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ABSTRACT

Despite a strong theoretical basis for relationships between physiological performance and organismal fitness, empirical assessments are lacking. Using parental care-providing smallmouth bass (*Micropterus dolomieu*), we tested for relationships between cardiac performance and fitness-related behaviours in wild fish. Although fitness is thought to be dependant on physiological capacity for exercise, our results suggest intraspecific variation in heart rate performance alone does not relate to parental care behaviour in this species. Moreover, heart rate was not repeatable between days and nights. There was, however, evidence of diel variation in heart rate. Further studies are required to confirm relationships between physiological diversity and parental care investment and to further reveal the apparently complex relationships between physiology, behaviour, and fitness in wild animals.

BACKGROUND

- There is a strong theoretical basis that physiological performance (e.g. heart rate (f_H)) may play an important role in mediating fitness and fitness-related behaviours¹.
- Smallmouth bass (SMB) parental care behaviours (e.g. fanning eggs, deterring predators) are energy demanding and require vigilance².
- Centrarchids (e.g. SMB) undergo behavioural and physiological adaptations, including modulating f_H frequency to enhance reproductive performance³.
- This, combined with the relationship between f_H and metabolism, supports the theory, however the theory has yet to be validated.



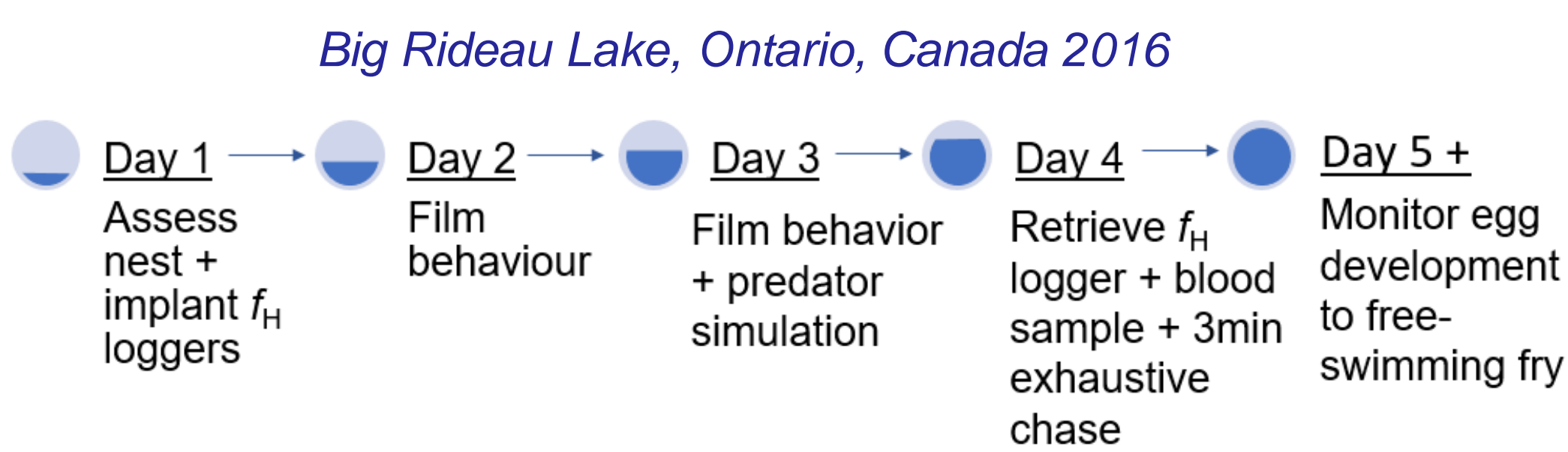
OBJECTIVES

Aim: Demonstrate that physiological performance mediates fitness by investigating the relationship between f_H and parental care behaviours in SMB.

Hypothesis: f_H is related to parental care behaviour investment.

Prediction: Since the cost of parental care increases with decreasing scope for f_H (lower capacity for frequency modulation), individuals that routinely utilize a higher proportion of their scope for f_H will invest less time on nest tending parental care behaviours.

METHODS



Analysis

- Controlled against temperature effects on f_H and behaviour using the residuals from the linear regression.
- Random Forest analysis identified most influential cofactors.
- Linear model related percent routine f_H within scope for f_H ($R\% f_H$) to cofactors (nesting behaviour, aggression score, brood, hematocrit).
- Linear regression compared f_H vs temperature.
- One-Way ANOVA identified trends in parental care behaviours and diel pattern in f_H .

RESULTS

- 22 implanted fish; 17 successful.
 - Water temperature ranged from 15.7-23.8°C.
1. There is intraspecific variation in $R\% f_H$; there is no evidence of a relationship between $R\% f_H$ and parental care behaviour, brood size, and aggression level (all p -values >0.05).

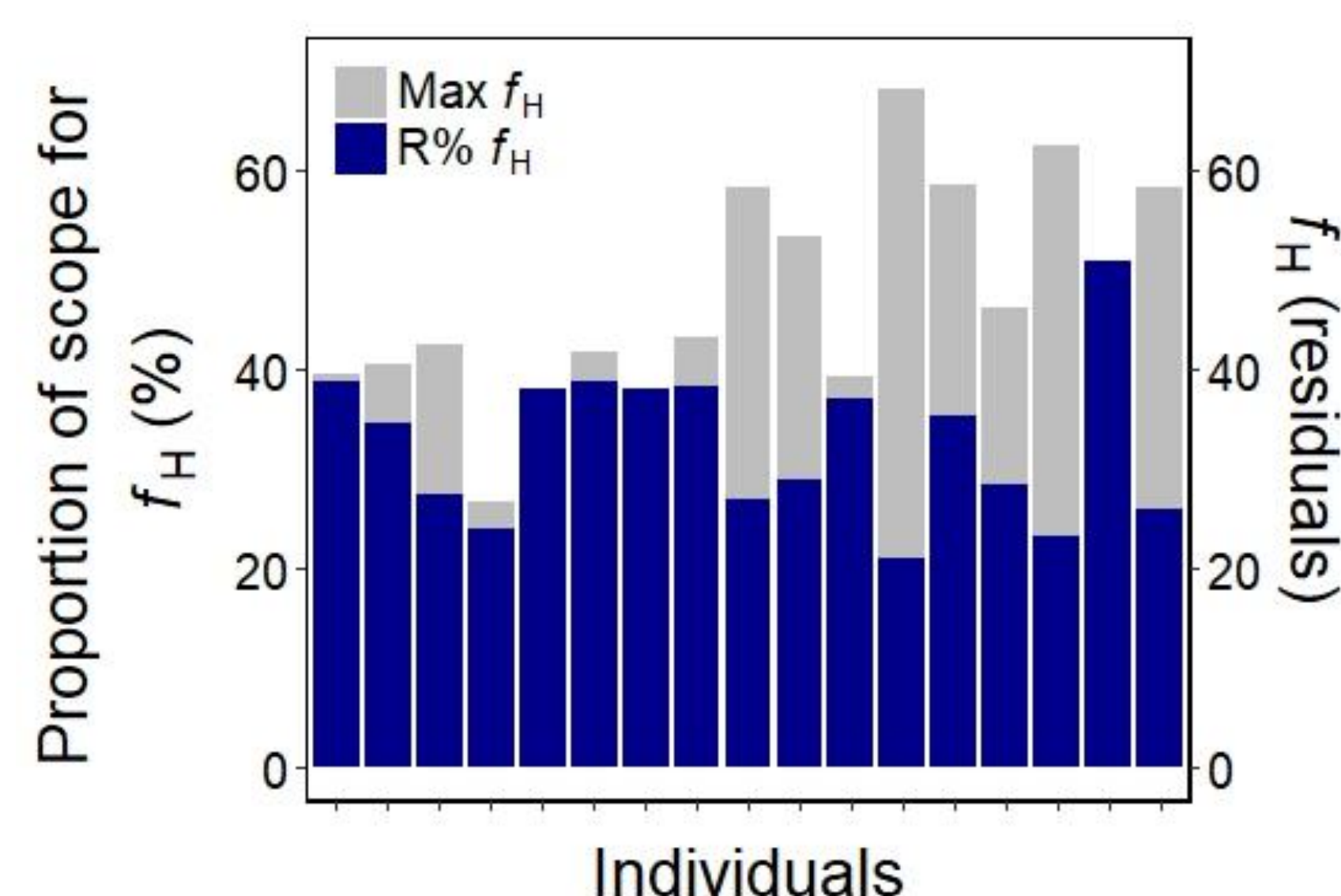


FIG 1. f_H variability between individuals.

TABLE 1. Results of linear model comparing $R\% f_H$ and the six most influential cofactors according to random forest analysis.

Full model:
lm(rank(HR)~(Nest.Tending*Nest.Defending*Nest.guarding)+ Predator+Hematocrit+Aggression.score+Time.to.first.attack +Time.swim.jar+Length+Egg.score+Spawned, family=gaussian, data=Res)

Cofactors dropped	AIC	P-value
-	59.9	-
Time swim jar	58.8	0.35
Time to first attack	58.2	0.64
Hematocrit	59.1	0.28
Aggression score	58.4	0.54
Nest guarding* Nest defending	58.1	0.76

2. Parental care-providing SMB spent the greatest proportion of their time guarding the nest, followed by tending to the nest (p -value << 0.001), and the least time defending the nest (p -value << 0.001 both cases).

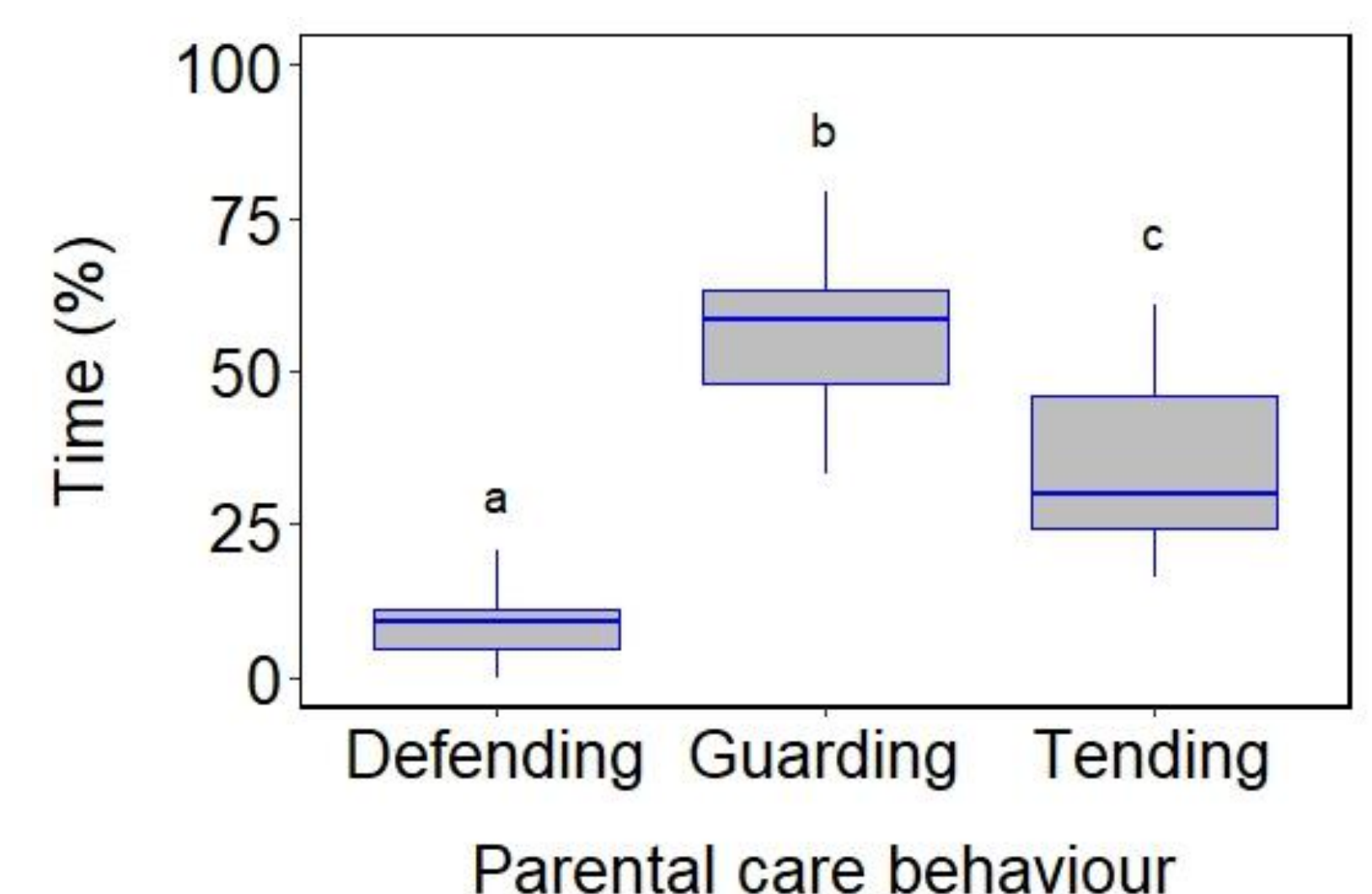


FIG 2. Percentage of time male SMB spent on each nesting behaviour over 40 minutes (p -value << 0.001 for all cases).

3. Although behaviour remained constant overtime, f_H was not repeatable between days or nights (p -value >> 0.05). However, there was evidence of diel variation in f_H : $R\% f_H$ was 23% higher during the day than at night (p -value = 0.0013).

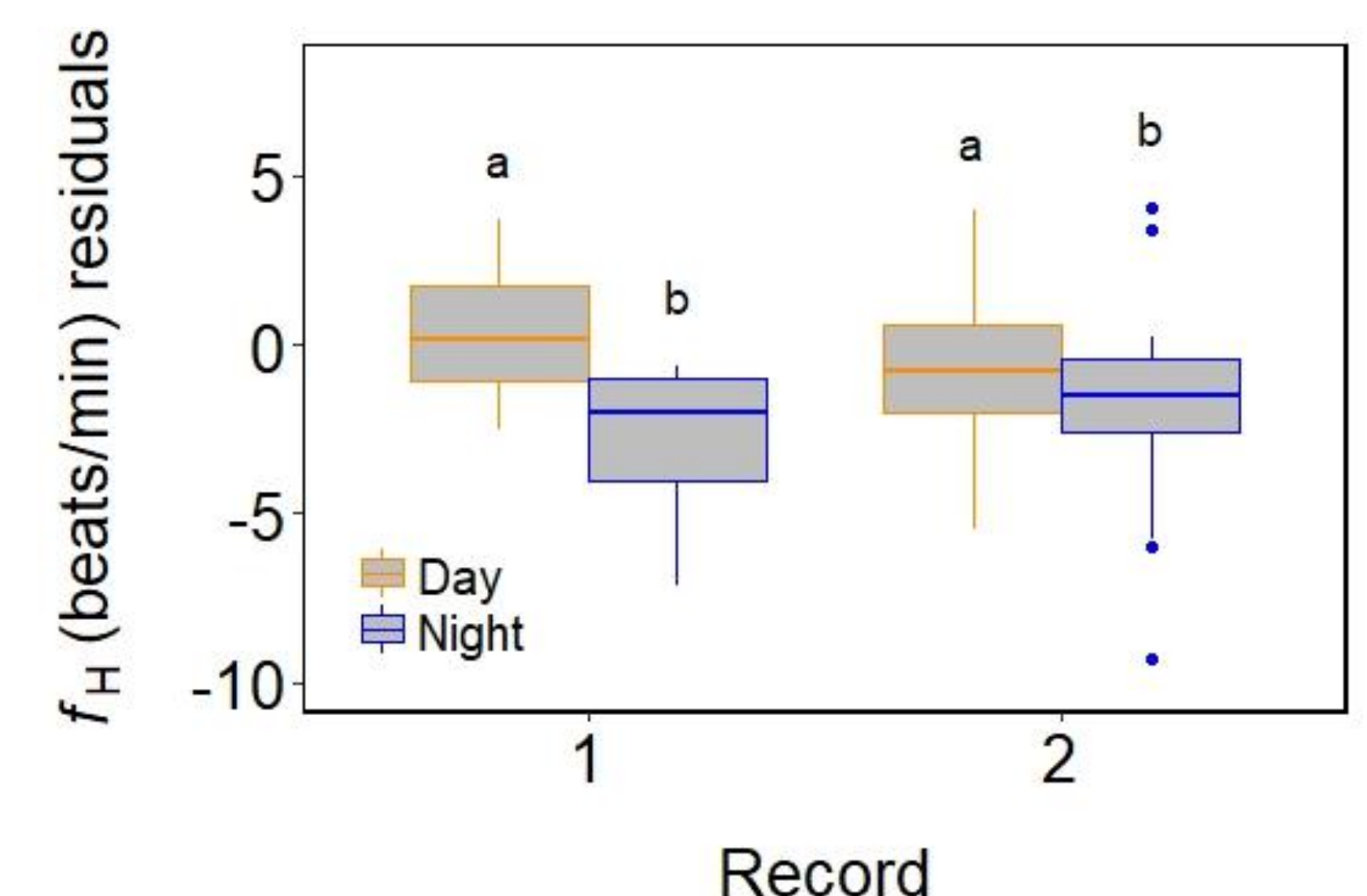


FIG 3. Diel variation in $R\% f_H$ over 48 hours (two days and two nights; p -value = 0.0013).

CONCLUSIONS

- Results do not support the hypothesis: f_H alone does not appear to be directly related to parental care investment in SMB.
- SMB split their time between nest tending and nest guarding behaviours.
- Diel pattern in f_H suggests that f_H is predominantly influenced by endogenous and environmental factors and less influenced by behaviour and activity.
- While evidence that activity is fundamental to parental care performance in SMB implies a relationship between physiological performance and fitness^{1,2}, further research is required to describe the mechanisms.

ACKNOWLEDGEMENTS

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REFERENCES

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3. Cooke et al. 2003. *Trans.Am.Fish.Soc.* 132.