# Tracking Bats

## Radio Telemetry, GPS, and New Technologies

# Acknowledgements


- All of the researchers mentioned herein!

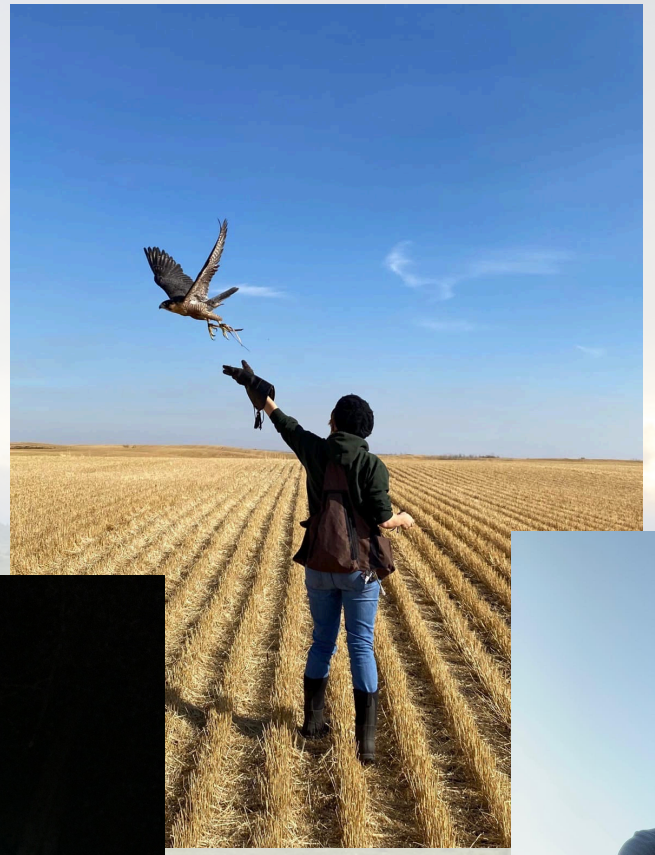

GBatNet

Global Union of Bat Diversity Networks

University of Regina

Faculty of Science

TheEyepatchBiologist



TheEyepatchBiologist

# What is Tracking?

- The science and art of observing animal signs with the goal of gaining understanding of the landscape and the animal being tracked.
    - Deeper understanding of the systems and patterns of wildlife within the environment

# Tracking Bats

# IT IS DIFFICULT.

Bats are:

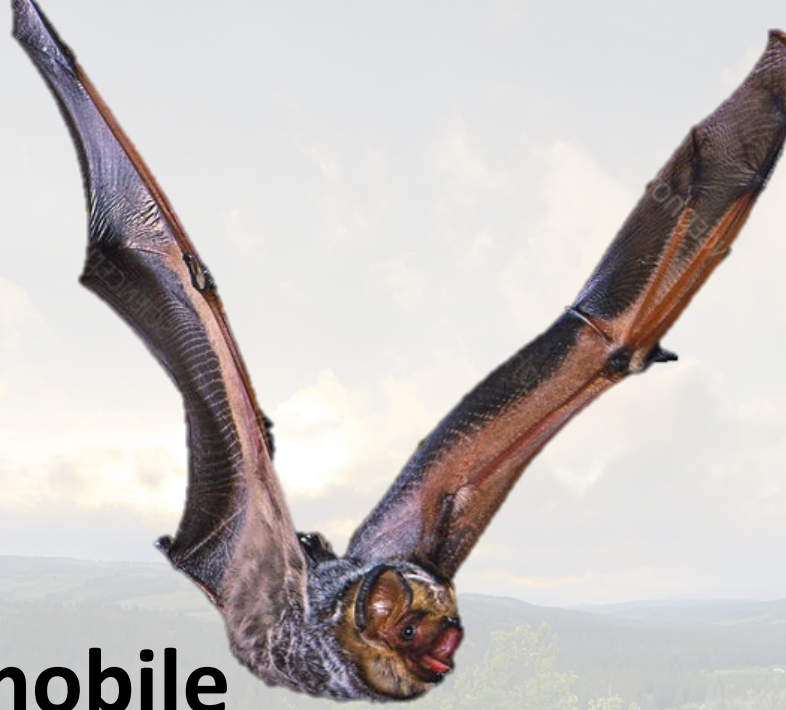
- Small
- Highly mobile
- Recaptures rare
- Nocturnal

Answer questions about:

- Roosting
- Foraging
- Habitat use
- Thermoregulation

# Limitations

- Battery life
  - Size
  - Attachment
  - Can’t recharge
- The “5% Rule”



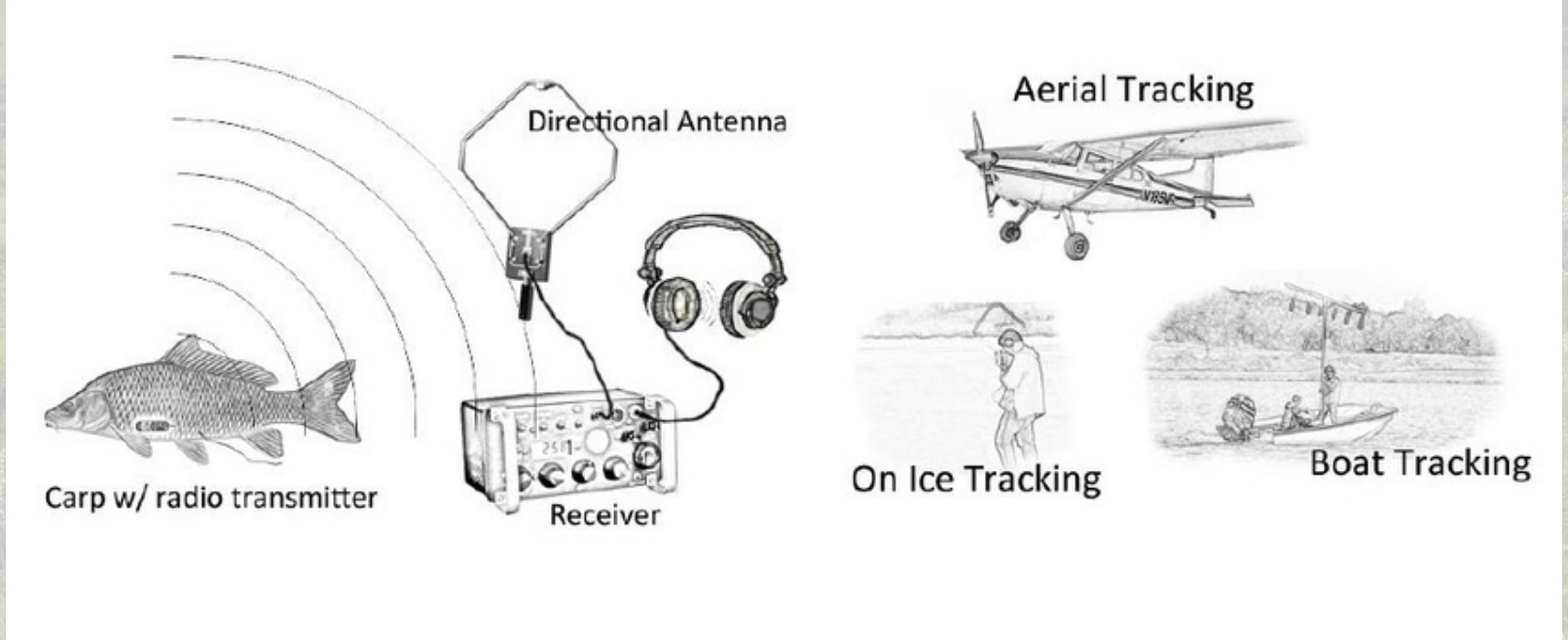
**Bats are:**

- **Small**
- **Highly mobile**
- **Recaptures rare**
- **Nocturnal**

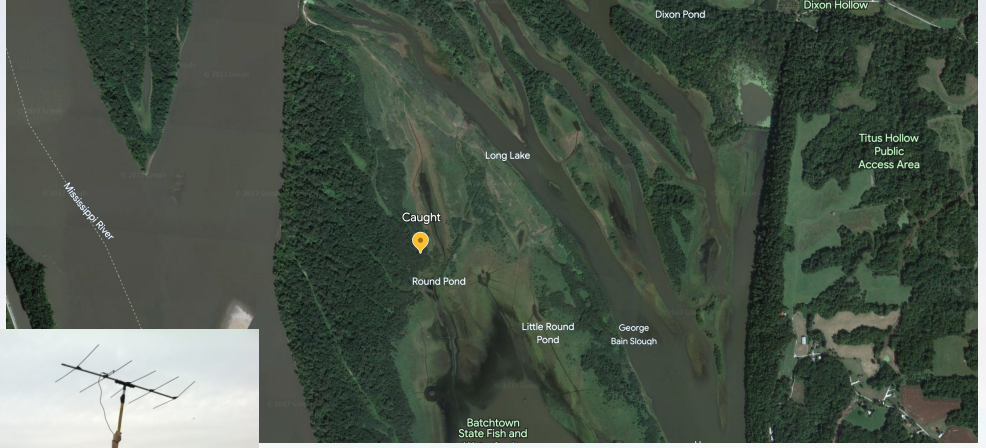
# Radio Telemetry

- Radio telemetry uses radio signals, which are made up of invisible and silent electromagnetic waves

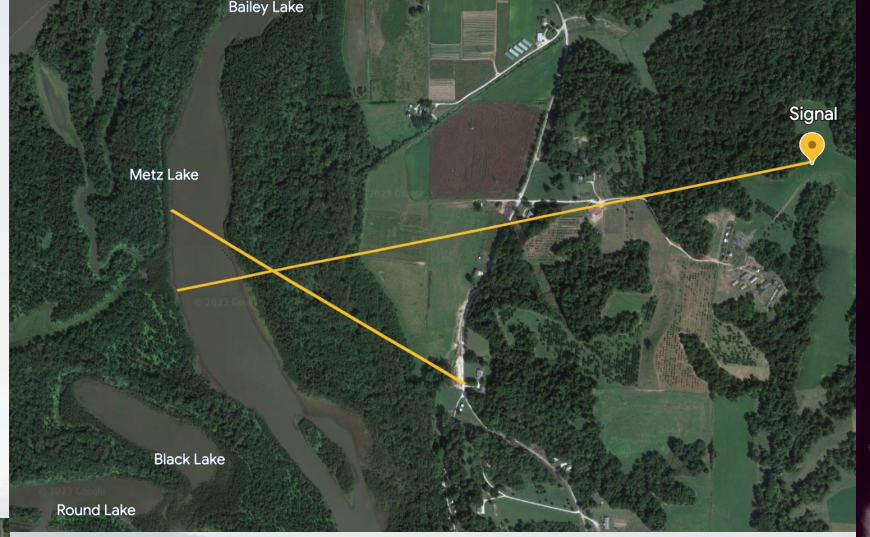
- 3 parts:
  - transmitter
  - antenna
  - receiver

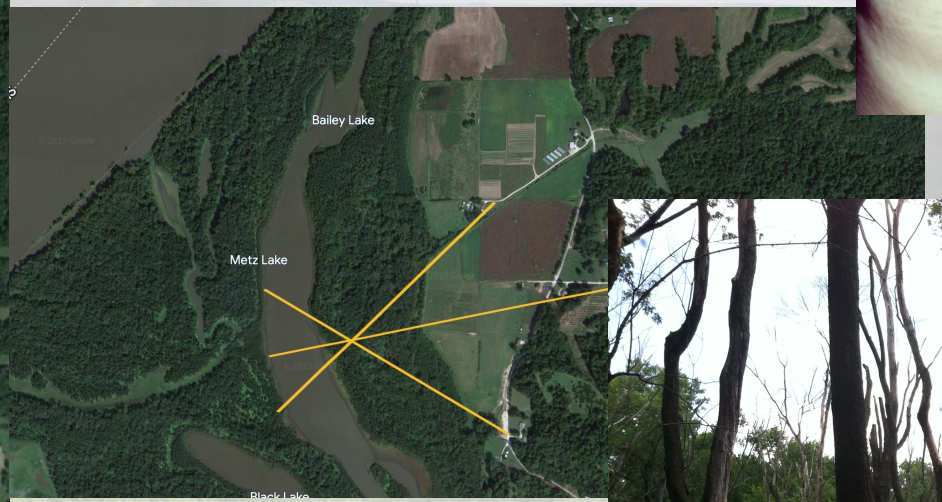


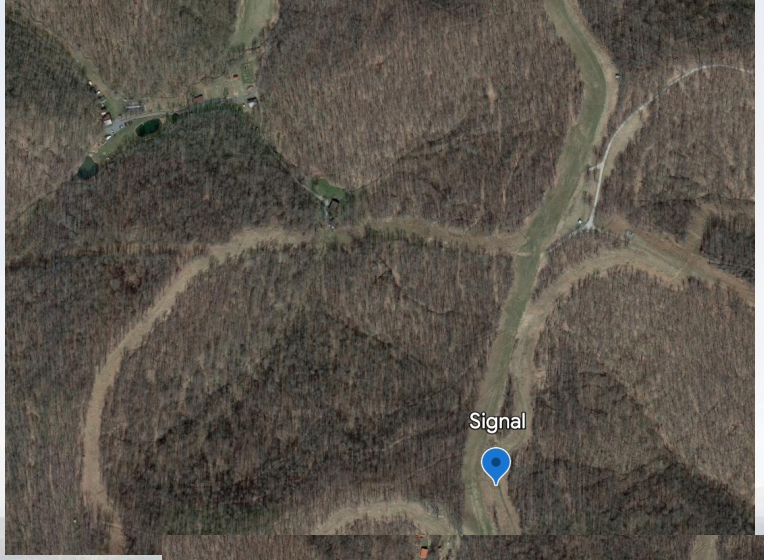
# Radio Telemetry – Tags

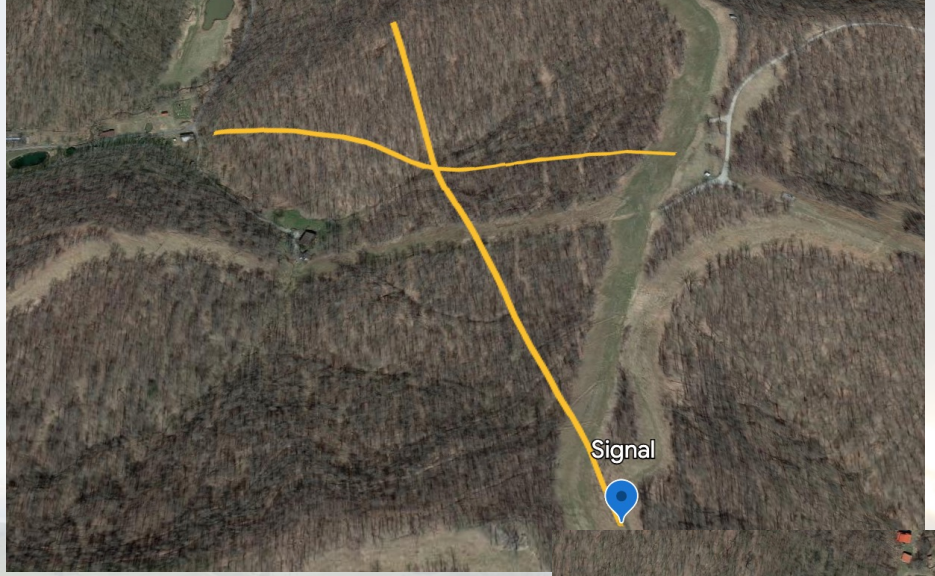


Dixon Pond
Dixon Hollow
Titus Hollow
Public
Access Area
Long Lake
Mississippi River
Caught
Round Pond
Little Round
Pond
George
Bain Slough
Batchtown
State Fish and

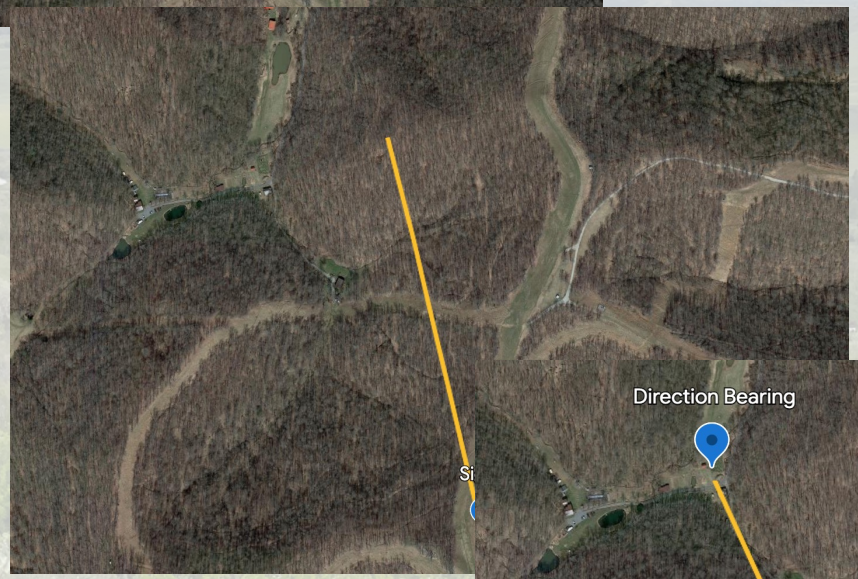

Signal

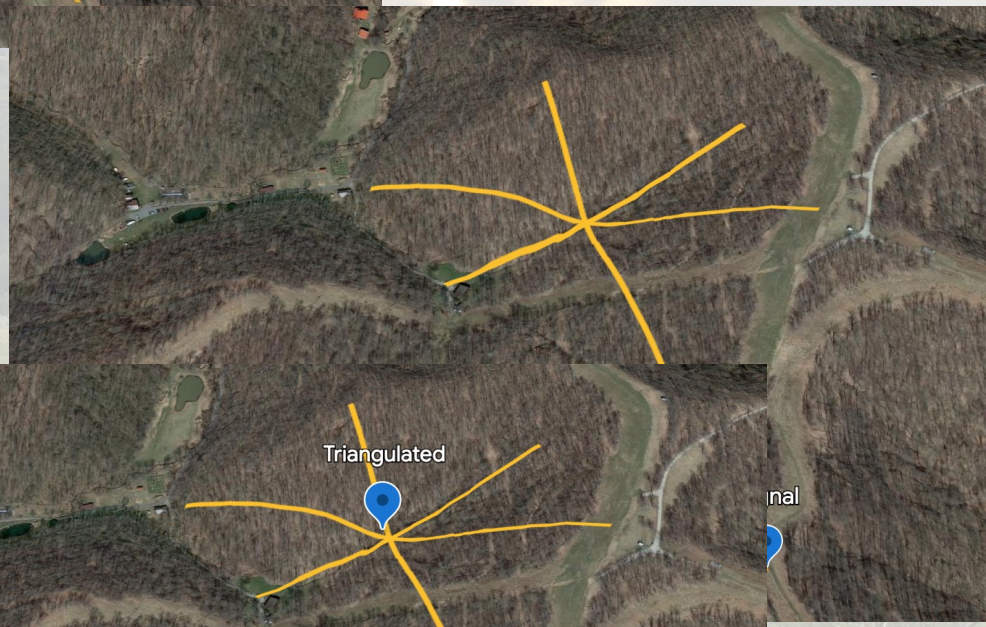

Bailey Lake
Signal
Metz Lake
Black Lake
Round Lake

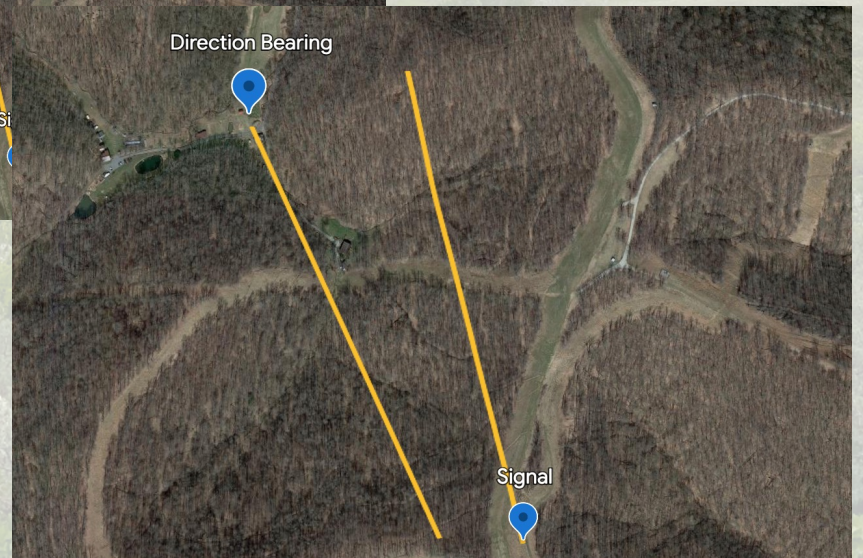

Bailey Lake
Metz Lake


Signal


Signal






Direction Bearing
Signal


Triangulated
Signal

# Radio Telemetry - Roosting

## Winter Roosting Ecology of Eastern Red Bats in Southwest Missouri

MANN, *Missouri State University, Department of Biology, 901 S. National Avenue, Springfield, MO 65897, USA*
INS,[1] *Missouri State University, Department of Biology, 901 S. National Avenue, Springfield, MO 65897, USA*

**Figure 3.** Eastern red bat taking flight during field trial.

*Article*

## Eastern Red Bat Responses to Fire during Winter Torpor

**Jason T. Layne [1,2,*], Dana Green [3], Anna Scesny [1,4] and Lynn W. Robbins [1,5]**

# Radio Telemetry– Colony Dynamics

## Roost switching, roost sharing and social cohesion: forest-dwelling big brown bats, *Eptesicus fuscus*, conform to the fission–fusion model

## Genetic relationships between roost-mates in a fission–fusion society of tree-roosting big brown bats (*Eptesicus fuscus*)

Jackie D. Metheny ✉, Matina C. Kalcounis-Rueppell, Craig K. R. Willis, Kristen A. Kolar & R. Mark Brigham

# Radio Telemetry - Thermoregulation

Craig K. R. Willis · R. Mark Brigham · Fritz Geiser

**Deep, prolonged torpor by pregnant, free-ranging bats**

**Fig. 1** Pregnant hoary bat (*Lasiurus cinereus*) in torpor

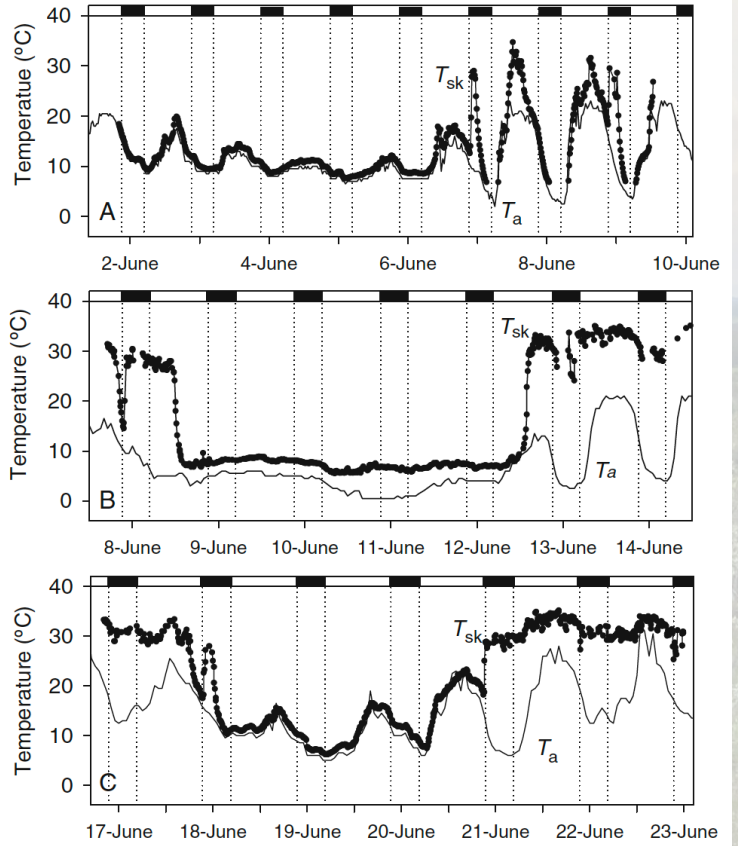



**Fig. 2** Representative patterns of skin temperature (*filled symbols*) for three pregnant hoary bats during periods of cold and wet/snowy spring weather from **a** 2–10 June 2001, **b** 8–12 June, and **c** 18–21 June 2002. *Dotted lines* represent sunrise and sunset times, and *dark bars* represent the dark phase. The *solid black line* indicates ambient temperature recorded at each bat's roost site. Bats gave birth within 3.1±1.3 days of final arousal from prolonged torpor

# Radio Telemetry – Short Migrations

## Nine years of Indiana bat (*Myotis sodalis*) spring migration behavior

PIPER L. ROBY,* MARK W. GUMBERT, AND MICHAEL J. LACKI

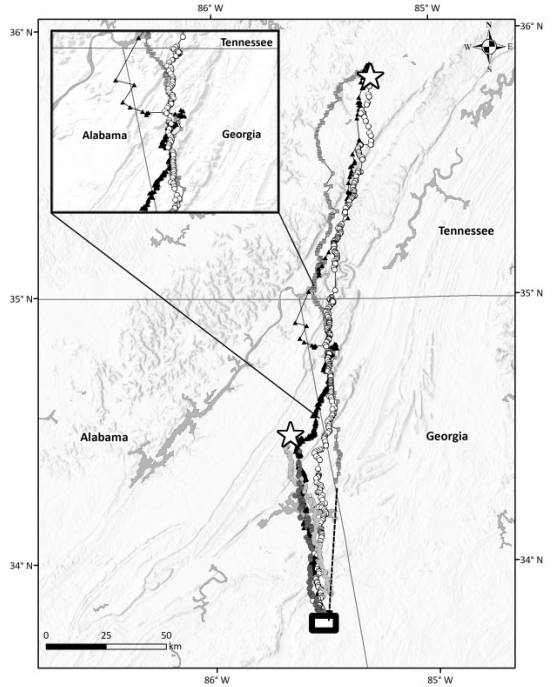



**Fig. 4.**—Travel paths comprised of location fixes for individual female Indiana bats (*Myotis sodalis*) aerially radiotracked during spring migration. Each large white star is a hibernaculum and each smaller symbol represents a different individual ($n = 5$ bats). All bats traveled south from hibernacula during spring migration to their shared maternity area (rectangle at the bottom of the migration paths). Filled gray irregular polygons represent lakes. Inset: overlapping migration paths.

# Radio Telemetry – Migration Behaviour

**Animal behaviour**

## Polarized skylight does not calibrate the compass system of a migratory bat

Oliver Lindecke[1,2], Christian C. Voigt[1,2], Gunārs Pētersons[3] and Richard A. Holland[4]

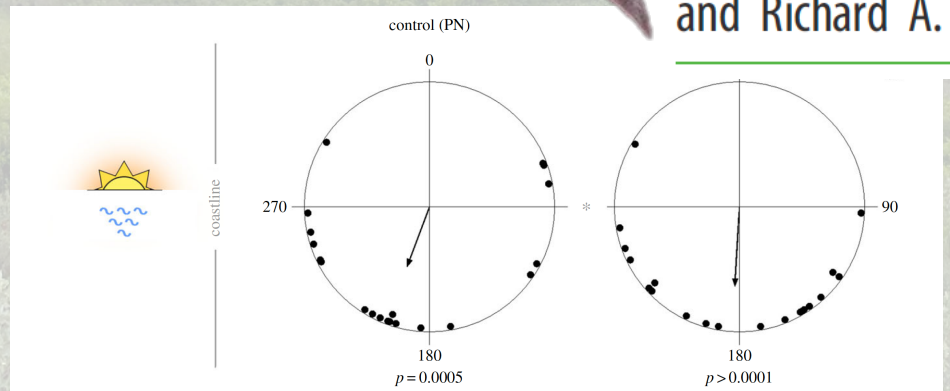
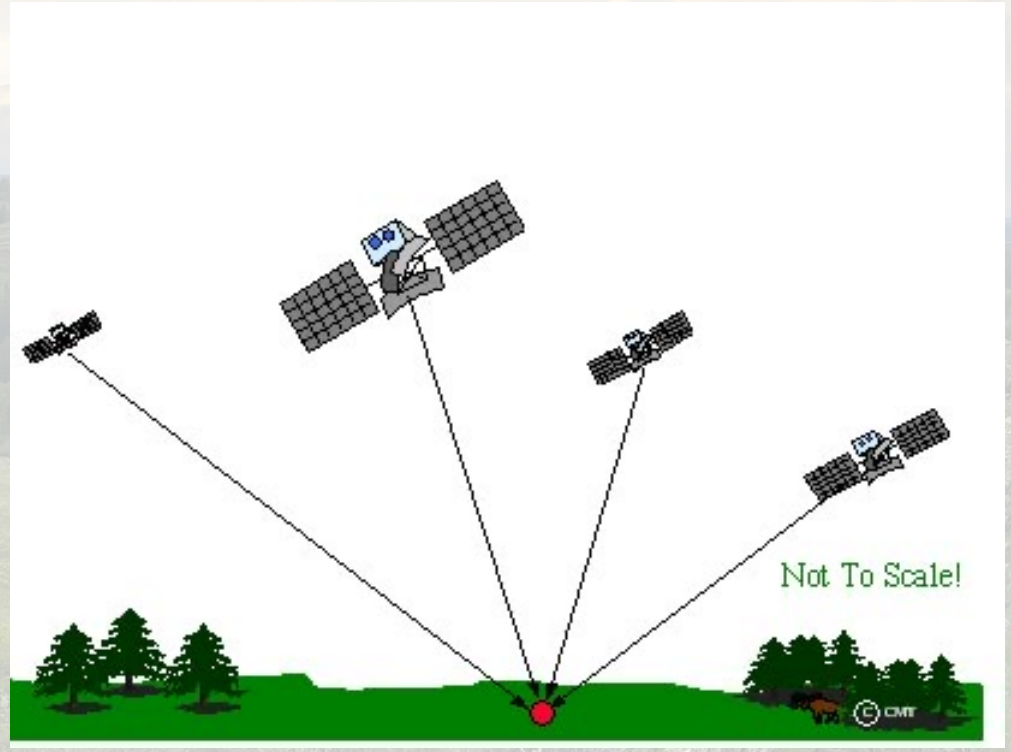



**Figure 1.** Vanishing bearings of bats translocated to the release site (asterisk) in a presumed unfamiliar area 11 km away east from the coastal migration corridor. The natural coastline, where bats were caught and treated, follows the line of longitude. North (0°) is the top of the circular plots. Arrows depict the mean and vector length of all individual migratory flights after departure of the control group tested for natural polarization direction (PN) and the experimental group (PS) treated with a 90° shifted polarization direction ($n_{PN} = 20$, $n_{PS} = 20$). *p*-values from the Rayleigh tests are shown. (Online version in colour.)

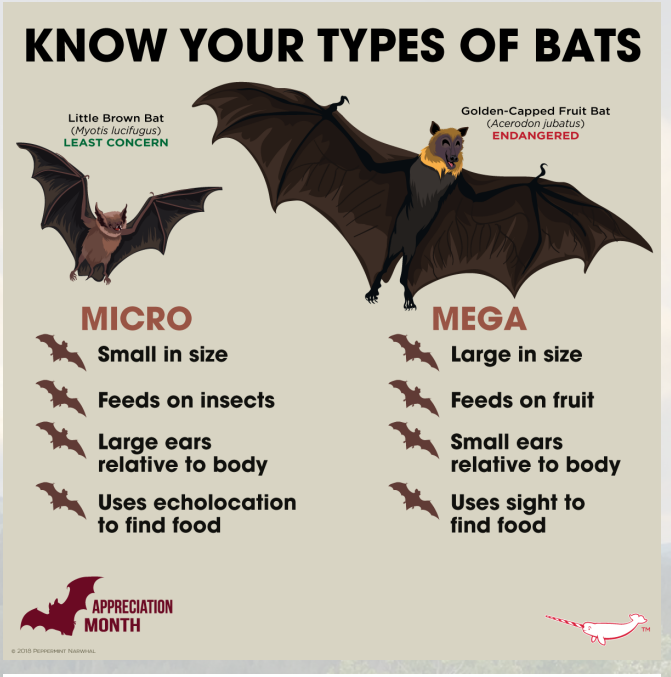
# GPS Tracking

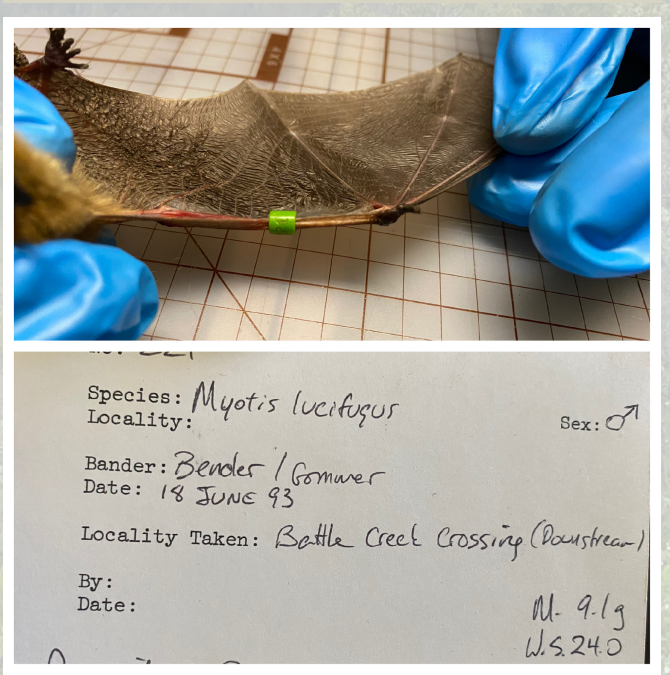
- Uses the Global Positioning System (GPS)
  - Part of global navigation satellite systems (GNSS)
    - Geolocation
    - Time information



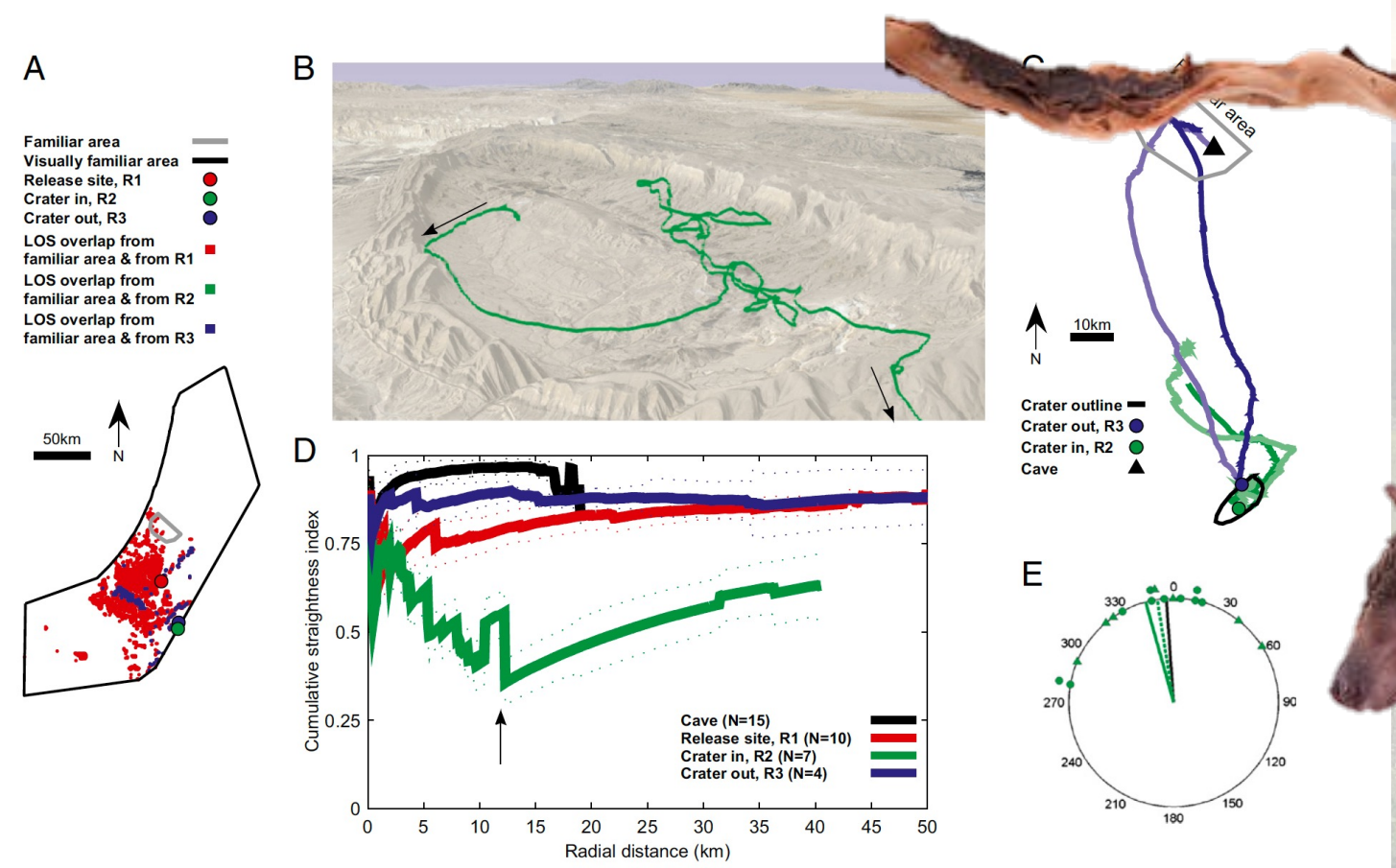
# Bats make it difficult…Again

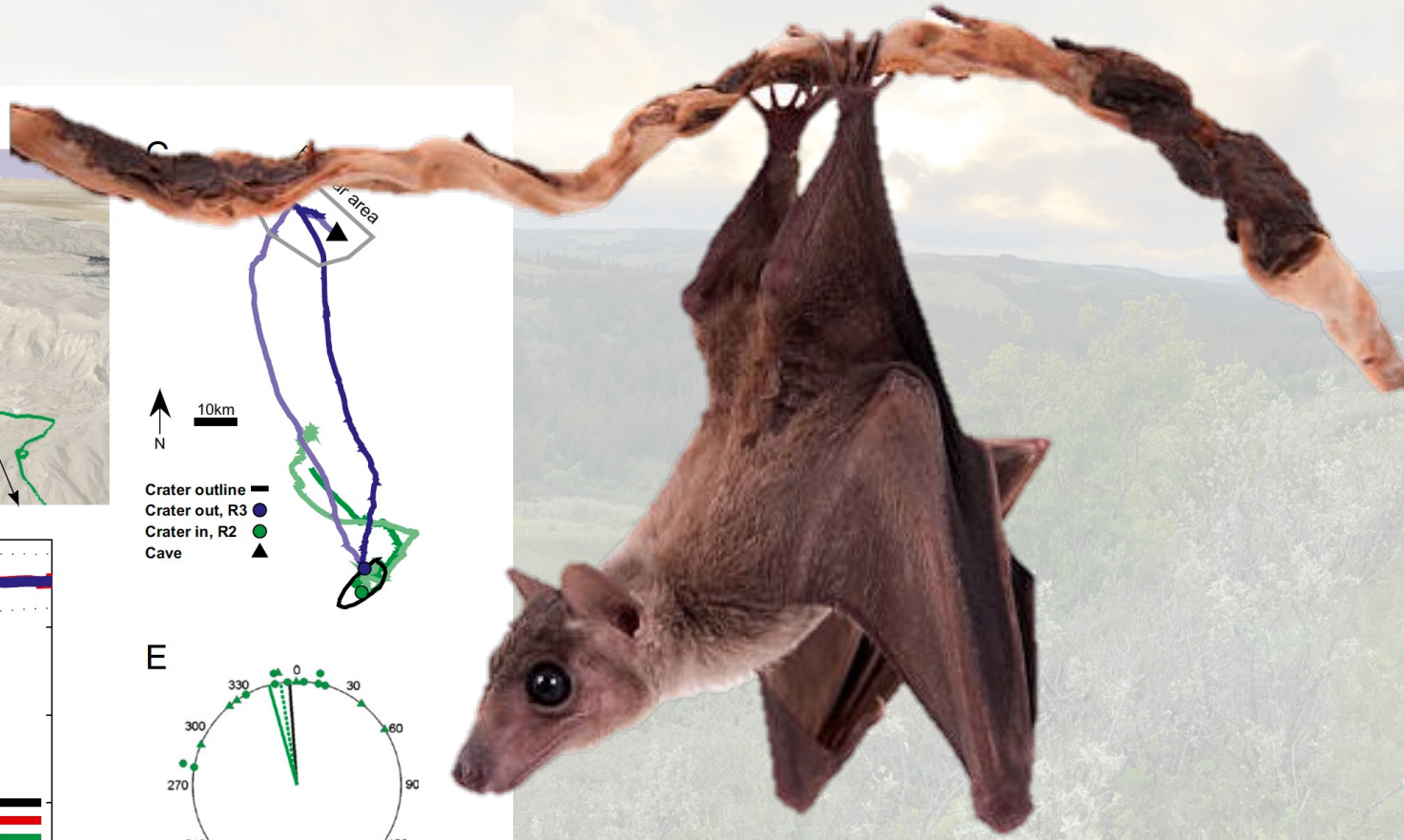
- Many bats are too small – >1000/1462
- Can not use solar power to charge
- Often bats are not recaptured



# GPS Tracking - Homing



Egyptian Fruit Bat

Tsoar et al. 2011Egyptian

# GPS Tracking - Discovery

Mammal Research (2019) 64:587–594
https://doi.org/10.1007/s13364-019-00446-1

ORIGINAL PAPER

Check for updates

## Highly selective roosting of the giant noctule bat and its astonishing foraging activity by GPS tracking in a mountain environment

Ladislav Naďo[1] · Denisa Lőbbová[2] · Ervín Hapl[2] · Martin Ceľuch[2] · Marcel Uhrin[3] · Michal Šara[2] · Peter Kaňuch[1,3]

RESEARCH ARTICLE

## Lek-associated movement of a putative Ebolavirus reservoir, the hammer-headed fruit bat (*Hypsignathus monstrosus*), in northern Republic of Congo

Sarah H. Olson[1]*, Gerard Bounga[2], Alain Ondzie[2], Trent Bushmaker[3], Stephanie N. Seifert[3], Eeva Kuisma[2], Dylan W. Taylor[1], Vincent J. Munster[3], Chris Walzer[1,4]

# GPS Tracking - Migration

## First Direct Evidence of Long-distance Seasonal Movements and Hibernation in a Migratory Bat

Theodore J. Weller[1], Kevin T. Castle[2], Felix Liechti[3], Cris D. Hein[4], Michael R. Schirmacher[4] & Paul M. Cryan[5]

# PIT Tagging

- P-assive I-ntergrative T-ransponder
  - Small (9 -12 mm in length)
  - Unique ID codes
  - No internal battery
  - Inexpensive

# PIT Tagging – Roosts

**Information transfer about roosts in female Bechstein's bats: an experimental field study**

**Gerald Kerth*** **and Karsten Reckardt**

*Zoologisches Institut, Universität Zürich, Verhaltensbiologie, Winterthurerstrasse 190, CH-8057 Zürich, Switzerland*

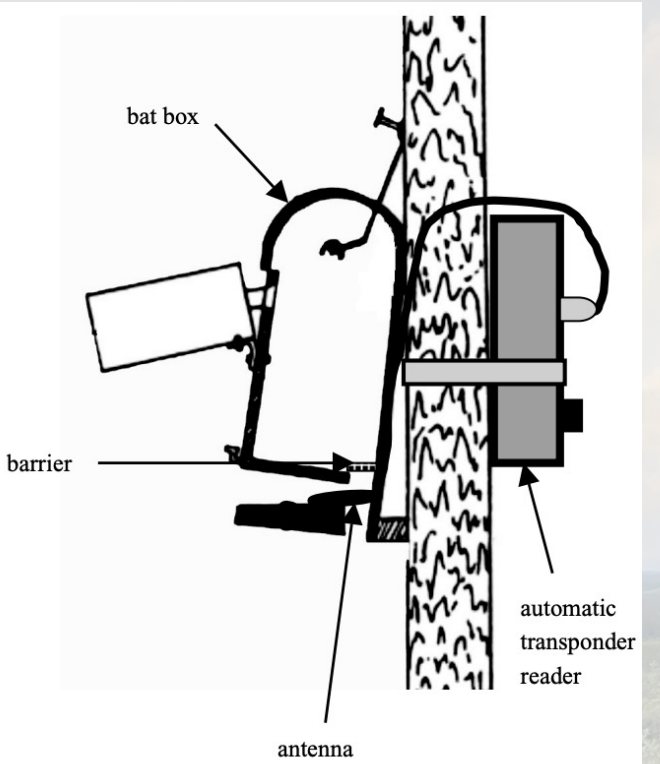



Figure 1. 'Unsuitable' experimental box: bat box equipped for continuous monitoring with an automatic transponder (PIT-tag) reader. A barrier blocking the interior entrance makes this box unsuitable for roosting (see text for details).

**Bats are able to maintain long-term social relationships despite the high fission–fusion dynamics of their groups**

**Gerald Kerth[1,2,3,*,†], Nicolas Perony[4,†] and Frank Schweitzer[4]**

# PIT Tagging – Passive Monitoring

# Monitoring little brown bat (Myotis lucifugus) movements using passive integrated transponders (PIT tags)

Joshua J.A. Christiansen, Hannah C. Wilson, Dana M. Green, Jack S.J. Nason, Kurt M. Samways, R. Mark Brigham

1. Bats are captuered using mist nets strung across Battle Creek in Cypress Hills, SK.

2. PIT tags with unique ID numbers are injected under the skin along the bats' backs.

3. Large antenna (10x3 m) that can detect PIT tags over an area of 12x5 m are installed in "open" and "cluttered" vegetation to access when and where bats are moving in open foraging areas.




Little Brown Bat
(Myotis lucifgus)

Silver-haired Bat
(Lasionycteris noctivagans)

Hoary Bat
(Lasiurus cinereus)

University of Regina

Joshua Christiansen
josh.christiansen.eco@gmail.com

# MOTUS

- Automated digital radio-telemetry array

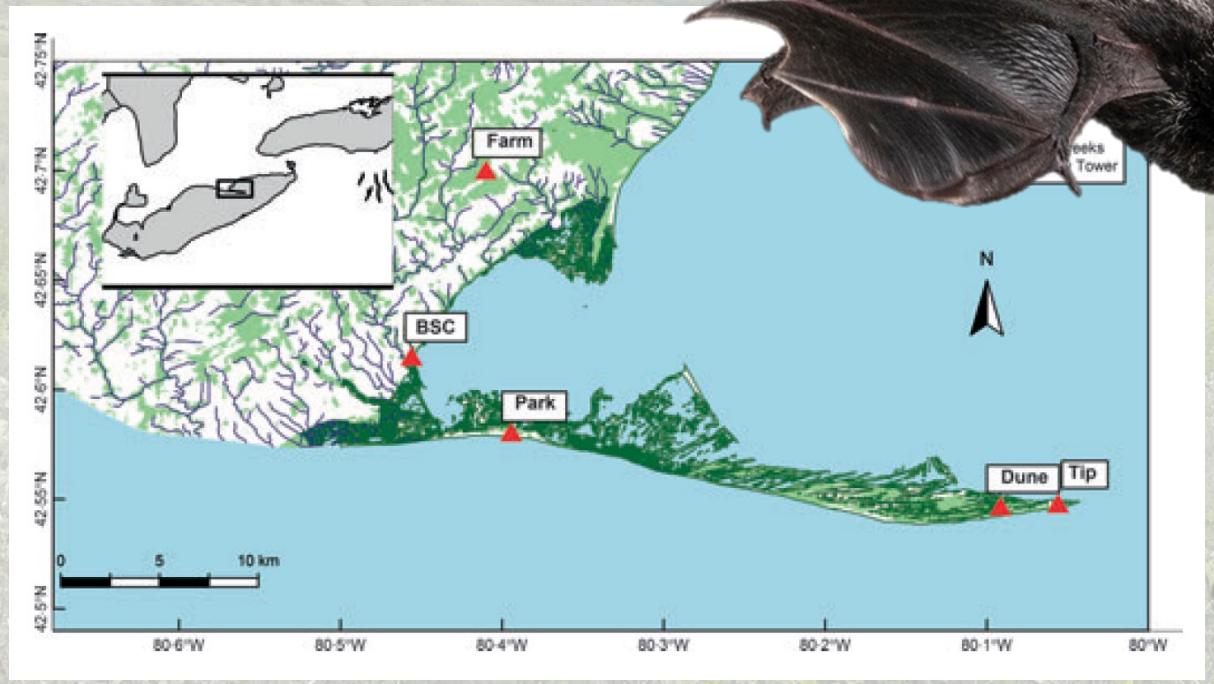
Motus
Wildlife Tracking System

***”International collaborative research network that uses coordinated automated radio telemetry to facilitate research and education on the ecology and conservation of migratory animals”***

# MOTUS - Migration

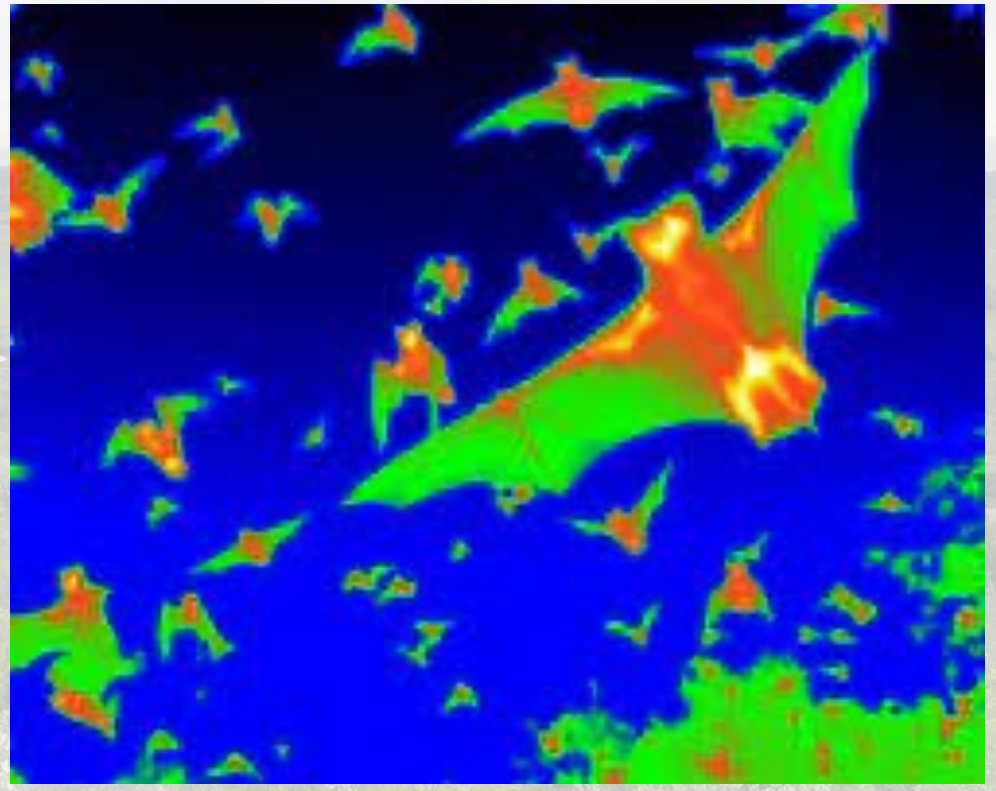
**Migratory stopover in the long-distance migrant silver-haired bat, *Lasionycteris noctivagans***

**Liam P. McGuire[1]*, Christopher G. Guglielmo[1], Stuart A. Mackenzie[1,2] and Philip D. Taylor[2,3]**



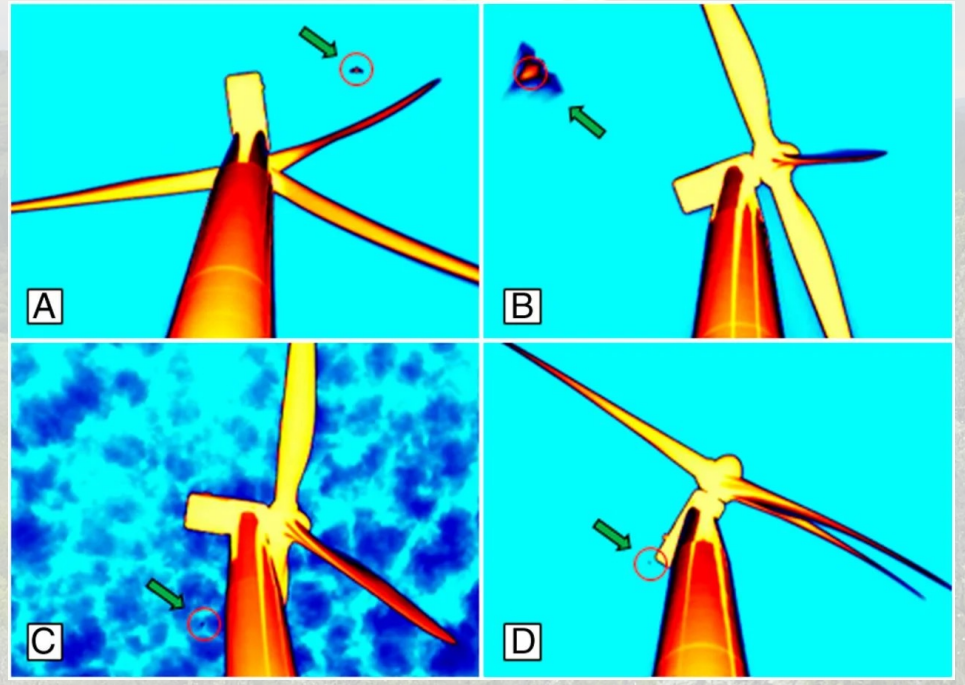

Not always about where they go…but how they do it!

# Other Technologies

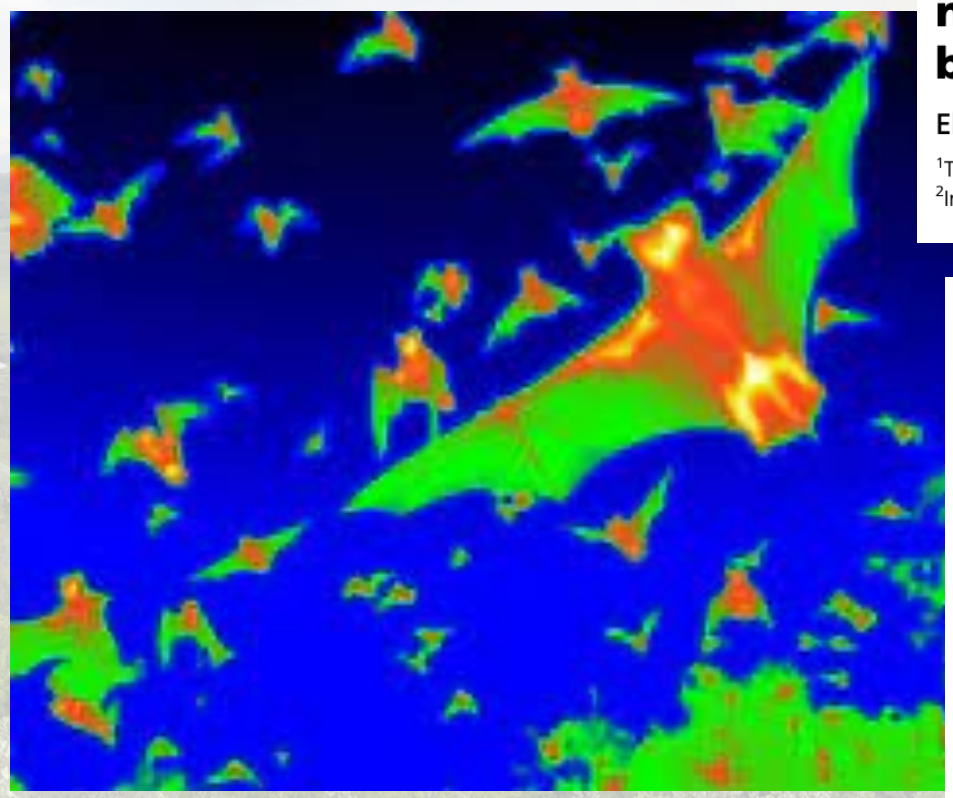


## Behavior of bats at wind turbines

Paul. M. Cryan, P. Marcos Gorresen, Cris D. Hein, +8, and David C. Dalton Authors Info & Affiliations



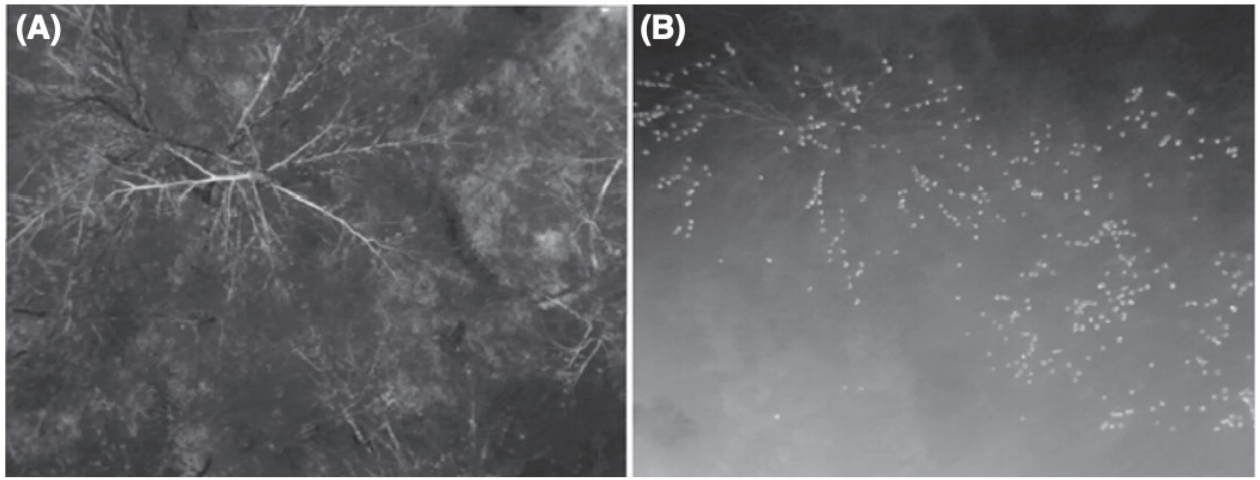
# Other Technologies



**Drone-based thermal remote sensing provides an effective new tool for monitoring the abundance of roosting fruit bats**

Eliane D. McCarthy[1], John M. Martin[2], Matthias M. Boer[1] & Justin A. Welbergen[1]

[1]The Hawkesbury Institute for the Environment, Western Sydney University, Richmond NSW, 2753, Australia
[2]Institute of Science and Learning, Taronga Conservation Society Australia, Bradleys Head Road, Mosman NSW, 2088, Australia

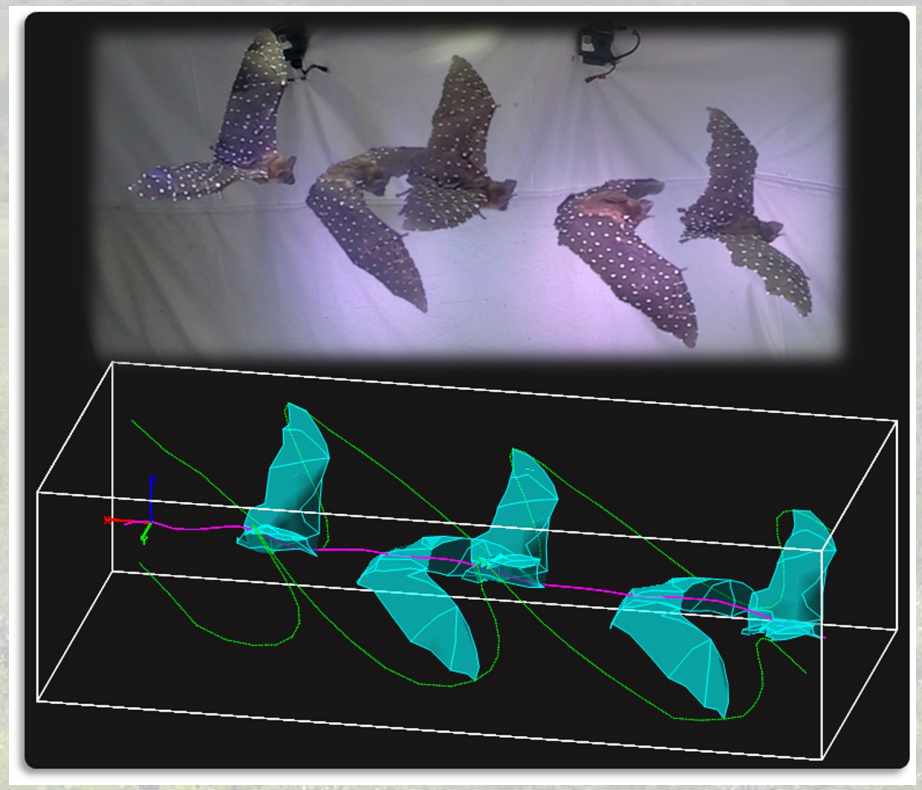



*“accurately reflected the true abundance of flying-foxes”*

# Other Technologies

**A computational investigation of lift generation and power expenditure of Pratt's roundleaf bat (*Hipposideros pratti*) in forward flight**

Peter Windes, Xiaozhou Fan, Matt Bender, Danesh K. Tafti, Rolf Müller



# Thank you!

dana.green.eco@gmail.com

@TheEyepatchBiologist

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