

# Surveillance for La Crosse Virus Vectors: An Evaluation of Four Mosquito Traps and their Gonotrophic Biases

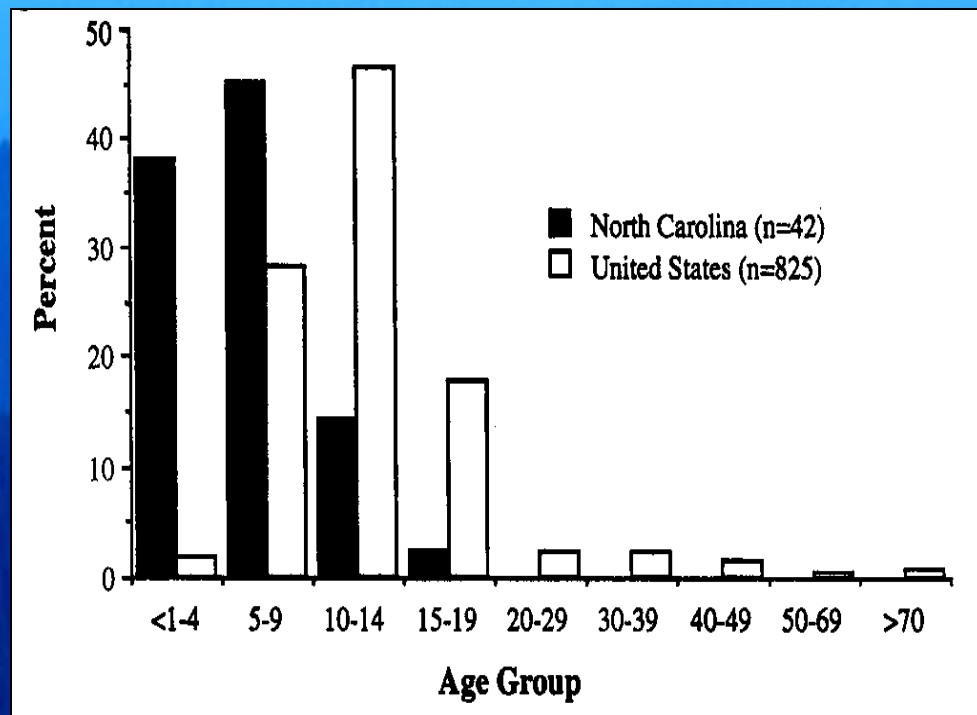
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Bruce Harrison<sup>3</sup>, and Gideon Wasserberg<sup>2</sup>**

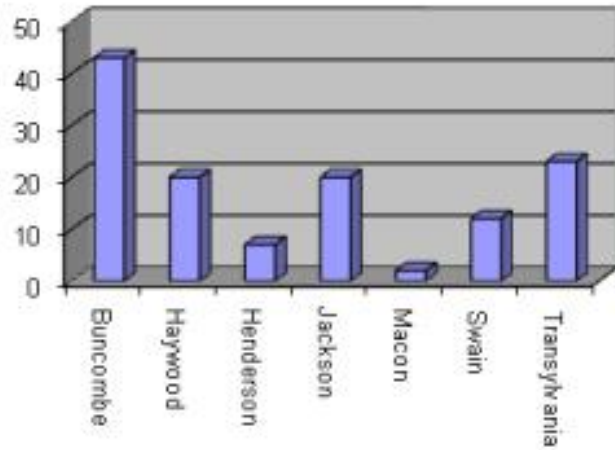
- 1. Environmental Health Sciences Program, Western Carolina University**
- 2. Ecology of Infectious Disease Group, UNC-Greensboro**
- 3. Public Health Pest Management, NCDENR**

# La Crosse Encephalitis

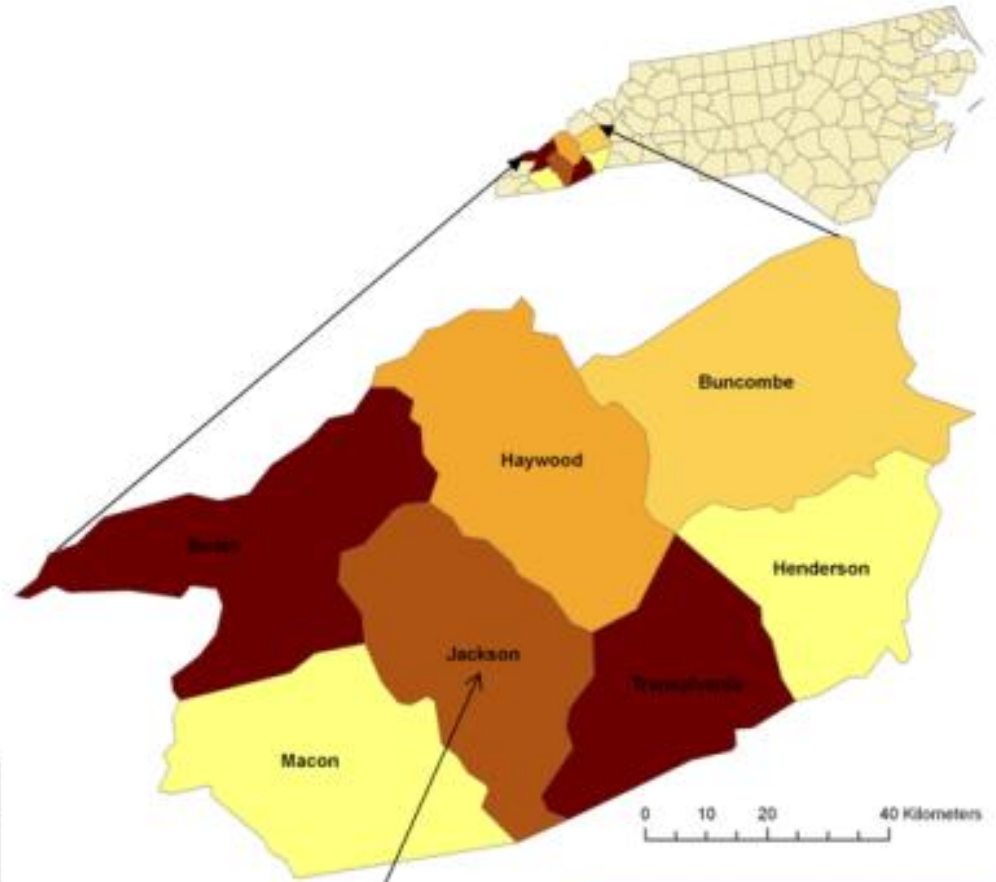
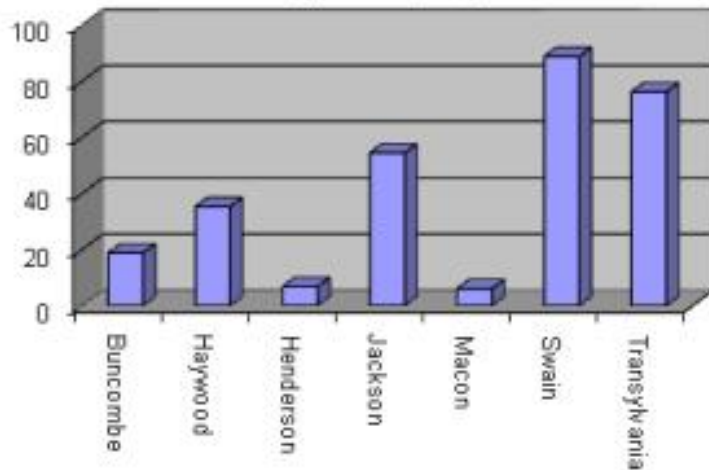
- Most common human arboviral disease in NC
- Infections are greatly under-recognized
- Disease most prevalent in children (<15 yrs)



**Confirmed LACE Cases (2000-2009) in Selected WNC Counties**



**Confirmed LACE Cases (2000-2009) in Selected WNC Counties (per 100,000)**



0 10 20 40 Kilometers

**LACE CASES SINCE 2000**  
Cases per 100,000

- 6.0 - 7.0
- 7.1 - 20
- 20.1 - 40
- 40.1 - 60
- 60.1 - 90

Western  
Carolina  
UNIVERSITY

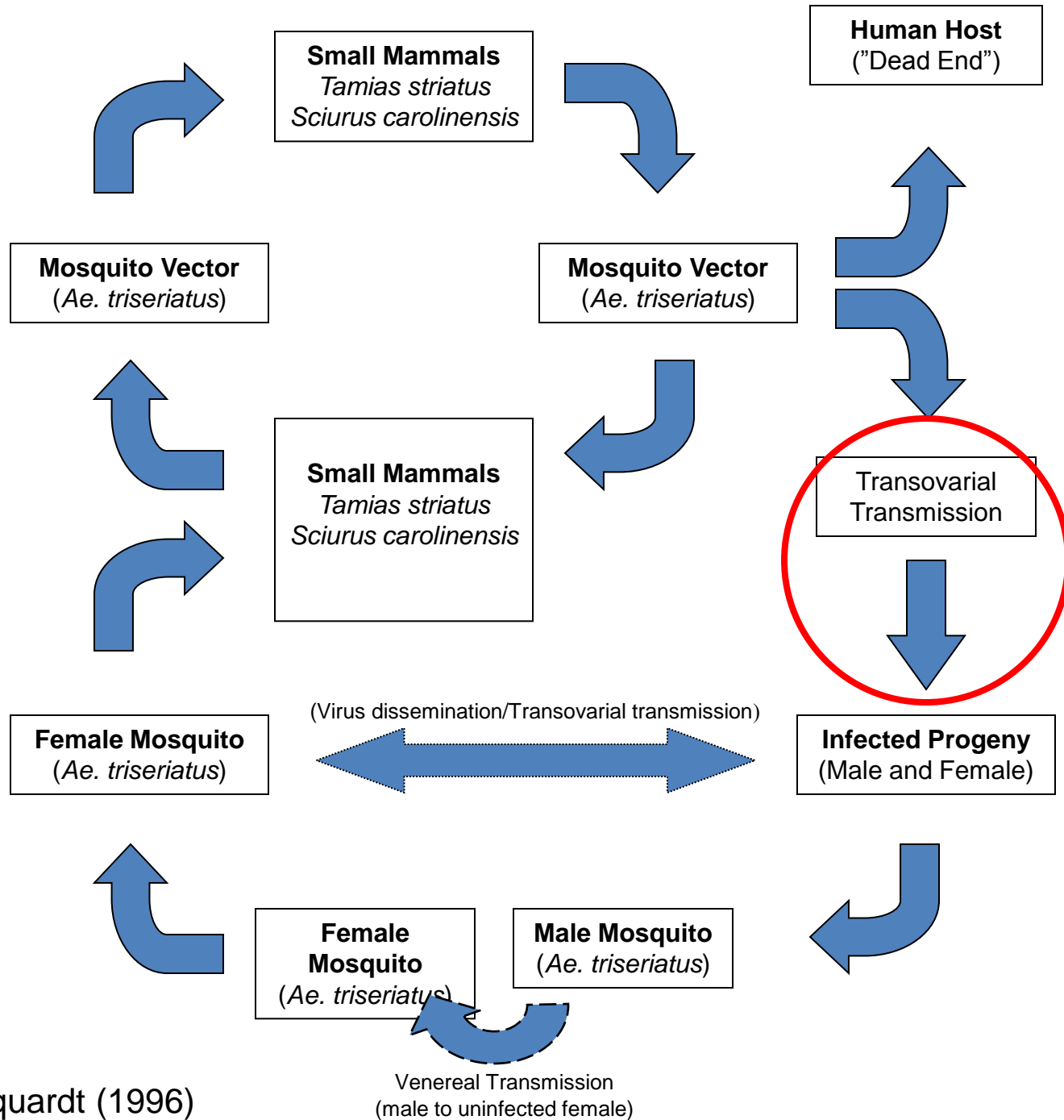
# *Aedes triseriatus*



Photo Credit: CDC: J.Gathany (2002)

LACV Primary “natural” vector: *Eastern Tree-hole Mosquito*

# LACV "Life" Cycle



# *Aedes albopictus*



Invasive species found naturally infected with LACV

# *Aedes japonicus*



Invasive species found competent for LACV in the lab

Photo: B. Byrd (2006)

**Sardelis et al.**, Laboratory transmission of La Crosse virus by *Ochlerotatus j. japonicus* (Diptera: Culicidae). J Med Entomol. 2002 Jul;39(4):635-9.

# Research Question

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Which surveillance trap type is most useful for collecting our target species?

Trap Needs to Target KNOWN/SUSPECTED LACV Vectors

*Ae. triseriatus*

*Ae. albopictus*

*Ae. japonicus*

# Research Question


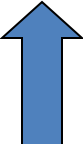
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Is abundance our only concern? No

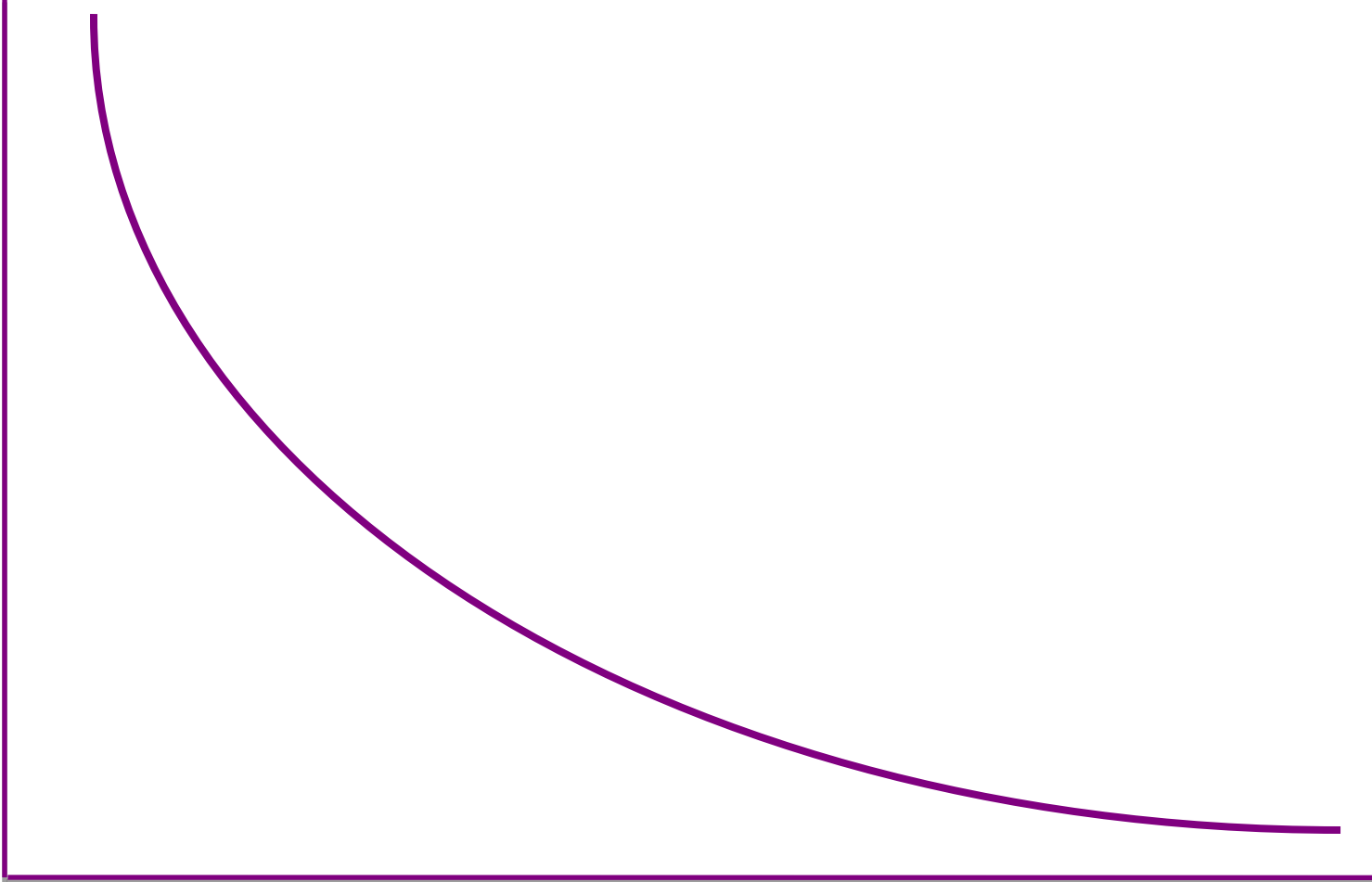
**Vector Abundance  $\neq$  Disease Risk**

# Age Matters

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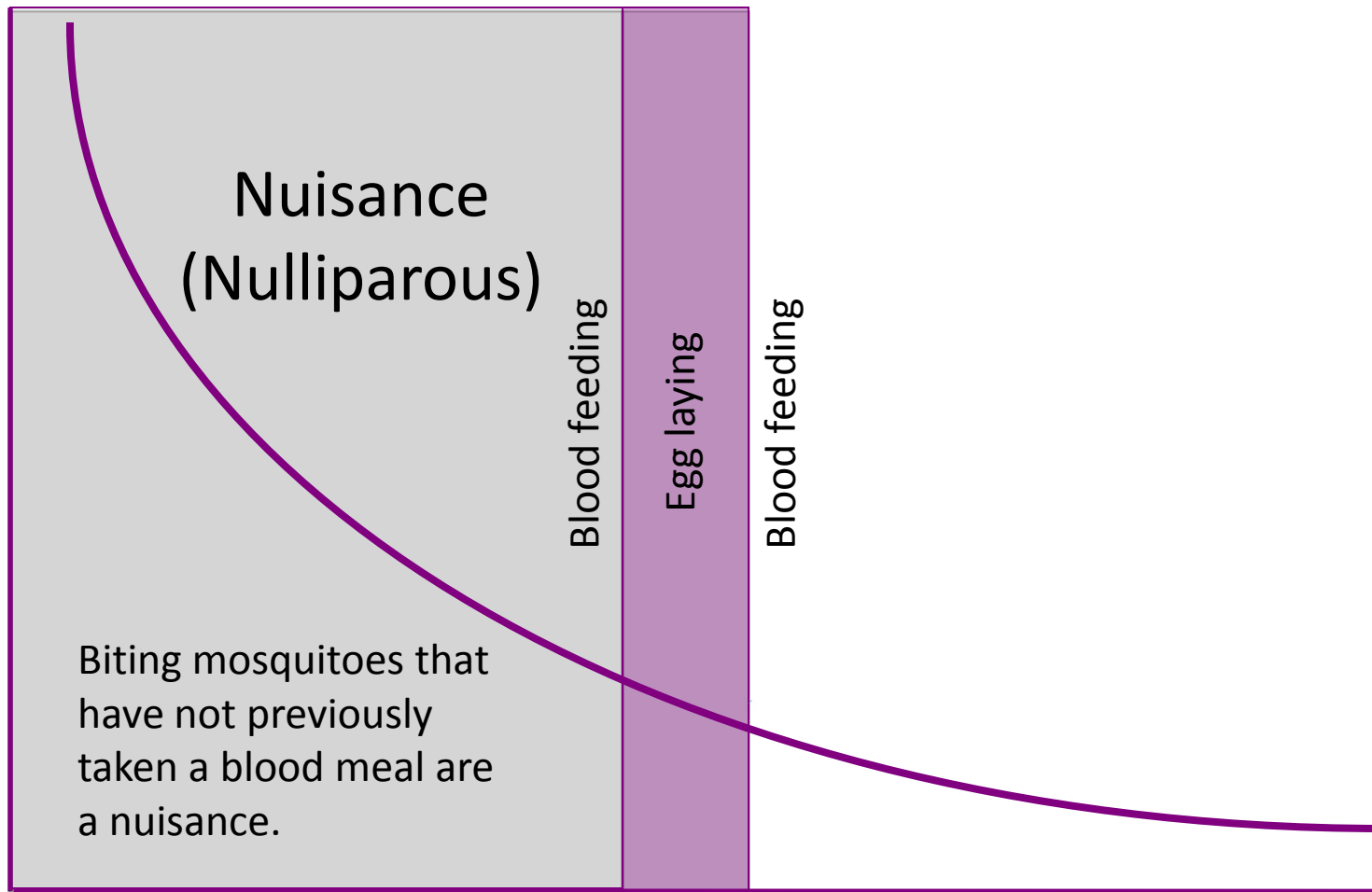
- The physiologic (gonotrophic) age relates to disease risk (in most arbovirus systems)
- Nulliparous mosquitoes =  Infection Risk
- Parous mosquitoes =  Infection Risk

Adult Survivorship

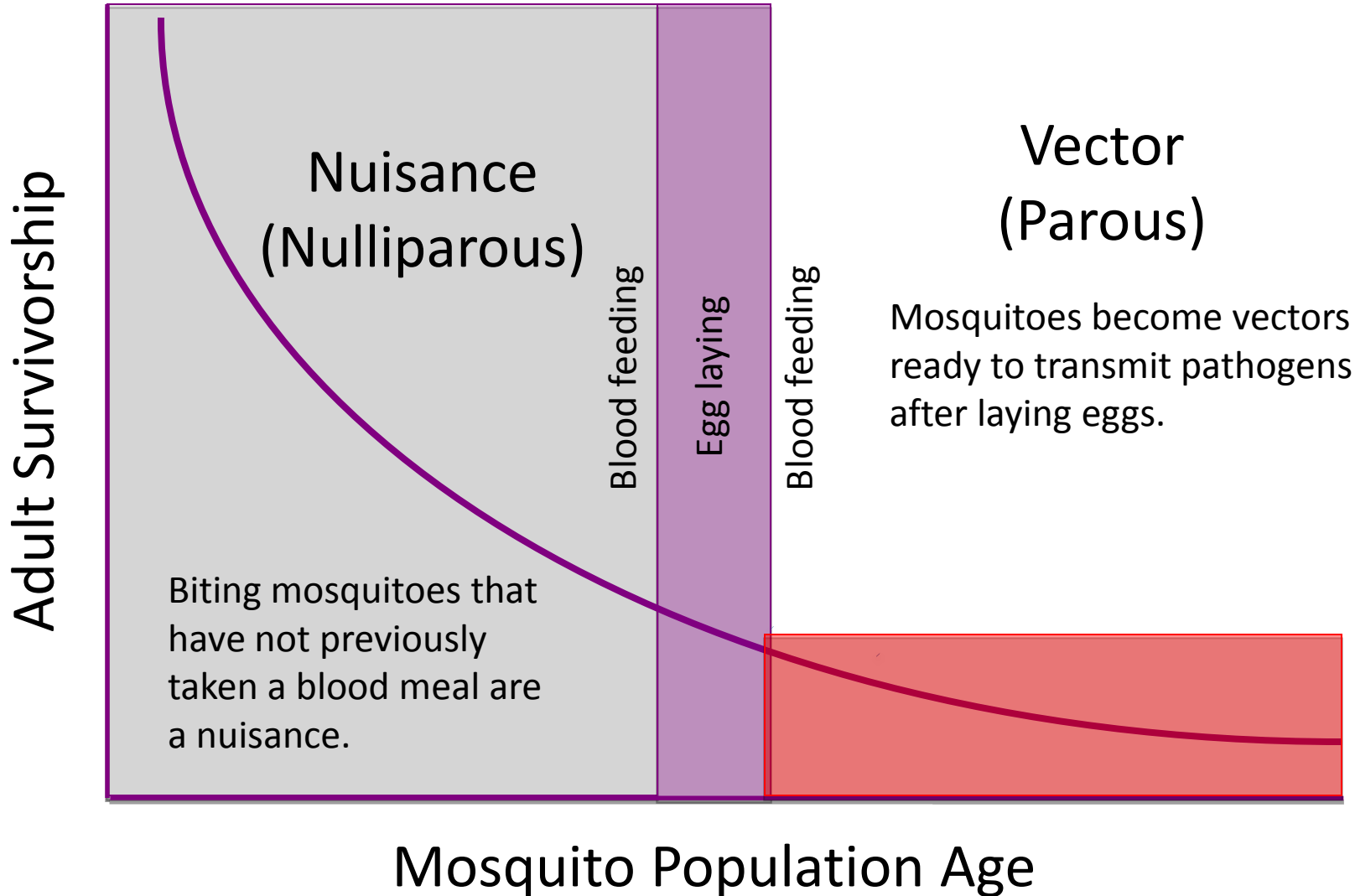


Mosquito Population Age

Adult Survivorship

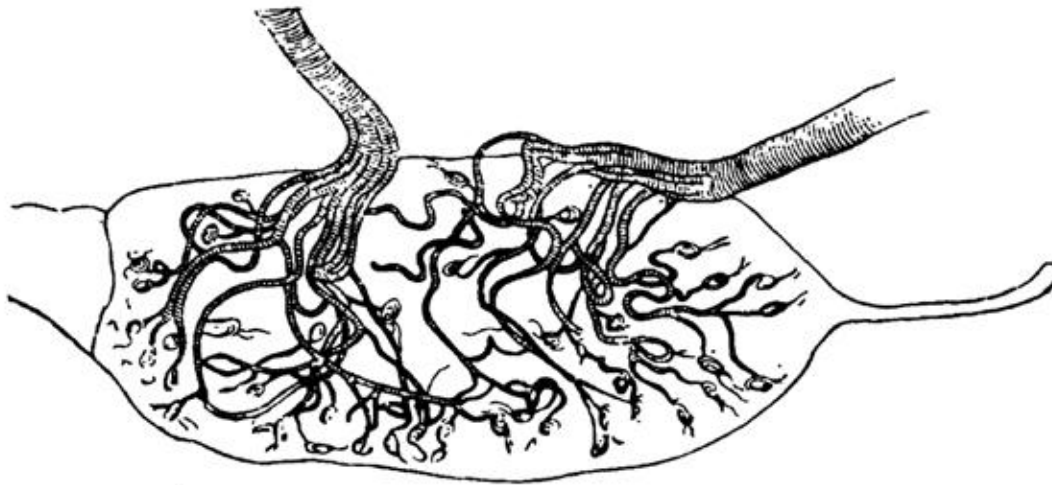


Mosquito Population Age



# Ovarian Tracheal Skeins

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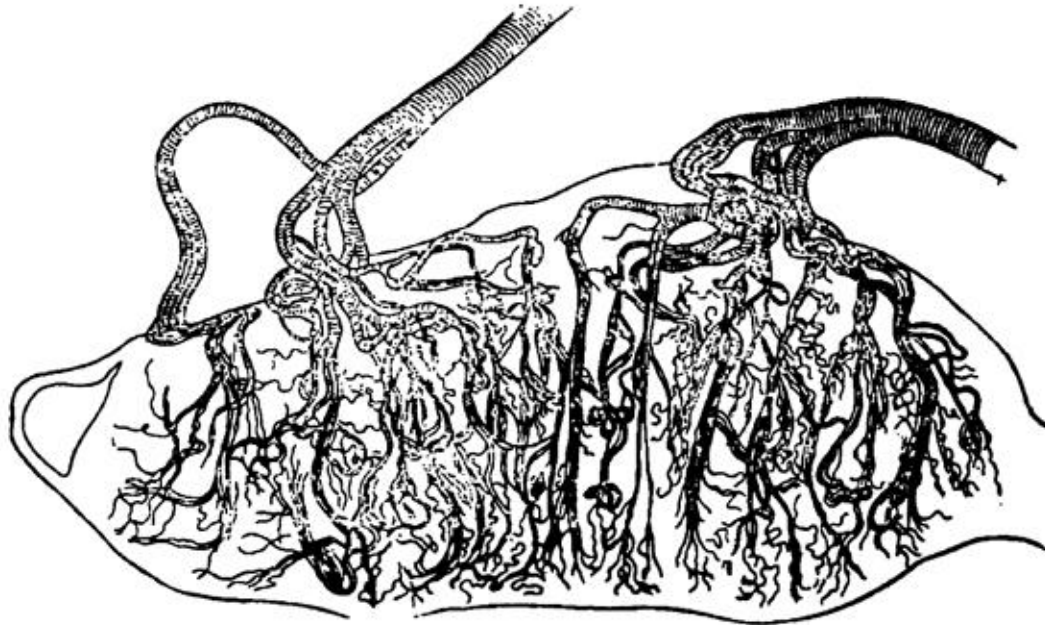
**Nulliparous**

**(Skeins are tightly coiled)**



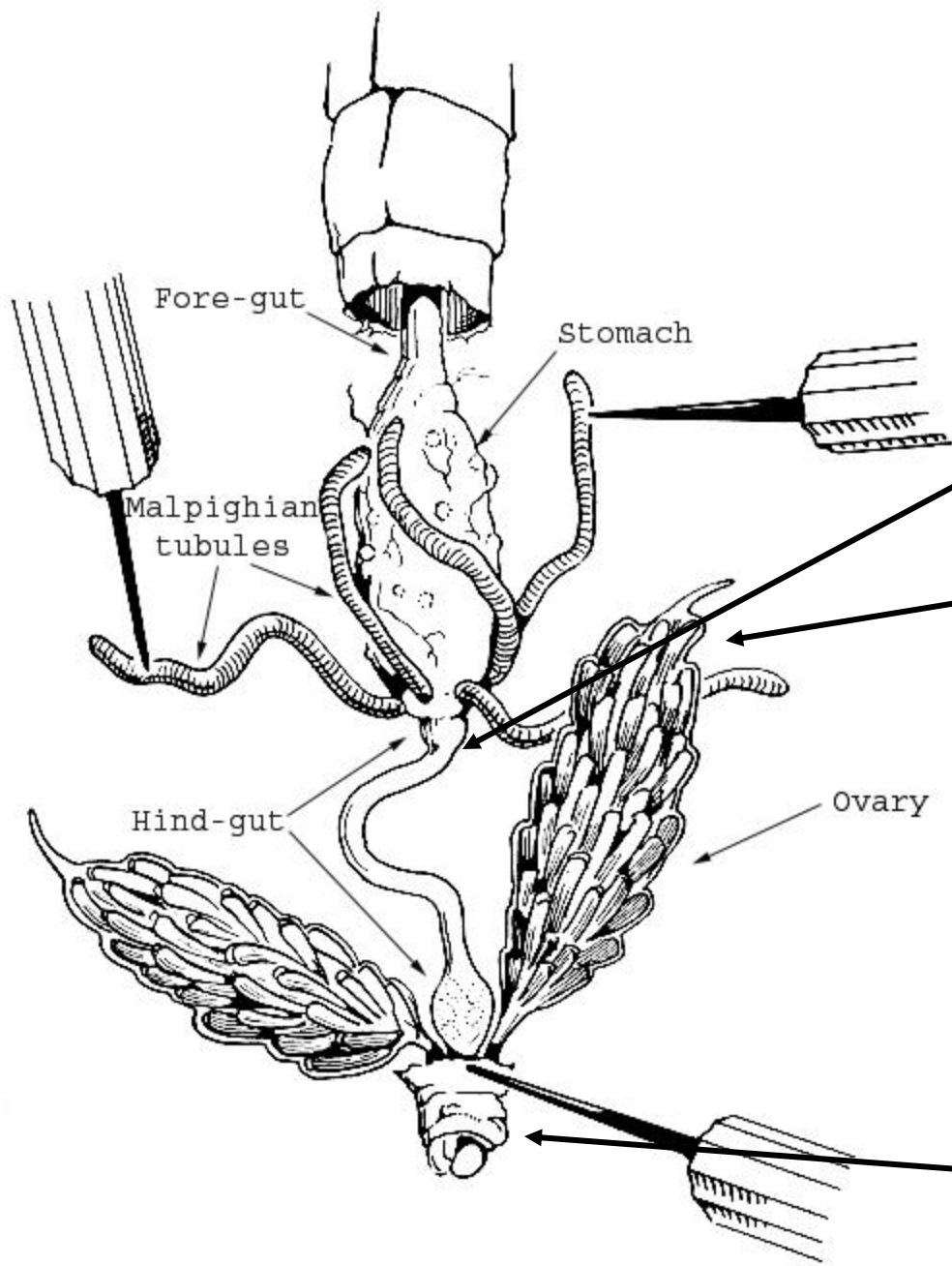
# Ovarian Tracheal Skeins

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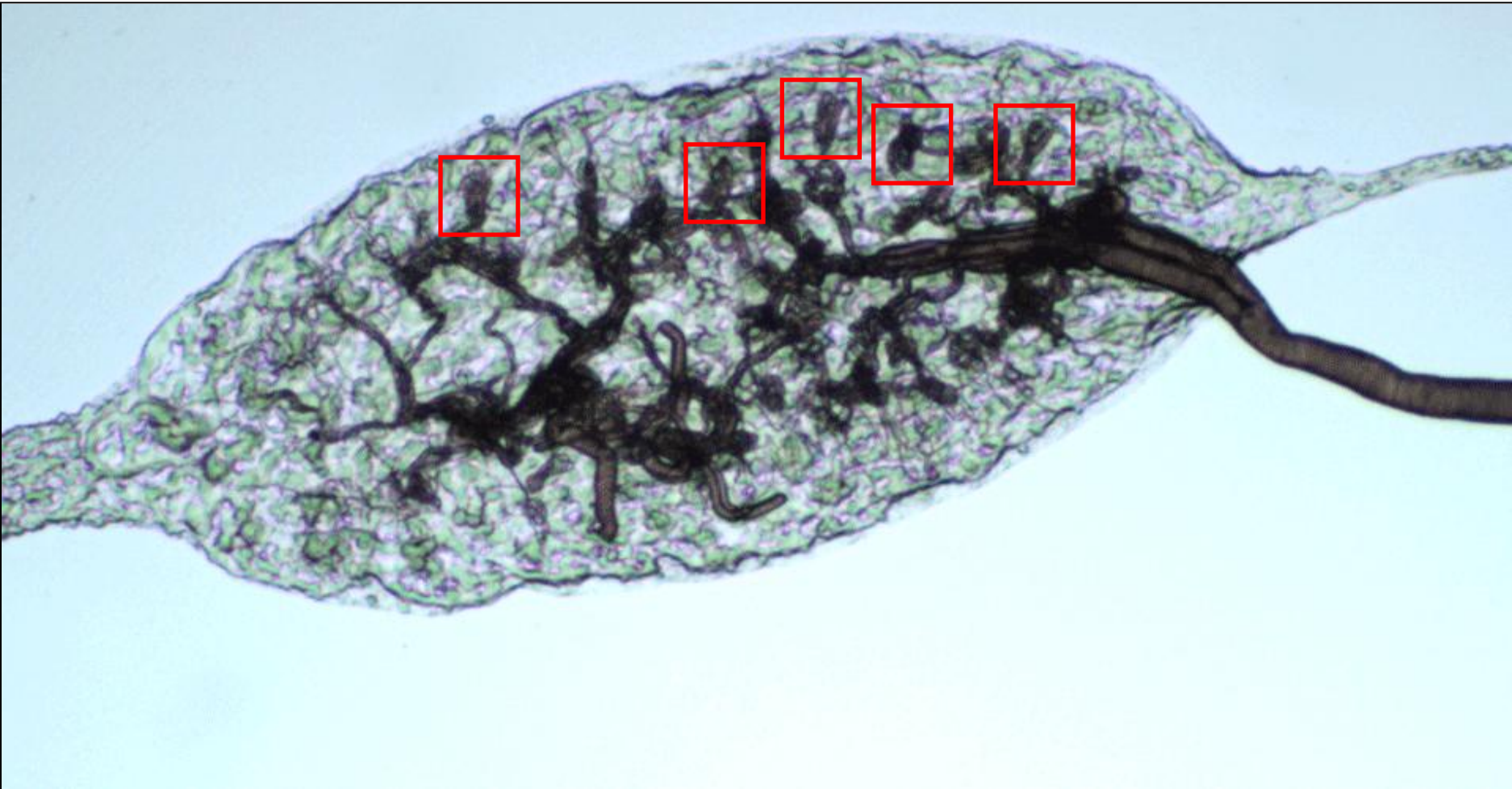


**Parous**

**(Skeins are unraveled)**

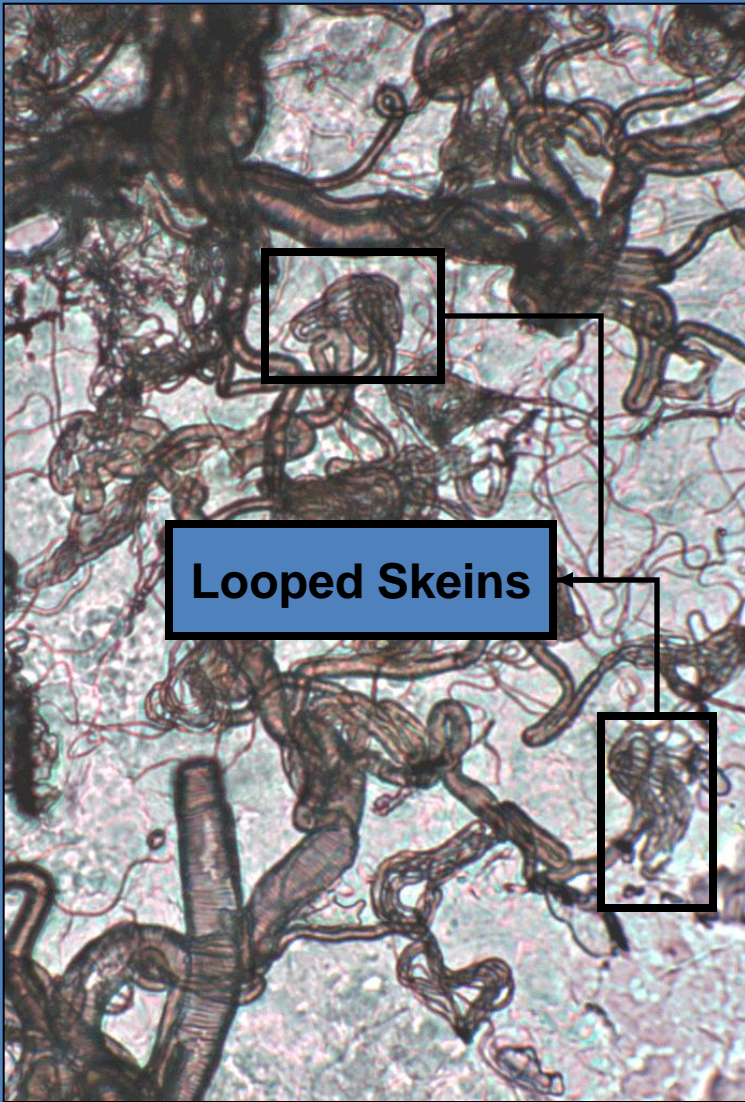


# Micrograph of Ovary

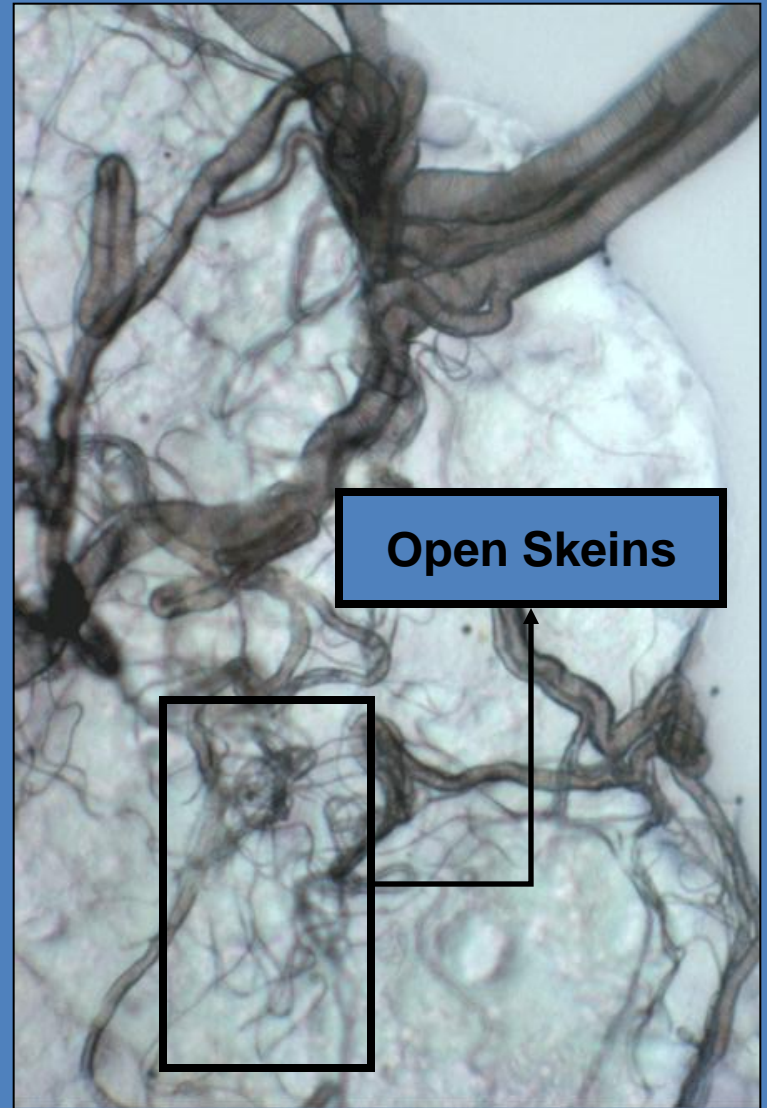


Micrograph of nulliparous ovary (100X)

Skeins may be seen at this magnification.



**Nulliparous Tracheoles**



**Parous Tracheoles**

# Research Questions

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- **Which surveillance trap type collects the greatest number of the three target species?**
- **Are there inherent physiologic biases in the trap?**  
(e.g., Gravid, Nulliparous, Parous, or Blood-Fed)

# The Traps



CO<sub>2</sub> baited CDC-Light Trap  
(sans light)



CO<sub>2</sub> baited BG-Sentinel



CO<sub>2</sub> baited Fay-Prince Trap



Infusion-Baited Gravid Trap

Photos: Internet Sources

# Study Design (Field)

- Four (4) Study Sites near WCU campus
- At each Site there are Four (4) Trap Positions
  - One location (position) for each trap type at each site
  - Each position > 30 meters from next
  - Experiment run for four (4) consecutive days
  - Two Trials (June and August)

	<b>Day 1</b>	<b>Day 2</b>	<b>Day 3</b>	<b>Day 4</b>
<b>Gravid Trap</b>	Position 1	Position 2	Position 3	Position 4
<b>Fay-Prince Trap</b>	Position 2	Position 3	Position 4	Position 1
<b>Sentinel Trap</b>	Position 3	Position 4	Position 1	Position 2
<b>CDC Light Trap</b>	Position 4	Position 1	Position 2	Position 3

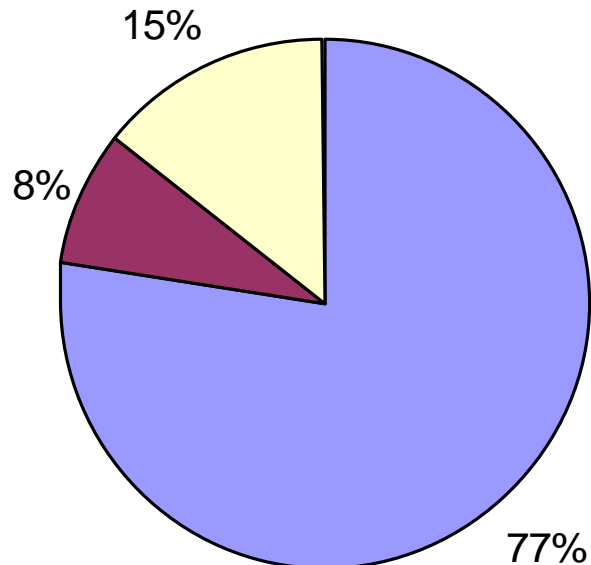
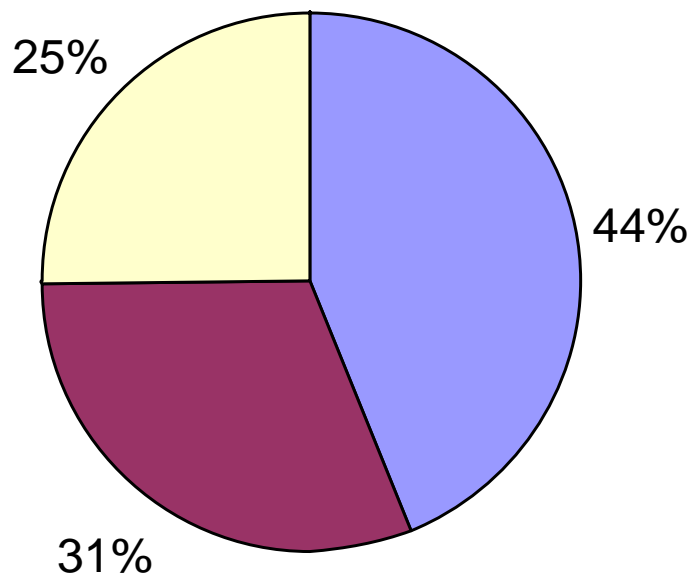
# Study Design (Field)

- Trap runs start between 0600-0630 daily
- AM Collections:
  - Traps are visited between 1230-1400 daily
  - Any collected mosquitoes are knocked down and brought to the lab.
  - Dry ice is replenished (if needed)
- PM Collections (2100-2130):
  - Any collected mosquitoes are knocked down and brought to the lab.
  - Batteries are retrieved
  - Traps are rotated to the next trap location

# Laboratory Methods

- Identify Mosquitoes
  - Species, Sex
- Physiologic Status
  - Gravid
  - Blood Engorged
  - Parity (NP vs P)
- Keep Thorax and Head
  - DNA Analysis (*Ae. triseriatus* vs *Ae. hendersoni*)
  - Virus Isolation

# Collection Results



## June

159

112

92

**n=363**

■ *Ae. albopictus*

■ *Ae. japonicus*

■ *Ae. triseriatus*

## August

233

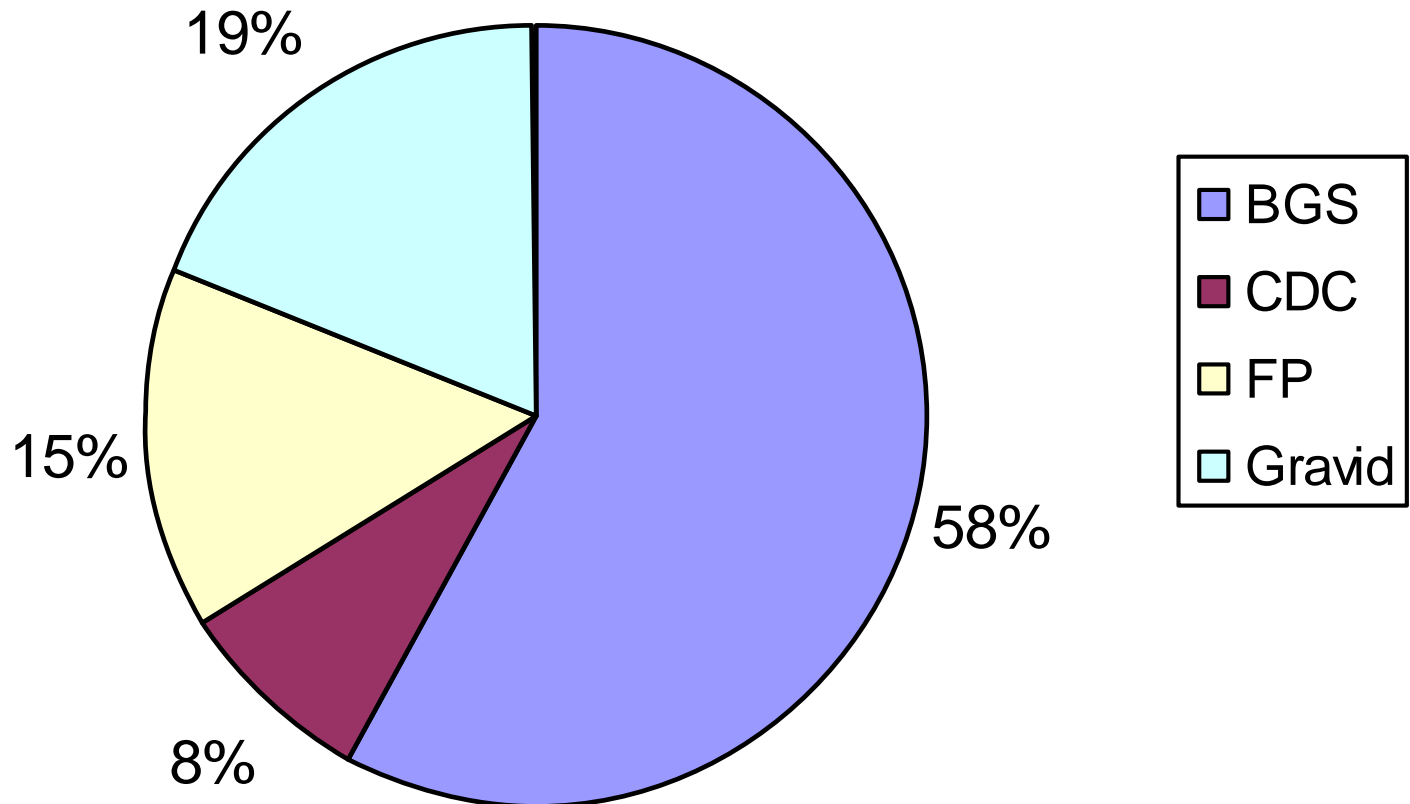
25

44

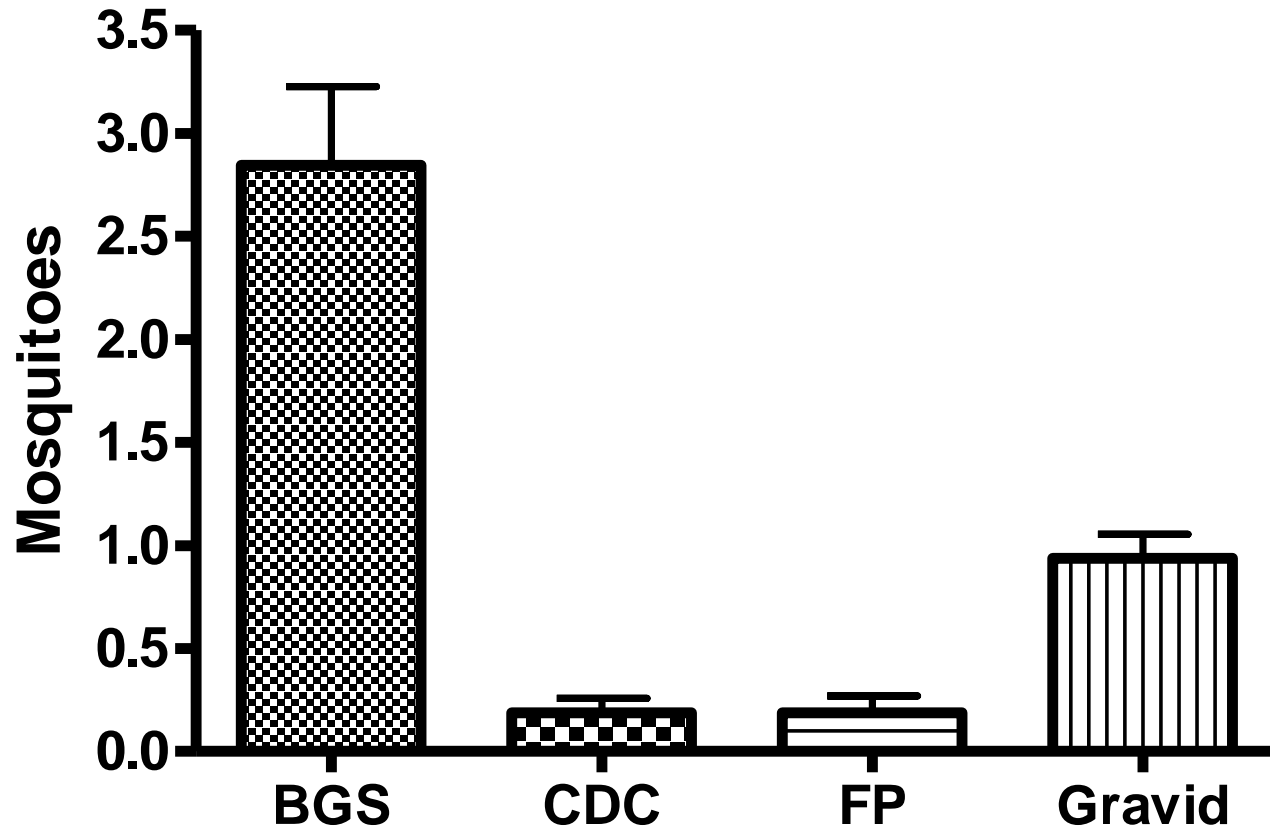
**n=305**

**668 Target Mosquitoes Collected/ 128 Trap-Days  
(5.2 Mosquitoes/Trap-Day)**

# Trap Type Collections (Overall)



# *Aedes triseriatus*



Dunn's Multiple Comparison Test

BGS vs CDC

BGS vs FP

BGS vs Gravid

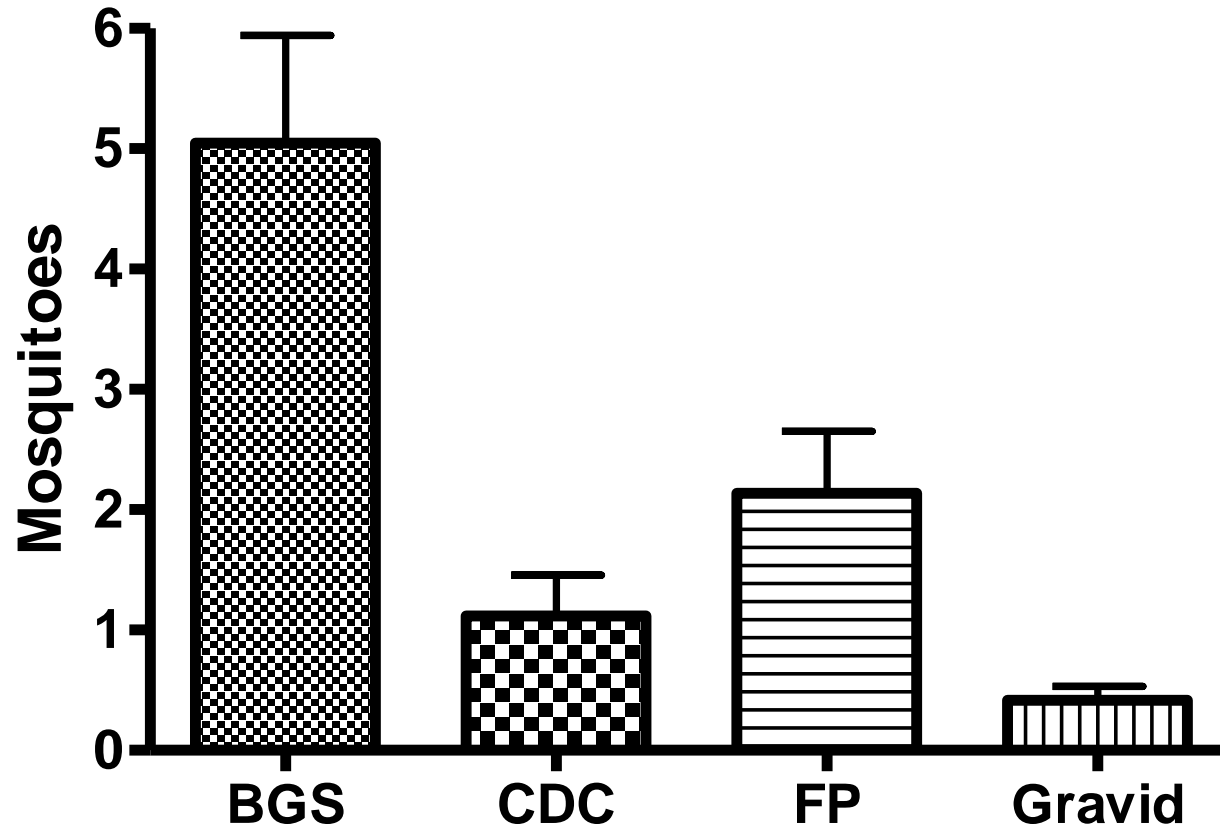
P value

P < 0.001

P < 0.001

P < 0.01

# *Aedes albopictus*



Dunn's Multiple Comparison Test

BGS vs CDC

BGS vs FP

BGS vs Gravid

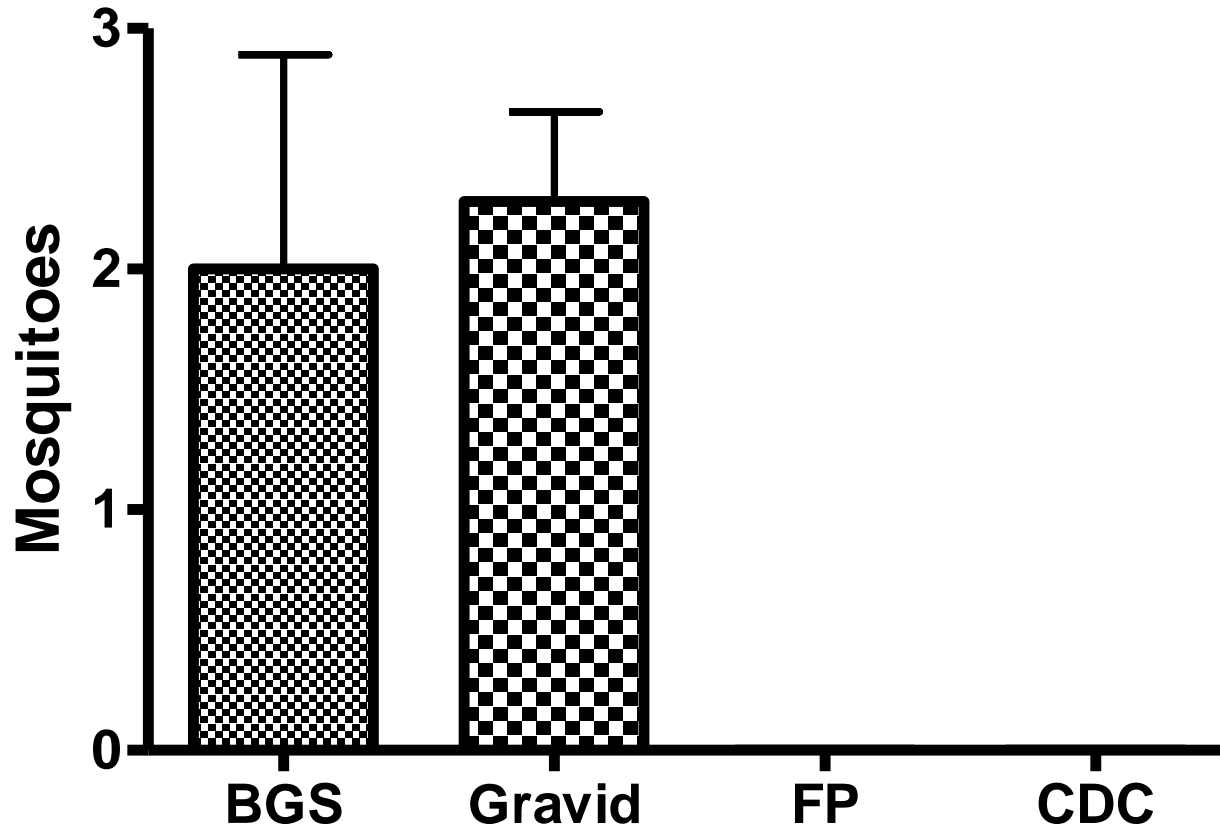
P value

P < 0.001

P < 0.01

P < 0.001

# *Aedes japonicus*

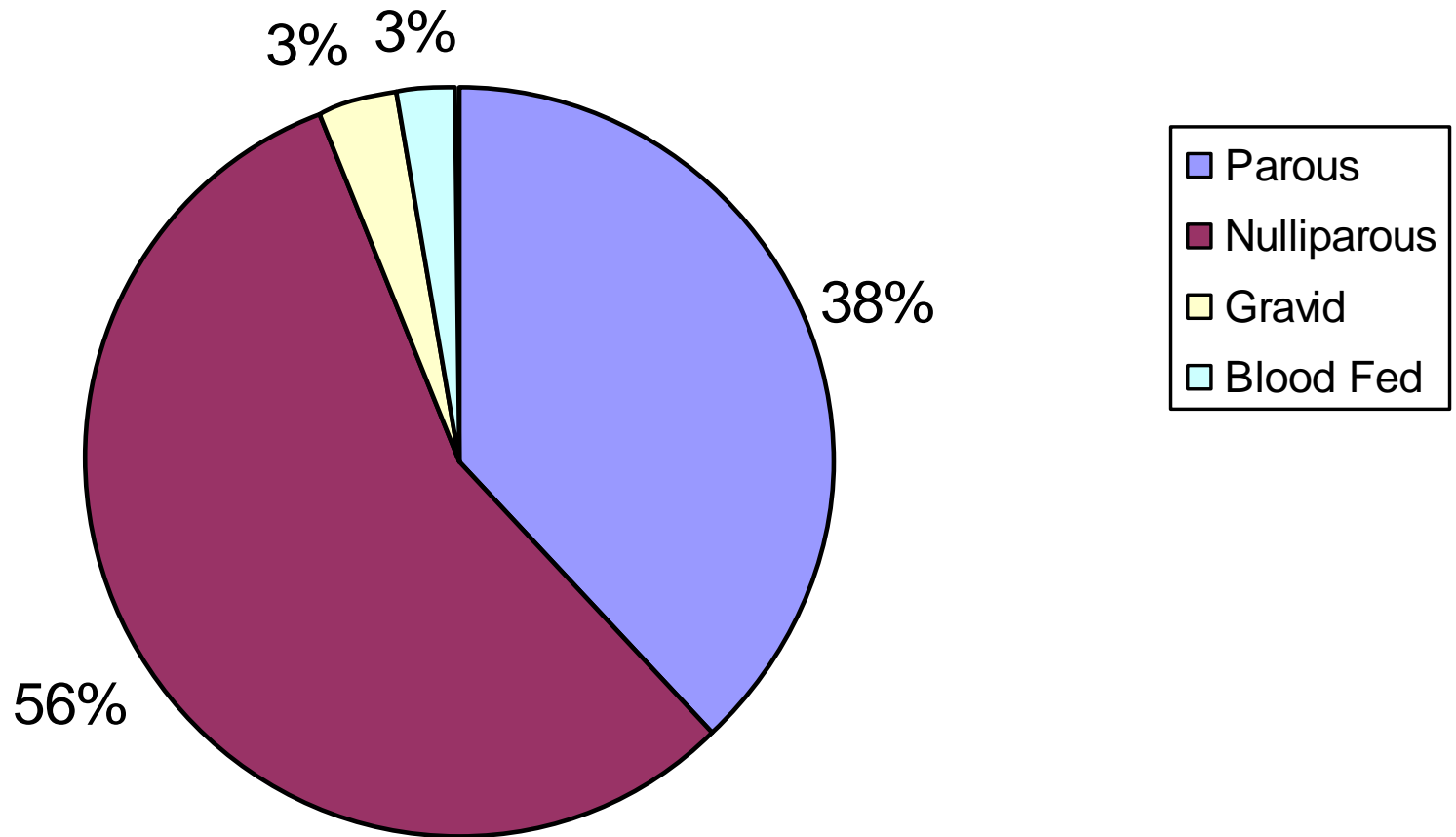


P-value (NS)

# Collection Summary

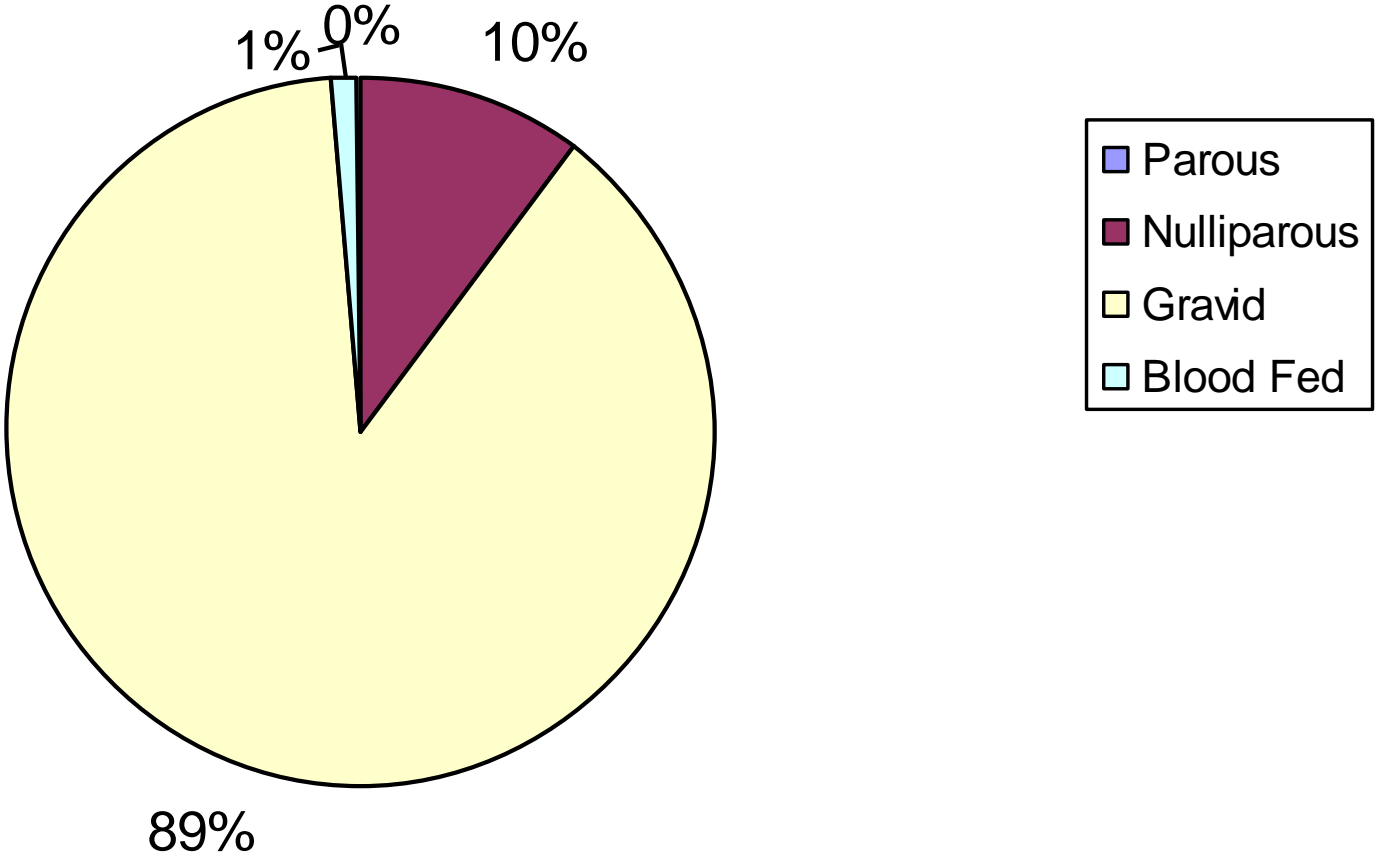
- The CO<sub>2</sub> Baited-BG sentinel trap collected:
  - 68.4% of the total *Ae. triseriatus*
  - 57.8% of the total *Ae. albopictus*
  - 46.7% of the total *Ae. japonicus*
- Gravid traps
  - 53.3% of the total *Ae. japonicus*
  - 22.6% of the total *Ae. triseriatus*
- Most mosquitoes (76%) collected b/w 1300-2100

# Parity Status (BG-Sentinel)



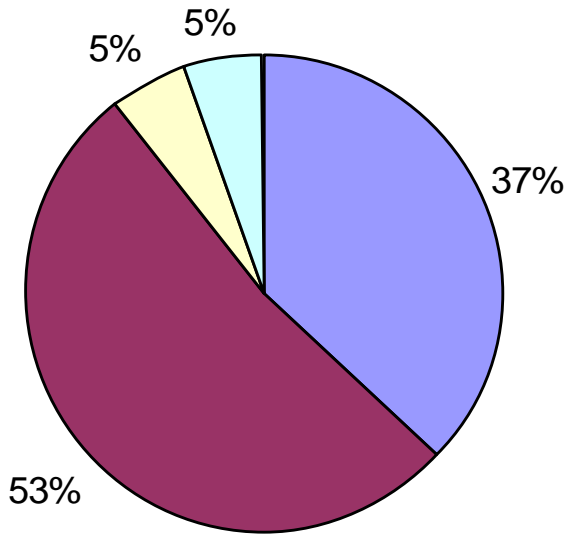
N=234 (89.7% Success Rate)

# Parity Status (Gravid Trap)

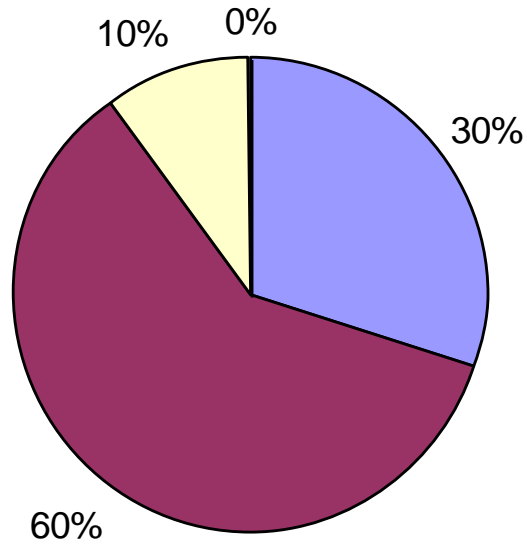


N=75 (92% Success Rate)

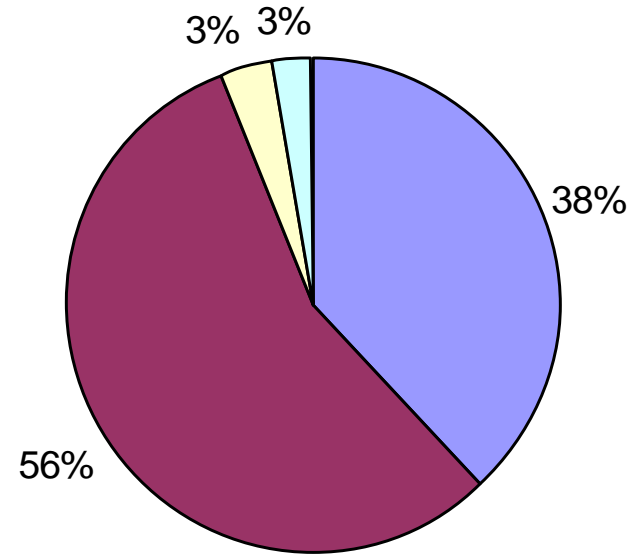
# Host Seeking Traps



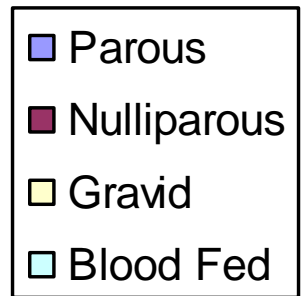
Fay Prince



CDC



BG-Sentinel



# Gonotrophic Status (Species)

<b>BG-SENTINEL</b>	P (%)	N (%)	G (%)
<i>Ae. triseriatus</i>	57.6	32.2	10.2
<i>Ae. albopictus</i>	35.9	49.5	14.6
<i>Ae. japonicus</i>	15.5	<u>81.0</u>	3.4

P=Parous

N=Nulliparous

G=Gravid

<b>GRAVID TRAP</b>	P (%)	N (%)	G (%)
<i>Ae. triseriatus</i>	0	11.8	88.2
<i>Ae. albopictus</i>	0	100	0
<i>Ae. japonicus</i>	0	6.3	<u>93.7</u>

# Conclusions

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- The BG-Sentinel
  - Best Trap (*Ae. triseriatus* and *Ae. albopictus*)
  - No different than Gravid Trap for *Ae. japonicus*
- Gonotrophic Status
  - Gravid Trap: The name says it all
    - (Except for *Ae. albopictus*?)
  - BG Sentinel: Does not appear to be different from other CO<sub>2</sub> baited traps

# Future Directions (Summer 2011)

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- CO<sub>2</sub>-Baited BGS vs BG Lure + CO<sub>2</sub>-Baited BGS
- BGS vs Human (Landing “Biting”)
- BGS vs Nasci Aspirator
- Novel Traps?

# Acknowledgements

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**Dr. Charles Apperson (NCSU)**

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**NC DENR (PHPM)**

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# Questions?

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