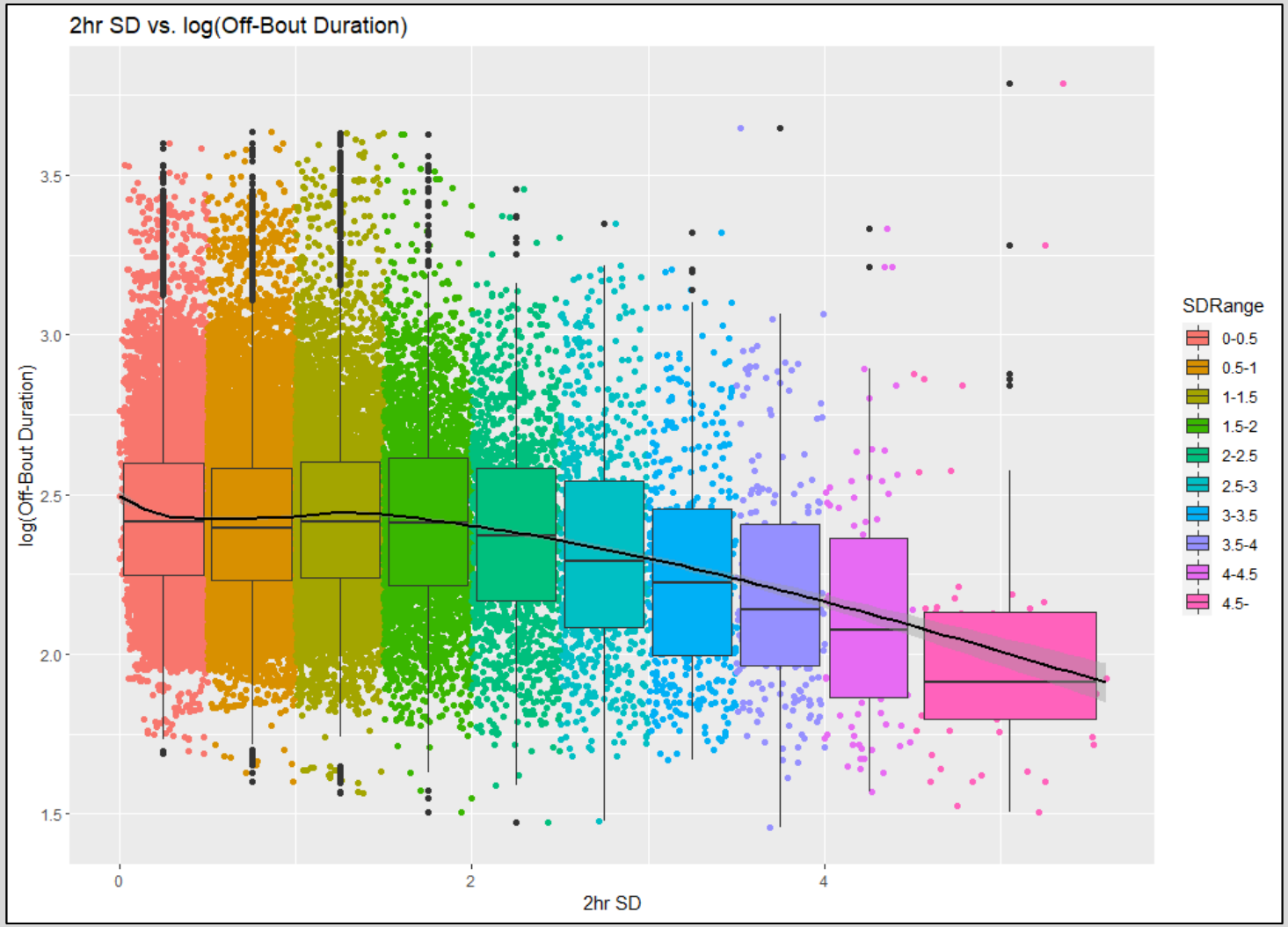
Behavioral Measurements – Incubation Constancy

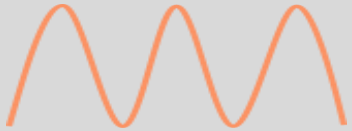


Hypotheses

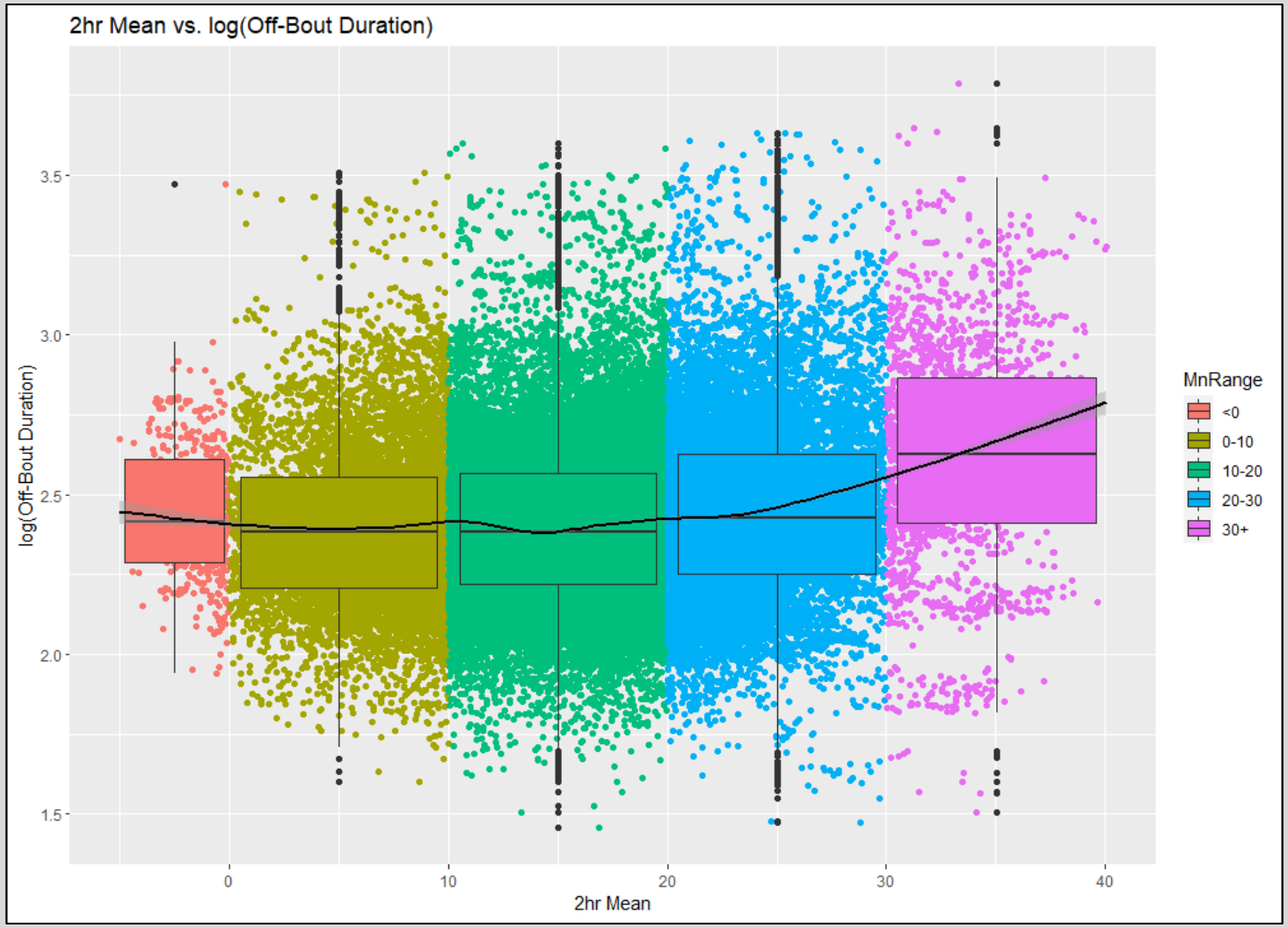
- **Hypothesis 1**
  - **Thermal variability affects adult breeding behavior and egg temperatures.**
- Hypothesis 2
  - Thermal variability of the nest drives offspring phenotypes.
- Hypothesis 3
  - Experimentally increased temperature mean and variation will influence the duration of off-bouts and the thermal environment of the egg.

High resolution temperature data suggests alternating relationships between thermal measurements and individual off-bout duration



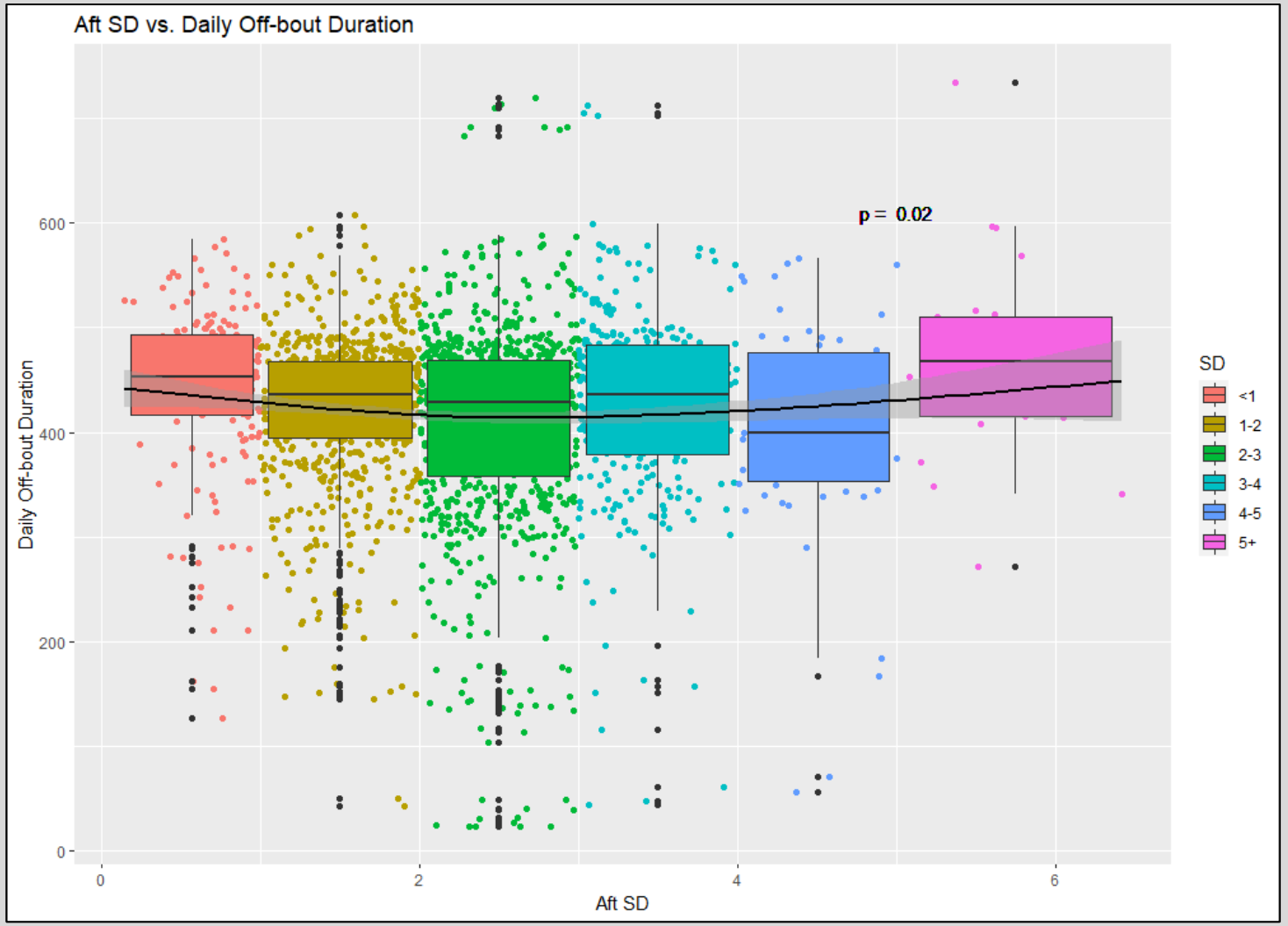


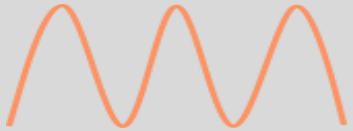
High resolution temperature data suggests alternating relationships between thermal measurements and individual off-bout duration



Low resolution temperature data suggests alternating relationships between thermal measurements and individual off-bout duration

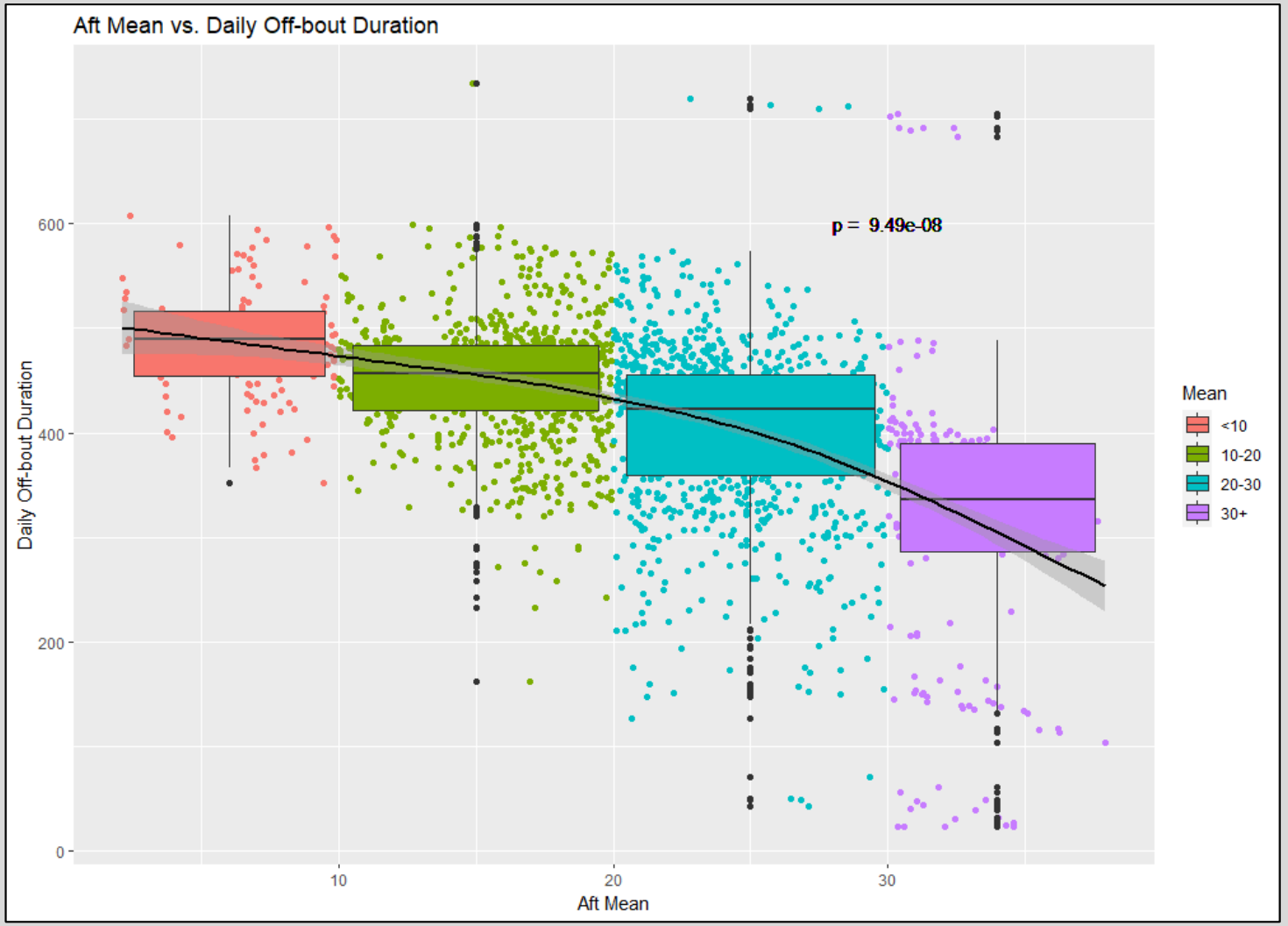
Total Daily





Low resolution temperature data suggests alternating relationships between thermal measurements and individual off-bout duration

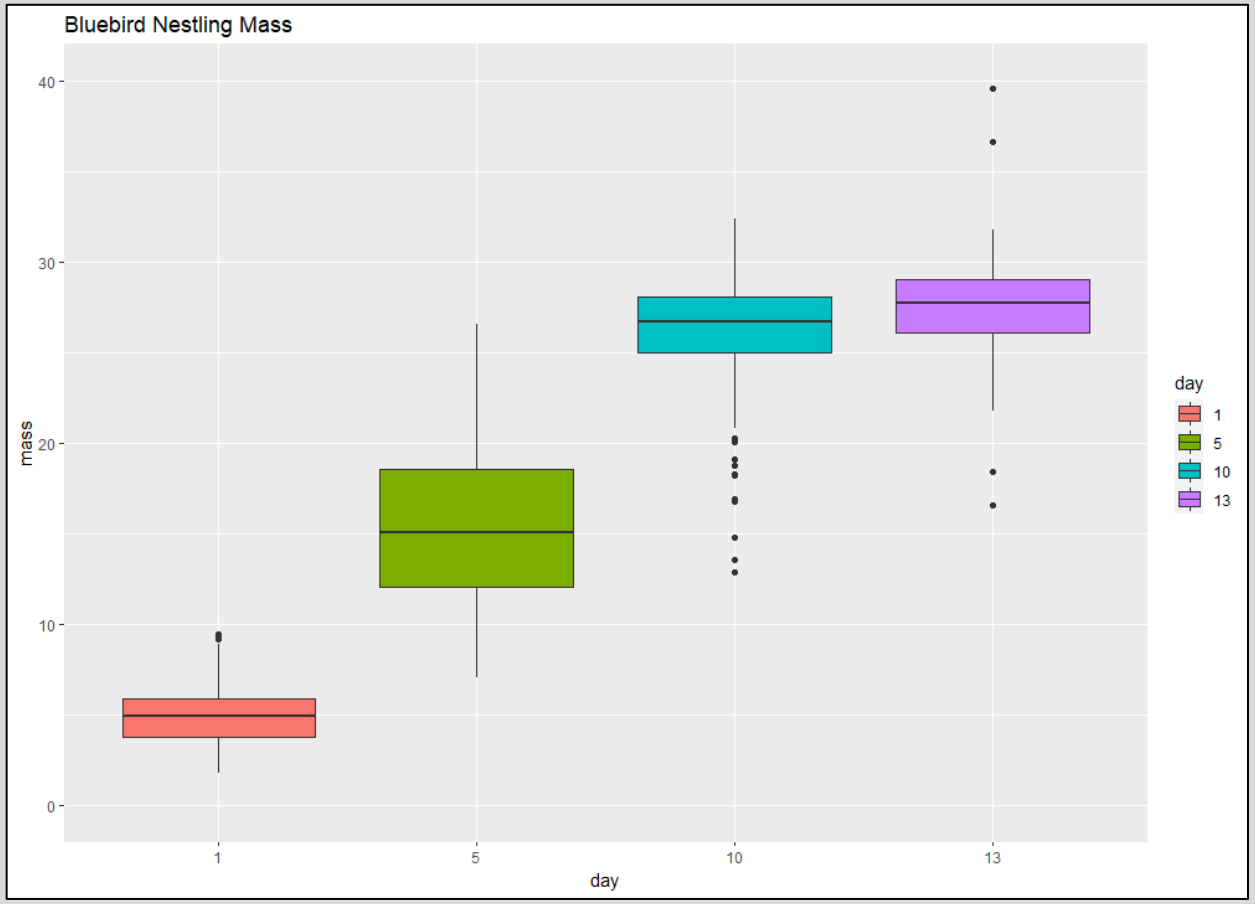
Total Daily

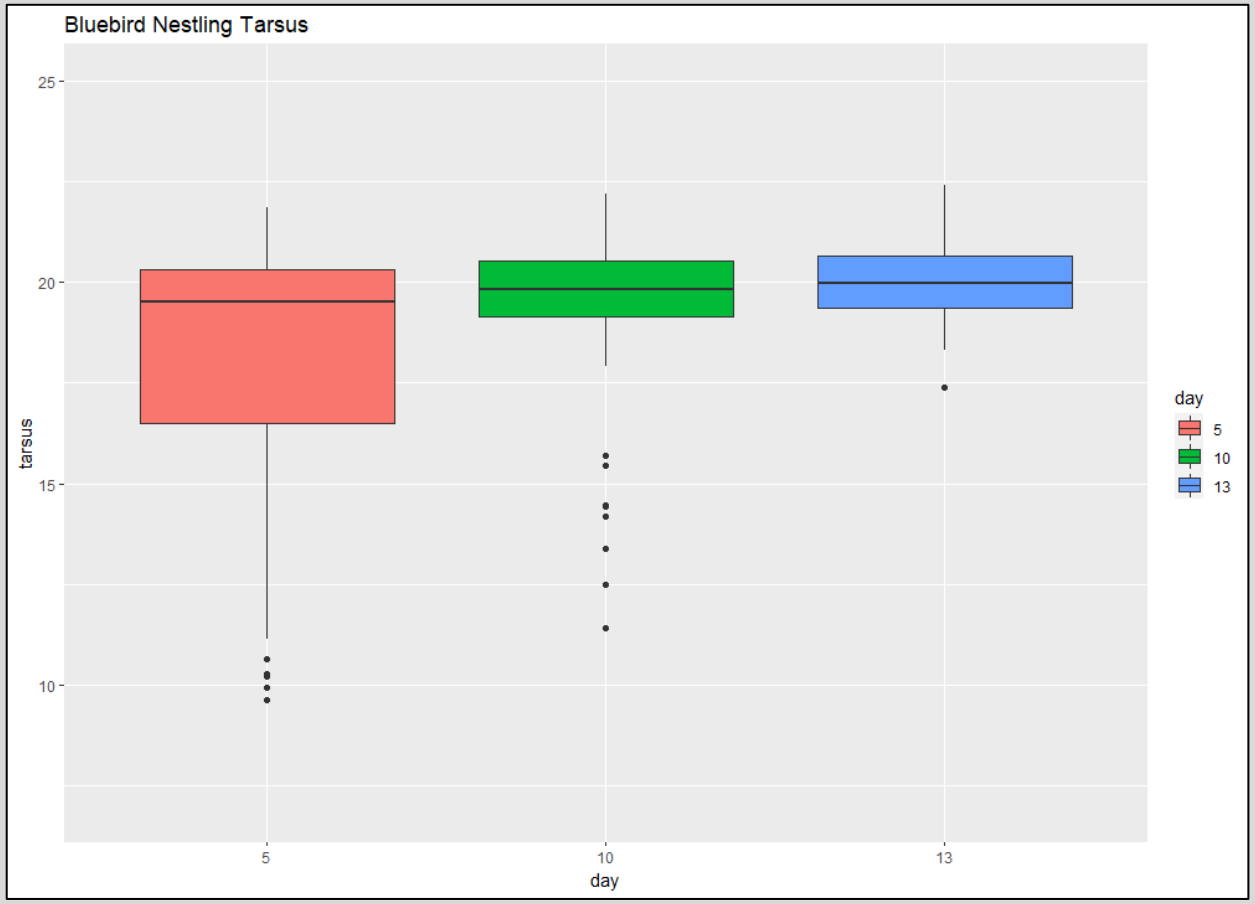


Hypotheses

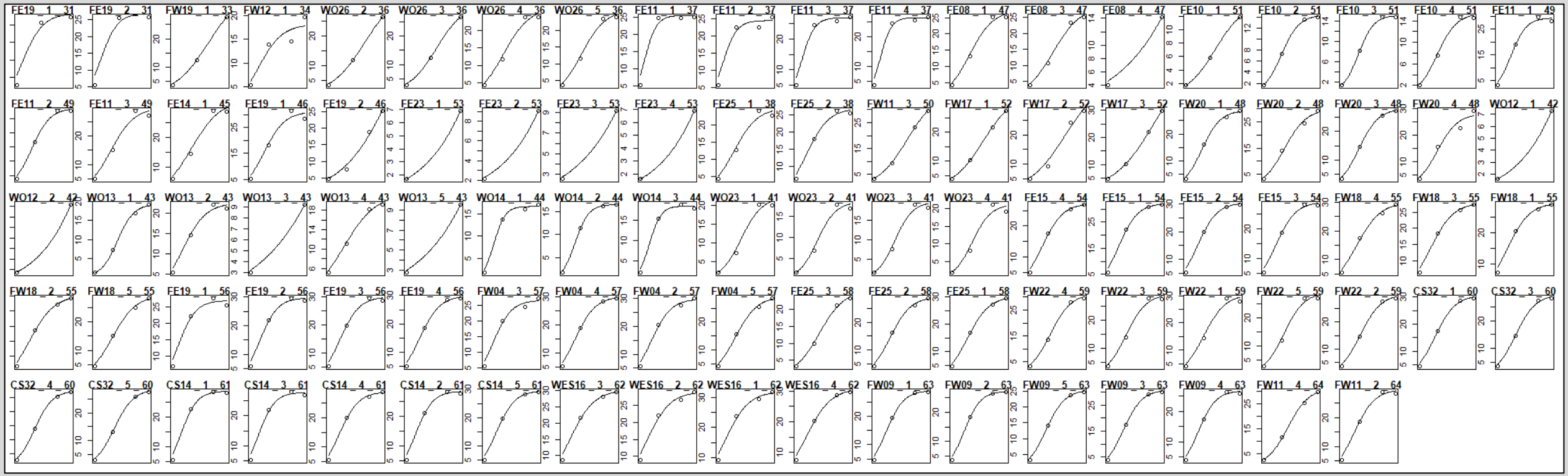
- Hypothesis 1
    - Thermal variability affects adult breeding behavior and egg temperatures.
- **Hypothesis 2**
    - **Thermal variability of the nest drives offspring phenotypes.**
- Hypothesis 3
    - Experimentally increased temperature mean and variation will influence the duration of off-bouts and the thermal environment of the egg.

Summary of Mass and Tarsus Growth





Growth Rates



Blood hematocrit, Blood smears, and MG Swabs

- This Summer, we began taking blood samples and doing mouth swabs to
  - Measure blood hematocrit
  - Create blood smears
  - Determine presence of MG
- I mentored a REU student, Chris, who used sampled nestlings and used blood smears to identify white blood cells.
- This Fall, I am training with Erin Sauer and Maddie Sudnick to identify white blood cells and use my swabs to test for MG presence.

Hypotheses

- Hypothesis 1
    - Thermal variability affects adult breeding behavior and egg temperatures.
- Hypothesis 2
    - Thermal variability of the nest drives offspring phenotypes.
- **Hypothesis 3 (Coming soon!)**
    - **Experimentally increased temperature mean and variation will influence the duration of off-bouts and the thermal environment of the egg.**

Moving Forward

- Comprehensive Exams
- Growth rate analysis
- Quail Project (writing Discussion now)
- MG swabs + White blood cell counts
- Develop experimental protocol for the Spring 2023 deployment


Thank you!
Questions?