Investigating Barn Owl nest box size and use of shade panels to mitigate extreme temperatures

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Background

American Barn Owls (*Tyto furcata*) are commonly attracted to breed in nest boxes on California farms for Integrated Pest Management; however, nesting Barn Owls face threats from the accelerating frequency and severity of heatwaves.

Previous research has shown that the upper limit of a Barn Owl's thermal neutral zone is 32°C (90°F)[1]. Negative effects of extreme temperatures on avian taxa include stunted nestling growth[2], delayed fledging[3], dehydration[2] hyperthermia[1], and death[4].

Objective: We compared temperatures between two commonly used nest box designs to investigate heat mitigating attributes of size and shade panels.

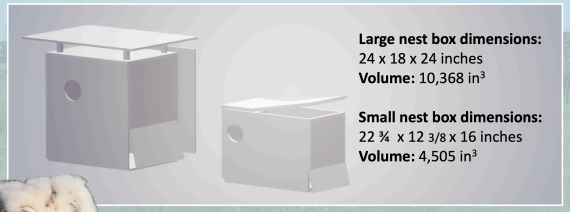

Figure 1. 3D to-scale renderings of the Large (left) and Small (right) nest box designs

Methods

- This study took place on a vineyard in the Central Valley of California, USA with a Mediterranean climate; temperatures regularly rise above 38°C (100°F) in the summer
- We used Maxim Integrated iButtons (Models: DS1921G; DS1923) to measure internal temperatures of large (n = 4) and small (n = 4) nest box designs (Figure 1)
- We extracted ambient temp from an on-site weather station
- We used a Kruskal-Wallace and pairwise Wilcoxon test to assess temp differences between large, small, and ambient
- We used a linear mixed-effects model to compare internal daily max temps with ambient daily max temps and box type

Results

- Collected hourly temperature from April to October 2023 in large nest boxes (n = 13,541) and small nest boxes (n = 9,728; Table 1; Figures 2 & 3)
- Small nest boxes were significantly hotter than large nest boxes and ambient temperature (smaller–larger $p < 0.001$; smaller–ambient $p < 0.001$)
- There was no statistical difference between larger nest boxes and ambient temperature (larger–ambient $p = 0.54$)
- The interaction of box type and ambient temperature significantly influenced internal nest box temperatures (Table 2)
- For every 1°C increase in ambient temperature, large nest boxes increased by 0.92°C (1.7°F), and small nest boxes by 1.05°C (1.89°F; Figure 4)

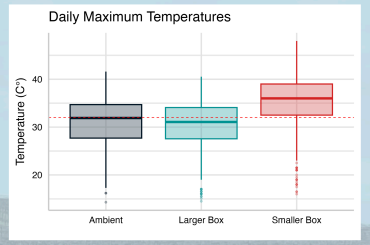

Figure 2: Box plot of maximum daily temperatures. Dashed line (32°C; 90°F) represents the upper limit of a Barn Owl's thermal neutral zone

All Temperatures (°C)	Mean	SD	Range
Small	23	9.5	3.5–48
Large	22	7.4	3.5–41
Ambient	23	7.5	4.1–42
Maximum Daily Temperatures (°C)	**Mean**	**SD**	**Range**
Small	35	6	32–48
Large	31	5.3	28–41
Ambient	30	5.4	27–42

Table 1: Summary statistics of all temperatures and daily maximum temperatures

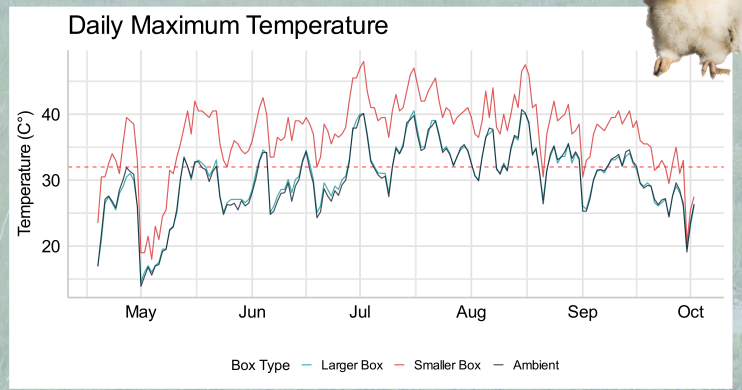

Figure 3: Daily maximum temperatures April-October 2023. Dashed line (32°C; 90°F) represents the upper limit of a Barn Owl's thermal neutral zone

Conclusion

- We compared two commonly used Barn Owl nest box designs and found a 5°C (9°F) difference between the small and large nest boxes when ambient temperature nears the upper limit of a Barn Owl's thermal neutral zone of 32°C (90°F).
- Our results indicate that nest box designs that mitigate heat can provide a benefit to nesting Barn Owls by buffering owls against extreme temperatures and heatwaves.
- Further research is suggested to identify if shade panels and/or ventilation holes could help mitigate heat in smaller nest boxes.
- To maximize the impact of Barn Owls in Integrated Pest Management programs, nest box temperature should be considered in regions with warm climates.

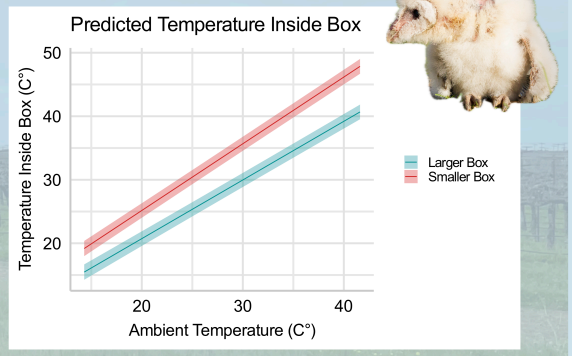

Figure 4: Prediction of nest box temperatures in relation to ambient temperature and nest box type

Parameter	Coefficient [95% CI]	SE	T-value
Intercept	2.26 [0.83 , 3.69]	0.73	3.108
Max ambient	0.92 [0.89 , 0.95]	0.02	61.098
Nest box type	1.90 [-0.11 , 3.90]	1.02	1.858
Max ambient x nest box type	0.13 [0.08 , 0.17]	0.02	5.948

Table 2: Results summary from a linear mixed-effects model:
Nest box temp ~ Ambient + nest box type + Ambient x nest box type

References: 1. Thouzeau et al., *Phys & Biochem Zoo.* 1999. 72(2); **2.** Salaberria et al., *Ibis.* 2014. 156; **3.** Cunningham et al., *PLoS ONE.* 2013. 8(9); **4.** Hindmarch and Clegg. *J Rapt Reas.* 2024. 58(1)

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