

Methods to estimate bat mortality at wind facilities

Kristen S. Watrous



Stantec

Observed Indiana bat mortality

- Three observed mortalities to date, all during migratory season:

Facility	Date	Habitat
Fowler Ridge, IN	September 11, 2009	Agriculture, grasslands
Fowler Ridge, IN	September 18, 2010	Agriculture, grasslands
North Alleghany Wind, PA	September 26, 2011	Forested ridge line

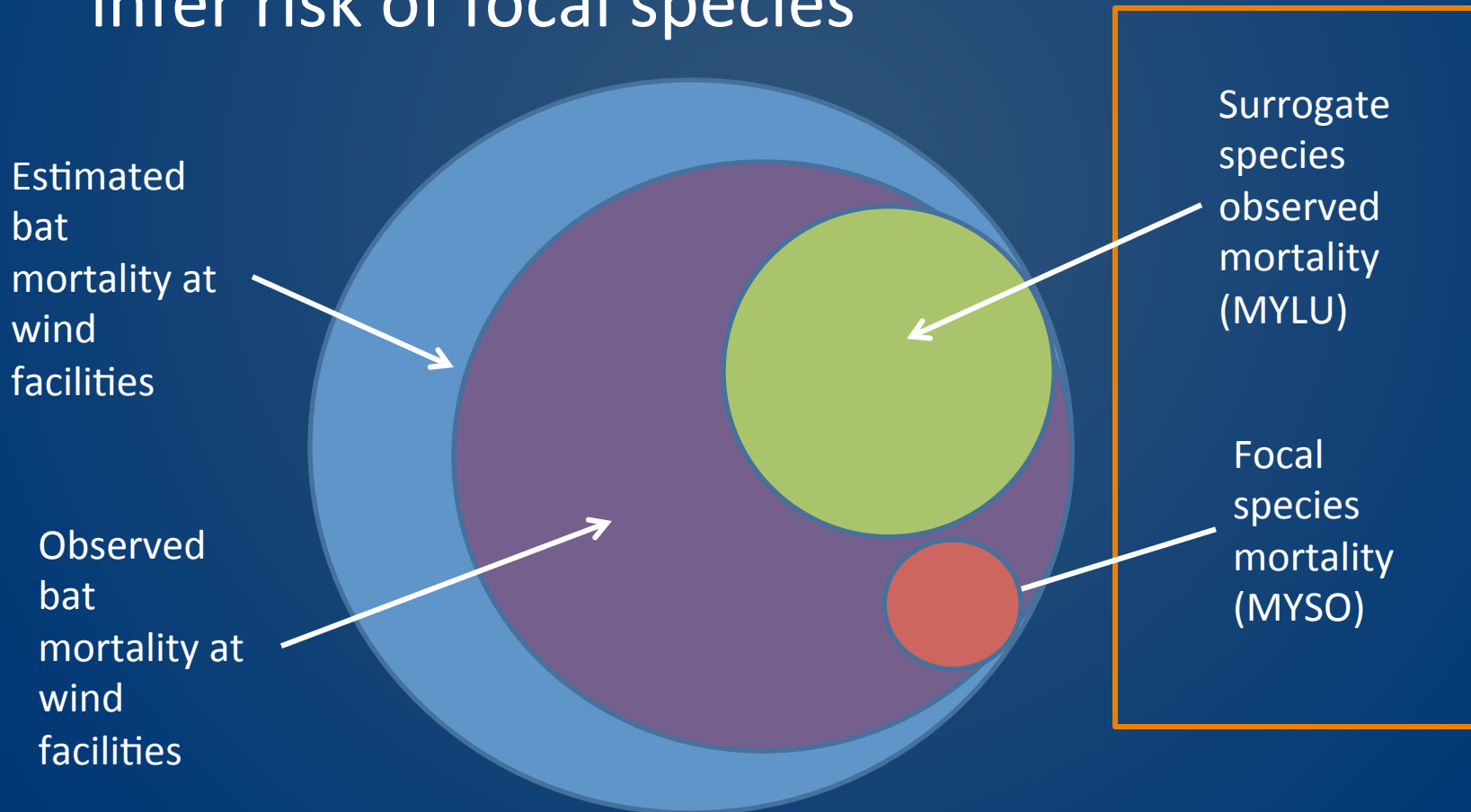
- Requires Incidental Take Permit (ITP), which requires an estimation of take.
- MYSO: Detection of a rare event.

Methods for Estimation

- Surrogate approach
 - Shaffer Mountain Biological Opinion
- Modeling approach
 - Models developed for estimating bird mortality

Surrogate Approach

- Use data on mortality of surrogate species to infer risk of focal species



Surrogate Approach - Capture

- Example (Shaffer Mountain B.O.):
 - Total bat fatality from existing facilities:
 - 6.8 to 48 b/t/y (average = 27.5 b/t/y).
 - MYLU mortality at same facilities:
 - 4.5% to 24.3% (average = 11.8%) of total.
 - Thus, 0.6 to 6.9 MYLU/t/y (average = 3.2 MYLU/t/y).
 - Or, 18 to 207 MYLU (average = 96) for the 30 turbine project.

Surrogate Approach - Capture

- Example (Shaffer Mountain Biological Opinion):
 - 18 to 207 MYLU (average = 96)
 - Mist net surveys found ratio of MYSO:MYLU of:
 - 0.01 in 2007; 0.03 in 2008, and 0.016 overall
 - Or, 1% to 3% (average = 1.6%)
 - Predict 1 to 3 MYSO fatalities (average = 1.5)

Surrogate Approach - Capture

- Advantages:
 - SIMPLE!
 - Easy to understand
 - Utilizes existing information

Surrogate Approach - Capture

- Assumptions:
 - Risk between two species is **similar**.
 - Relative proportions can be **accurately measured** from mist netting.
 - Relative proportions are the same **pre- and post-construction**.
 - Relative proportions are the same in **summer AND during migration**.

Surrogate Approach - Capture

- Drawbacks:
 - Relative proportions may change over time.
 - White nose syndrome
 - Different effect on different species
 - Effects mist net capture success in general

Modeling Approach

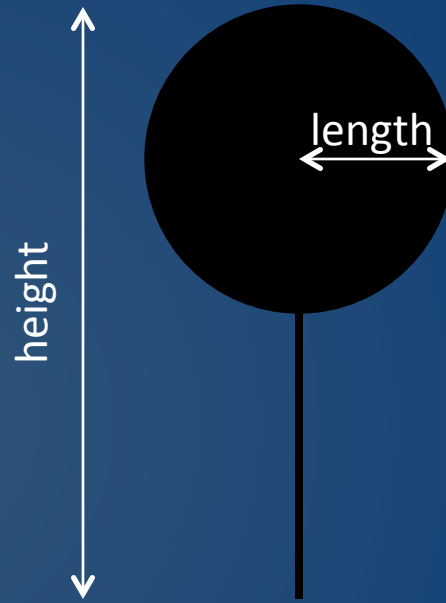
- Direct estimate of mortality based on biology, ecology.
- Several collision risk models exist for birds:
 - **Bolker model**: terns at Cape Wind (Hatch and Brault 2007, Bolker et al. 2006)
 - **Tucker model**: marbled murrelets at Radar Ridge (Nations and Erickson 2009, Tucker 1996)
 - **Band model**: hen harriers in UK (Whitfield and Madders 2006, Band 2000, Band et al. 2005)
 - **ARC model**: petrel, shearwater at Kaheawa Pastures (Podolsky 2003, 2005)

Collision Risk Models

- “Under conditions of **high uncertainty, simple models** with minimal inputs are generally preferred in the risk assessment literature to more complex models with a large number of inputs” (Warren-Hicks and Moore 1998).

Collision Risk Models

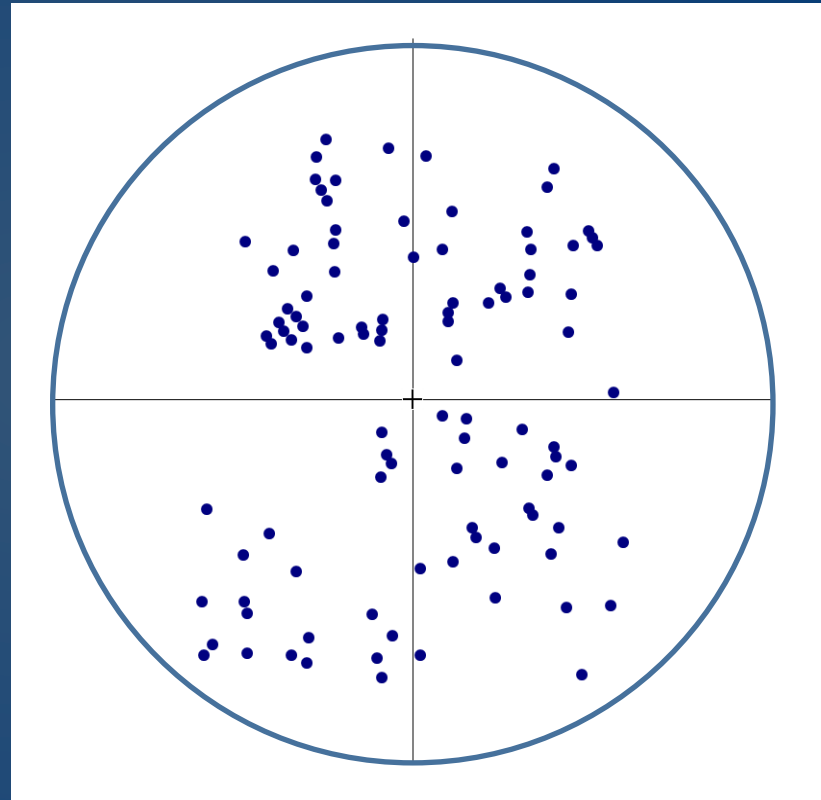
- Turbine height
- Rotor length
- Turbine location
- Angle of approach
- Flight height
- Probability of safe passage



- Bolker model treats turbines as “lollipops” (others more complex)

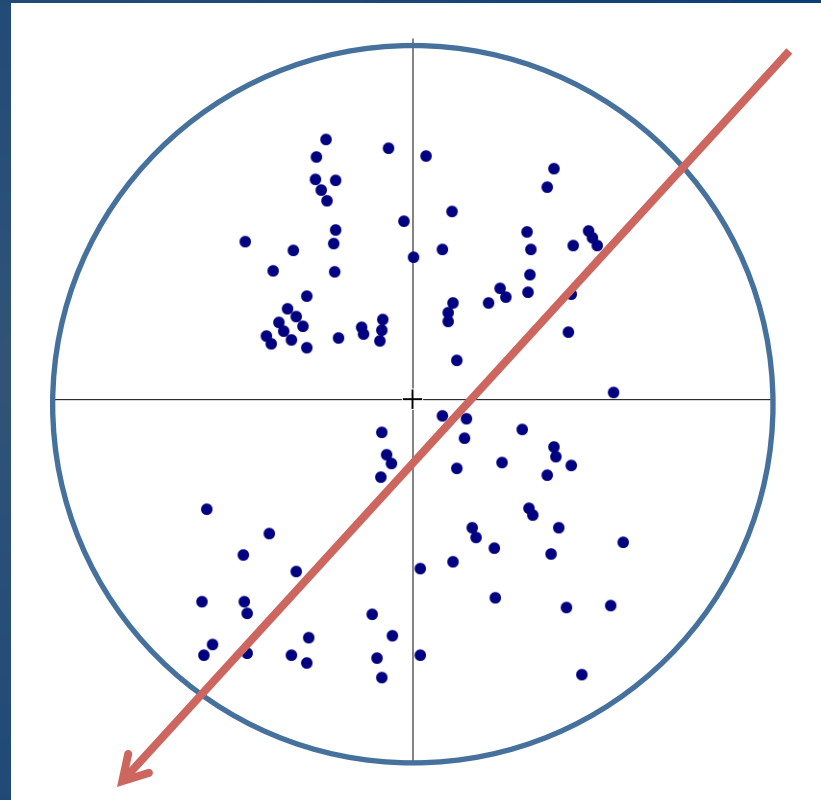
Collision Risk Models

- Turbine height
- Rotor length
- **Turbine location**
- Angle of approach
- Flight height
- Probability of safe passage



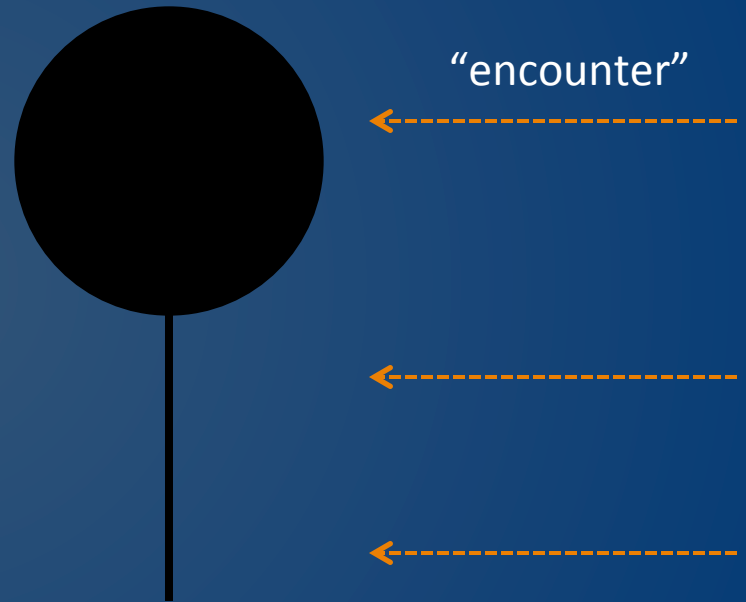
Collision Risk Models

- Turbine height
- Rotor length
- Turbine location
- **Angle of approach**
- Flight height
- Probability of safe passage



Collision Risk Models

- Turbine height
- Rotor length
- Turbine location
- Angle of approach
- **Flight height**
- Probability of safe passage



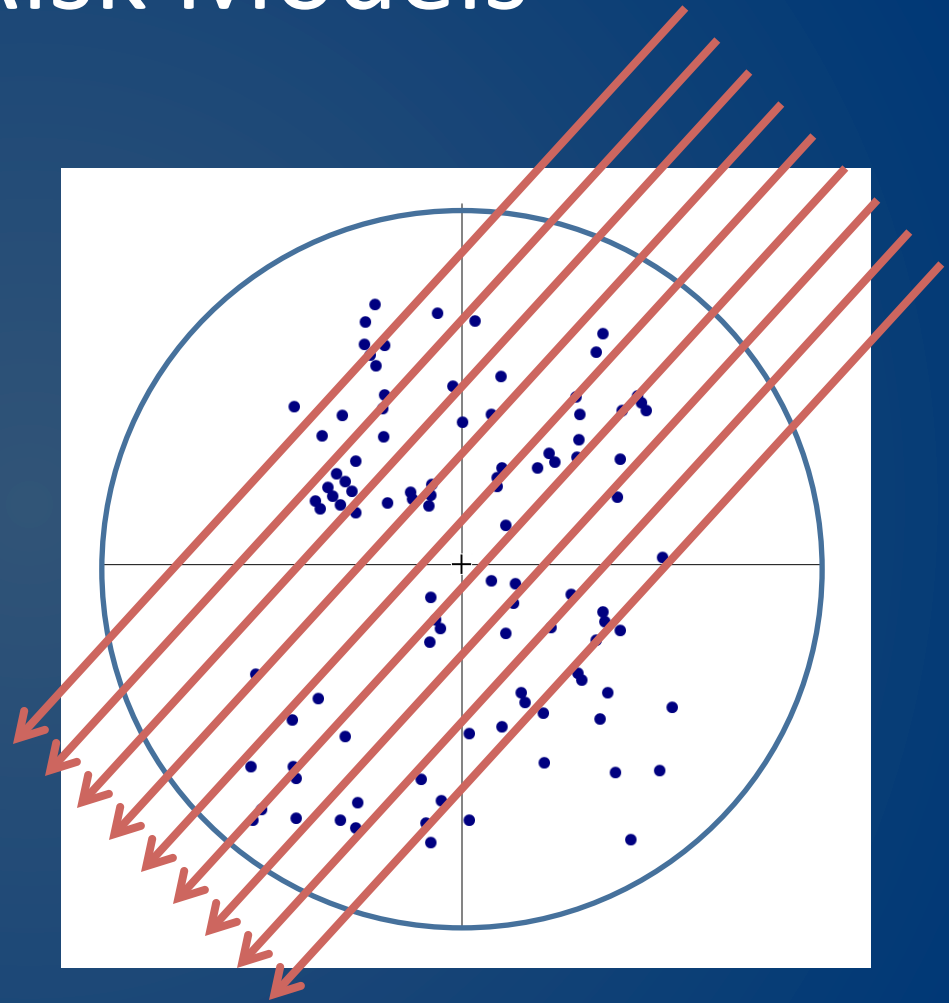
Collision Risk Models

- Turbine height
- Rotor length
- Turbine location
- Angle of approach
- Flight height
- **Probability of safe passage**

- **Avoidance/attraction**
- **Geometry of encounter**
- **Size of bird**
- **Speed which it crosses through a revolving rotor**
- **Distance from the center of the turbine**

Collision Risk Models

- Birds - visual counts to determine:
 - Number of birds present
 - Movements across the project area (direction, duration)
 - Flight height
 - Conditions (time of year, weather patterns) affecting presence



Collision Risk Models

	Bats
Number of individuals present	Mist net surveys, hibernacula counts
Movements across the project area (direction, duration)	<ul style="list-style-type: none">• All directions• Erratic flight• Summer vs. migration
Flight height	Acoustic surveys
Conditions (time of year, weather patterns) affecting presence	Patterns of acoustic activity, mortality

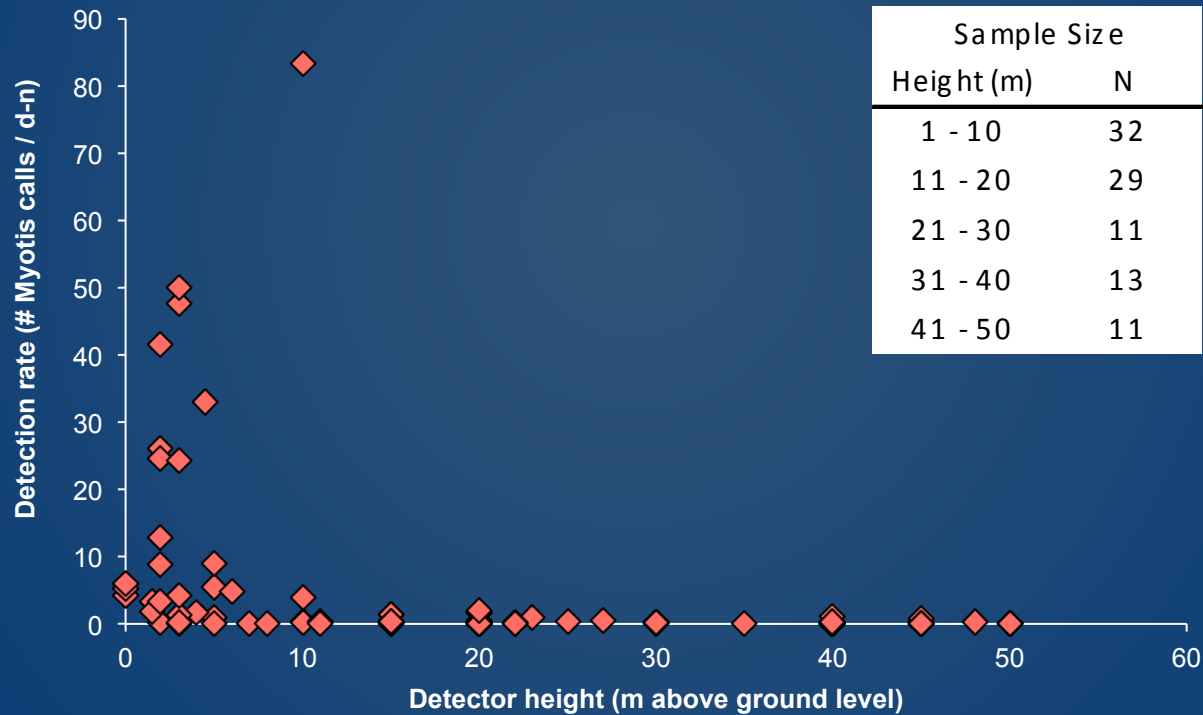
Collision Risk Models

	Bats
Number of individuals present	Mist net surveys, hibernacula counts
Movements across the project area (direction, duration)	<ul style="list-style-type: none">• Erratic flight• All directions• Summer vs. migration
Flight height	Acoustic surveys
Conditions (time of year, weather patterns) affecting presence	Patterns of acoustic activity, mortality

Collision Risk Models

	Bats
Number of individuals present	Mist net surveys, hibernacula counts
Movements across the project area (direction, duration)	<ul style="list-style-type: none">• Erratic flight• All directions• Summer vs. migration
Flight height	Acoustic surveys
Conditions (time of year, weather patterns) affecting presence	Patterns of acoustic activity, mortality

Collision Risk Models

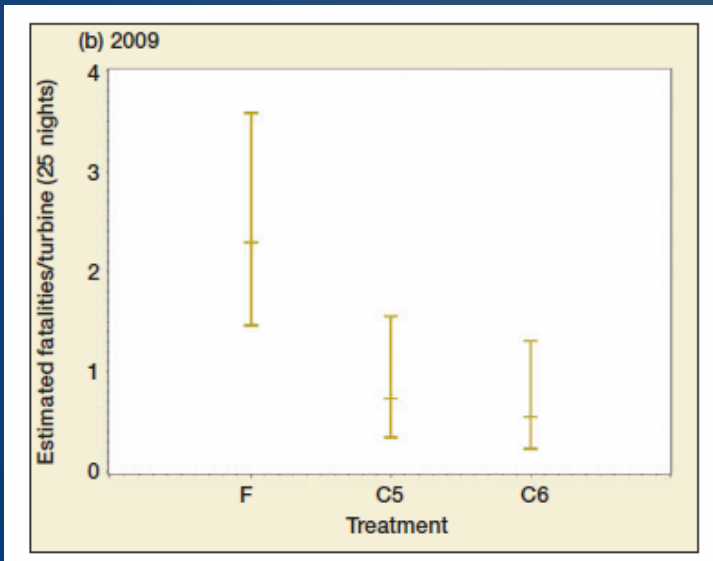
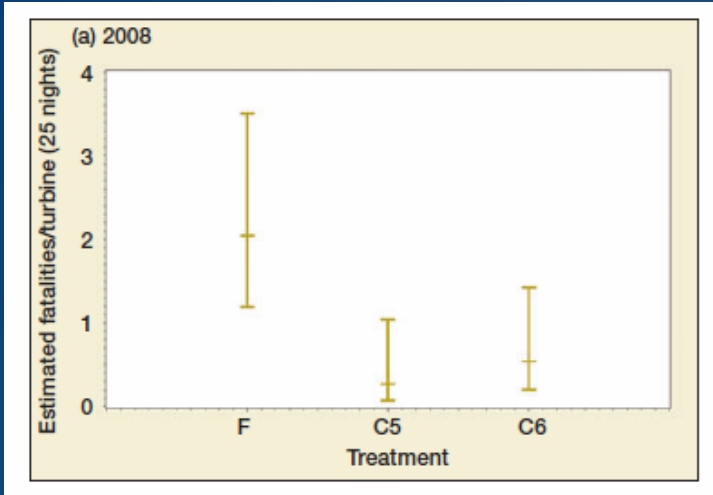


Collision Risk Models

	Bats
Number of individuals present	Mist net surveys, hibernacula counts
Movements across the project area (direction, duration)	<ul style="list-style-type: none">• Erratic flight• All directions• Summer vs. migration
Flight height	Acoustic surveys
Conditions (time of year, weather patterns) affecting presence	Patterns of acoustic activity, mortality

Collision Risk Models

Mortality



Source: Arnett et al. 2010

Figure 12b.

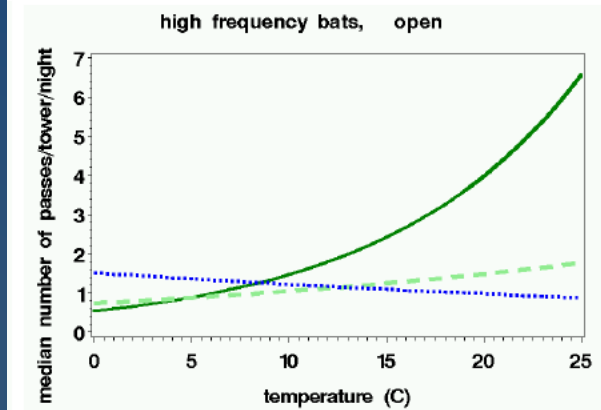
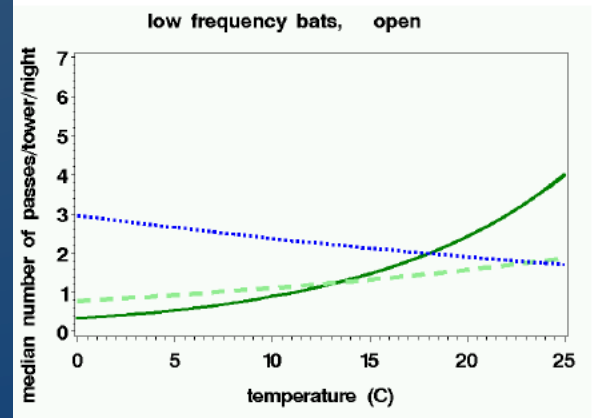


Figure 12d.



Source: Arnett et al. 2006

Activity

Collision Risk Models

- Disadvantages:
 - More difficult to understand and explain.
 - Requires detailed information on bat behavior.
 - Must estimate and make assumptions about each input into the model.
- Assumptions:
 - Variable depending on quality of information.

Collision Risk Models

- Advantages:
 - Uses known patterns or information specific to an individual species.
 - Lends itself to adaptive management by refining assumptions.
 - Uncertainty can be accounted for using statistics.

In the future....

