A multi-agency, multi-national, long-term monitoring program to assess status and trends of North American Bats.

**Mission:** Improve the state of conservation science for bats through

- standardized protocols,
- a unifying sample design,
- and integrated data analysis.

**Primary Goal:** Provide regular analyses and reporting to inform managers and policymakers so that they can manage bat populations effectively.
NABat Targeted Species

- All 47 species common to US, Canada, & Mexico
Monitoring Methods

Acoustic Surveys
- Mobile Transects
- Stationary Points

Colony Counts
- Hibernacula
- Maternity Colonies
- Emergence
<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Statistical Model</th>
<th>Desired Inference</th>
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<tbody>
<tr>
<td><strong>Summer</strong></td>
<td>• Single and Multispecies Occupancy Models</td>
<td>species distributions</td>
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<tr>
<td></td>
<td>• Dynamic Occupancy Models</td>
<td>(occupancy, colonization, extinction)</td>
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<tr>
<td><strong>Summer and Winter</strong></td>
<td>• GLMM</td>
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<tr>
<td></td>
<td>• Binomial Mixture Models</td>
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<td></td>
<td>• Dail-Madsen Model</td>
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<tr>
<td><strong>Stationary acoustic</strong></td>
<td>• GLMM</td>
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<td><strong>Mobile acoustic</strong></td>
<td>• Binomial Mixture Models</td>
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<tr>
<td><strong>Roost occupancy</strong></td>
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<td><strong>Mobile acoustic</strong></td>
<td>• GLMM</td>
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<tr>
<td><strong>Hibernacula surveys</strong></td>
<td>• Binomial Mixture Models</td>
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<td><strong>Maternity surveys</strong></td>
<td>• Dail-Madsen Model</td>
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<td>• GLMM</td>
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</table>

*Summer* and *Winter* Local abundance (indices, population dynamics)
Monitoring Tools

- A comprehensive online database
- On demand visualizations and maps
- State-focused internal reporting tools
- Annual state-level population assessments
NABat Monitoring Tools
• Improve early detection, risk assessment, surveillance and control of WNS
Role-based Access to contributor data

Public – open access
NABat Administrator/Analysts – access to all NABat data
Project Leader – access to all project data
Project Biologist/staff – access determined by leader
Researcher – must submit proposal to access data

• Project Leader (data contributor) decides level of data accessibility

• All data will be obfuscated to the grid cell level for mapping, etc. no point location information will be made available unless by request
Population-level impacts to Hoary Bats?

- Status and trend
- Can we predict and avoid future impacts through improved siting?
Hoary Bat

Consistent with a hypothesis that wind energy development has ALREADY impacted hoary bat population in Northwestern US.

Regional Conservation Assessment

\[ \hat{\lambda} \approx 0.8 \pm 0.1 \]

net trend “growth rate” appears to be in decline

2018 predictions - provisional results

2018 Hoary Bat Predicted Probabilities of Occurrence
What’s happening to bats in the fall?

Full-annual-cycle population models

• Integrate multiple data types to estimate seasonal abundance

• Estimate vital rates driving changes in seasonal abundances (e.g. summer to winter)
  (Zipkin et al. 2017)

• Improved precision

• e.g., using open-population dynamic N-mixture model
  (Dail and Madsen 2011)
INFORMING THE WNS RESPONSE

DATA REQUEST:
- Internal winter colony counts
- Legacy data
- Current surveys

BECOME A NABAT PARTNER

Go to nabatmonitoring.org to start your NABat project

OR

Get assistance from Bat Conservation International in data curation and migration to NABat. Email Tina Cheng: tcheng@batcon.org

Project funded by US Fish & Wildlife Service
NABat® Range-wide impacts of WNS

- 3378 surveys across >565 sites
- 24 US states

Cheng et al. *in prep*
Finding wintering bats on the leading edge of WNS spread.

- 207 culverts surveyed for over-wintering bats from October-February in 2016-2018 following NABat sample design.

- Factors influencing use of culverts

Meierhofer et al. accepted Journal of Mammalogy
**Local objective:** species inventory

**Landscape Objective:** changes in bat communities in relation to water quality and urban development

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**Ecology and Evolution**

*Open Access*

Separating the effects of water quality and urbanization on temperate insectivorous bats at the landscape scale

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<tr>
<td>Corynorhinus rafinesquii (CORA)</td>
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<td>Eptesicus fuscus (EPFU)</td>
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<td>Lasionycteris noctivagans (LANO)</td>
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<td>Nycticeius humeralis (NYHU)</td>
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<td>Perimyotis subflavus (PESU)</td>
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<td>Tadarida brasiliensis (TABR)</td>
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Variation in regional and landscape effects on occupancy of temperate bats in the southeastern U.S.

Benjamin D. Neece, Susan C. Loeb, David S. Jachowski

1 Department of Forestry and Environmental Conservation, Clemson University, Clemson, South Carolina, United States of America. 2 U.S. Forest Service, Southern Research Station, Clemson, South Carolina, United States of America.

Fig 1. Estimated effect of forest edge density on hourly bat (Lasiuruscinereus) probability of occupancy across South Carolina, May-July 2013 and 2014. Probability of occupancy is based on the top-ranked model for hourly bats. Gray shading indicates the 50% credible interval.

Fig 5. Predicted distribution maps for bat species across South Carolina. Distributions are based on effect estimates in the top-ranked occupancy model for each species, if non-null, and measures of environmental covariates in each cell. Black-outlined squares indicate cells where species were detected in 2015, 2016, or both years. Known summer ranges are based on Mensah et al. [43]. Refer to Table 1 for species code definitions.
Example: Crater Lake National Park

Effects of forest thinning on bat activity nested within NABat monitoring grid cells
NABat Decision Support Tools

Siting and development

BAT CONSERVATION PRIORITY AREAS

- NABat species occurrence maps
- Known roost locations
- Habitat maps

Hoary Bat Occurrence in Colorado
‘State of North American Bats’

- 5-year report
- Collaboration with NABCA
- Updated distribution maps
- Drivers of species distributions and evaluations of those drivers
- trend assessments
Regional snag density predicts regional distributions of forest bats.

Increase to an average of ~6 large diameter stems per hectare ≈ 2000% increase in long-legged bat occurrence probability.