

# Pre- & Post-Hibernation Changes in Body Condition of Bats Susceptible to White Nose Syndrome at Mammoth Cave National Park

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Photo Courtesy of Wil Orndorff, VA  
Dept. Cons. & Rec.



**White Nose Syndrome (WNS)**

Photo Courtesy of Marvin  
Moriarty, USFWS



# Bat Body Condition



# Bat Body Condition

- Changes during staging & swarming



# Bat Body Condition

- Changes during staging & swarming
- Critical to understanding WNS;  
immediate & long-term impacts

# Objective

Investigate trends in body condition of bats prior to & following hibernation

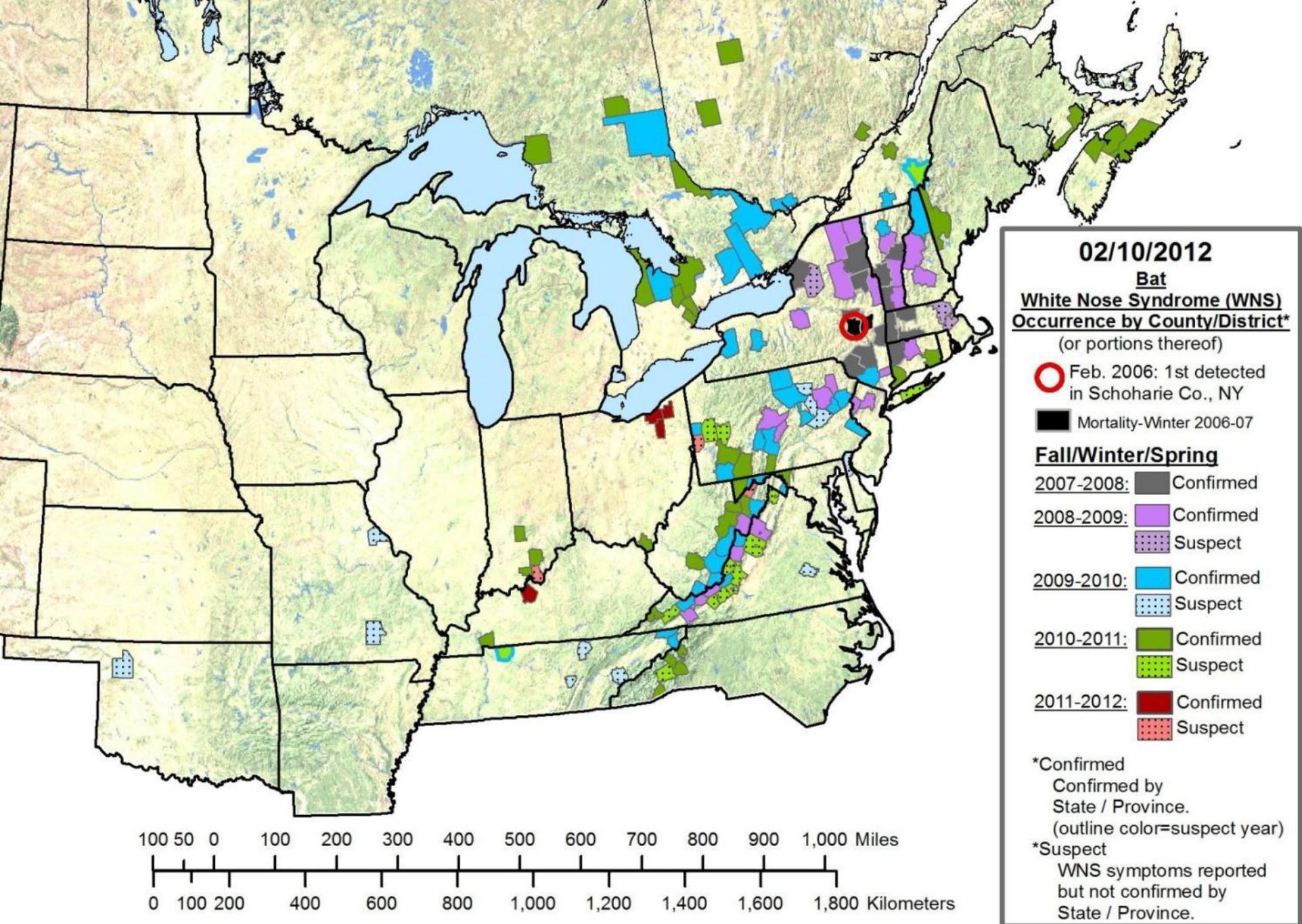


# Objective

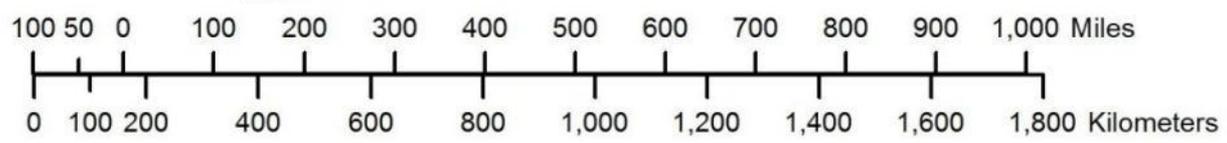
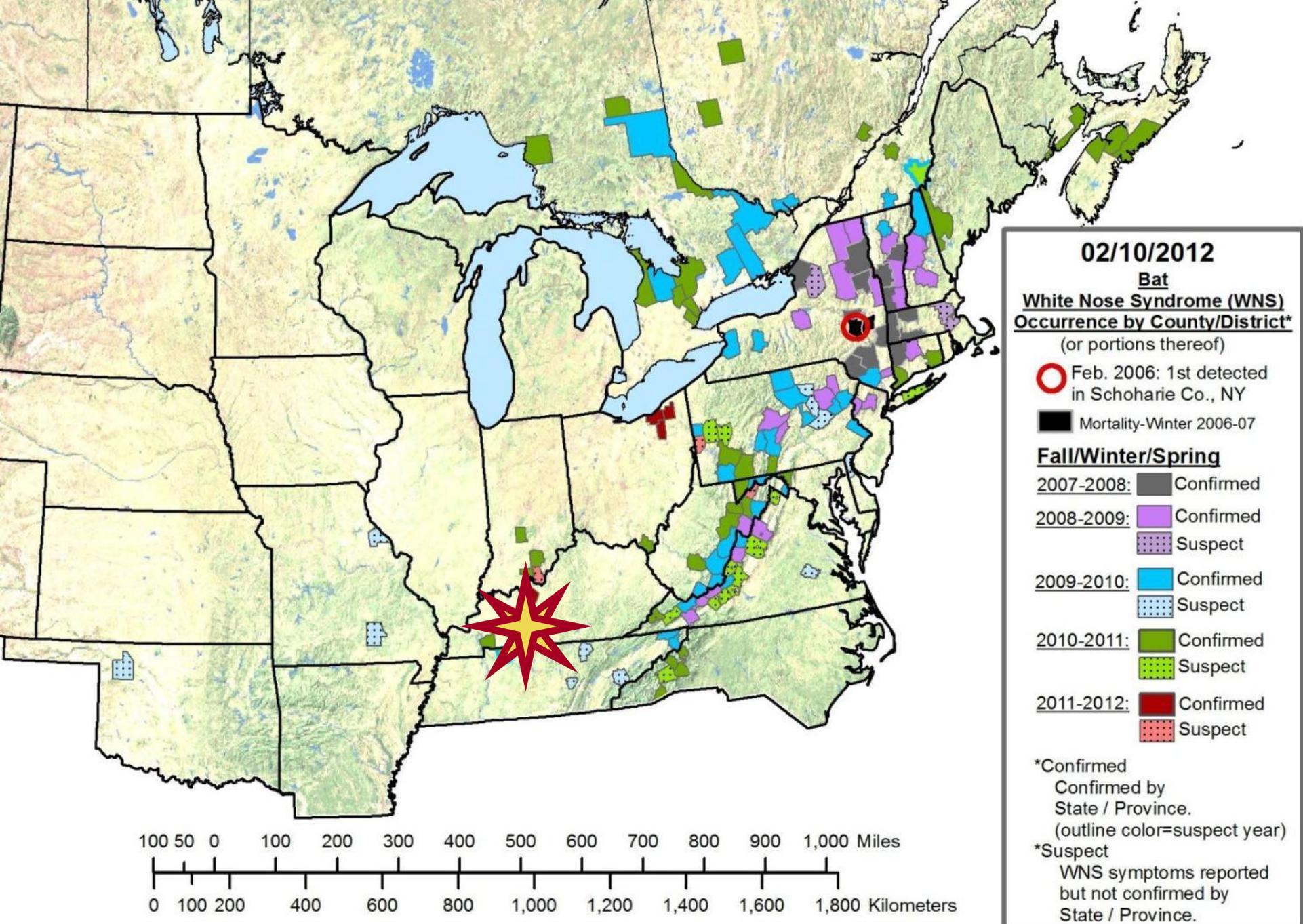
Investigate trends in body condition of bats prior to & following hibernation

How do these changes compare with prey availability?





Map by: Cal Butchkoski, PA Game Commission



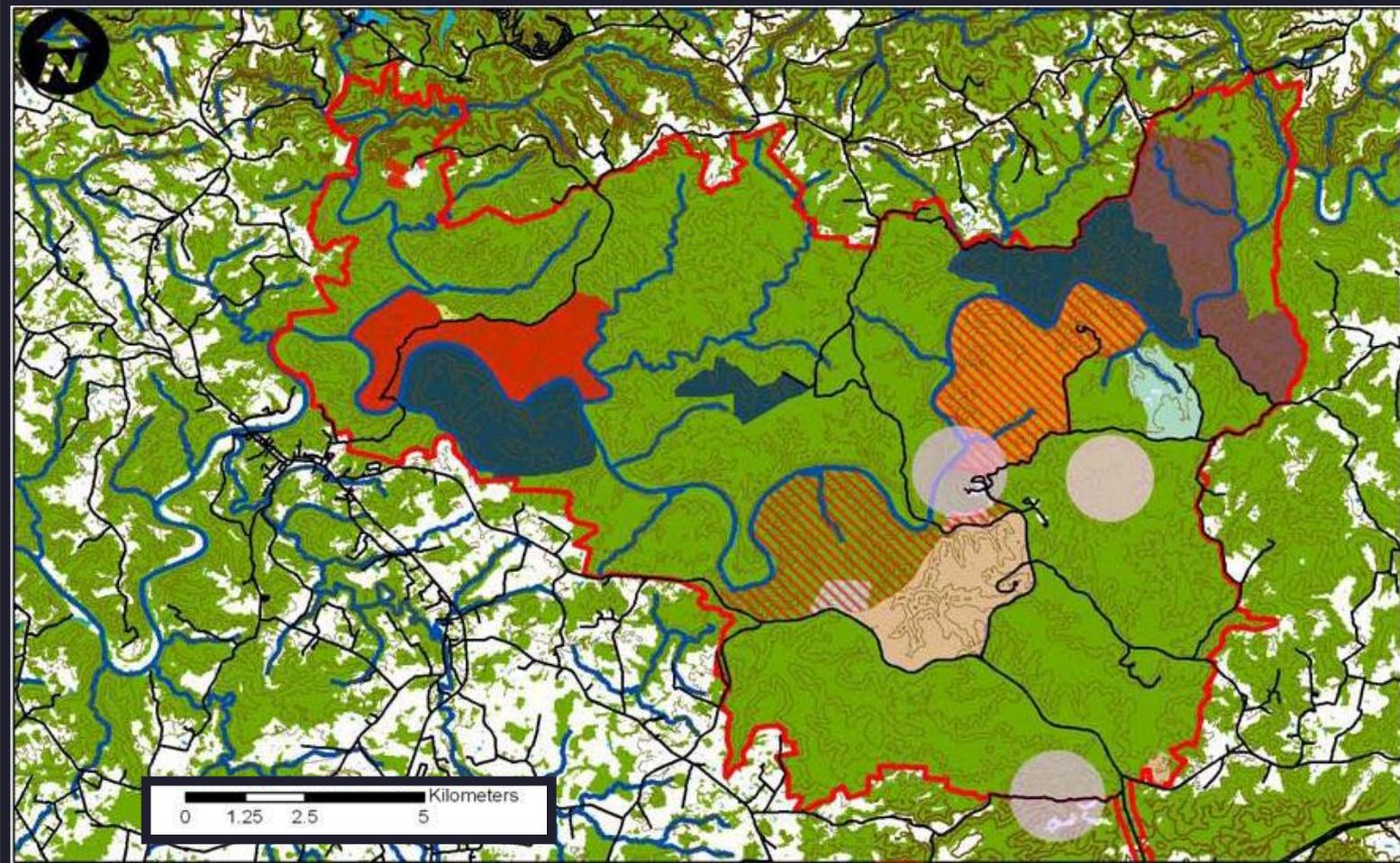
Map by: Cal Butchkoski, PA Game Commission

# Mammoth Cave

## Burn Areas



 Core  
Hibernacula

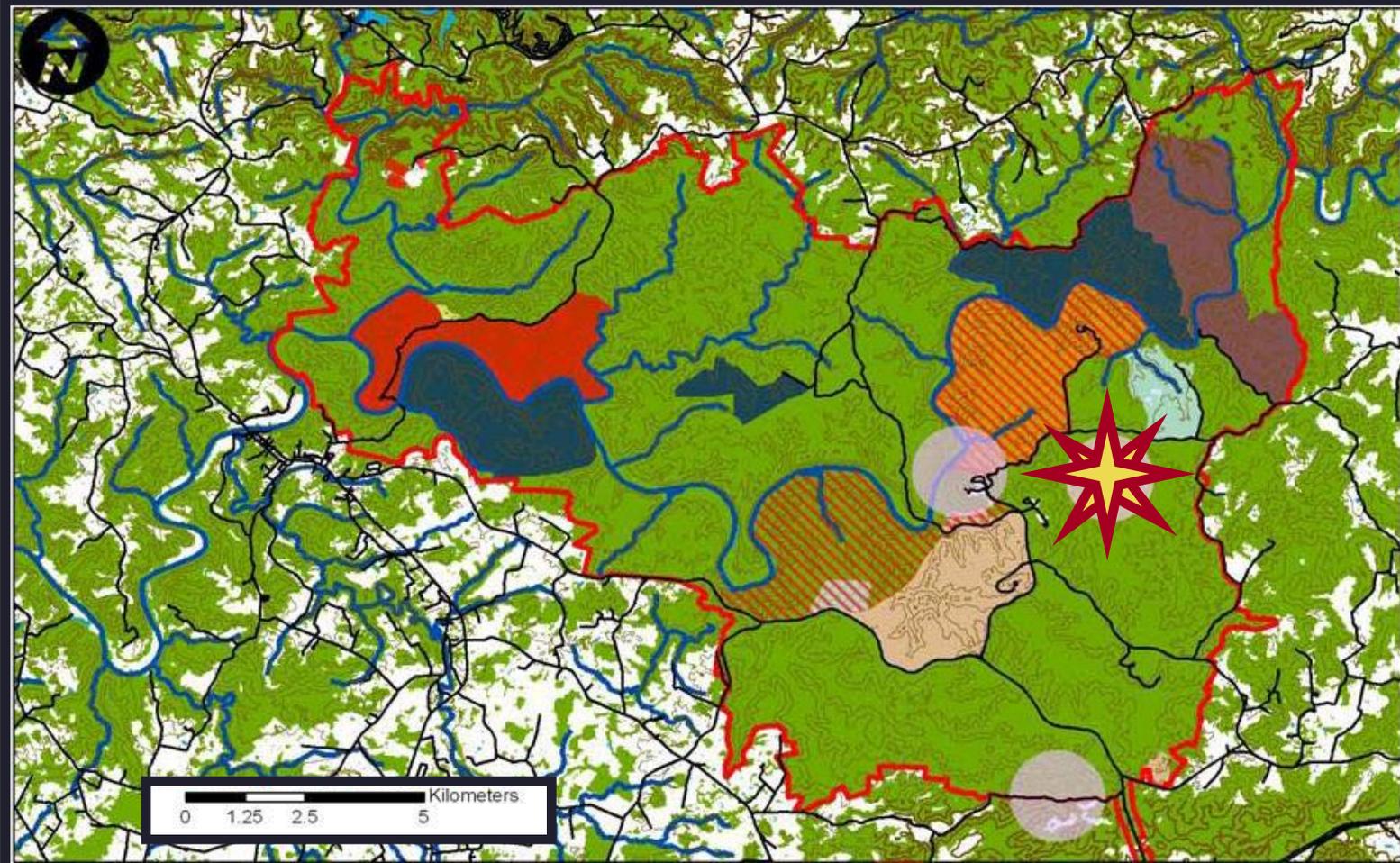


# Mammoth Cave

## Burn Areas



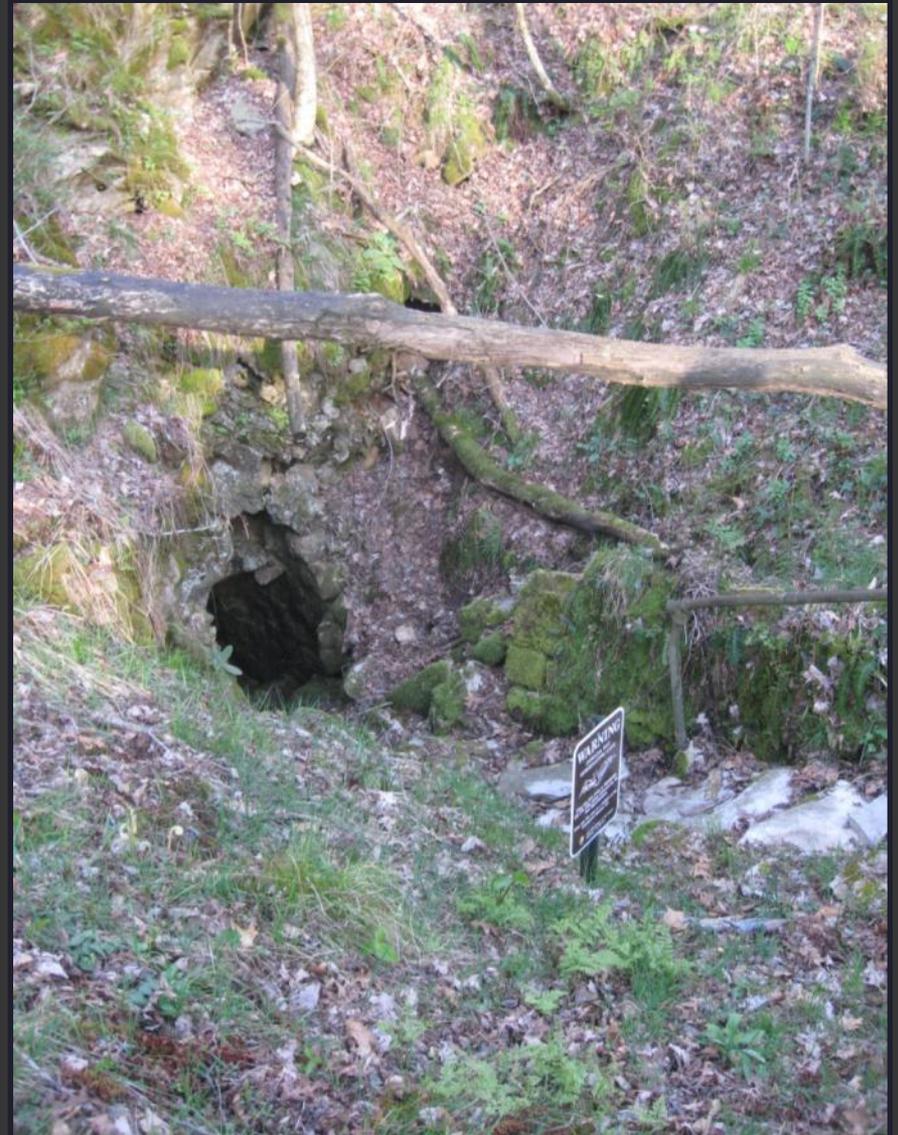
 Core  
Hibernacula



# Mammoth Cave

## Colossal Cave

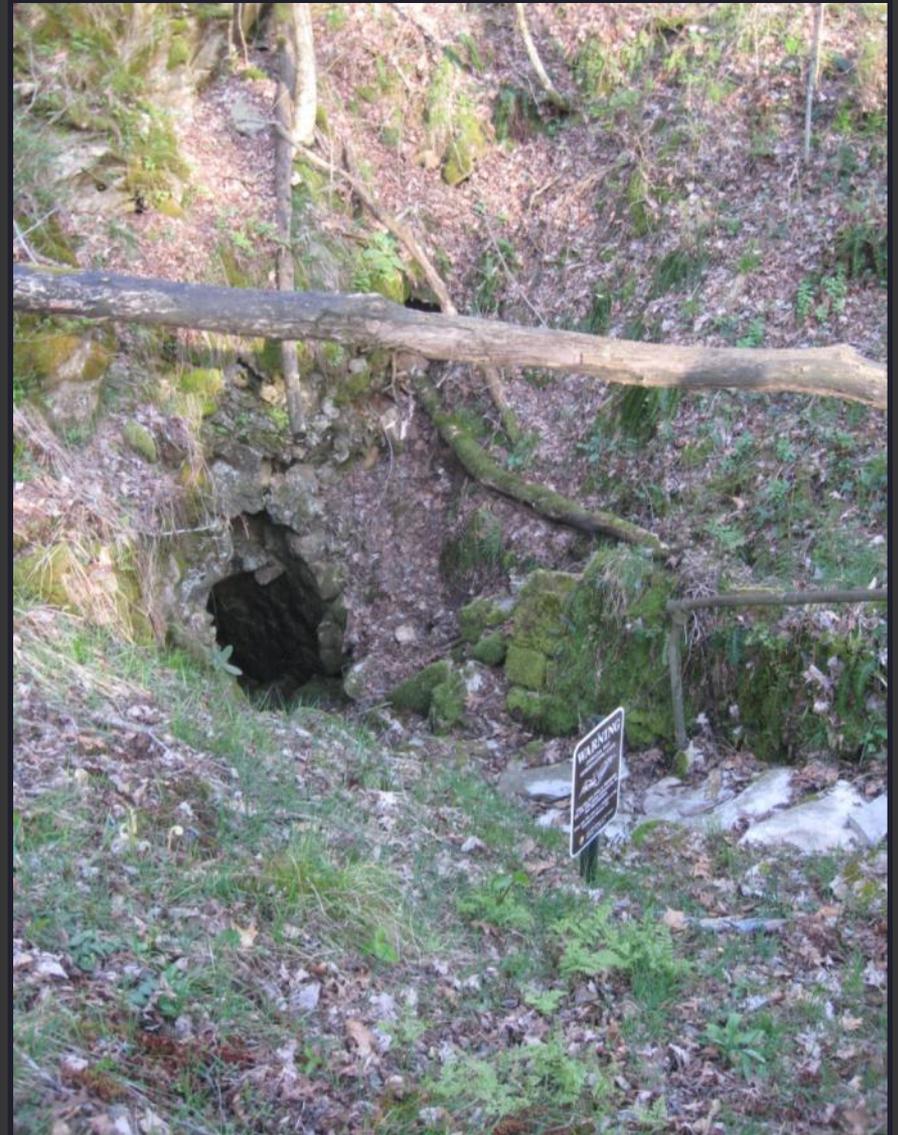
- Portion of Mammoth Cave system receiving commercial use in late 1800's
- Artificial entrance (for tours)



# Mammoth Cave

## Colossal Cave

- Hibernaculum
  - “Priority 2” for *M. sodalis*
  - Also *M. lucifugus*
  - Not suspected to be swarming site for tree bats



# Methods

## Harp-Trapping



# Methods

## Harp-Trapping



**WARNING**  
INDIANA BAT  
HIBERNATION CAVE

**WARNING**  
INDIANA BAT  
HIBERNATION CAVE

**Caves Closed**

# Methods

## Body Condition

- Forearm ( 0.01 mm)
- Weight ( 0.01 gram)
- Body Condition Index<sup>1</sup> =  
Weight/Forearm (g/mm)



<sup>1</sup> Pearce et al. 2008. Acta Chiropterol., 10: 153-159.

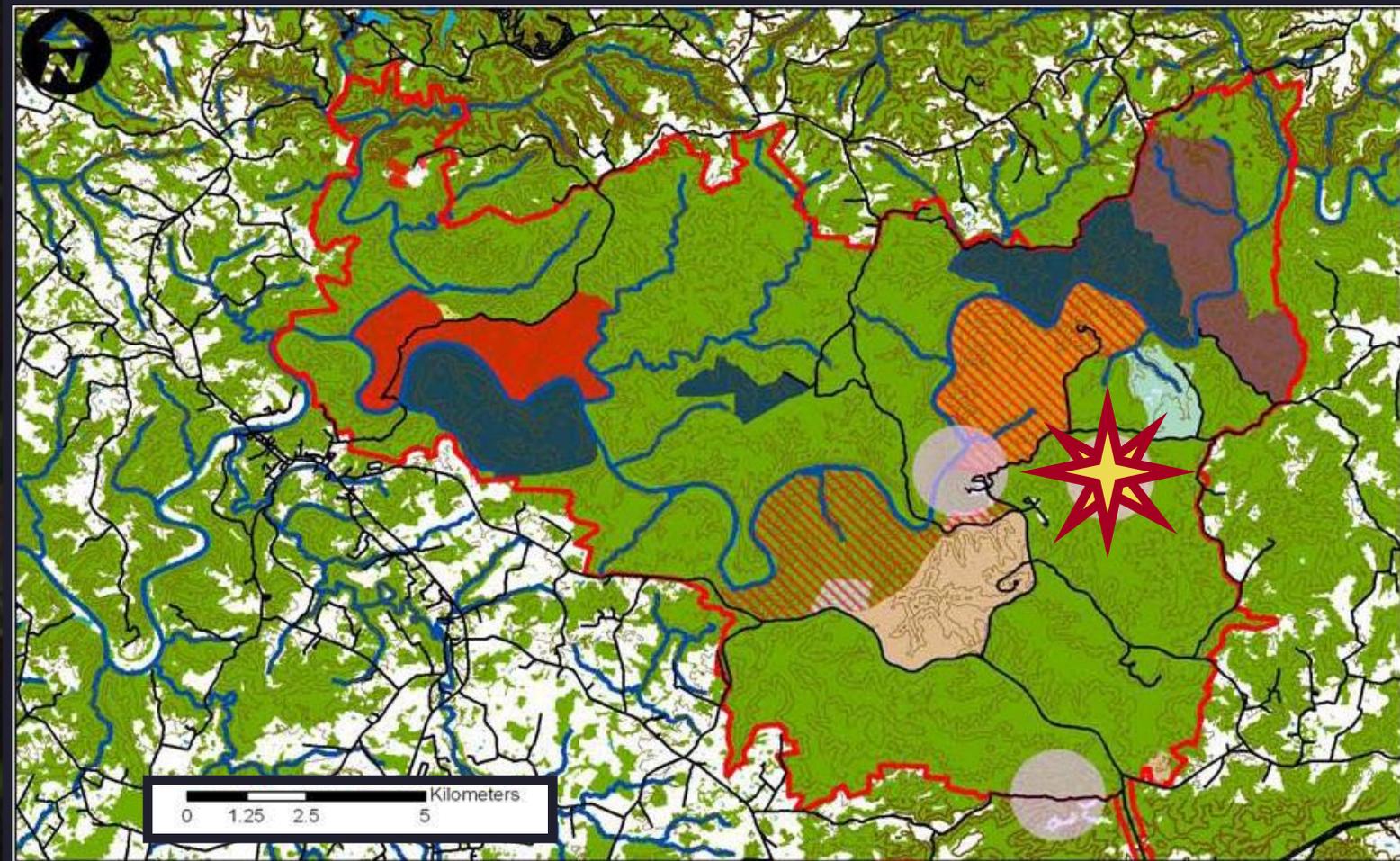
# Methods

## Insect Occurrence



# Methods

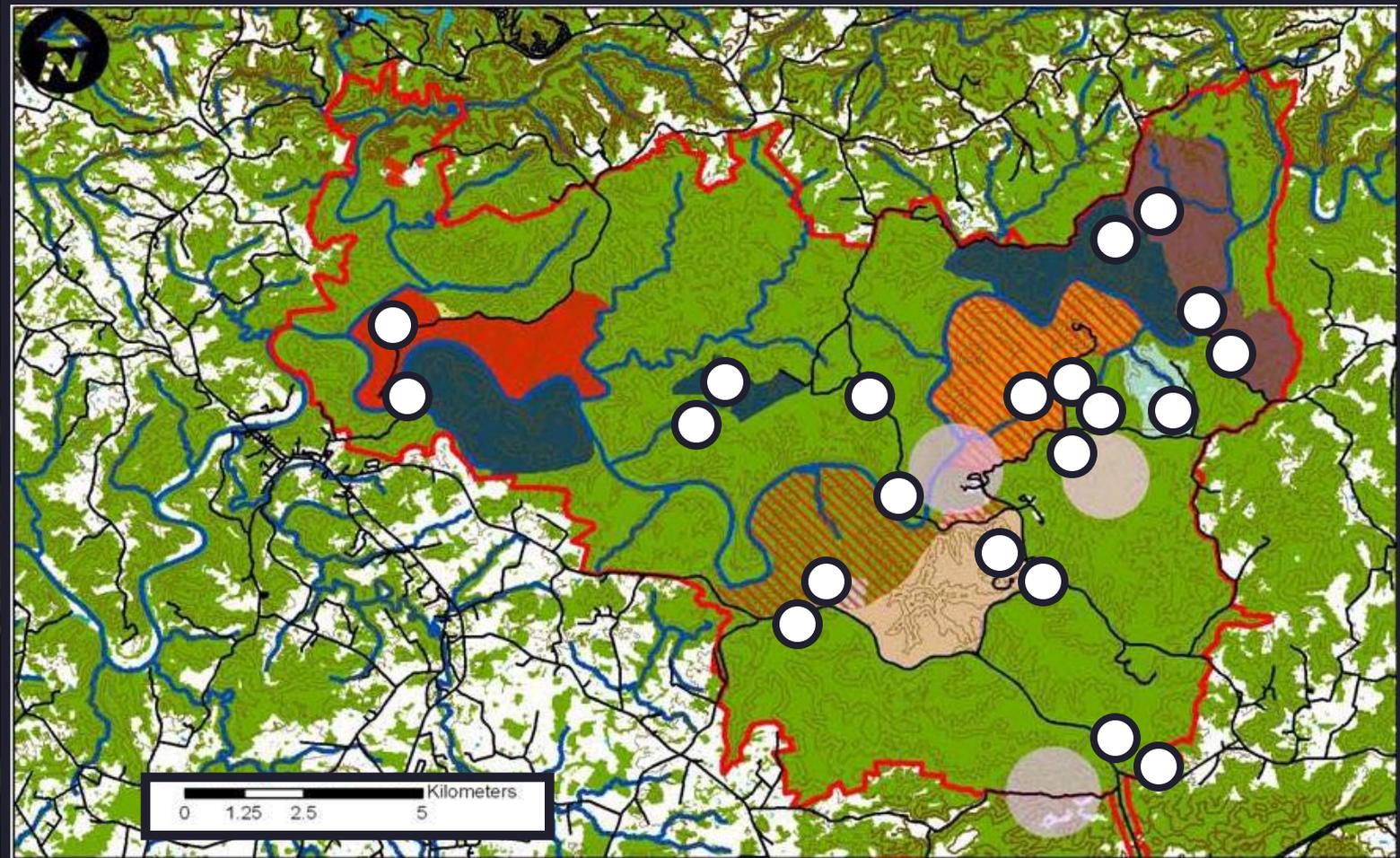
## Insect Occurrence



# Methods

## Insect Occurrence

- Park-wide study design; transects of insect traps (●) deployed in tandem with acoustic surveys



# Staging Results

- Three surveys: April 6<sup>th</sup>, 12<sup>th</sup>, & 28<sup>th</sup>
- Total capture of 168 bats



# Staging Results

- Three surveys: April 6<sup>th</sup>, 12<sup>th</sup>, & 28<sup>th</sup>
- Total capture of 168 bats
  - *Corynorhinus rafinesquii* (2)
  - *Eptesicus fuscus* (2)
  - *Myotis leibii* (4)
  - *M. lucifugus* (10)
  - *M. septentrionalis* (118)
  - *M. sodalis* (4)
  - *Perimyotis subflavus* (28)



# Staging Results

- Three surveys: April 6<sup>th</sup>, 12<sup>th</sup>, & 28<sup>th</sup>
- Total capture of 168 bats



- *Myotis leibii* (4)
- *M. lucifugus* (10)
- *M. septentrionalis* (118)
- *M. sodalis* (4)
- *Perimyotis subflavus* (28)

No models significant for effects of sample interval or sex ( $P > 0.05$ )

# Swarming Results

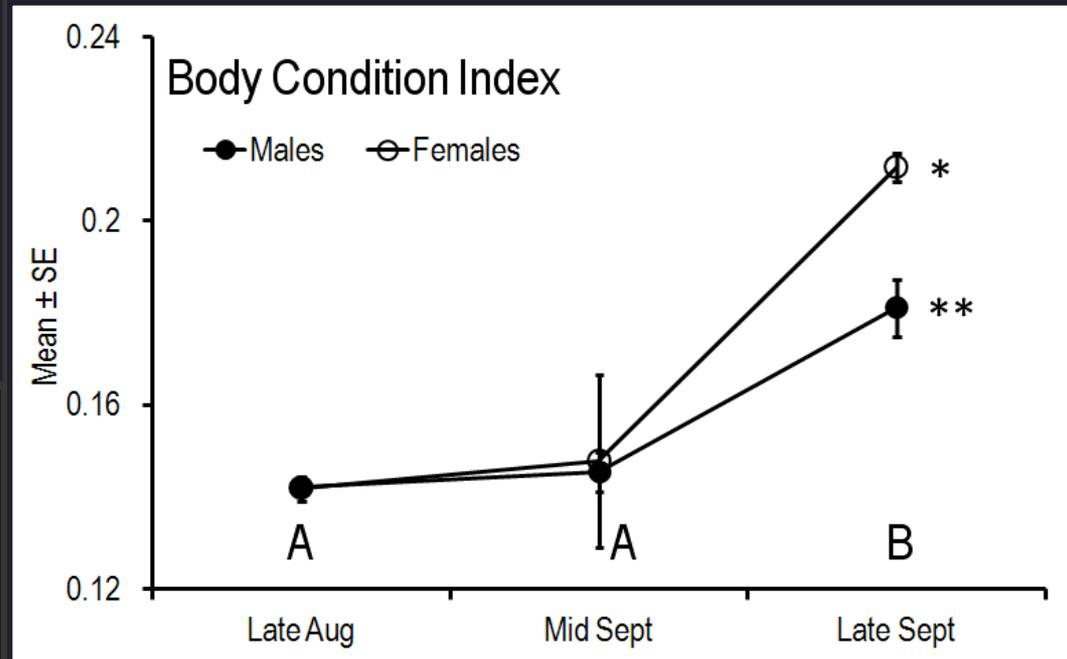
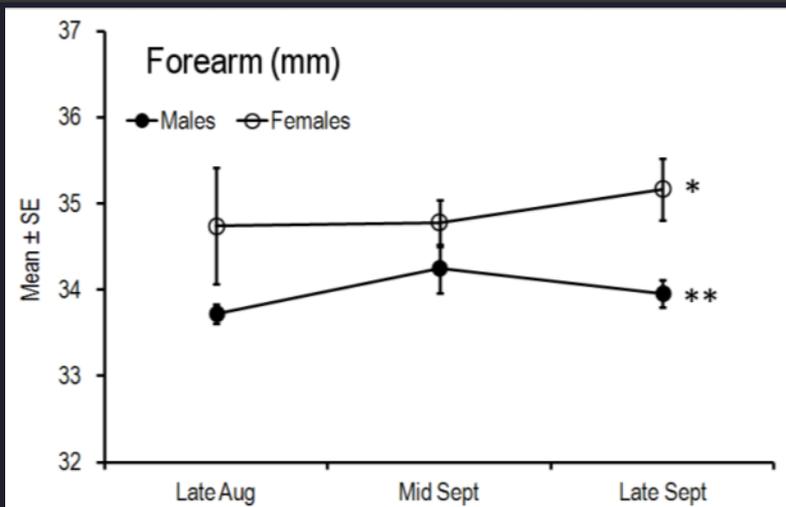
- Three surveys: August 23<sup>rd</sup>, September 13<sup>th</sup>, & 21<sup>st</sup>
- Total capture of 260 bats

# Swarming Results

- Three surveys: August 23<sup>rd</sup>, September 13<sup>th</sup>, & 21<sup>st</sup>
- Total capture of 260 bats
  - *Myotis leibii* (3)
  - *M. lucifugus* (17)
  - *M. septentrionalis* (63)
  - *M. sodalis* (10)
  - *Perimyotis subflavus* (167)

# Swarming Results

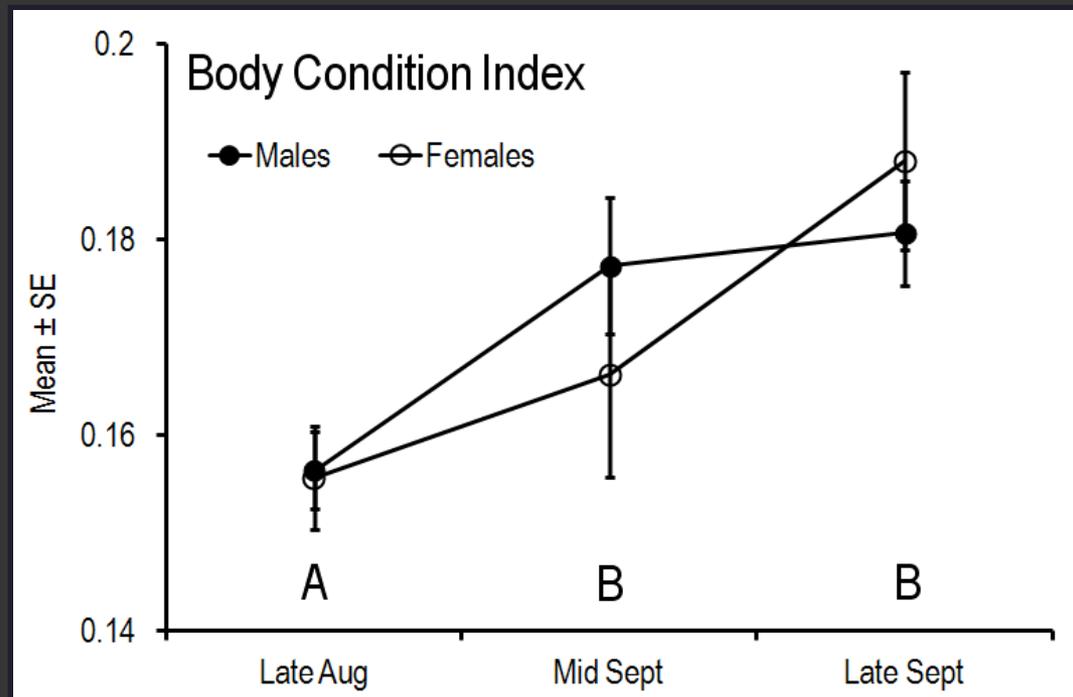
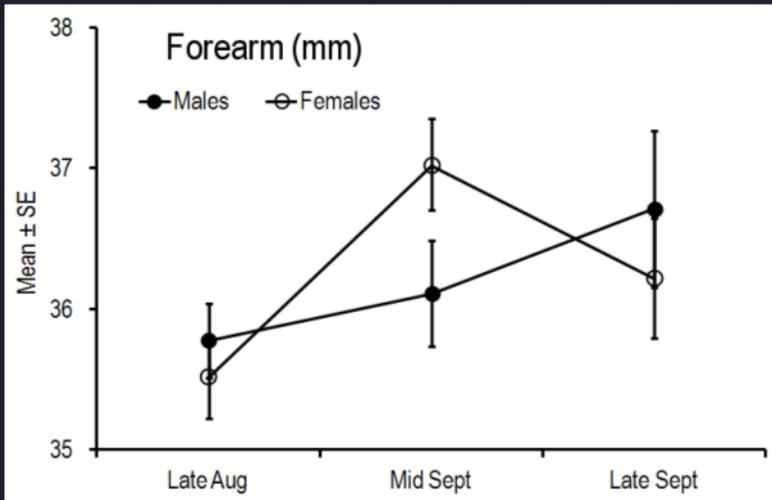
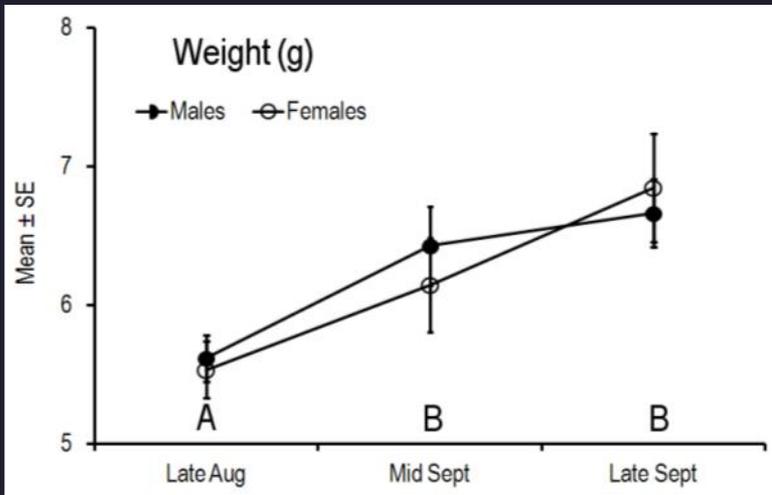
## *Perimyotis subflavus*



2x3 ANOVAs, Untransformed data (n = 166)  
Asterisks denote differences between sexes ( $P \leq 0.05$ )  
Letters denote differences across survey dates ( $P \leq 0.05$ )

# Swarming Results

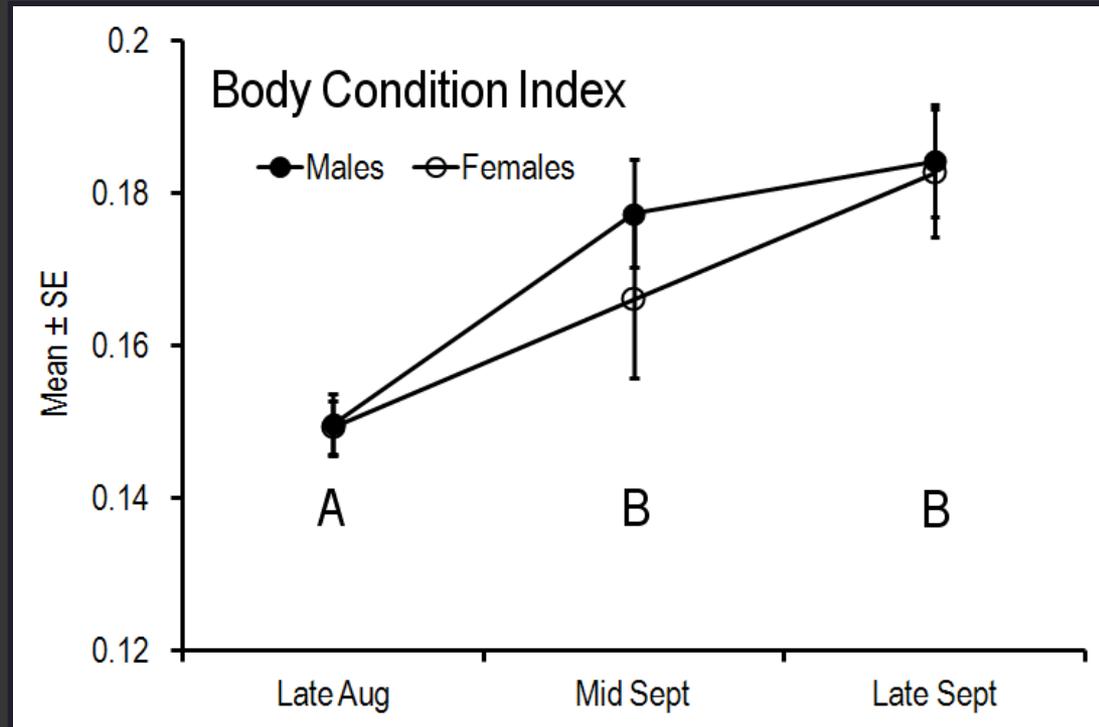
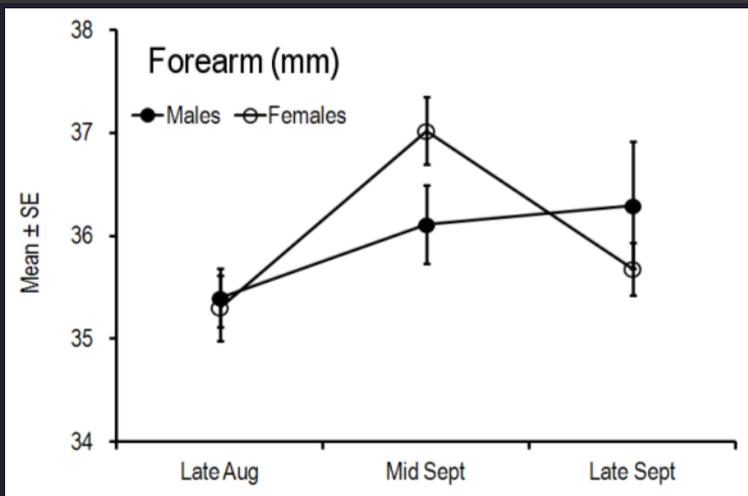
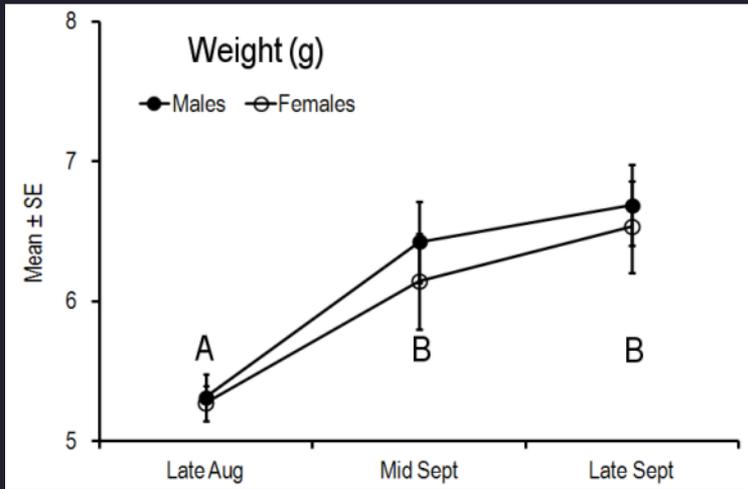
## Myotis



2x3 ANOVAs, Untransformed data (n = 91)  
No differences between sexes for any model ( $P > 0.05$ )  
Letters denote differences across survey dates ( $P \leq 0.05$ )

# Swarming Results

## *M. septentrionalis*



2x3 ANOVAs, Untransformed data (n = 61)  
No differences between sexes for any model ( $P > 0.05$ )  
Letters denote differences across survey dates ( $P \leq 0.05$ )

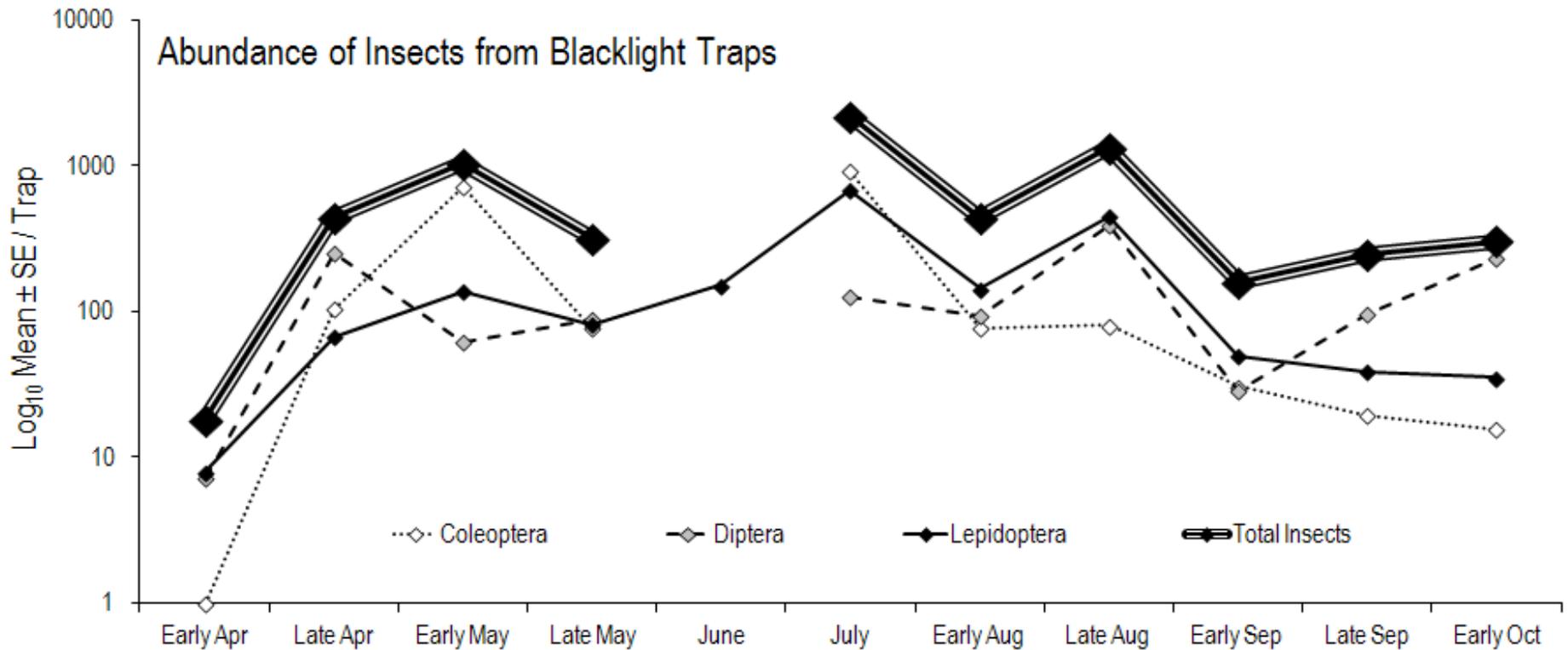
# Results

## Insect Occurrence



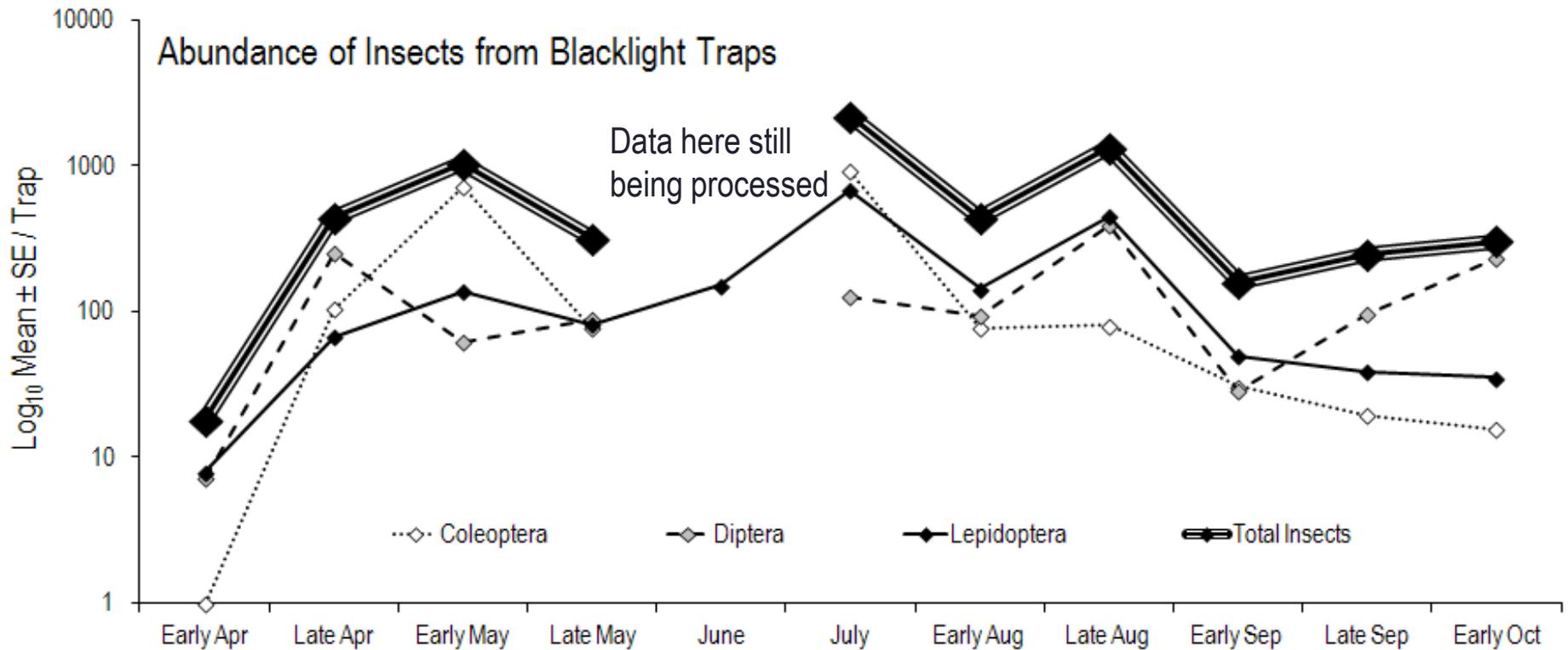
# Results

## Insect Occurrence



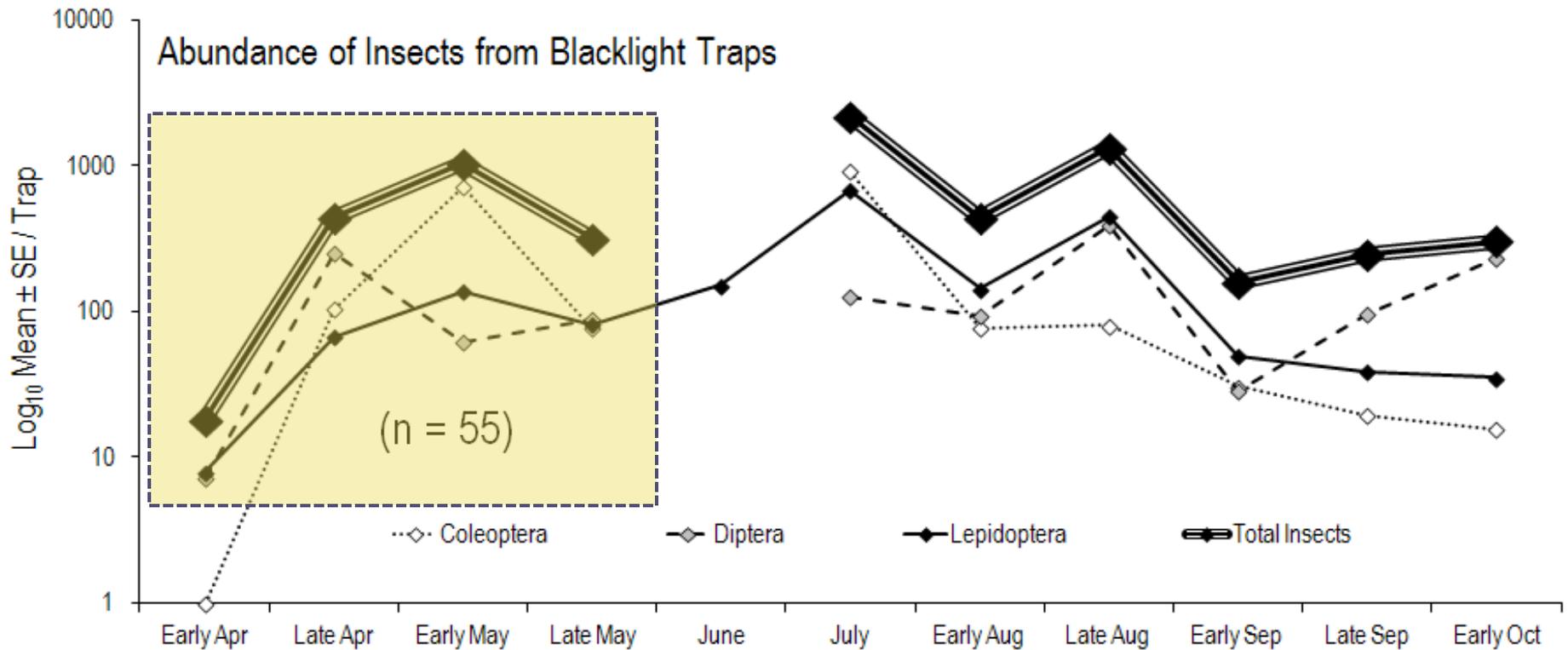
# Results

## Insect Occurrence



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# Results

## Insect Occurrence During Staging

- Wettest Spring on record;  
impacts on sampling effort

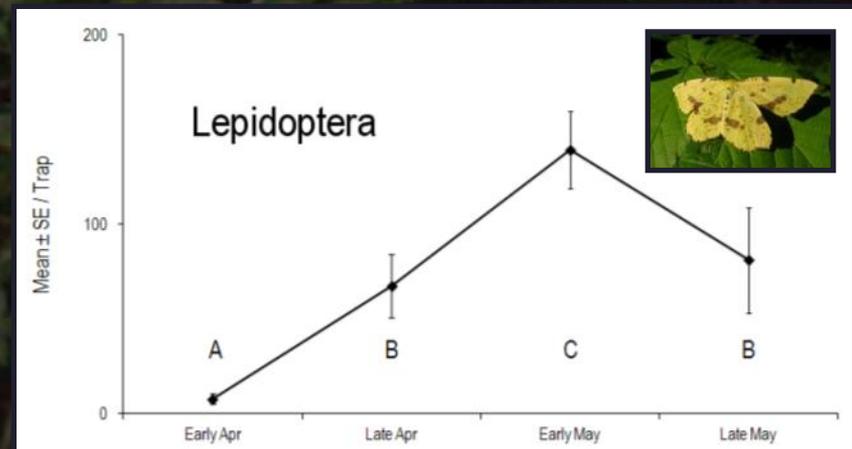
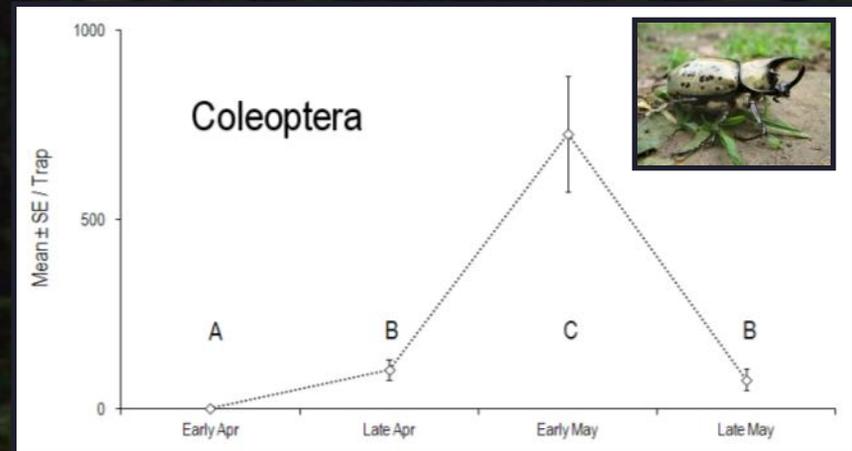


# Results

## Insect Occurrence During Staging

- Wettest Spring on record; impacts on sampling effort
- Prey availability increases...
  - Late April

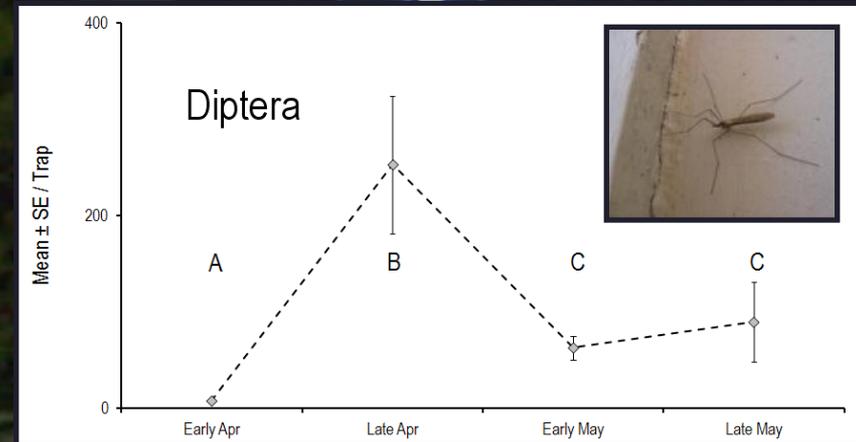
One-way ANOVAs, Untransformed data (n = 55)  
 $P \leq 0.05$  for all models



# Results

## Insect Occurrence During Staging

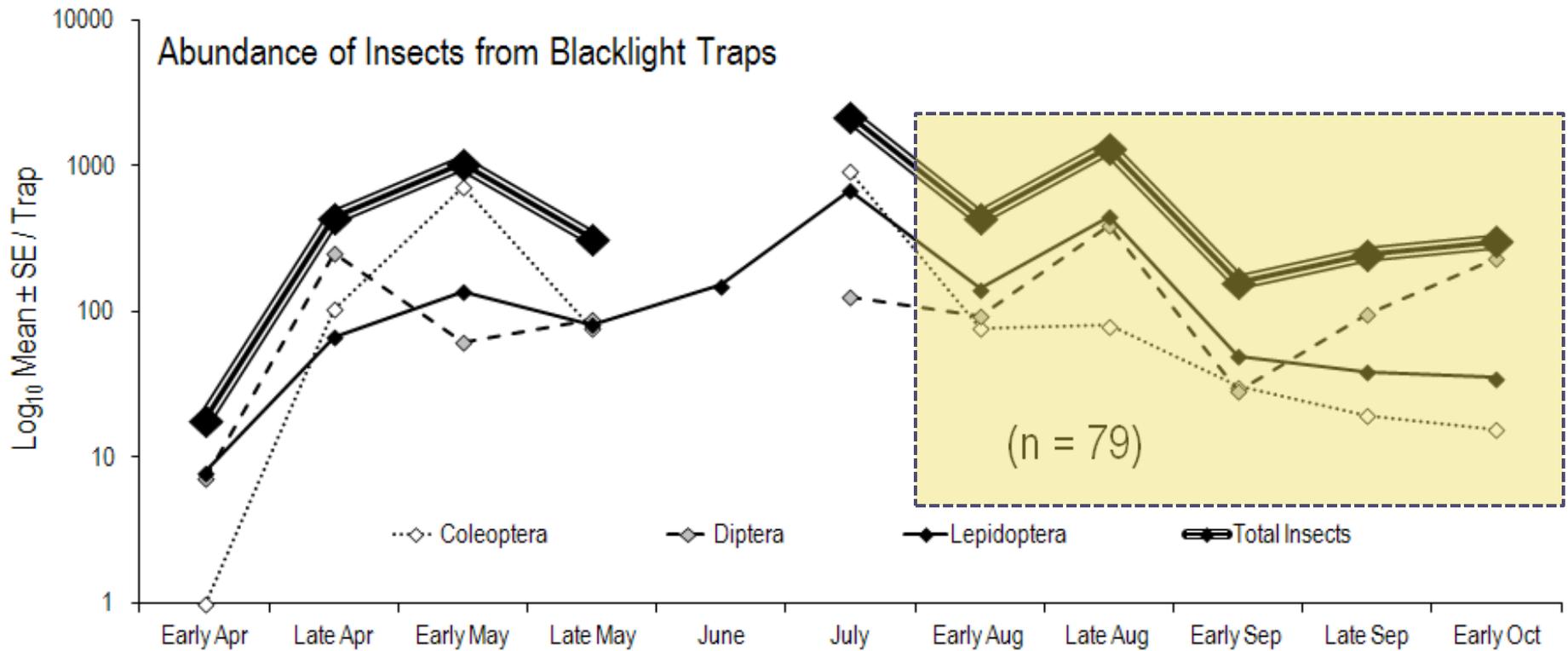
- Wettest Spring on record; impacts on sampling effort
- Prey availability increases...
  - Late April



One-way ANOVAs, Untransformed data (n = 55)  
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# Results

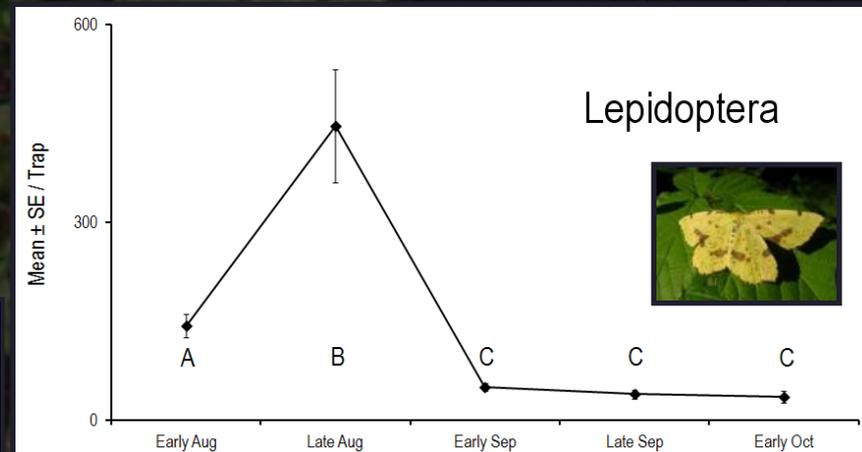
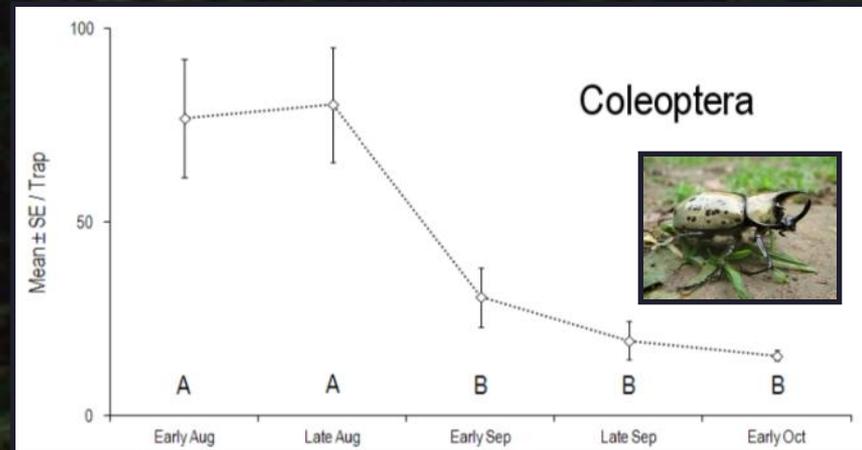
## Insect Occurrence



# Results

## Insect Occurrence During Swarming

- Declines for Coleoptera & Lepidoptera

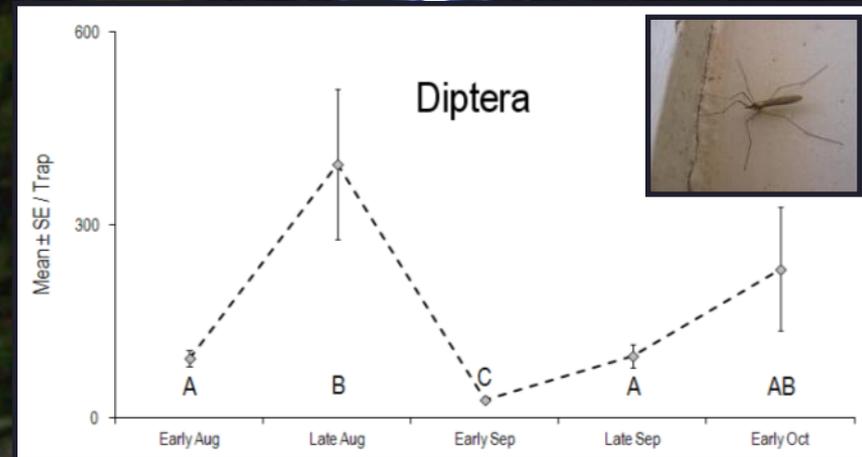


One-way ANOVAs, Untransformed data (n = 79)  
 $P \leq 0.05$  for all models

# Results

## Insect Occurrence During Swarming

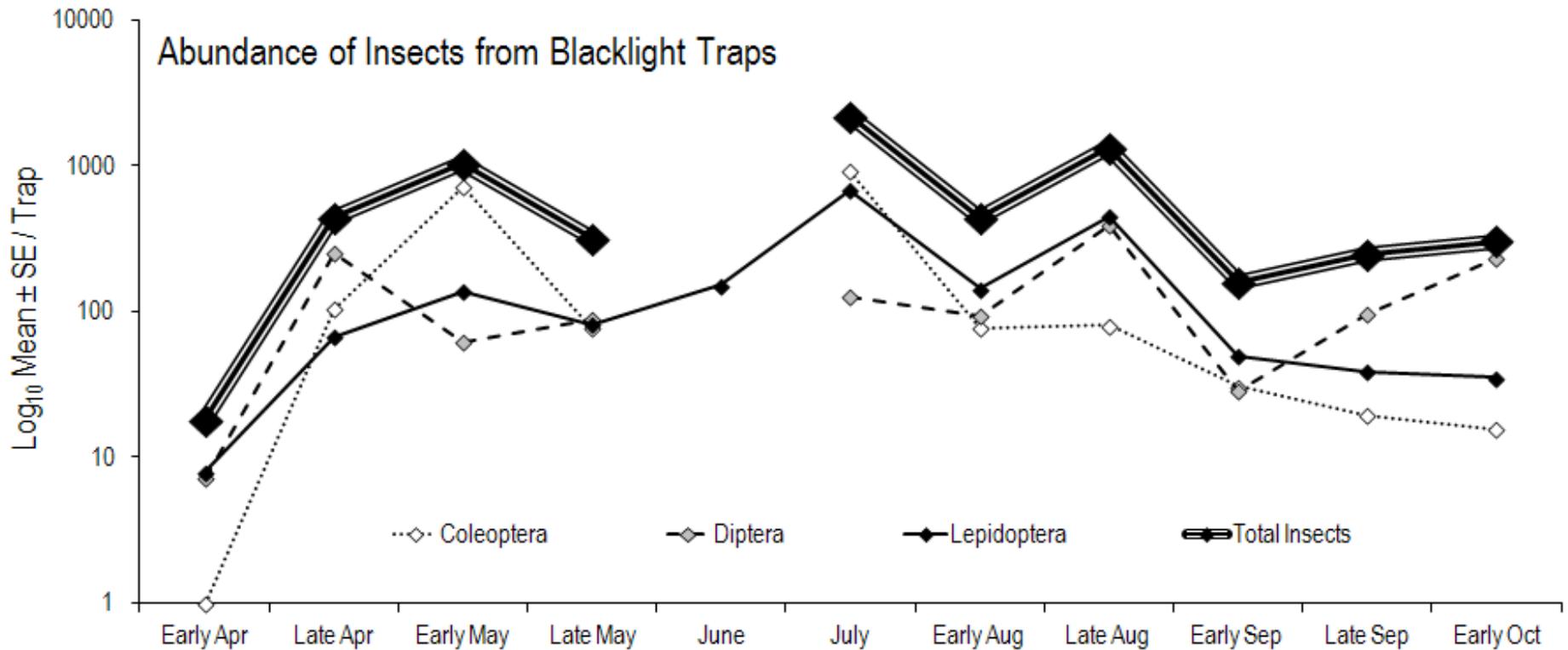
- Declines for Coleoptera & Lepidoptera
- No discernable trend for Diptera; similar to results during Staging



One-way ANOVAs, Untransformed data (n = 79)  
 $P \leq 0.05$  for all models

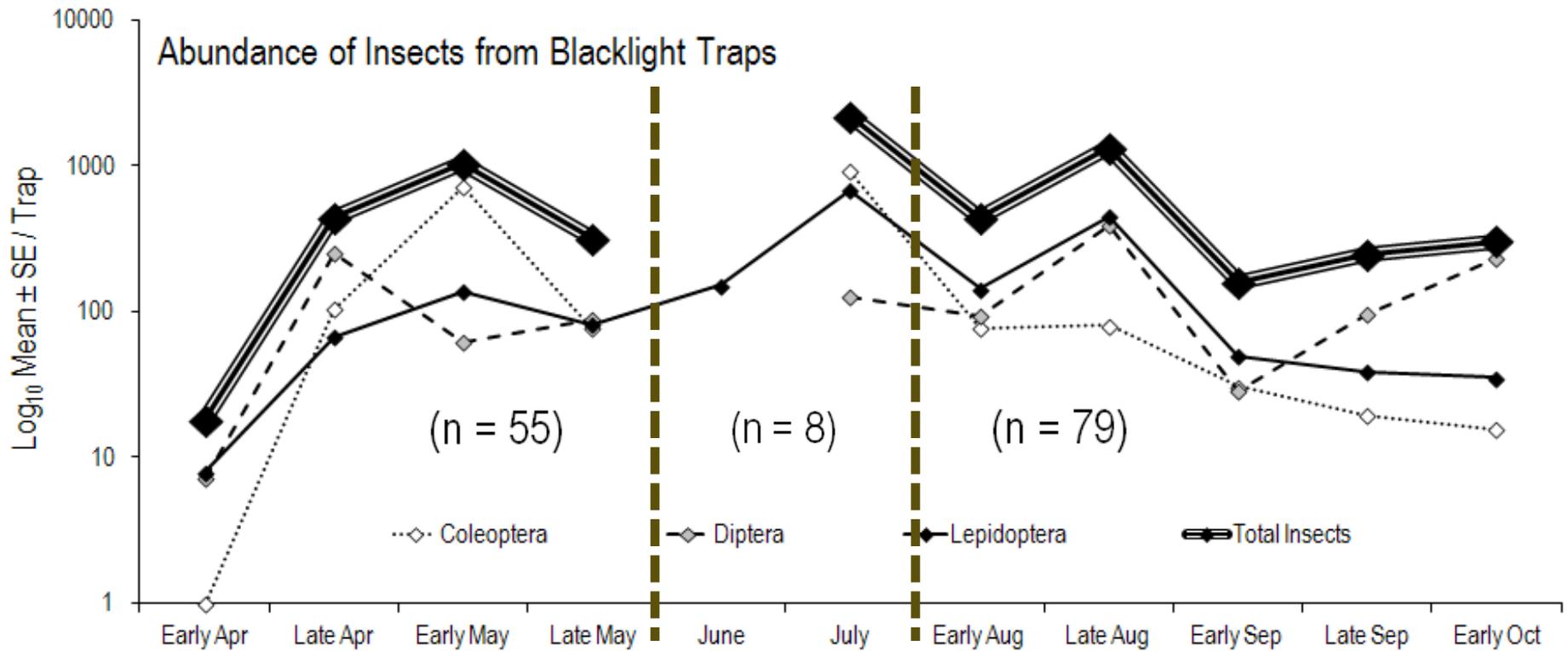
# Results

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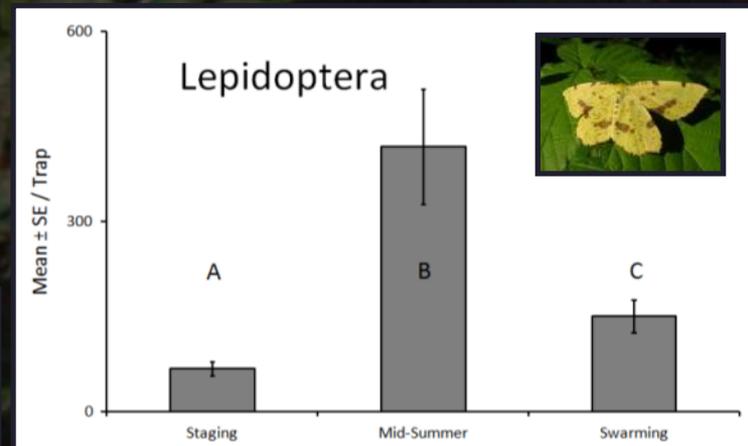
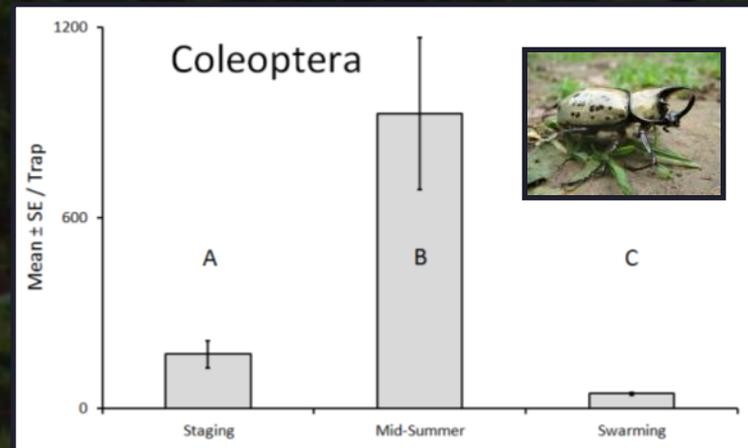


# Results

## Insect Occurrence Across Seasons

- Strong differences for Coleoptera & Lepidoptera

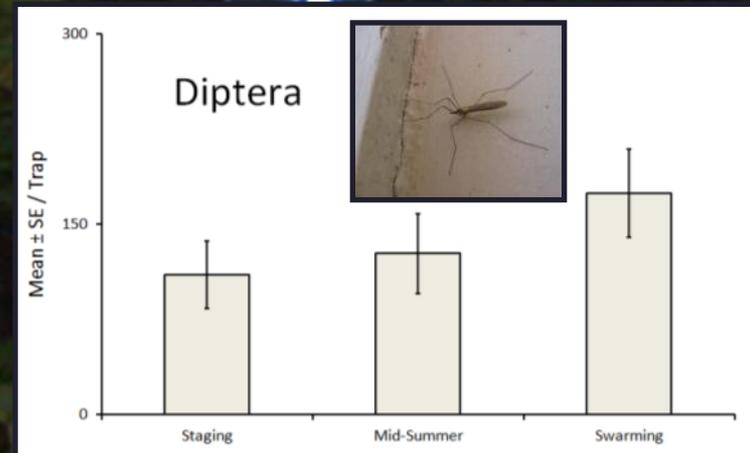
One-way ANOVAs, Untransformed data (n = 142)  
 $P \leq 0.05$  for all models



# Results

## Insect Occurrence Across Seasons

- Strong differences for Coleoptera & Lepidoptera
- Variation in Diptera;  
consistent resource for bats?

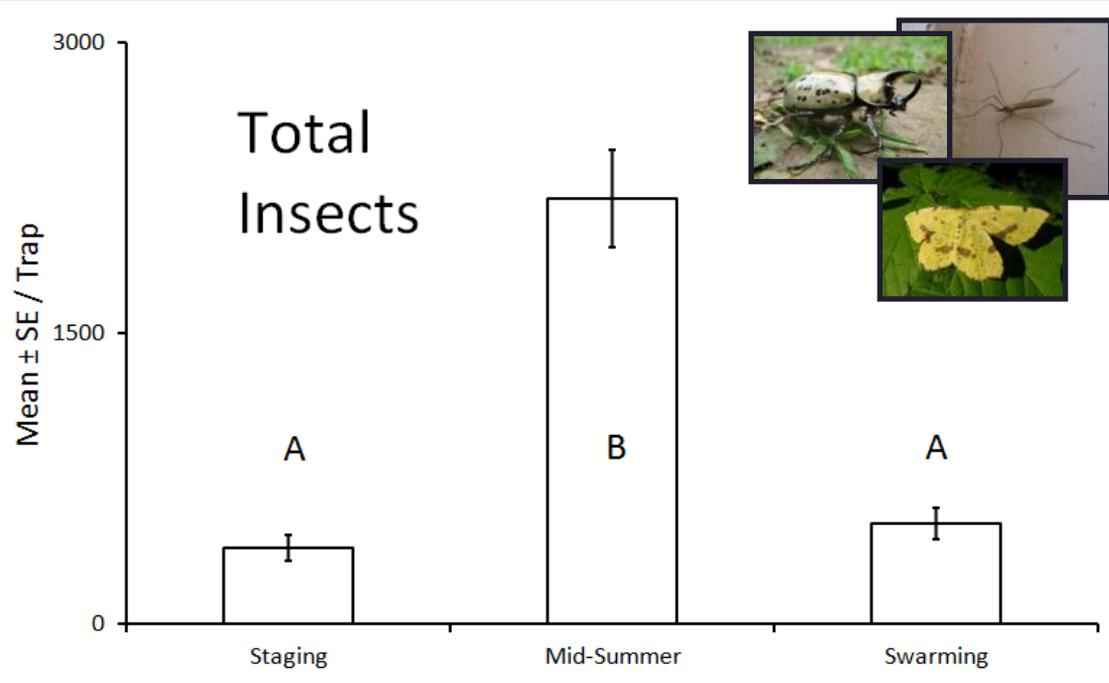


One-way ANOVAs, Untransformed data (n=142)

$P > 0.05$  for this model

# Results

## Insect Occurrence Across Seasons



One-way ANOVAs, Untransformed data (n=142)

$P \leq 0.05$  for this model

# Implications

- Continued investigation of body condition in relation to prey trends

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- Continued investigation of body condition in relation to prey trends
- Baseline data for testing hypotheses
  - WNS?<sup>1</sup>
  - Sex?<sup>2,3</sup>

<sup>1</sup> Francl et al. 2011. J Wildlife Disease, 47: 41-48.

<sup>2</sup> Jonasson & Willis. 2011. PLoS One, 6: e21061.

<sup>3</sup> Kunz et al. 1998. Ecoscience, 5: 8-17.

# Thanks!

- Collaborators: USFS Northern Research Station
  - Matt Dickenson
  - Nick Skowronski
- Funding
  - Joint Fire Science Program
- Technicians & Help!
  - Tracy Culbertson
  - Jack Grider
  - Levi Miller (USFS)
  - Jennifer Winters

