Individual Differences of Female Chronotypes and Fitness Consequences in Wild Great Tits *Parus major*

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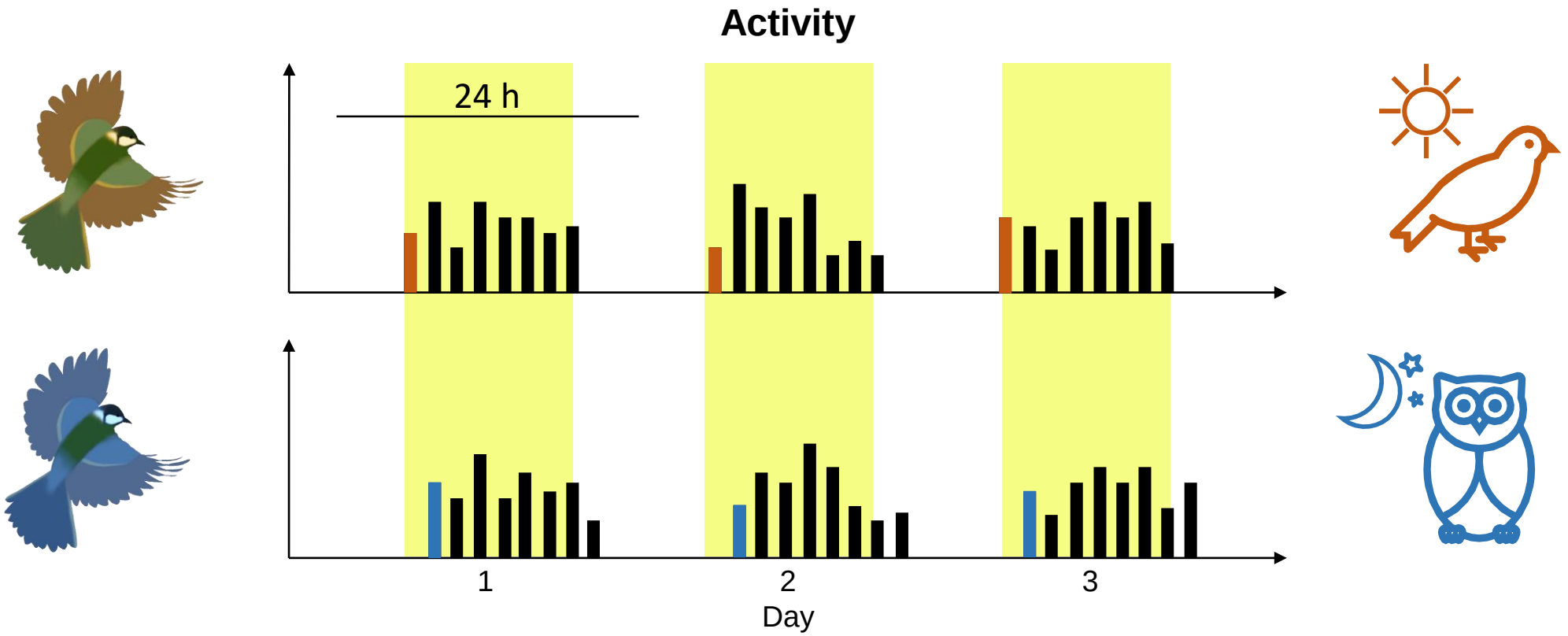
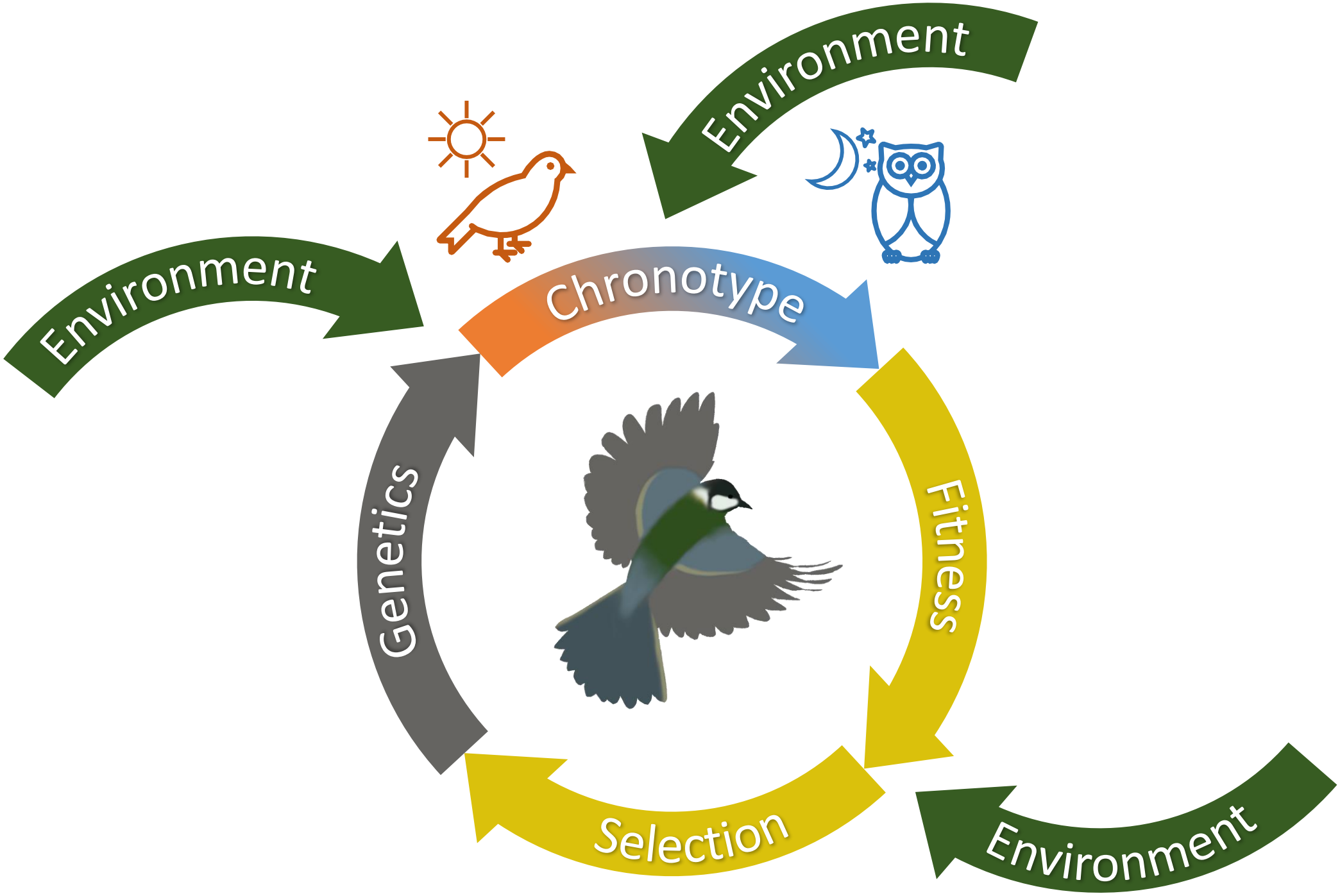
Chronotype

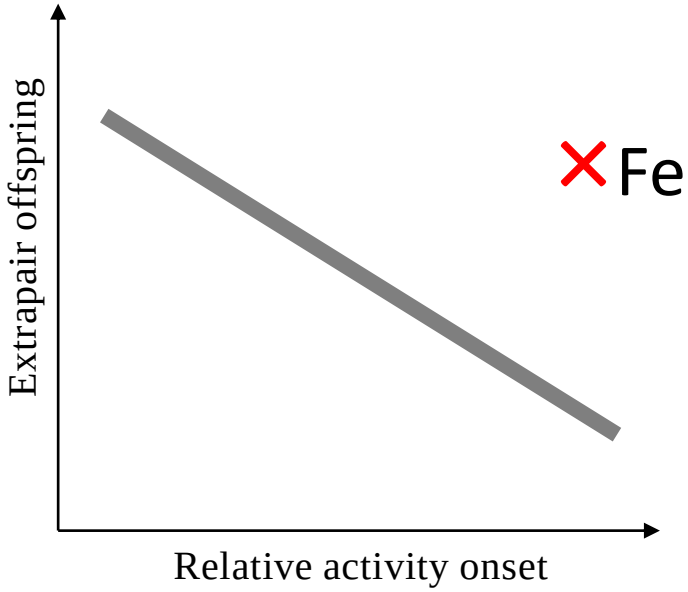
- Diel rhythms of activity: endogenous clock + environment (Helm et al. 2017)
- Differences between individuals → early birds vs night owls



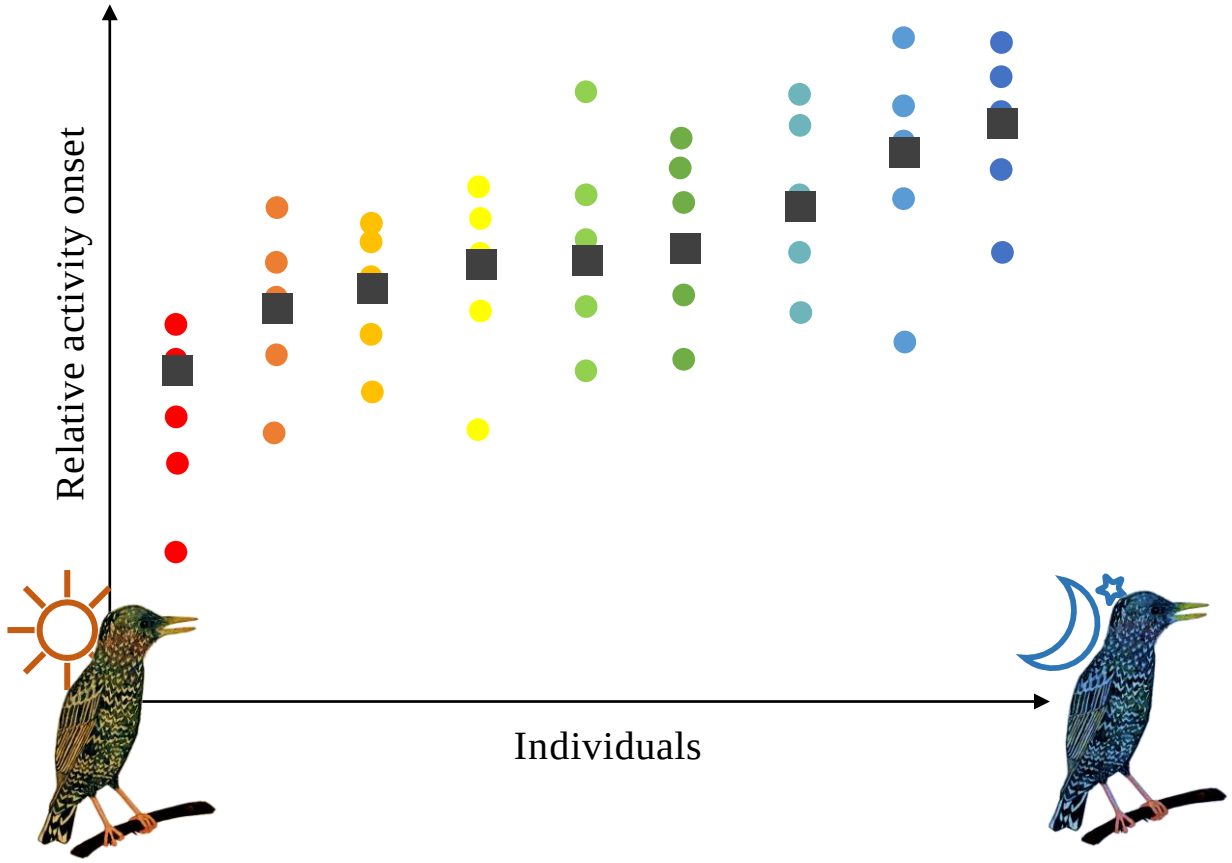

Environment
Environment
Chronotype
Fitness
Selection
Genetics
Environment

Does the early bird catch the worm?

- Large variation within species
- More extrapair offspring for early males (Poesel et al. 2006, Greives et al. 2015), but no effect on EPP for early females (Schlicht et al. 2014)



✕Females



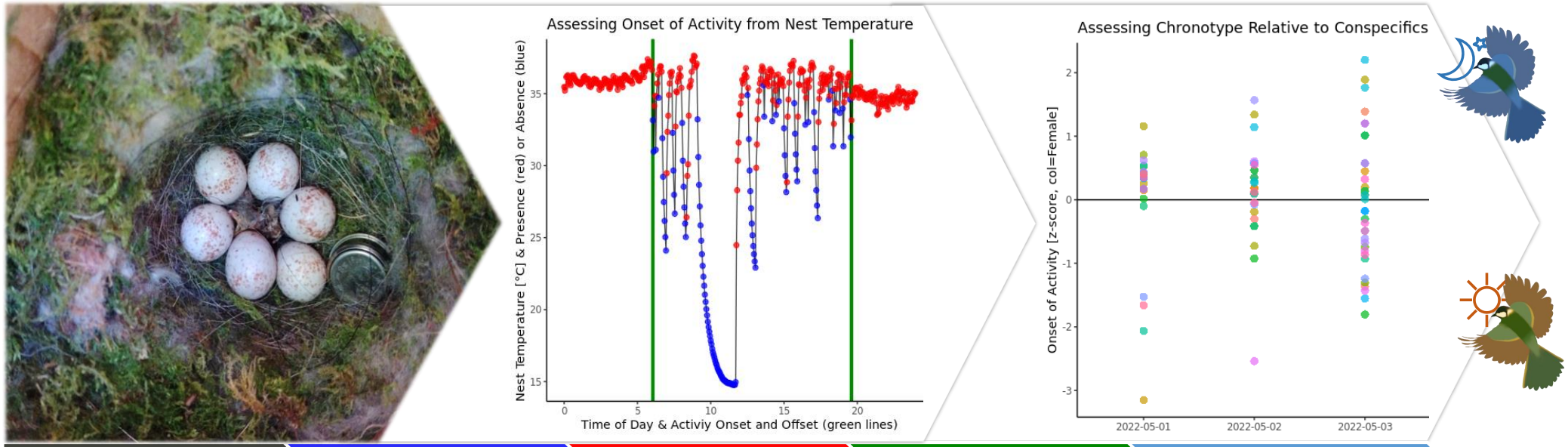
Fitness benefits and costs of female chronotypes

Incubation in Great Tits

- Female incubation ca 14 days until hatching
- Egg development depends on temperature (Podlas & Richner 2013)
- Trade-off: incubation vs self-maintenance (Reid et al. 2000)

Assessing Chronotype

- Presence and absence from nest temperature data
  - Maximal drop and rise at night as reference (Capilla-Lasheras 2018)
- 150 female chronotypes



No Relationship with Hatching or Breeding

- ✕ Fledge success
- ✕ Number of Hatchlings or Fledglings Womack et a. 2022: Early females had more fledglings
- ✕ Chicks' Biometrics: Weight, Size (Tarsus/P3 Feather)

Similar to Pagani-Núñez & Senar 2016, Maury et al. 2020 and Womack et al. 2022

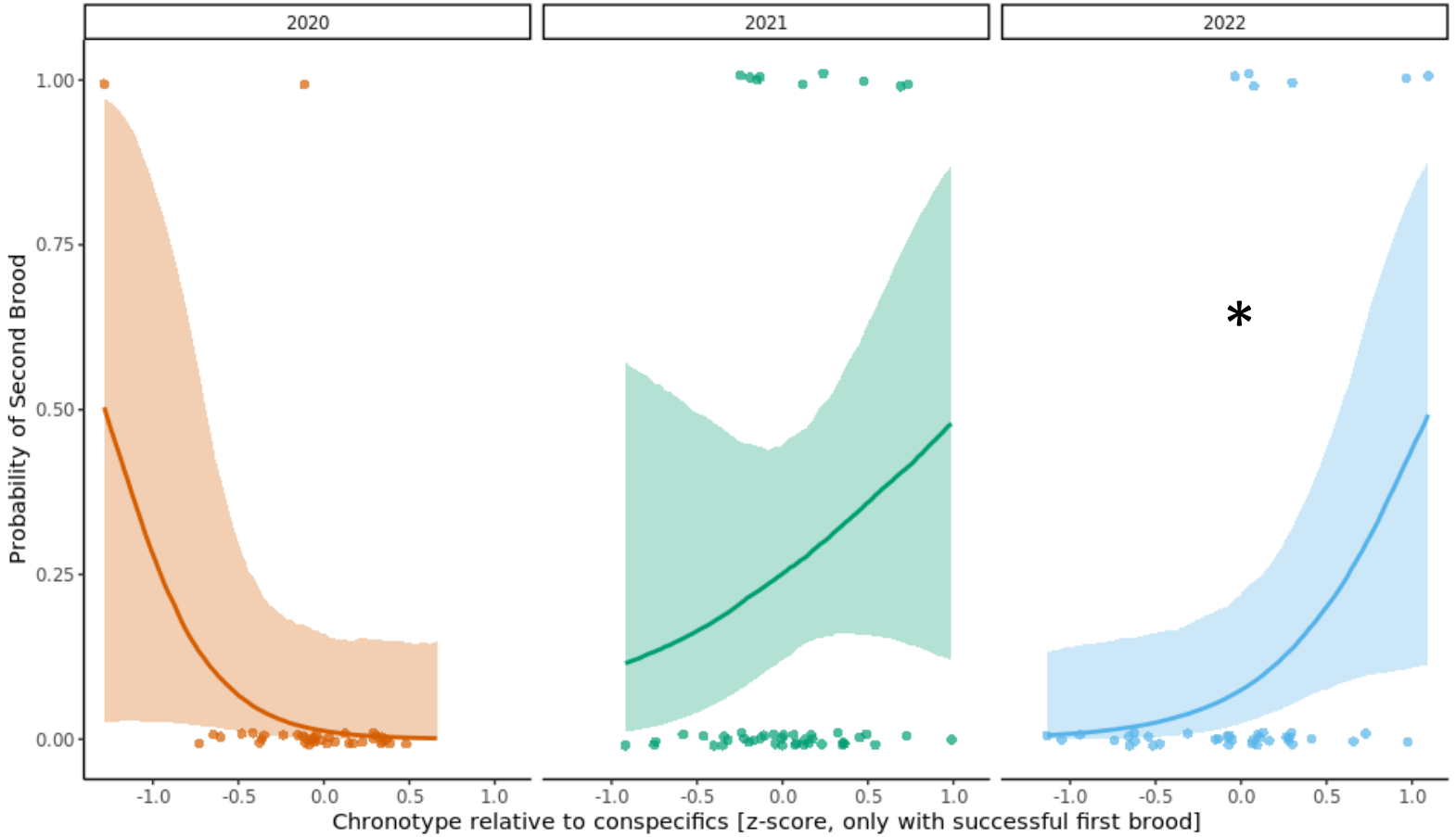



Differences in Life-History Traits?

- ✗ **Lay Date** But positive correlation e.g. in Graham et al. 2017
- ✗ **Clutch Size**
- ✗ **Female Weight**

- ✓ **Second Brood**

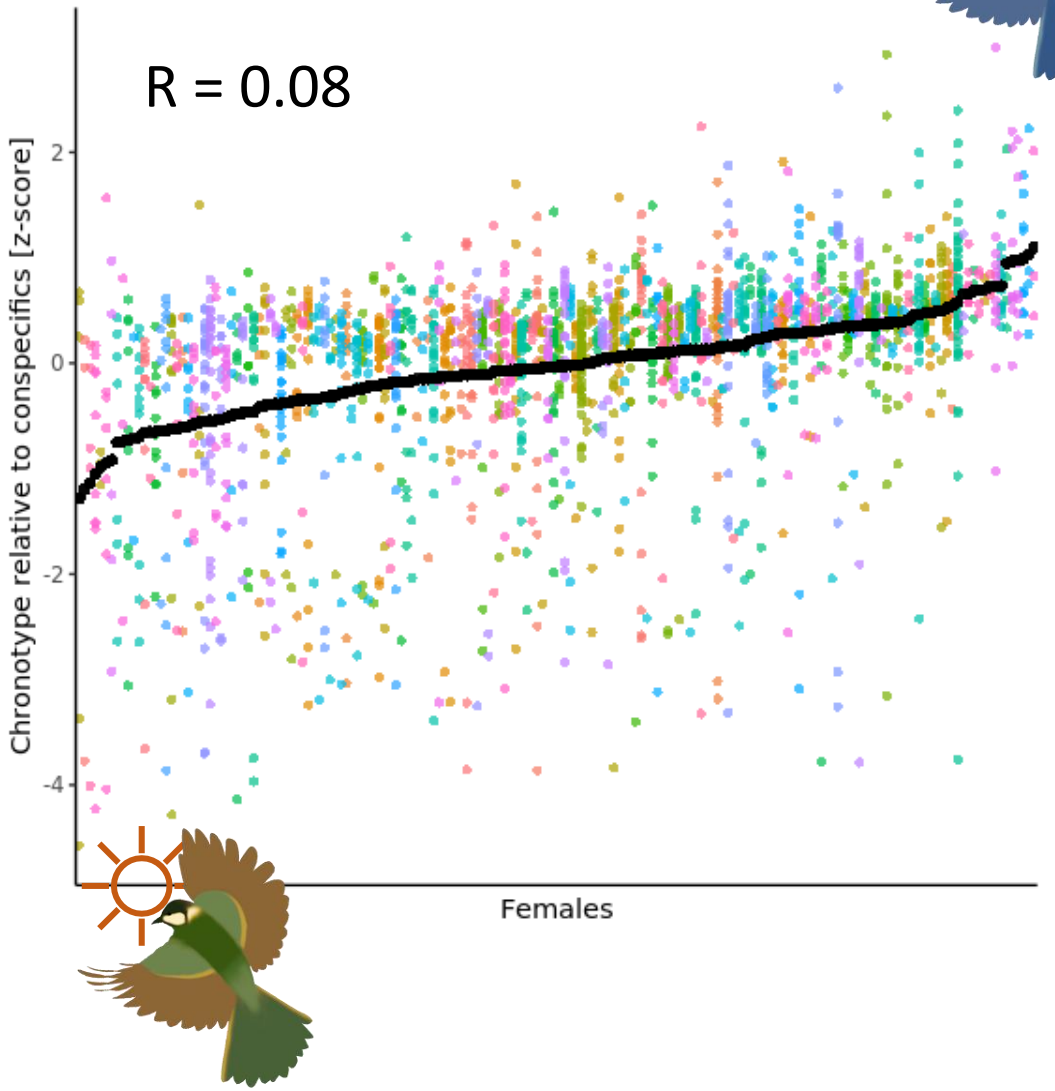
Similar to Maury et al. 2020



Within-Individual Variation

- Low repeatability of chronotype, but also onset of activity
  - High within individual variation compared to between individual variation
  - R = 0.13 – 0.67 (R = 0.03)
    Stuber et al. 2015, Maury et al. 2020, Schlicht & Kempenaers 2020, Meijdam et al. 2022, Womack et al. 2022
- Plasticity due to differences in energetical state/quality

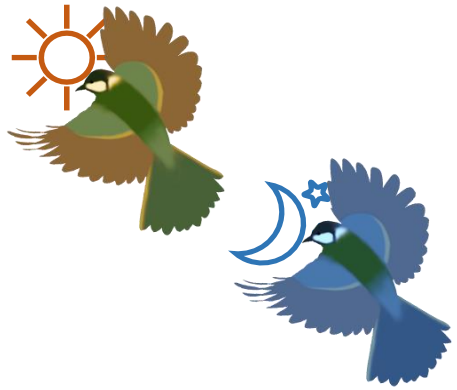
➢ No selection on chronotype possible



Pace-of-Life

- Interactions between physiology, behaviour and life-history traits → trade-offs
- From species to individuals

  Réale et al. 2010



slow	Pace-of-Life	fast
	Life History	
Long	Lifespan	Short
Slow	Reproduction Rate	Fast
Slow	Growth Rate	Fast
	Physiology	
Low	Metabolism	High
High	Immune response	Low
	Behaviour	
Low	Aggression	High
Shy	Shy/Bold	Bold
Slow	Exploration	Fast
Low	Activity	High
Late?	**Chronotype?**	Early?

- Circadian clock? Matsumura et al. 2018, Tudorache et al. 2018
- Chronotype – Life History? Graham et al. 2017, Maury et al. 2020
- Chronotype – Exploration? Stuber et al. 2015, Gharnit et al. 2020

➢ Contradicting findings due to complexity

Variation in Selection Pressures

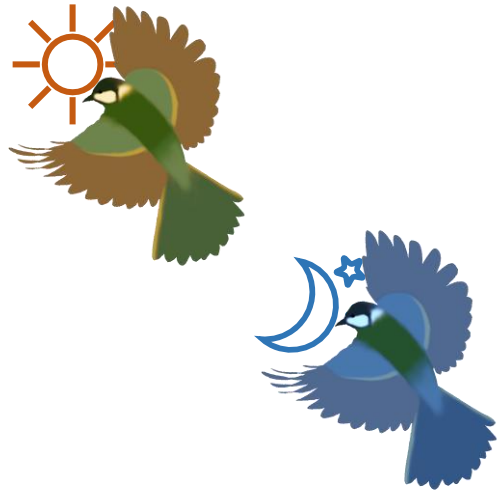
- Differences between years due to changes in environment
  - Chronotype – Exploration (Gharnit et al. 2020)
  - Exploration – Fitness (Dingemanse et al. 2004)

- Differences within years due to changes in trade-offs
  - moulting, overwintering

- Differences between sexes
  - season-dependent (more different in breeding season?)

➢ Fluctuating selection can maintain variation in phenotypes

Summary



✗ No relation to fitness parameters
- Low repeatability and large variation within individuals

✗ No relation to most life-history traits

✓ Second brood more likely depending on chronotype-year interaction
- Some indication for pace-of-life and/or fluctuation in selection pressures

➢ No strong selection for specific chronotype in females

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