# A global review of bat box research

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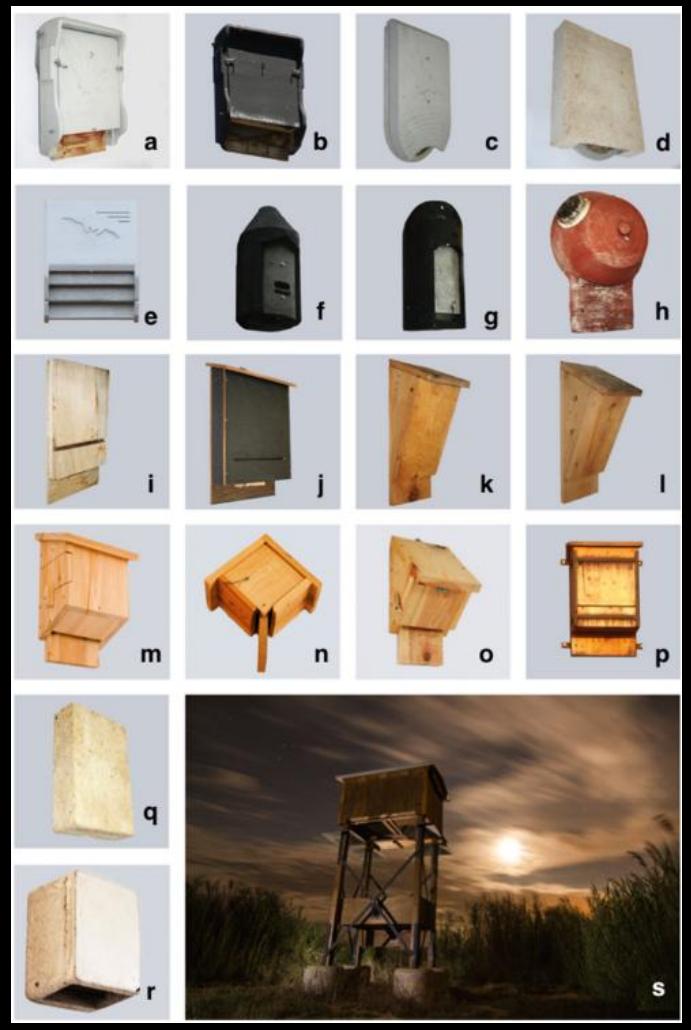
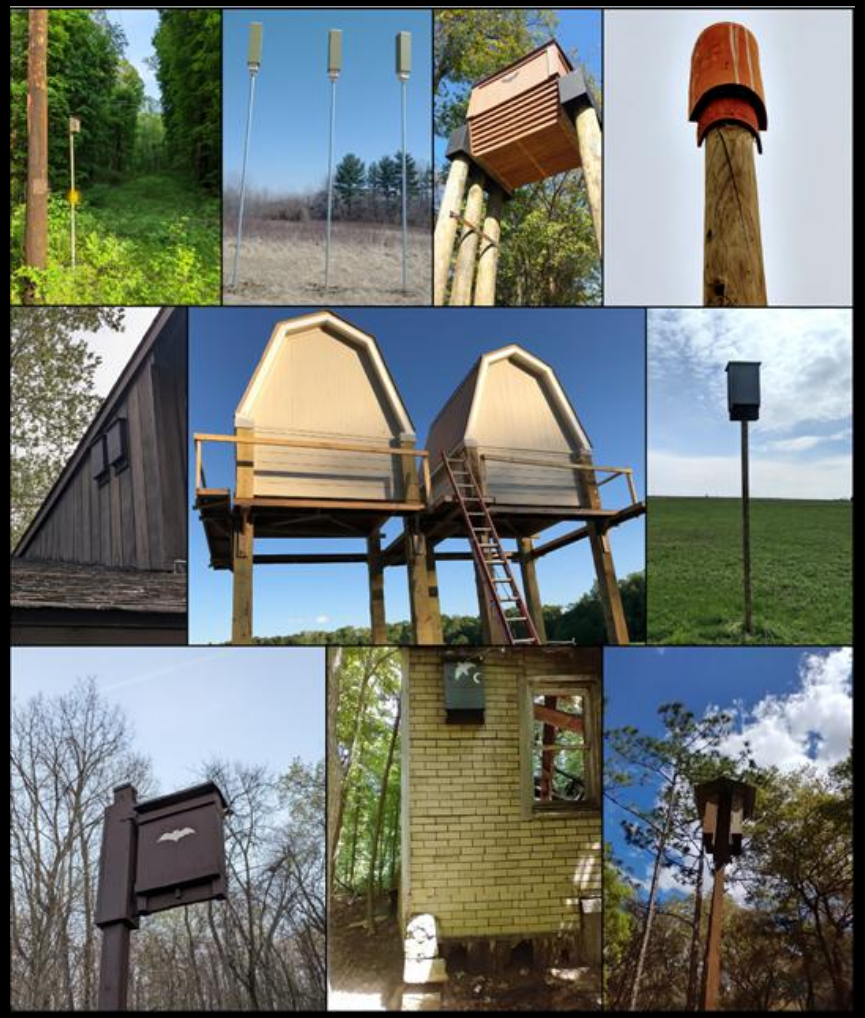
ILLINOIS

# About Me!

- Ph.D. in Ecology, Evolution, and Conservation Biology at the University of Illinois at Urbana-Champaign
- M.S. in Biology at Eastern Kentucky University
- B.S. in Biology at Indiana State University
- 9 years of research with boxes

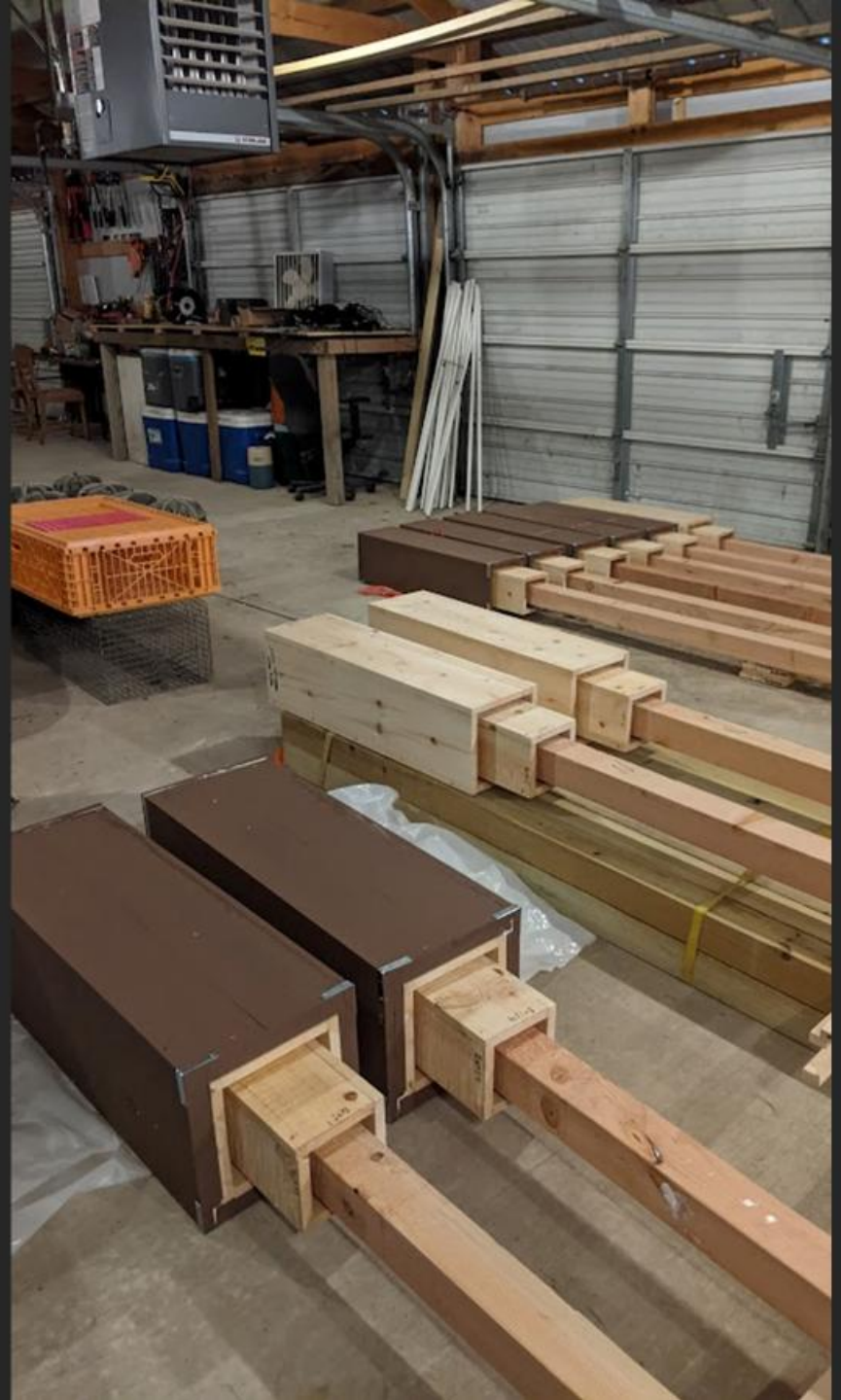
# What are bat boxes?



Martin Bideguren et al. 2018. Biodiv. and Conserv.


Bat boxes are used by many bat species globally




DEWALT




https://wildlife.nres.illinois.edu/safer_bat_boxes/

# Bat box research has been going on for a long time

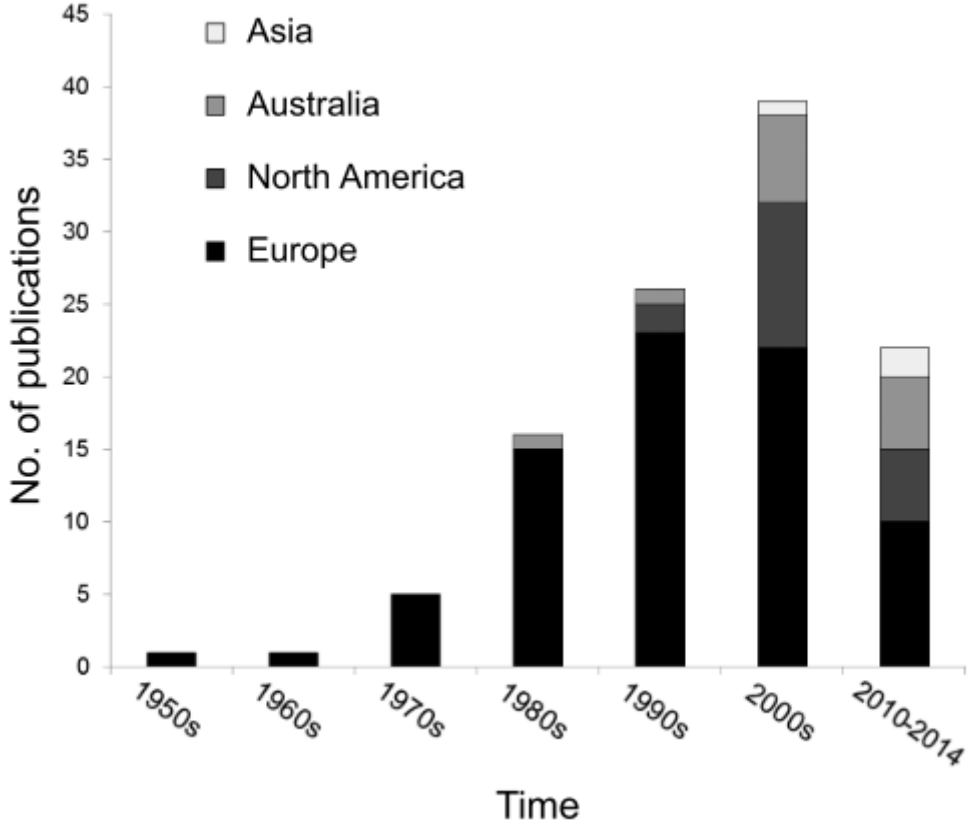



FIG. 2. Number of reviewed publications by decade and region

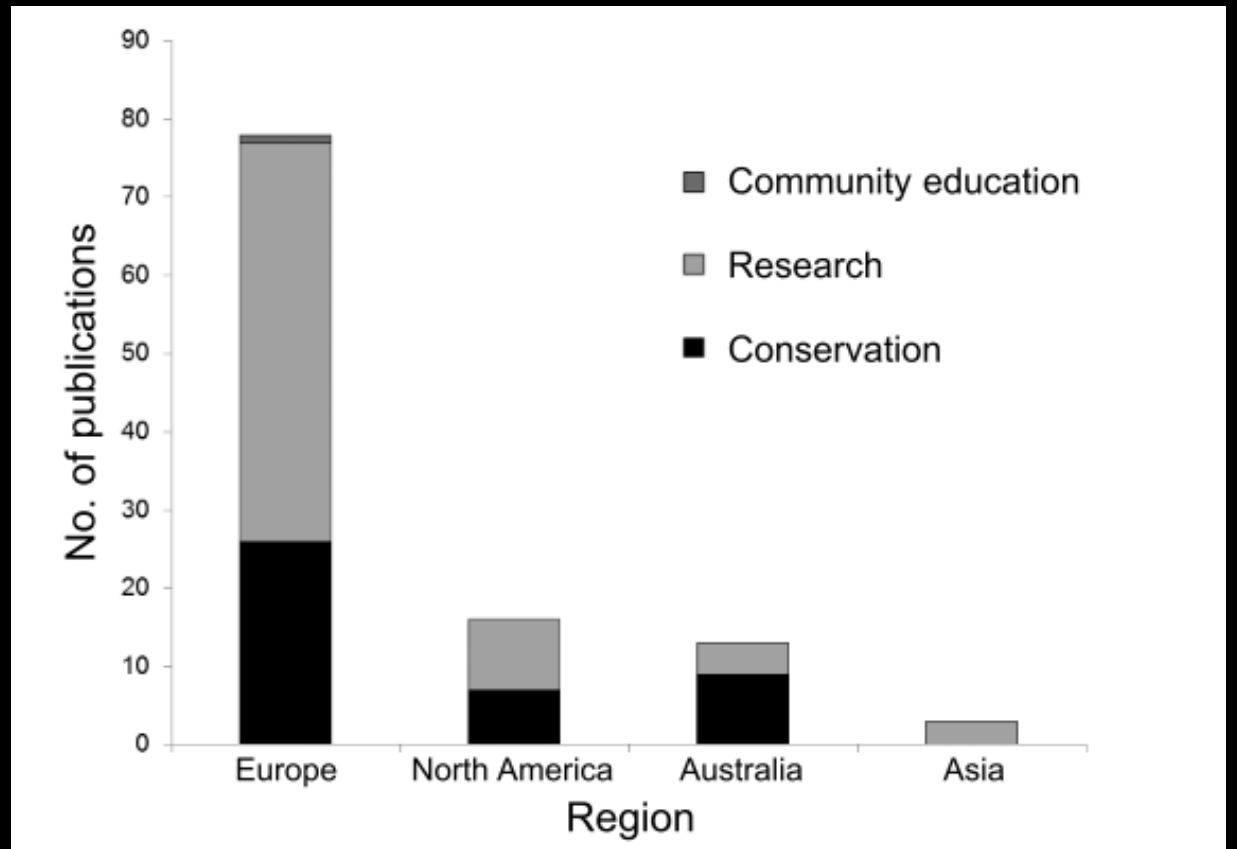



FIG. 1. Number and type of the reviewed bat box publications per region

Rueegger. 2016. Acta Chrio.

# Methodologies

- Spotlights
- Exit counts
- Guano detection

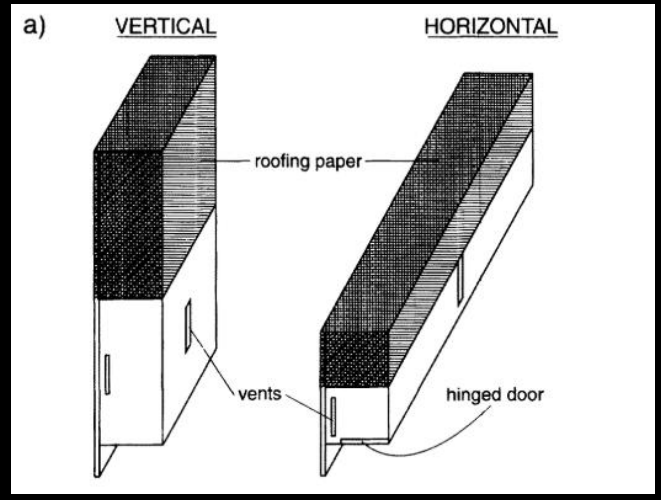
# Methodologies

- Radio transmitters
- Pit tags

# Solar-exposed bat boxes are attractive

- Many bats will preferentially select sun-exposed bat boxes
- Warm roosts favor pup development and reduce energy expenditure

Homeowners installed two bat-box designs (horizontal on left and vertical on right) on the building that housed the bat maternity colony. Photo by Lisa Williams.




Brittingham and Williams. 2000. Wildlife Society Bulletin

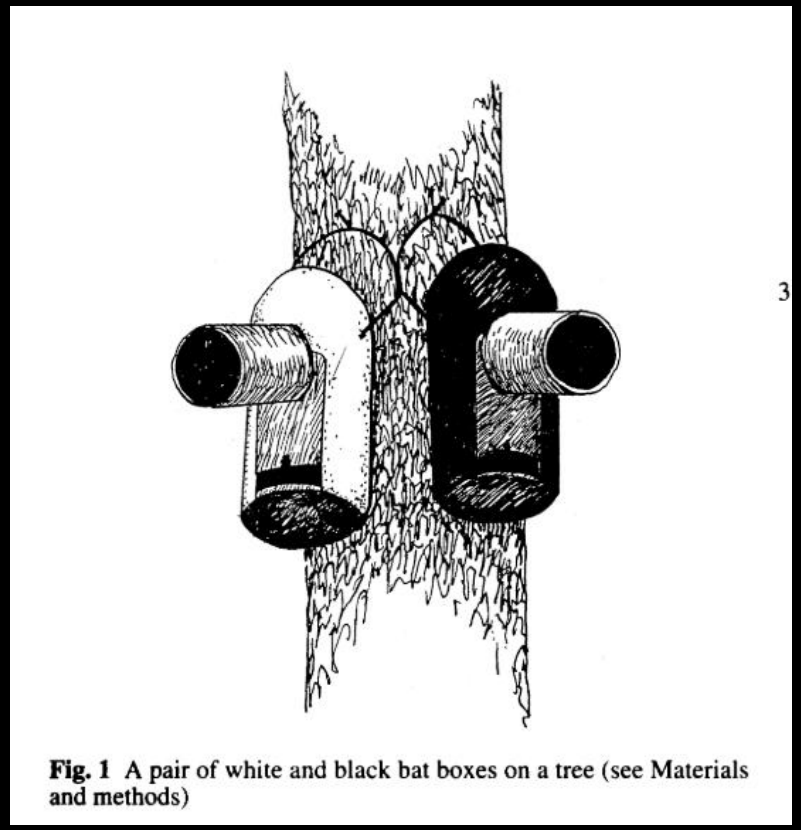


Fig. 1 A pair of white and black bat boxes on a tree (see Materials and methods)

Kerth et al. 2001. Oceologia


Weier et al. 2019. PeerJ

# Darker paint colors are attractive

# Design can improve attractiveness



Hoeh et al. 2018. Plos One

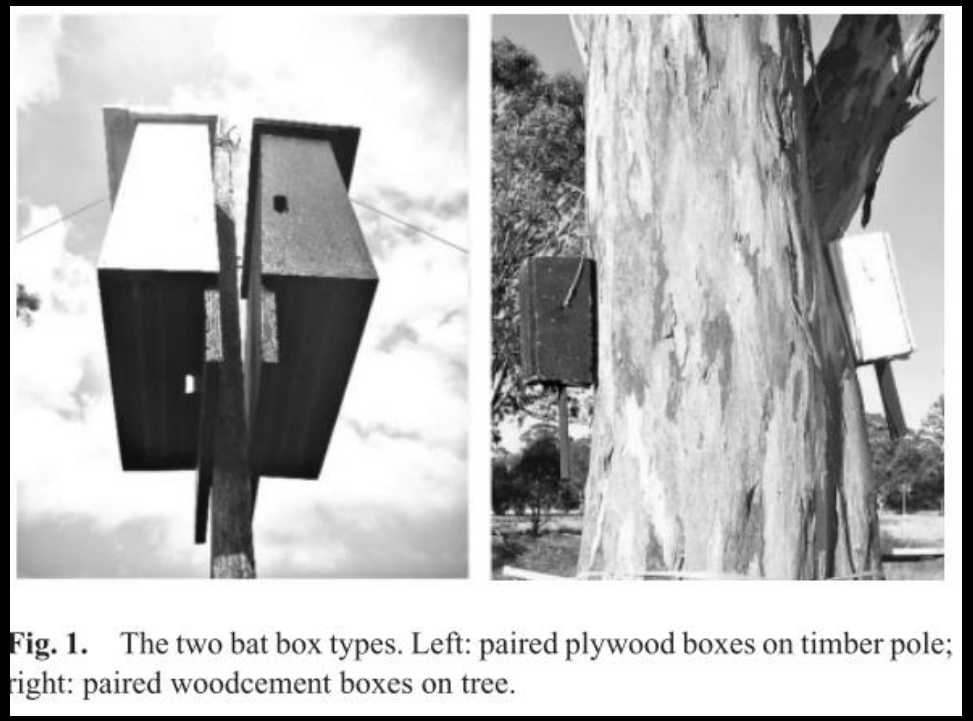


**Fig. 1.** The two bat box types. Left: paired plywood boxes on timber pole; right: paired woodcement boxes on tree.

Rueegger et al. 2020. Pacific Conservation Biology

# Using bat boxes to measure the economic importance of bats

- Crop pest suppression
  - Reduction in crop damage
  - Diet
- Reforestation

# Bat boxes can lead to pest suppression

Puig-Montserrat et al. 2015. Mammalian Biology

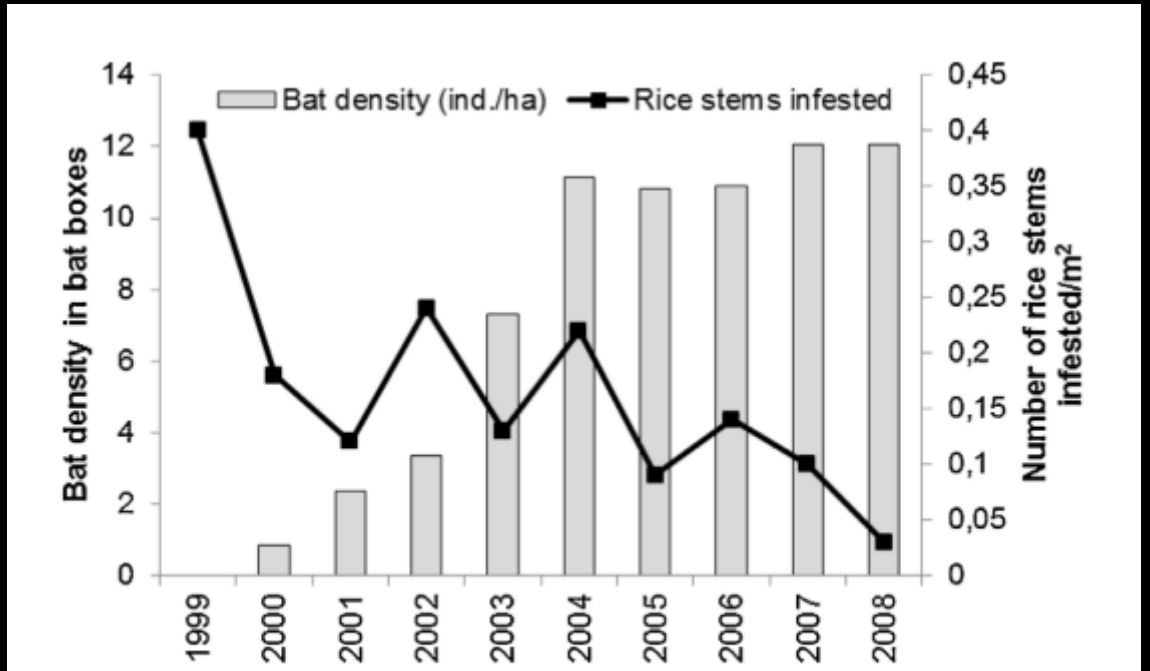



**Fig. 5.** Temporal patterns of striped rice borer damage (rice stems infested/$m^2$ during the first peak of the borer: $r = -0.73$, $p < 0.01$, $n = 10$) and bat densities (ind./ha: $r = 0.95$, $p < 0.001$, $n = 10$) on Buda Island since the bat boxes were installed.

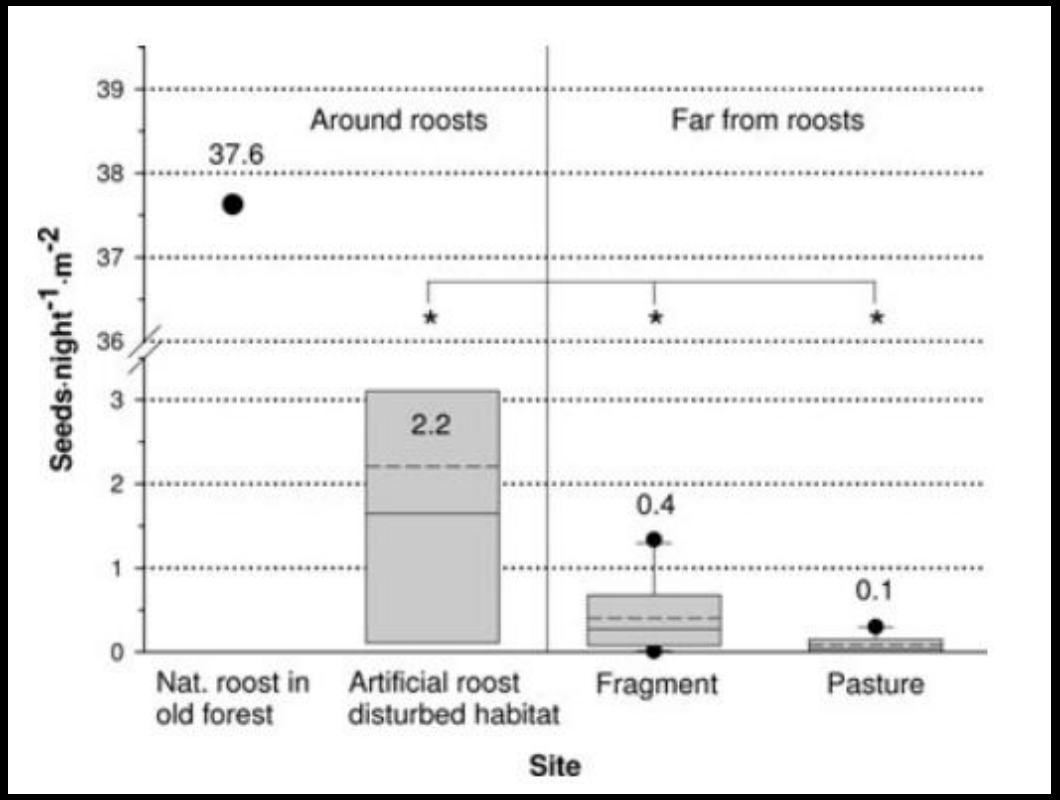
# Using bat boxes to study bat diets

MICROBIAL GENOMICS
Volume 11, Issue 2

Research Article | Open Access

**Molecular epidemiology of *Eimeria* spp. parasites and the faecal microbiome of Indiana bats (*Myotis sodalis*): a non-invasive, multiplex metabarcode survey of an endangered species**

Andrew J. Bennett[1], Cory D. Suski[1] and Joy M. O'Keefe[1]


Kelm et al. 2008. Conservation Biology

# Bax boxes and be used to study seed dispersal

# Using bat boxes to study social cues and behavior

- Do bats use roosts they are familiar with?
- Are conspecific cues important?

# Olfactory Cues

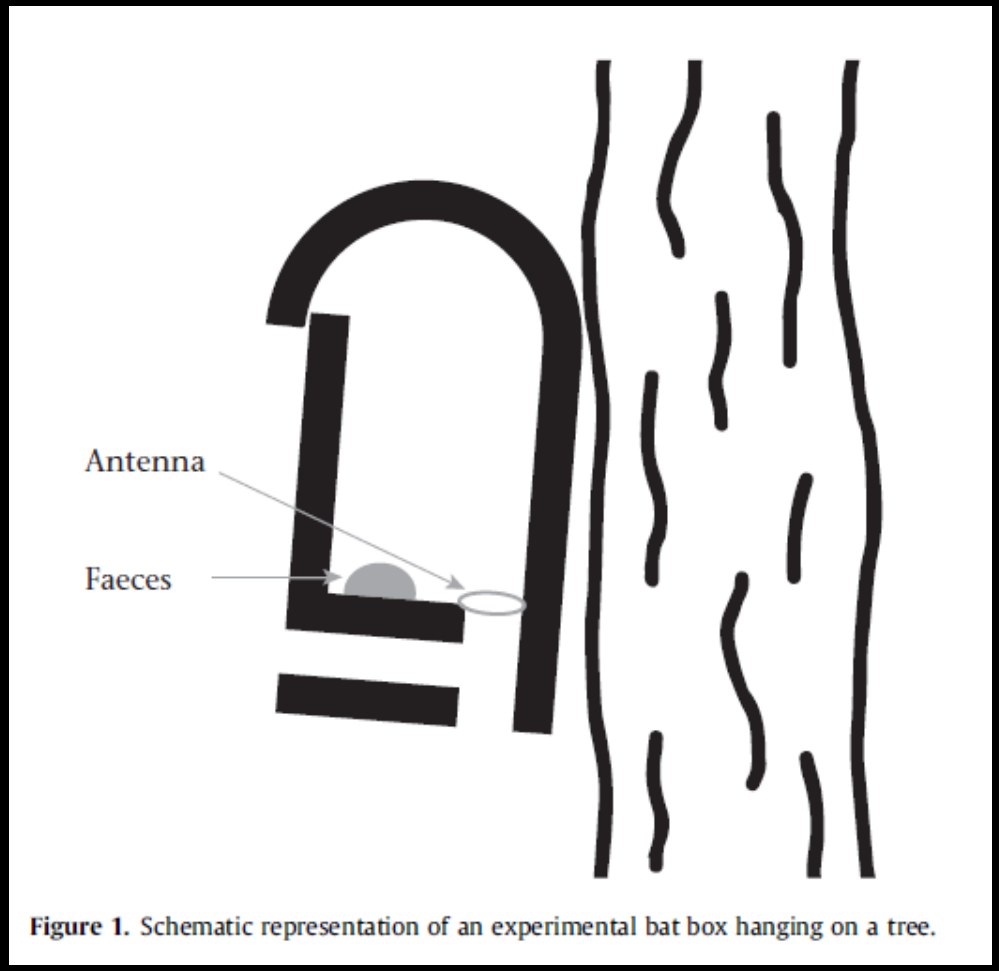


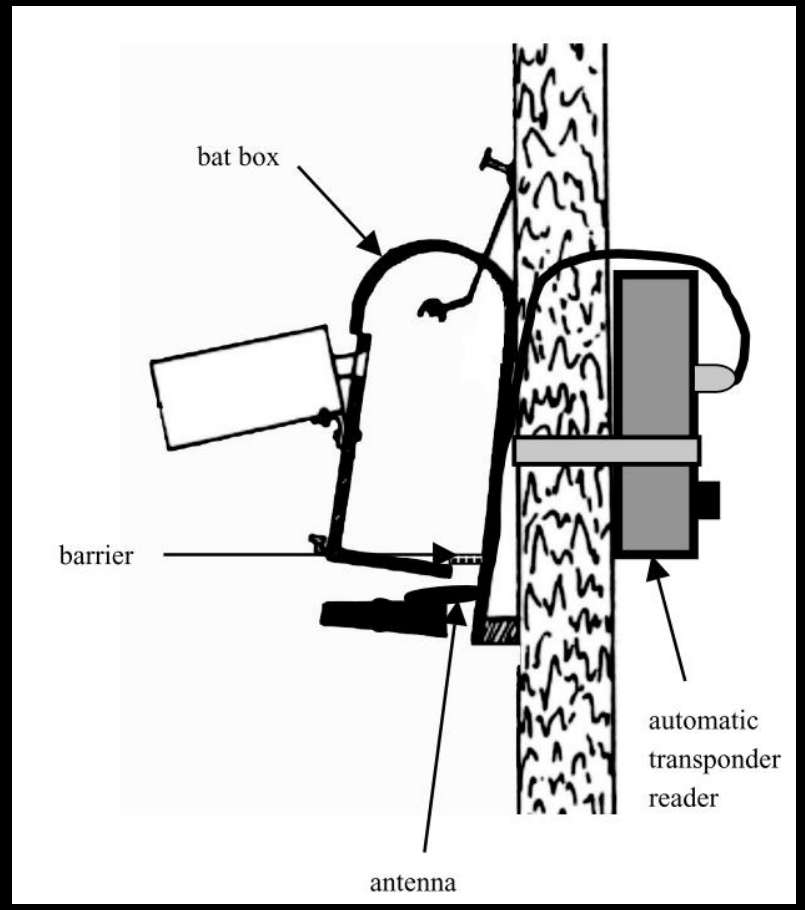

**Figure 1.** Schematic representation of an experimental bat box hanging on a tree.

Rizzi et al. 2025. Animal Behaviour

# Acoustic cues

Crawford et al. (in prep)

# Information transfer among bats


Kerth and Reckardt. 2003. Proc. R. Soc. Lond. B

# Improving bat boxes for conservation


DOI: 10.1111/cobi.14170

Conservation Biology

PRACTICE AND POLICY

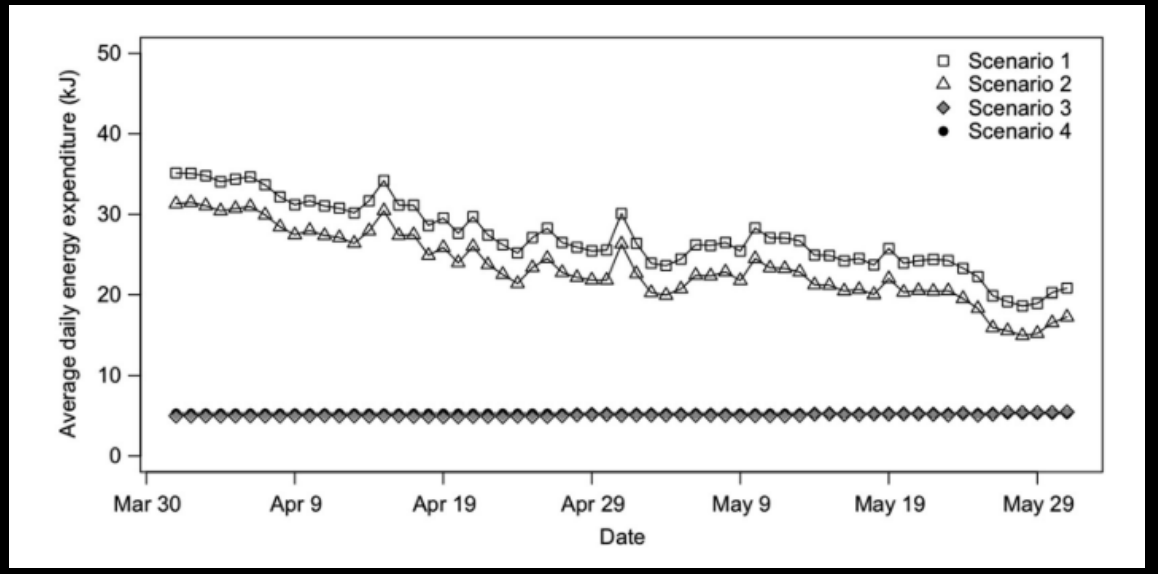
Improving the science and practice of using artificial roosts for bats

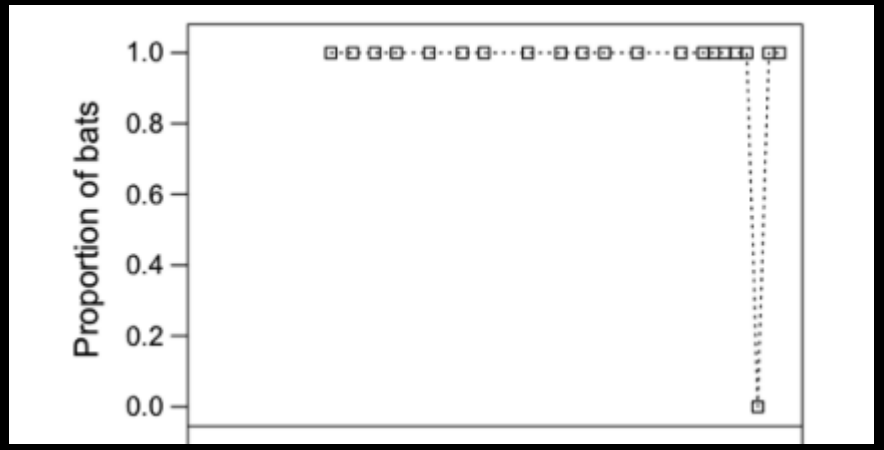
Reed D. Crawford[1] | Joy M. O'Keefe[1,2]

- Few measures of bat reproductive success and survival in artificial roosts
- Poor understanding of physiology and energetics
- Problems with overheating
- Problems with ectoparasites
- Potential for behavioral change
- Consequences of putting bat boxes up on degraded landscapes

# Energy expenditure and white-nose syndrome

- Bats with larger fat stores may have better odds of surviving winter with WNS
- Improving summer habitat could benefit WNS-impacted bats



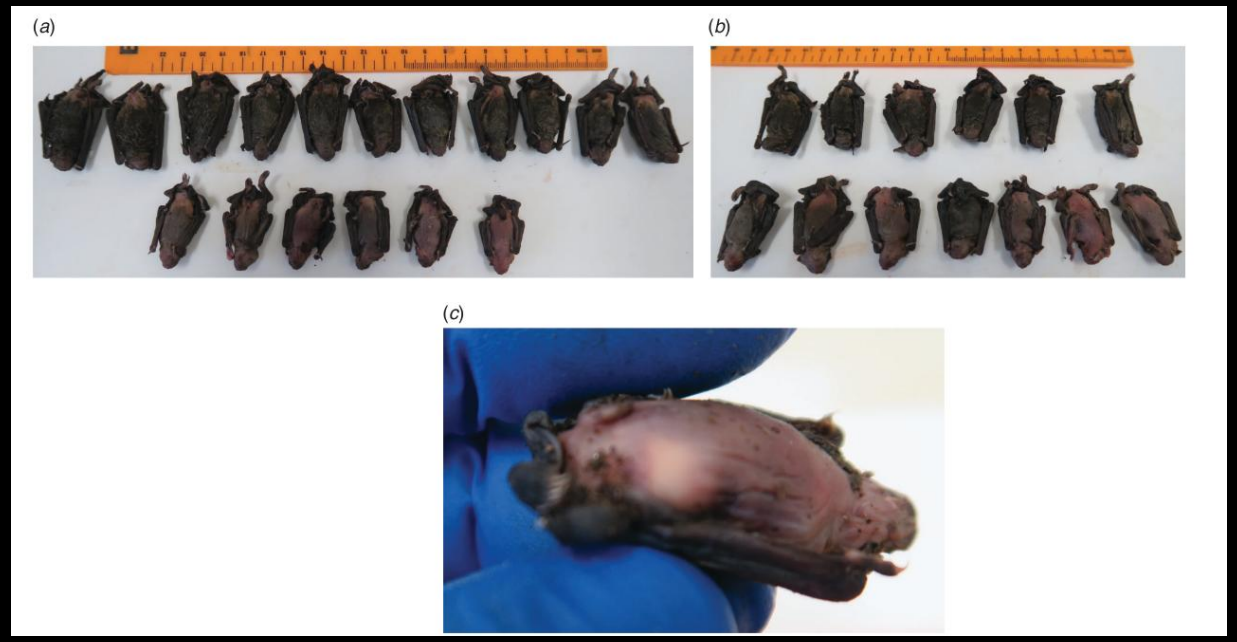




Wilcox and Willis. 2016. Conservation Physiology

# Ectoparasite loads

O’Keefe et al. (in prep)

# Bat deaths from overheating are becoming more common in the literature




Barbastella 7 (1)
ISSN: 1576-9720 SECEMU
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**Could overheating turn bat boxes into death traps?**

Carles Flaquer [1], Xavier Puig [2], Adrià López-Baucells [1], Ignasi Torre [1], Lídia Freixas [1], Maria Mas [1], Xavier Porres [3], Antoni Arrizabalaga [1]

Barbastella 10 (1)
ISSN: 1576-9720 SECEMU
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**Conservación de colonias reproductoras de murciélagos cavernícolas mediante refugios artificiales**

Juan Tomás Alcalde[1*], Iñaki Martínez[1], Aritz Zaldua[1], Inmaculada Antón[1]

CSIRO PUBLISHING
*Pacific Conservation Biology*
https://doi.org/10.1071/PC20083

**Overheating turns a bat box into a death trap**

*Stephen R. Griffiths* A,B,C

Conservation Physiology
Volume 10 • 2022
10.1093/conphys/coac027
SEB Society for Experimental Biology
Research article

**Evaluating bat boxes: design and placement alter bioenergetic costs and overheating risk**

Reed D. Crawford[1,2,*], Luke E. Dodd[1], Francis E. Tillman[4,5] and Joy M. O'Keefe[2,3,4]

# What temperatures are stressful to bats?

- Large body of respirometry literature on bat heat tolerance
- Field observations of bat behavioral responses to heat in barns and artificial roosts
- Bats generally avoid temperatures > 40°C
- Die after an hour exposure to 45°C

PLOS ONE

RESEARCH ARTICLE

# Surface reflectance drives nest box temperature profiles and thermal suitability for target wildlife

Stephen R. Griffiths[1]*, Jessica A. Rowland[2], Natalie J. Briscoe[2], Pia E. Lentini[2], Kathrine A. Handasyde[2], Linda F. Lumsden[3], Kylie A. Robert[1]

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Available online at www.sciencedirect.com

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Biological Conservation 119 (2004) 237–243

BIOLOGICAL CONSERVATION

www.elsevier.com/locate/biocon

# Influence of temperature in roost selection by *Pipistrellus pygmaeus* (Chiroptera): relevance for the design of bat boxes

Sofia I. Lourenço *, Jorge M. Palmeirim

Received: 13 July 2020 | Accepted: 17 October 2021

DOI: 10.1002/2688-8319.12112

Ecological Solutions and Evidence | BRITISH ECOLOGICAL SOCIETY

RESEARCH ARTICLE

# Design modifications affect bat box temperatures and suitability as maternity habitat

Francis E. Tillman Jr.[1,2,3] | George S. Bakken[2] | Joy M. O'Keefe[1,2,4]

environments

MDPI

*Article*

# Variation in Summer and Winter Microclimate in Multi-Chambered Bat Boxes in Eastern Australia: Potential Eco-Physiological Implications for Bats

Niels Rueegger

Conservation Physiology

Volume 10 • 2022

10.1093/conphys/coac027

SEB SOCIETY FOR EXPERIMENTAL BIOLOGY

Research article

# Evaluating bat boxes: design and placement alter bioenergetic costs and overheating risk

Reed D. Crawford[1,2,*], Luke E. Dodd[1], Francis E. Tillman[4,5] and Joy M. O'Keefe[2,3,4]

scientific reports

Check for updates

OPEN

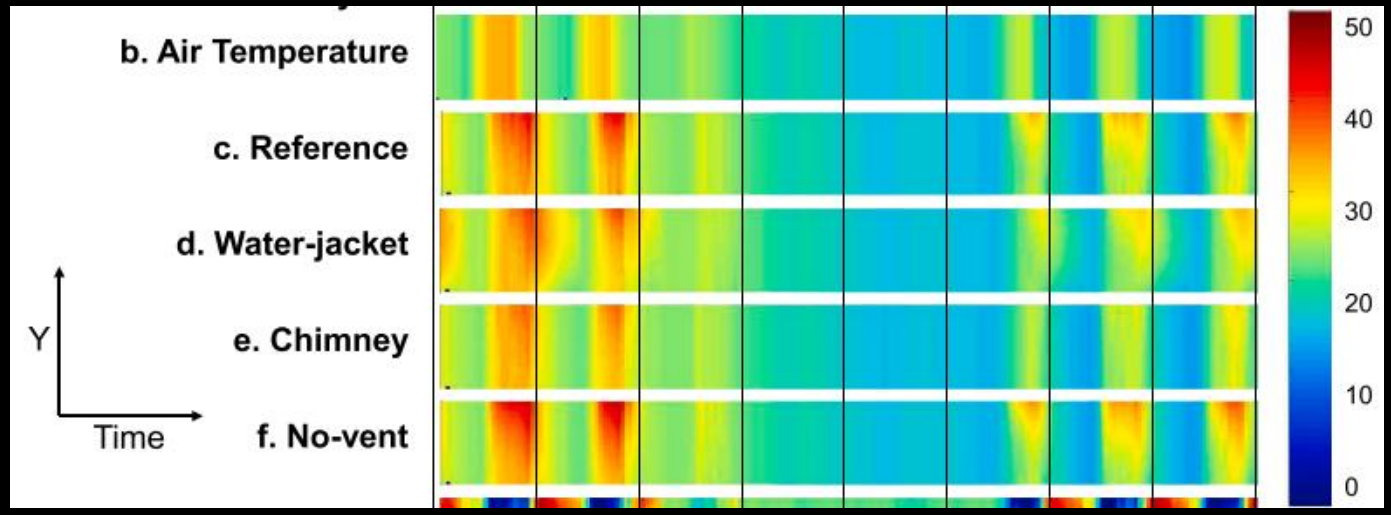
# Using mounting, orientation, and design to improve bat box thermodynamics in a northern temperate environment

Amélie Fontaine[1,2✉], Anouk Simard[2,3], Bryan Dubois[4], Julien Dutel[5] & Kyle H. Elliott[1,2]

# What can be done to prevent artificial roosts from overheating?

- Choose lighter paint colors (≤ 40% black)
- Increase the heat capacity of artificial roosts
- Increase the amount of insulation in artificial roosts
- Supply larger artificial roosts

Tillman et al. 2021 Ecological Solutions and Evidence

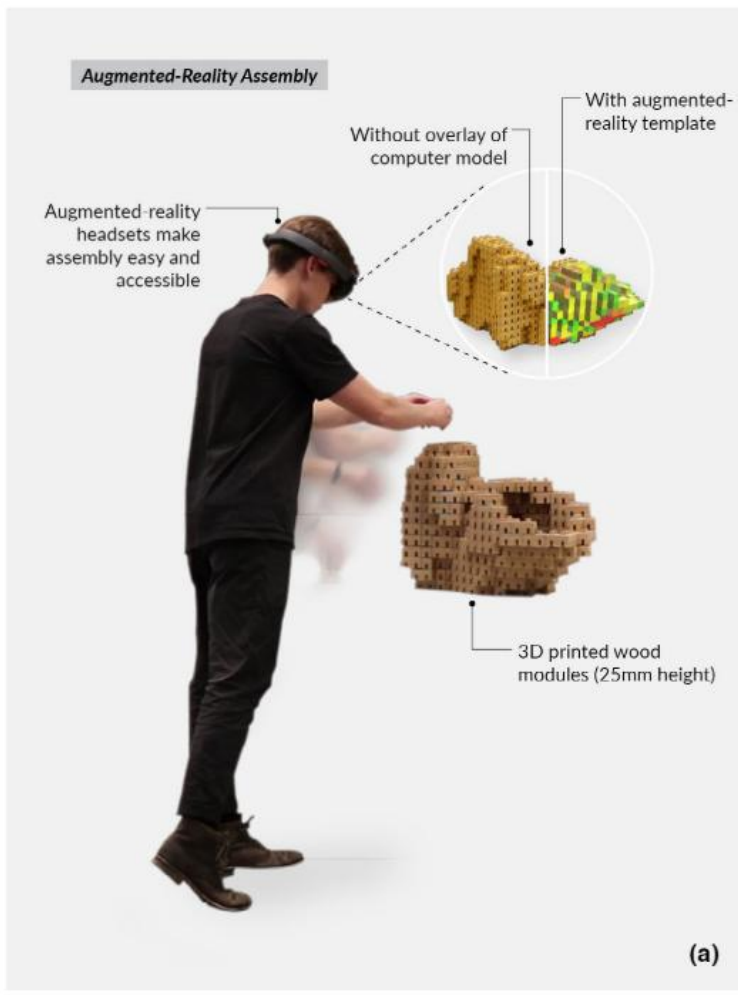



Bakken et al. 2022. Journal of Thermal Biology

# Frontiers in bat box research

More microclimate research is needed

# Frontiers in bat box research




Parker et al. 2022. Methods in Ecology and Evolution

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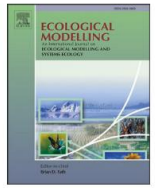

Check for updates

A dynamic thermal model for predicting internal temperature of tree cavities and nest boxes

Taylor B. Velander [a,b,*], Michael J. Joyce [b], Angela M. Kujawa [c,1], Robert L. Sanders [c,2], Paul W. Keenlance [d], Ron A. Moen [b,e]

# Frontiers in bat box research

- Behavior
  - What happens when bat box using colonies lose access to bat boxes?
  - What happens when you give nomadic species permanent roosts?
  - Do bats born in bat boxes preferentially select familiar bat boxes over other alternatives?

# Frontiers in bat box research

- Landscape context
  - How do predators of bats respond to boxes?
  - Should you put up bat boxes on highly degraded landscapes?

# Expand work to the Global South

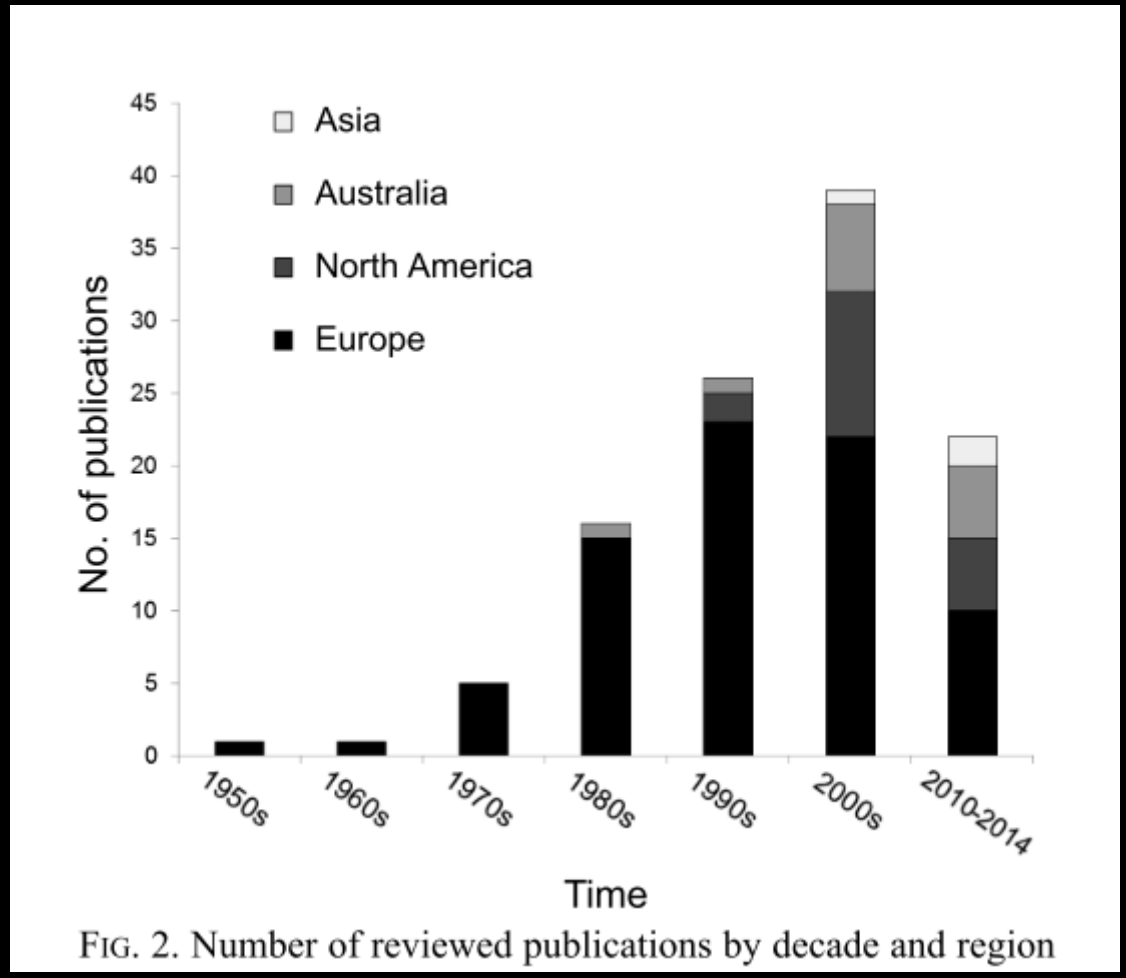


FIG. 2. Number of reviewed publications by decade and region

Rueegger. 2016. Acta Chrio.

# Overall value of bat box research

- Insights into roost selection
- Better understanding of bat social interactions
- Improve our understanding of the ecological and economic importance of bats