THE BUZZ ABOUT RAINWATER HARVESTING SYSTEMS & MOSQUITOES: IS THERE A PROBLEM & WHAT DO WE DO ABOUT IT?

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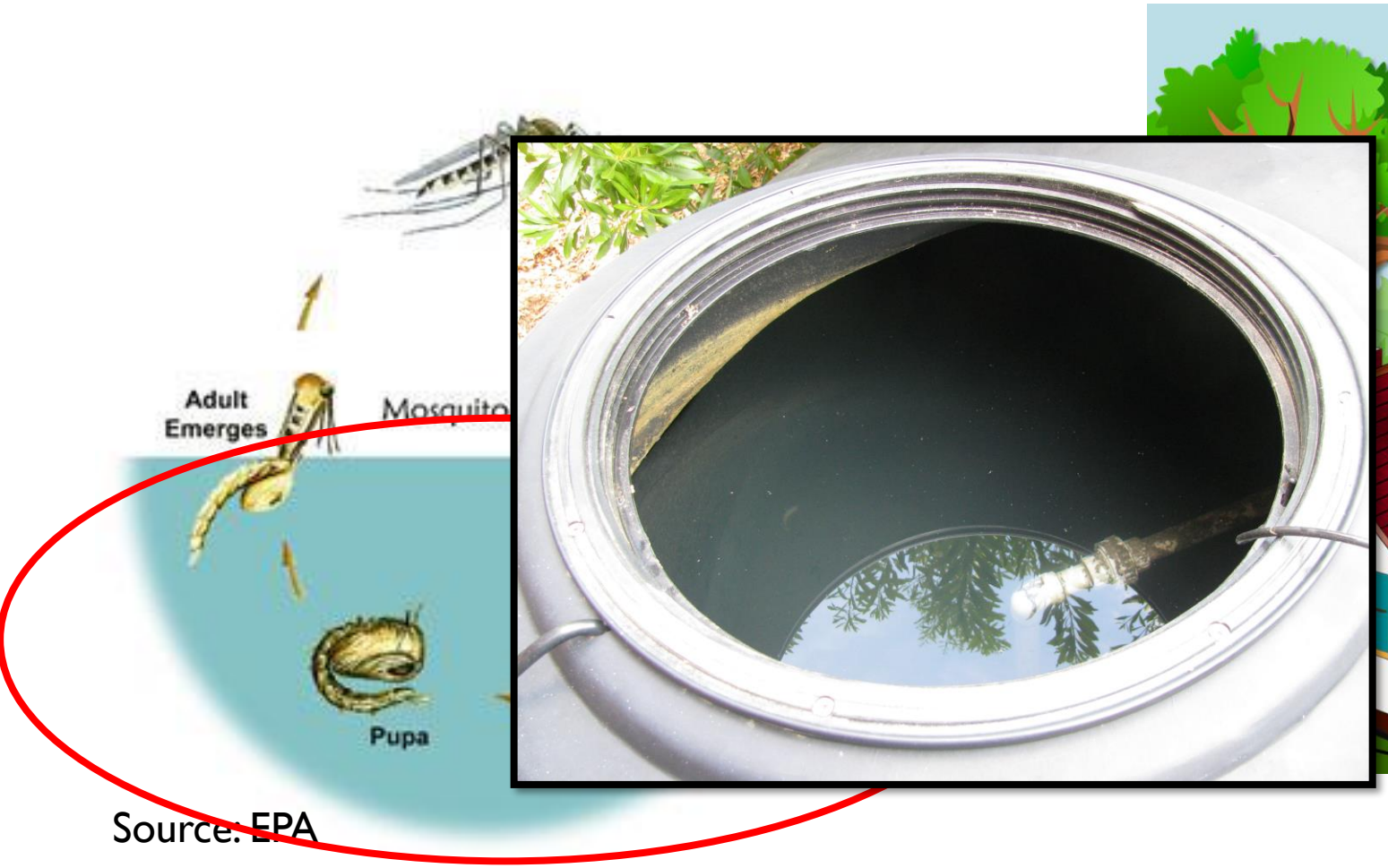
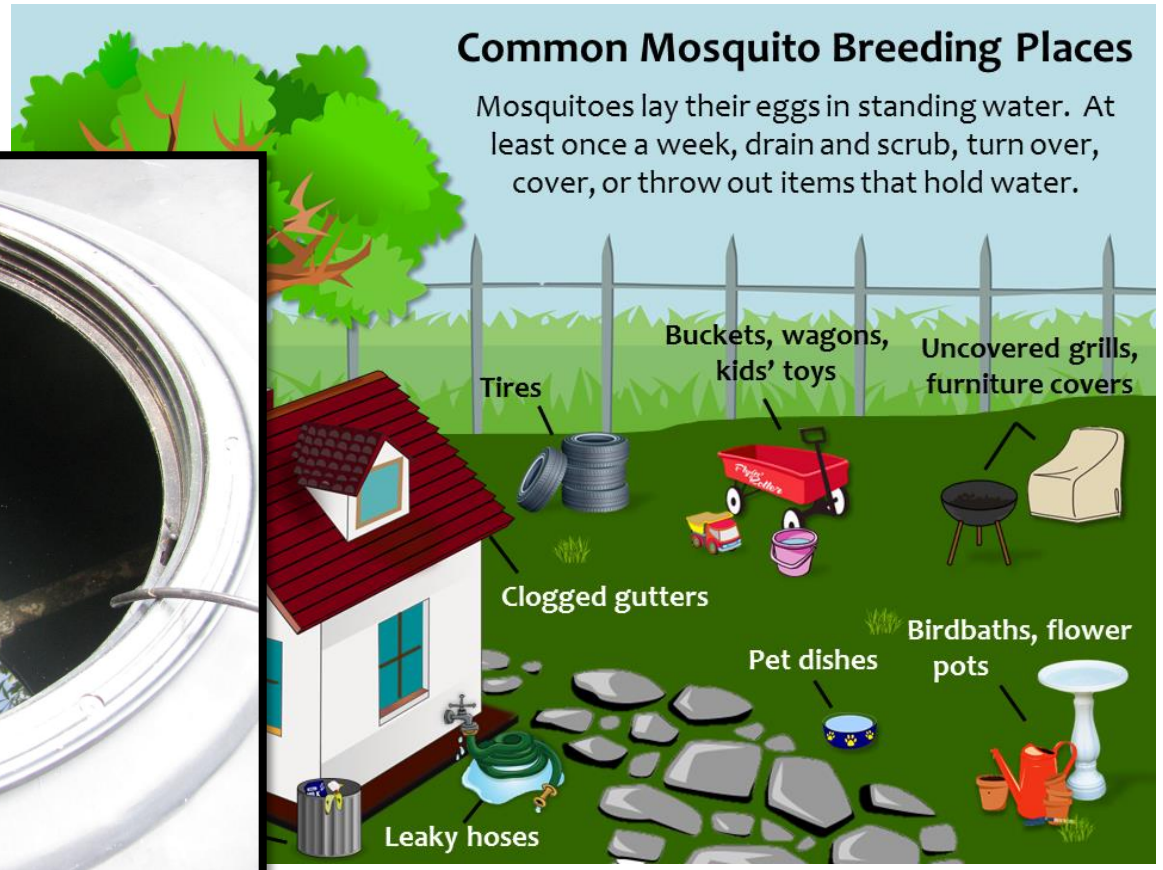
VMCA 2020 Annual Conference

MOSQUITOES LOVE/NEED STANDING WATER





Source: EPA

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Research Question #1: Are rainwater harvesting systems contributing to the presence/proliferation of mosquitoes?

IF "YES"…

1. What is their occurrence and relative abundance in those systems?
2. Which species of mosquitoes are present?
3. What is the relationship between the systems, environmental characteristics of sites, abundance, and types of mosquitoes found?

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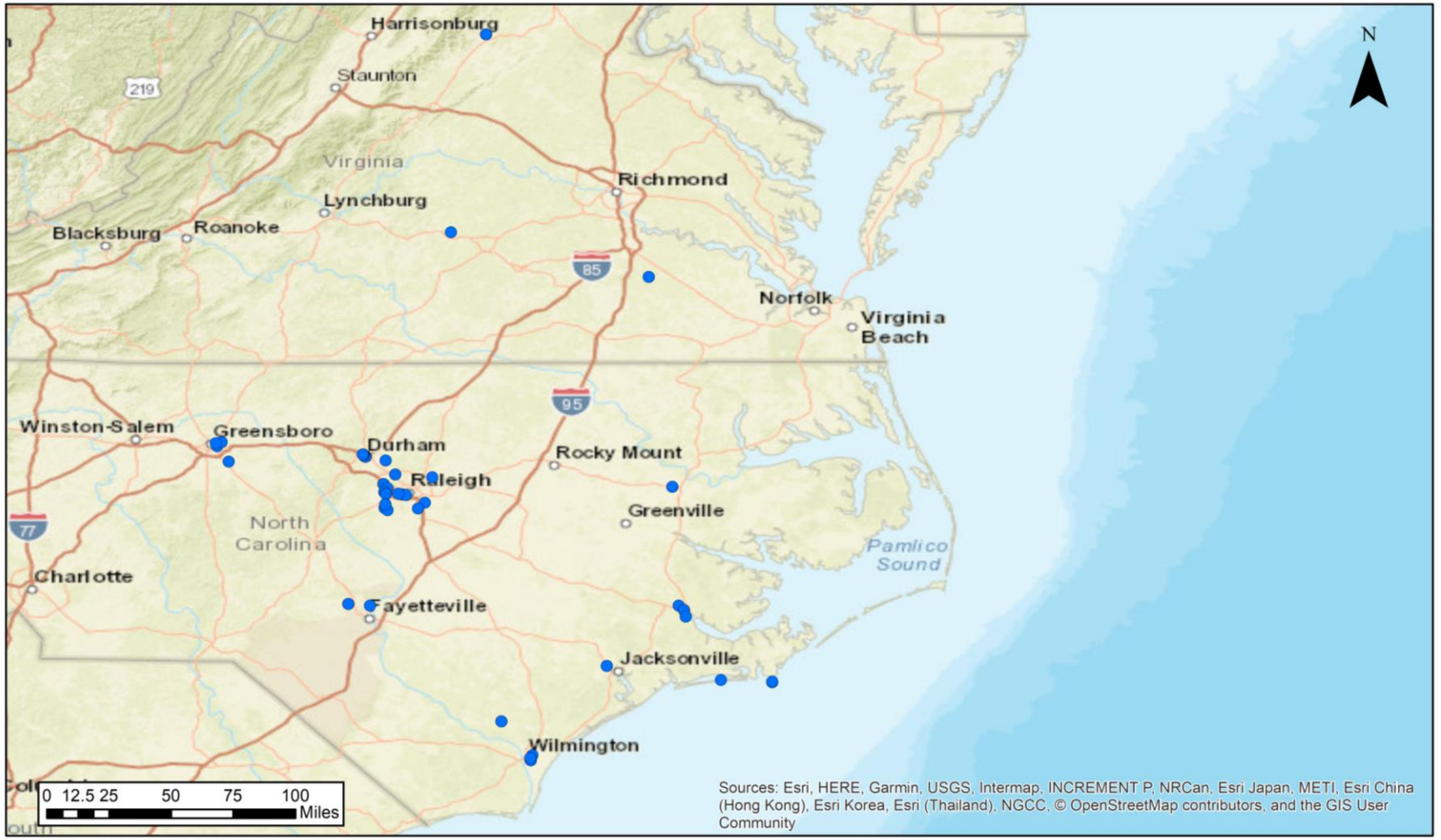
42 LOCATIONS; 64 RWH SYSTEMS



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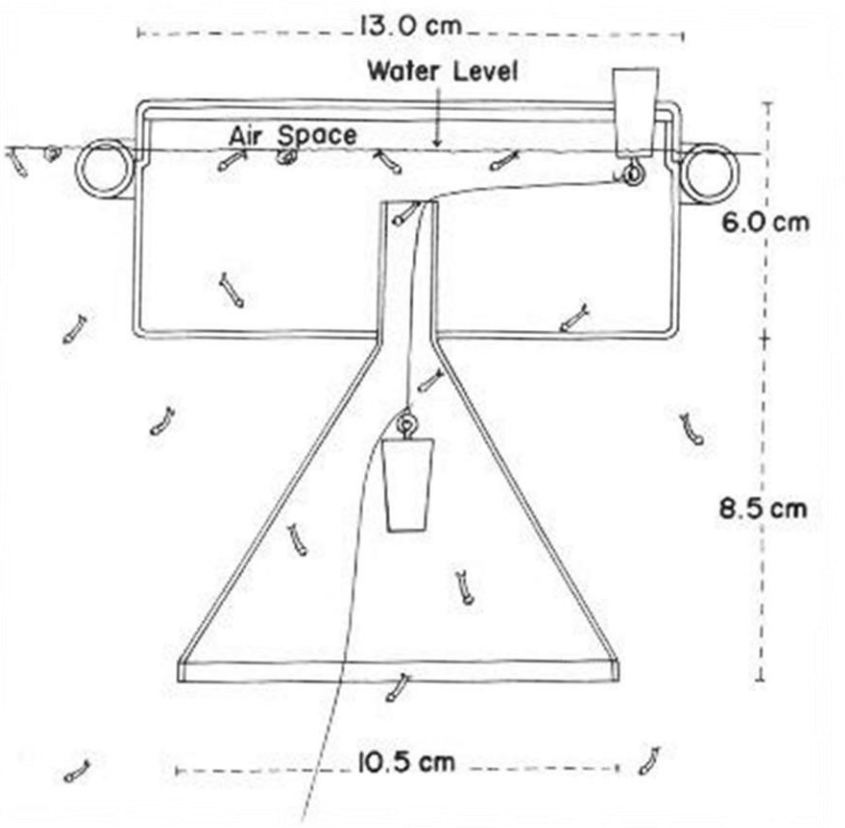
AFIRMS TRAP FOR SAMPLING LARVAE PRESENCE/ABUNDANCE



Harrison et al. 1982. An effective floating larval trap for sampling *Aedes Aegypti* populations (Diptera: Culicidae). *J. Med. Entomol.* Vol. 19, no. 6: 722-727

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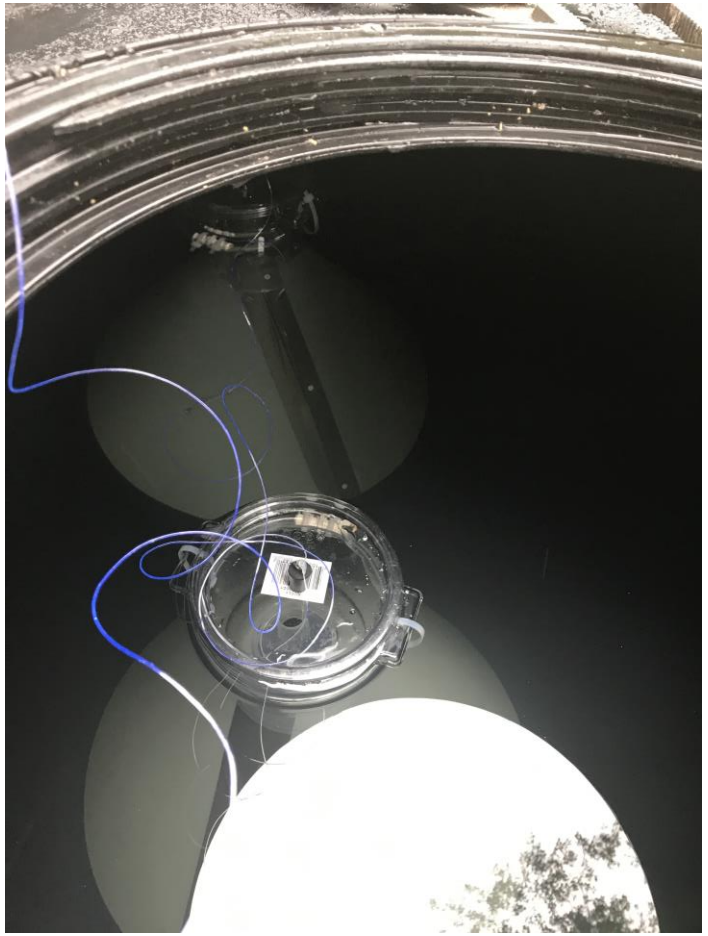

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EACH SYSTEM WAS SURVEYED FOR OVERALL DESIGN, OWNER MAINTENANCE HABITS, AND ENVIRONMENTAL FACTORS

Environmental

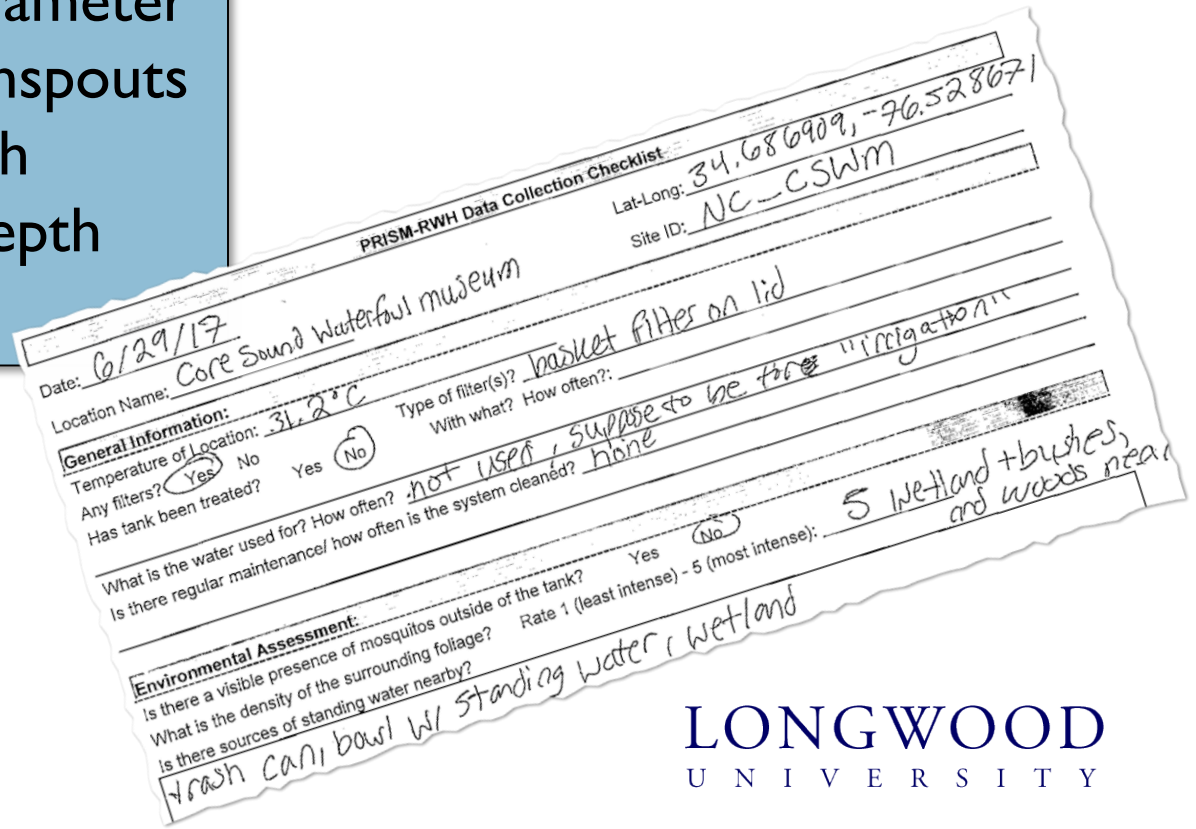
- Standing water
- Density of foliage
- Shadiness
- Overhanging trees

System

- Tank size, diameter
- No. of downspouts
- Water depth
- Sediment depth

Design/Maintenance

- Visible entry points
- Size & length of overflow
- Location of overflow exit points
- Number of screens present
- Frequency of maintenance


PRISM-RWH Data Collection Checklist

Date: 6/29/17 Lat-Long: 34.686909, -76.528671

Location Name: Core Sound Waterfowl museum Site ID: NC_CSWM

General Information:

Temperature of Location: 31.2°C

Any filters? (Yes) No Type of filter(s)? basket filter on lid

Has tank been treated? Yes (No) With what? How often?:

What is the water used for? How often? not used, suppose to be for "irrigation"

Is there regular maintenance/ how often is the system cleaned? none

Environmental Assessment:

Is there a visible presence of mosquitos outside of the tank? Yes (No)

What is the density of the surrounding foliage? Rate 1 (least intense) - 5 (most intense): 5 wetland + bushes, and woods near

Is there sources of standing water nearby?

trash can, bowl w/ standing water, wetland

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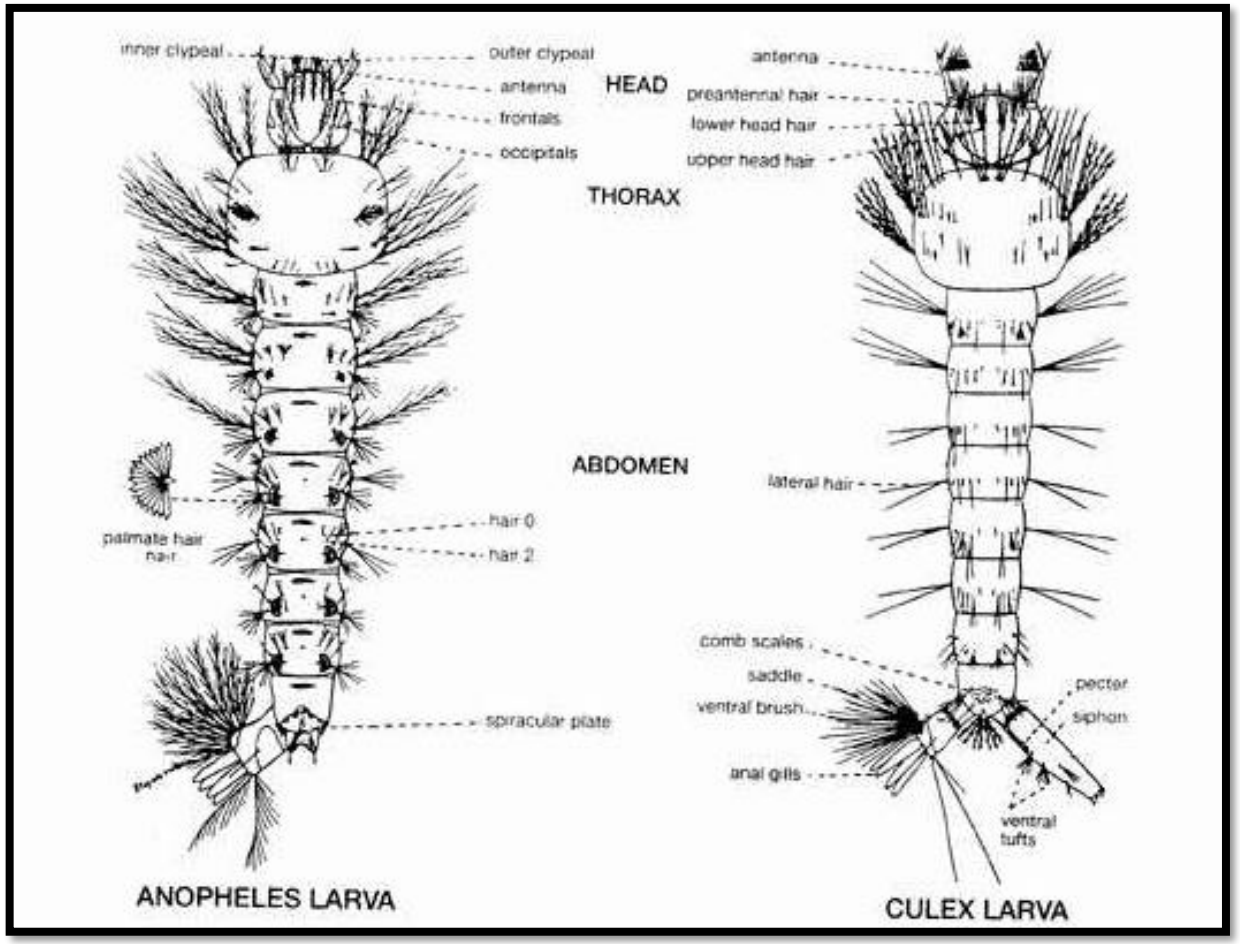
ALL CAPTURED LARVAE WERE PRESERVED, IDENTIFIED, & COUNTED



Source: Tuscola County

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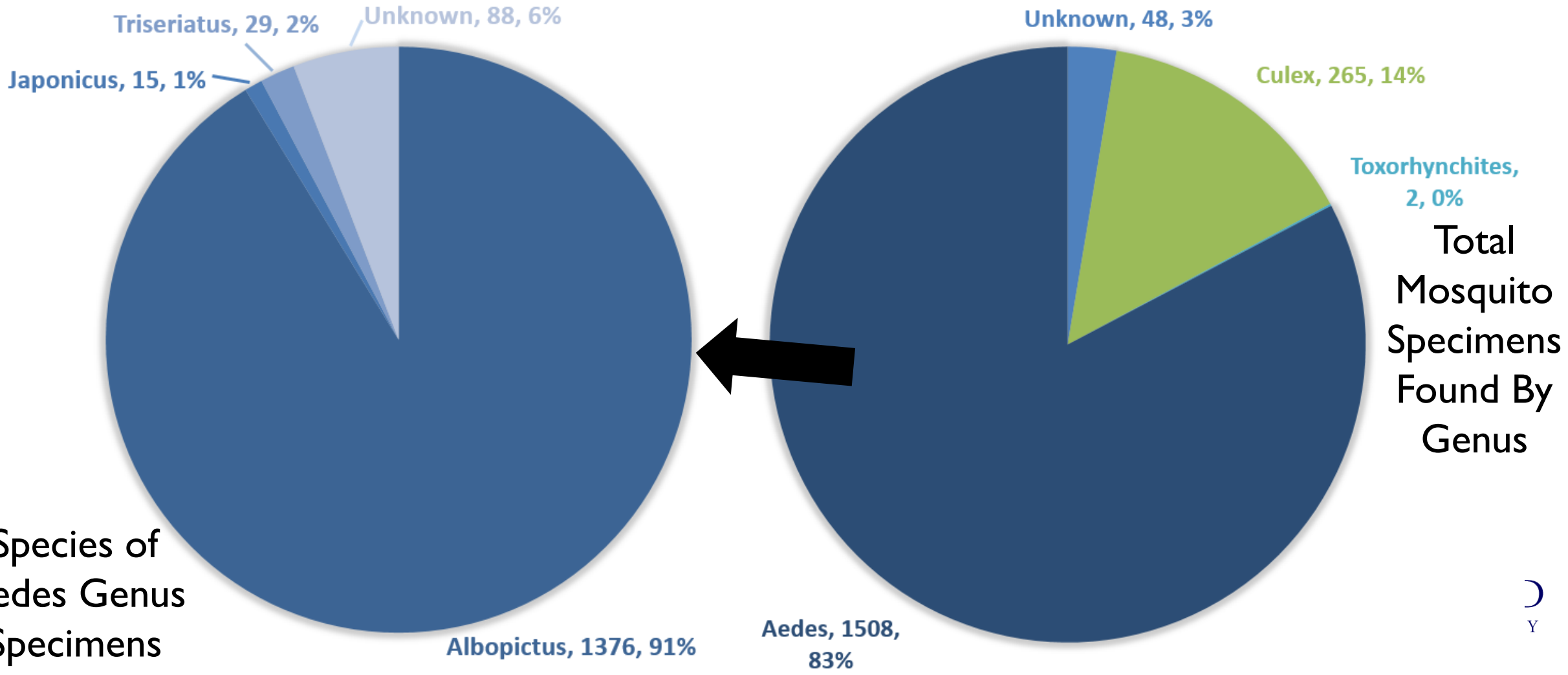
WHAT DID WE FIND?



Species of Aedes Genus Specimens

Total Mosquito Specimens Found By Genus

WHY DOES THE GENUS/SPECIES MATTER?

- *Aedes albopictus* > Eastern Equine Encephalitis, Zika virus, LaCrosse Encephalitis, West Nile virus
- *Aedes japonicus* > West Nile virus, LaCrosse Encephalitis
- *Aedes triseriatus* > LaCrosse Encephalitis
- *Culex* hybrid > St. Louis Encephalitis, West Nile virus
- *Tx. rutilus* > Not a vector mosquito

Cx. hybrid specimen

Ae. albopictus specimen

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SOME SYSTEMS HAD SEVERE MOSQUITO ISSUES WHY?

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2500/3000

OTHERS DID NOT…

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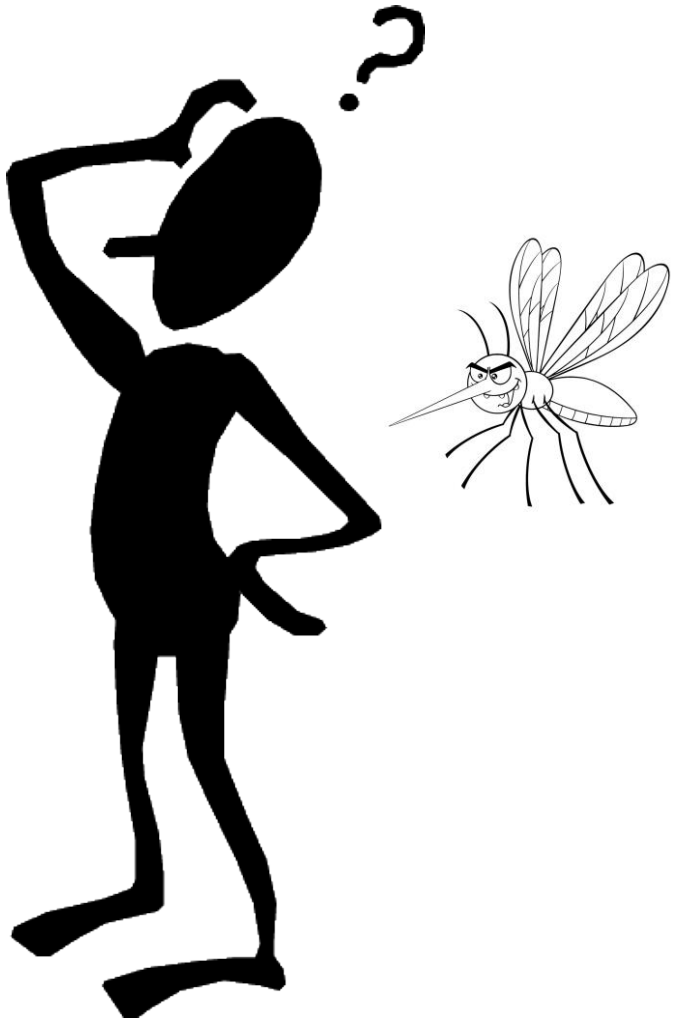
SO WHAT CORRELATED WITH THE PRESENCE OF MOSQUITOES?



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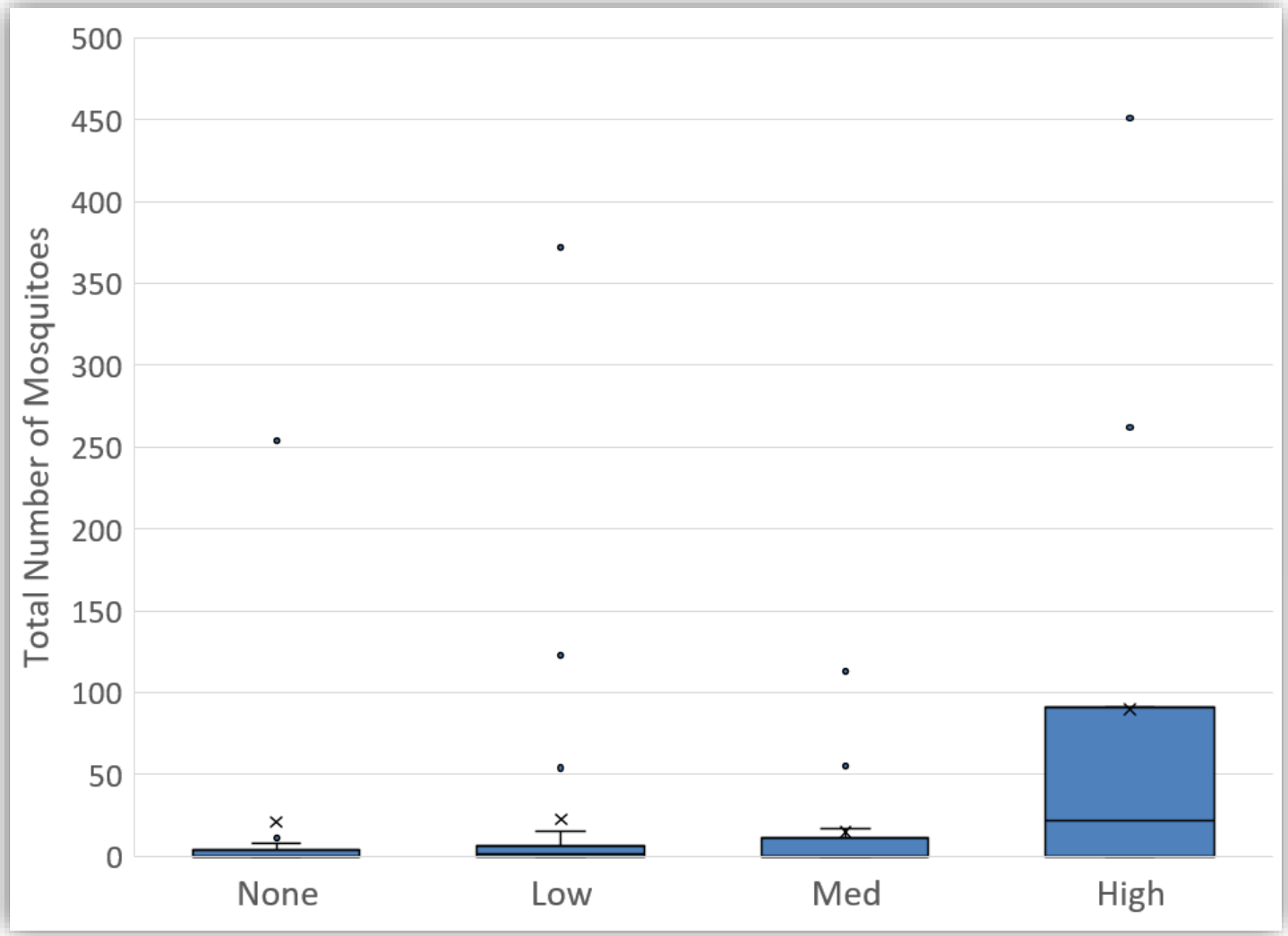
DIRTY GUTTERS = MORE MOSQUITOES ($p=0.02$; $\rho=0.28$)



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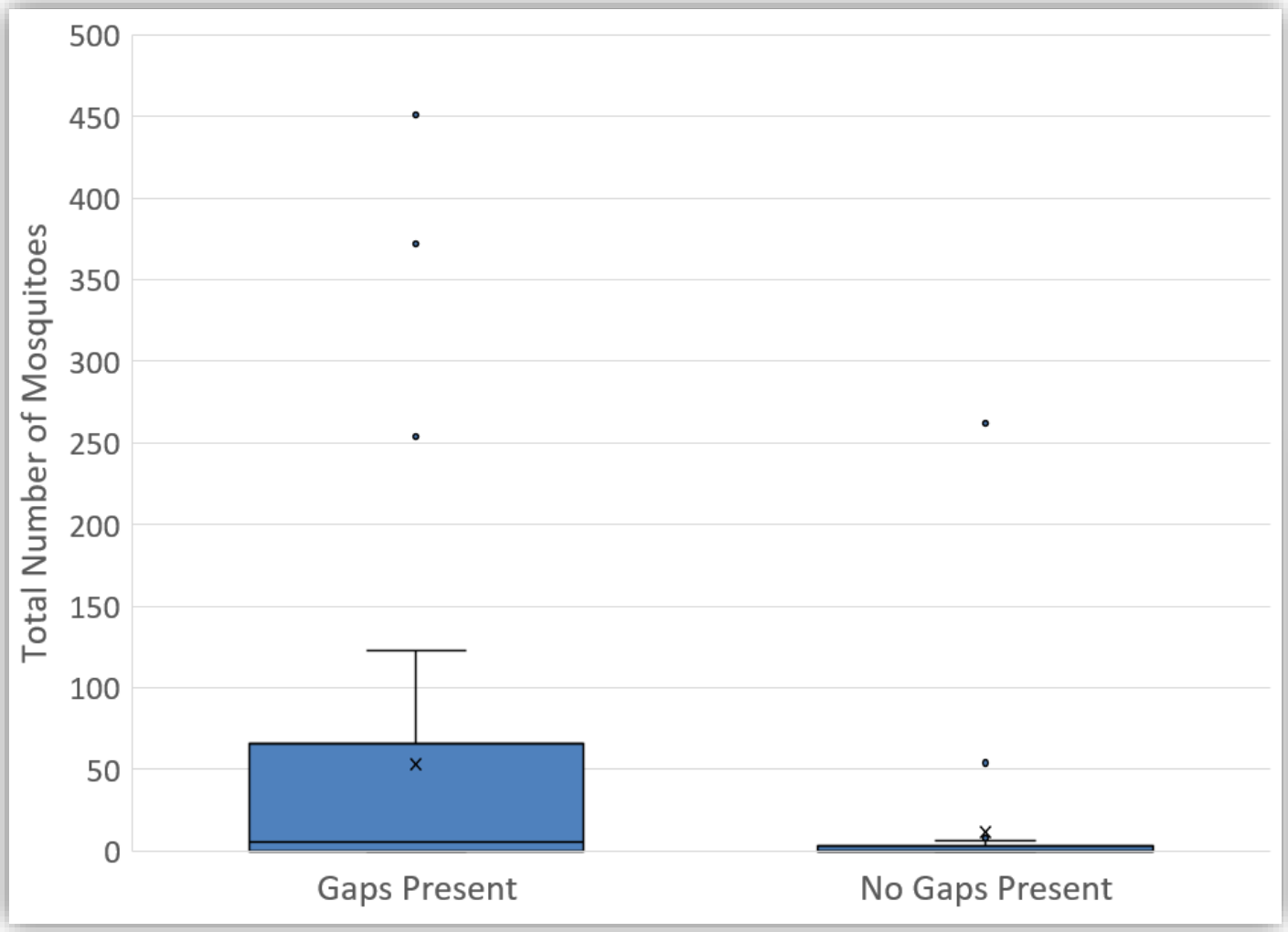
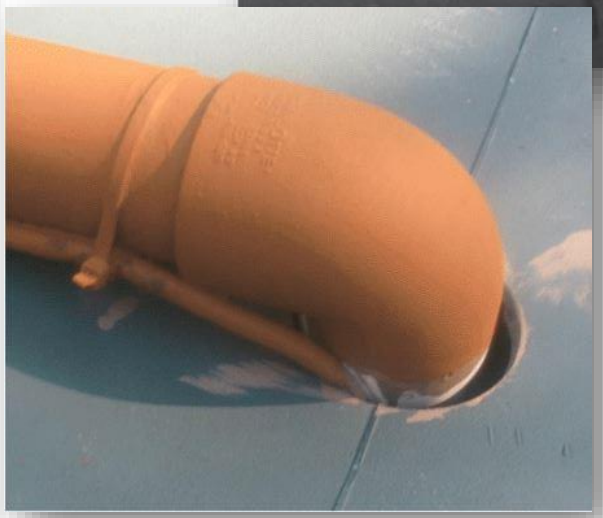
GAPS (ENTRY POINTS INTO CISTERN) = MORE MOSQUITOES ($p=0.003$; $\rho=0.36$)





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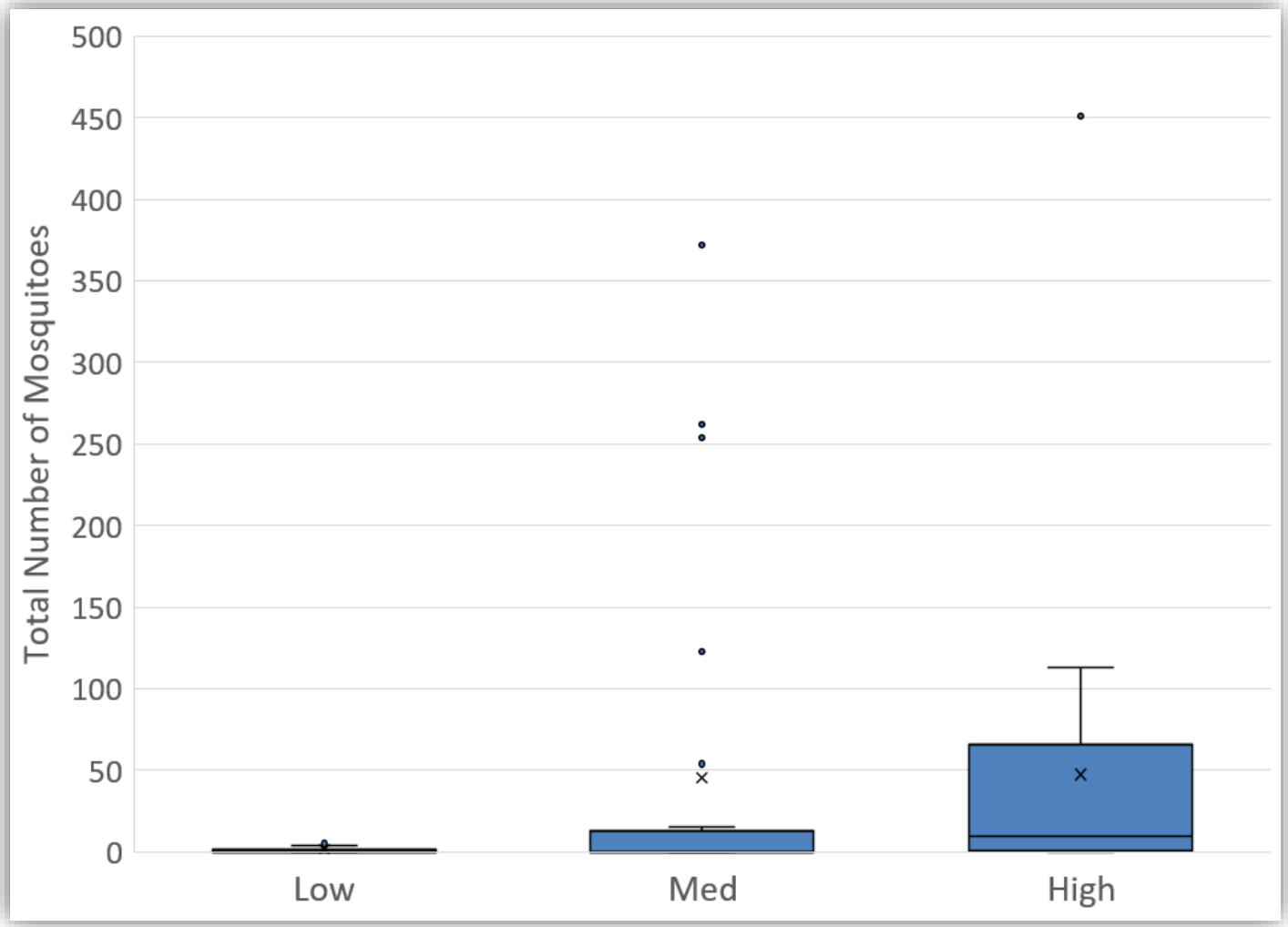
VEGETATION/FOLIAGE = MORE MOSQUITOES ($p=0.001$; $\rho=0.397$)



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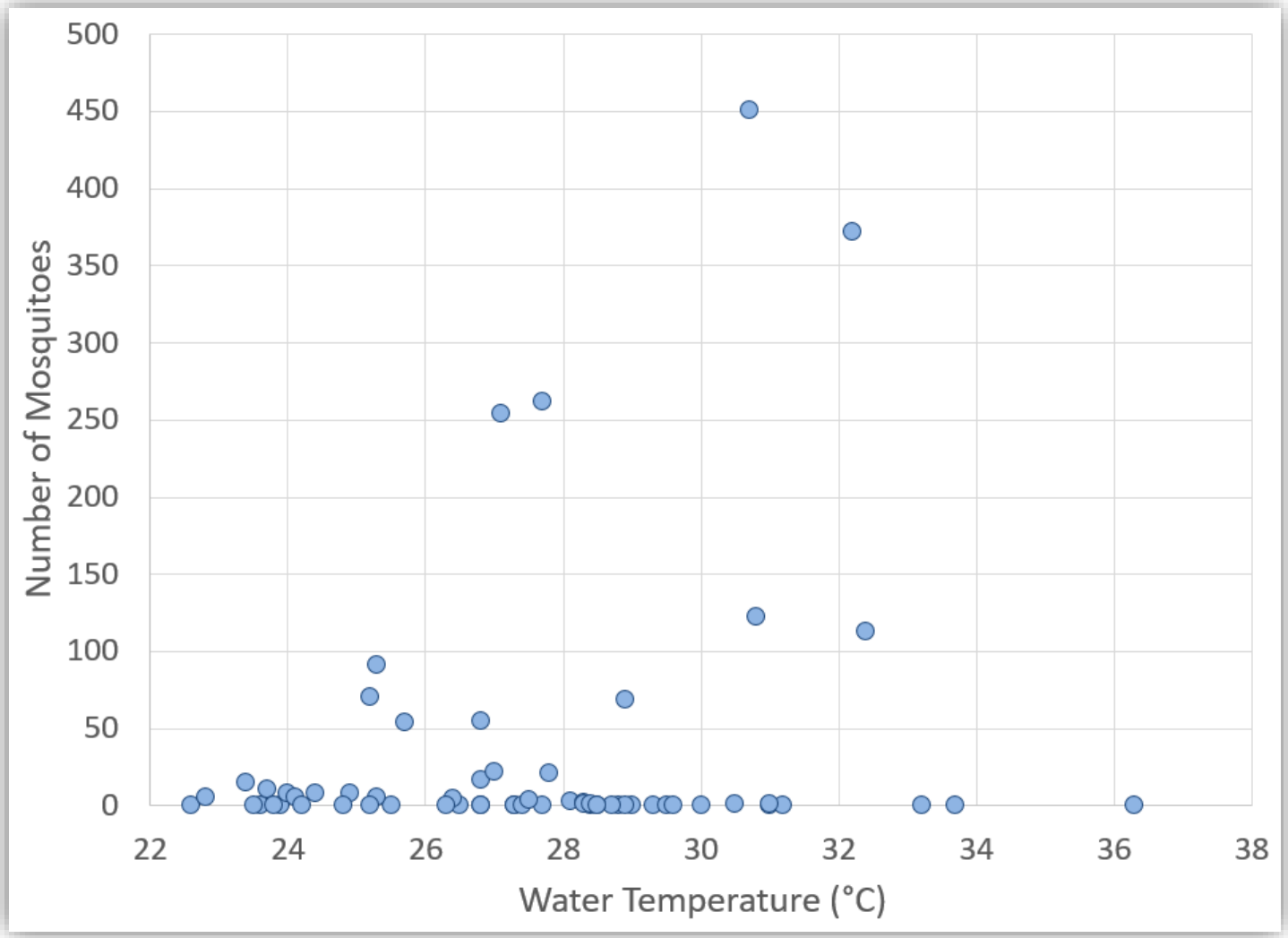
WATER TEMPERATURE ($p=0.019$; $\rho=-0.294$)



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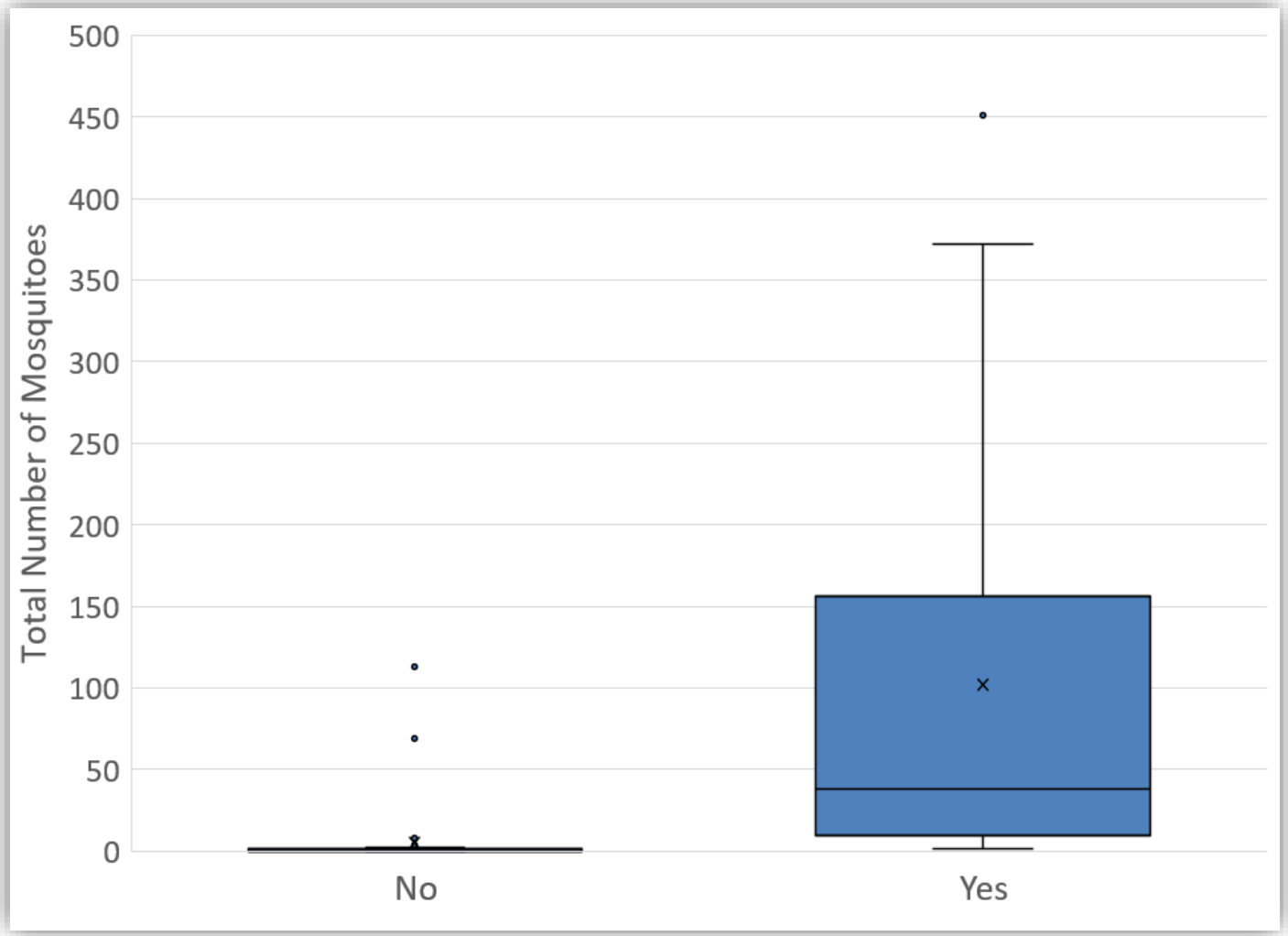
PRESENCE OF MOSQUITOES OUTSIDE THE TANK ($p=0.024$ $\rho=0.282$)



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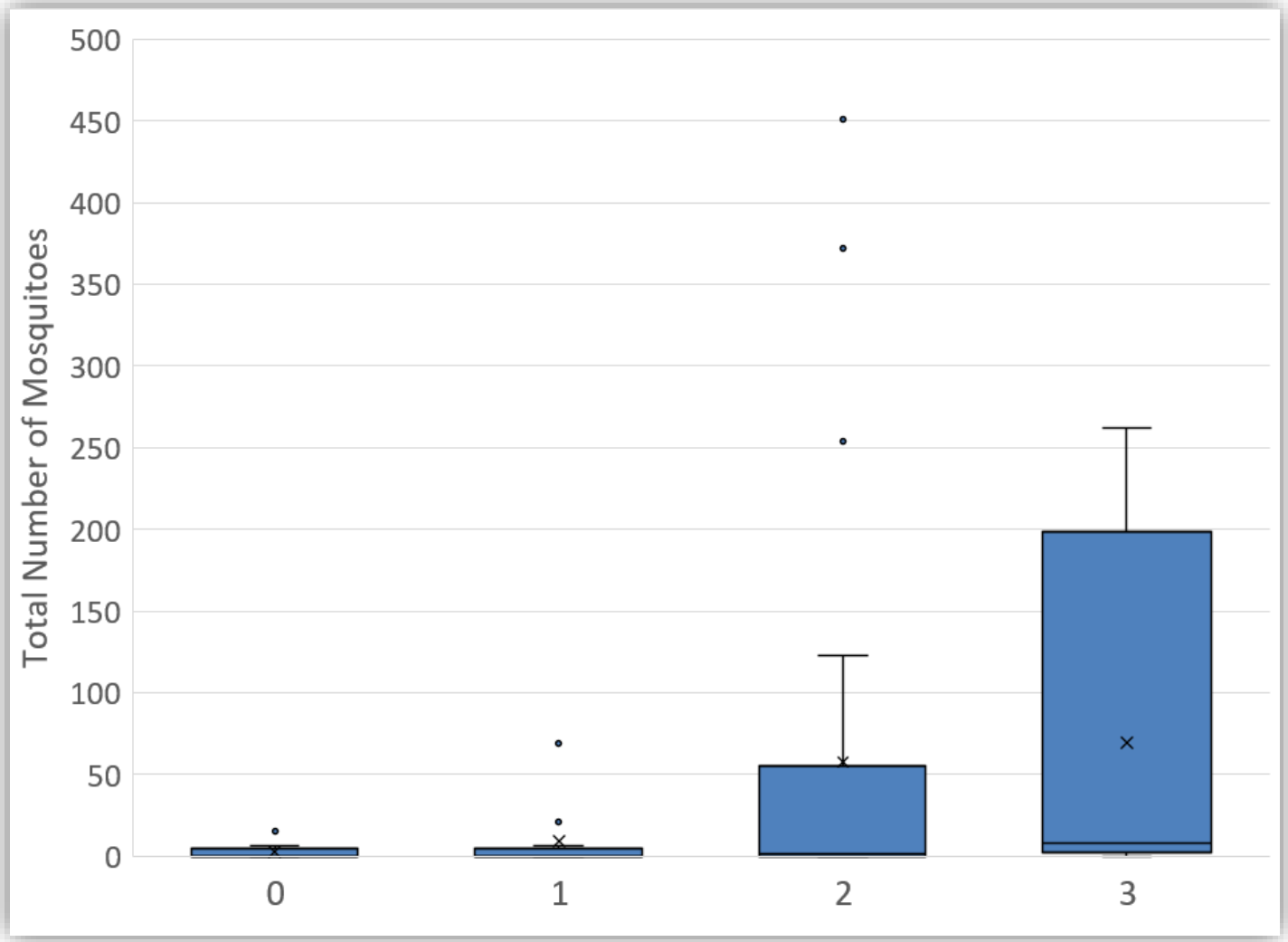
PRESENCE OF INLET FILTERS (p=0.039 ρ=0.261)



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WHAT *DIDN'T* CORRELATE WITH MOSQUITO PRESENCE?

- Standing water around system (p=0.112)
- Frequency of maintenance (p=0.189)
- Overflow length (p=0.214)
- Usage of system (p=0.246)
- Sediment depth in tank (p=0.475)
- pH of water (p=0.394)
- Overflow diameter (p=0.516)
- Debris in water (p=0.619)
- Tank size (p=0.656)

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TOBIT REGRESSION ANALYSIS

	Coefficient	Standardized Coefficient	Marginal Effect	P-value	Significant? (•=0.05)
Intercept	-255.63	-2.28		0.004	✓
Inlet Filters	51.62	0.46	18.23	0.02	✓
Gaps	90.64	0.81	32.01	0.01	✓
Maintenance	-44.40	-0.40	-15.68	0.049	✓
Foliage Density	40.31	0.36	14.24	0.07	
Stagnant Water	62.99	0.56	22.25	0.34	
logSigma	4.72	1.0		<2e-16	✓

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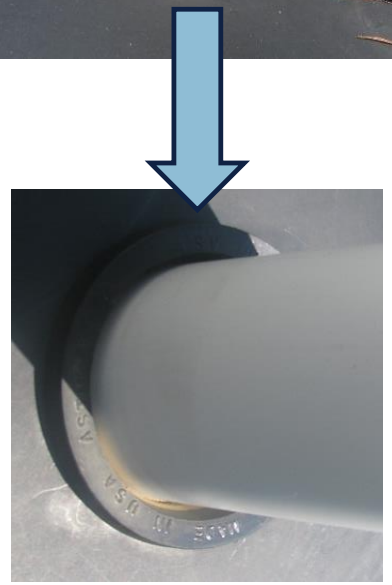
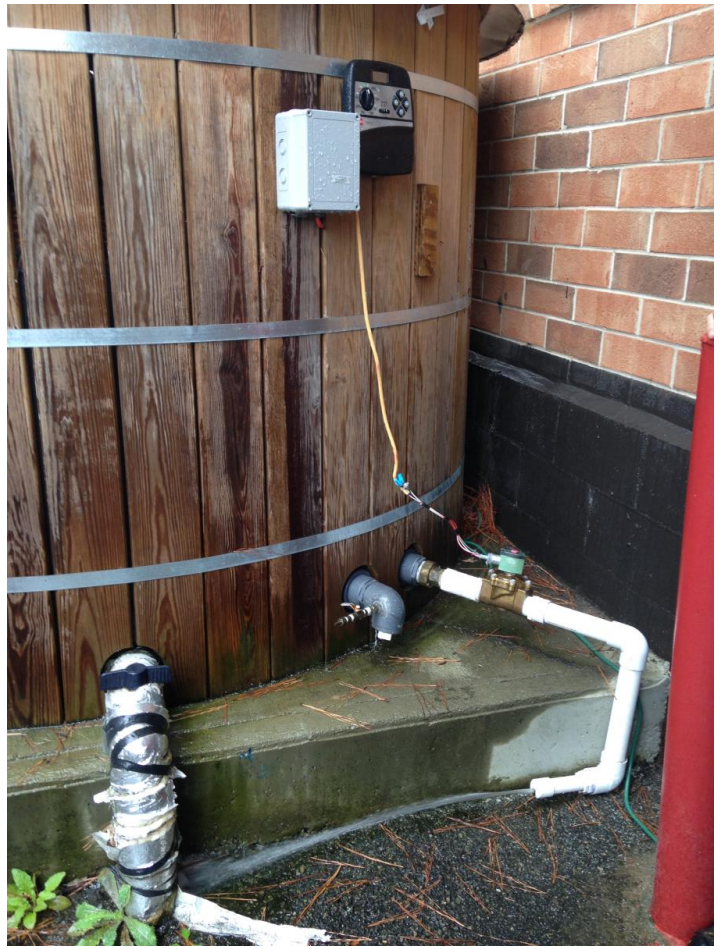
Research Question #1:
Are rainwater harvesting systems contributing to the presence/proliferation of mosquitoes?

ANSWER: In Some Cases

Research Question #2: What Do We Do About It?

WHAT ARE COMMON METHODS OF PREVENTING MOSQUITOES FROM BREEDING IN RWH SYSTEMS?





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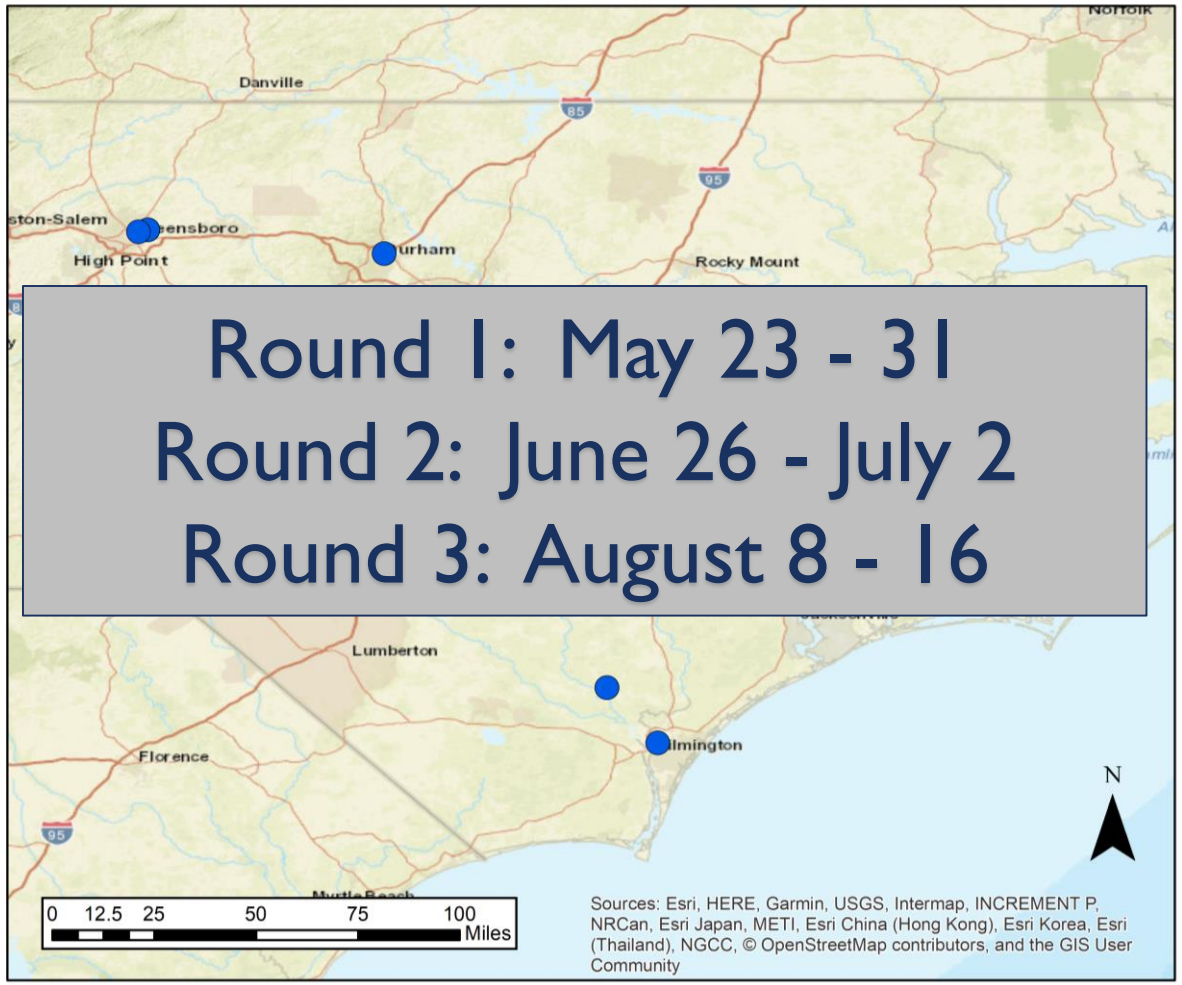
RESEARCH, ROUND 2: SUMMER 2019
BEFORE/AFTER DESIGN, 3 TREATMENTS + CONTROL



- 12 sites with the most mosquitoes found in 2017
- 20 RWH systems
  - 4 – screen & seal
  - 4 – automated drain
  - 4 – larvicide (Dunks)
  - 4 – larvicide (Natular)
  - 4 – control

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SAMPLING PROCEDURE

Larval Sampling Before/After Treatment + Adult Sampling Before/After Treatment

ADULT TRAPS

BioGents (BG) Sentinel Trap

Gravid Trap (Version 1 and 2)

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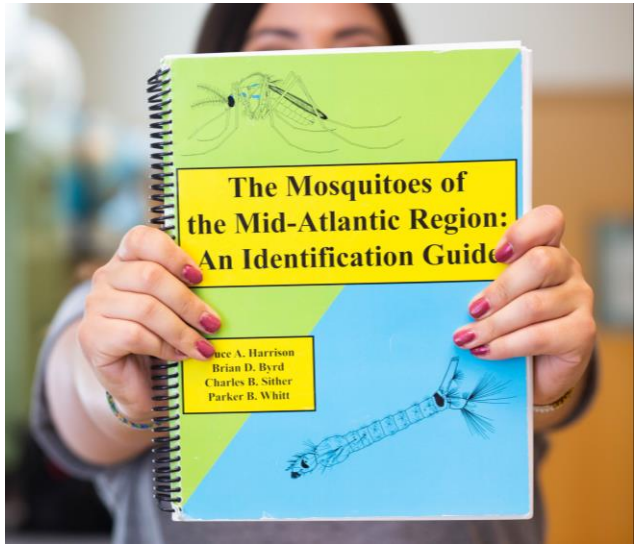
ALL SPECIMENS IDENTIFIED TO GENUS AND SPECIES



Harrison, Bruce A., et al. *The mosquitoes of the Mid-Atlantic region: an identification guide*. Cullowhee, NC: Western Carolina University, 2016.

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OVERALL RESULTS BY SPECIES (ALL ROUNDS)

Species	Larvae	Adults
Aedes albopictus	6163	1932
Aedes hendersoni	1	-
Aedes japonicus	-	18
Aedes triseriatus	-	4
Aedes vexans	-	5
Anopheles crucians	-	2
Anopheles punctipennis	-	16
Anopheles quadrimaculatus	-	2
Culex erraticus	-	68
Cules pipiens	45	555

Species	Larvae	Adults
Culex restuans	2	75
Culex salinarius	23	75
Culex territans	-	3
Psorophora ciliata	-	2
Psorophora columbiae	-	1
Psorophora ferox	-	7
Psorophora howardii	-	2
Coquillettidia perturbans	-	2
Orthopodomyia signifera	-	9
Toxorhynchites rutilus	16	-

Adult Total: 6,250 **Larvae Total: 2,778**

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LARVAE RESULTS BY SPECIES

	Round 1	Round 2	Round 3
Aedes albopictus	3439	1573	1151
Aedes hendersoni	-	1	-
Culex pipiens	45	-	-
Culex restuans	2	-	-
Culex salinarius	3	-	20
Toxorhynchites rutilus	16	-	-
TOTAL	**3505**	**1574**	**1171**

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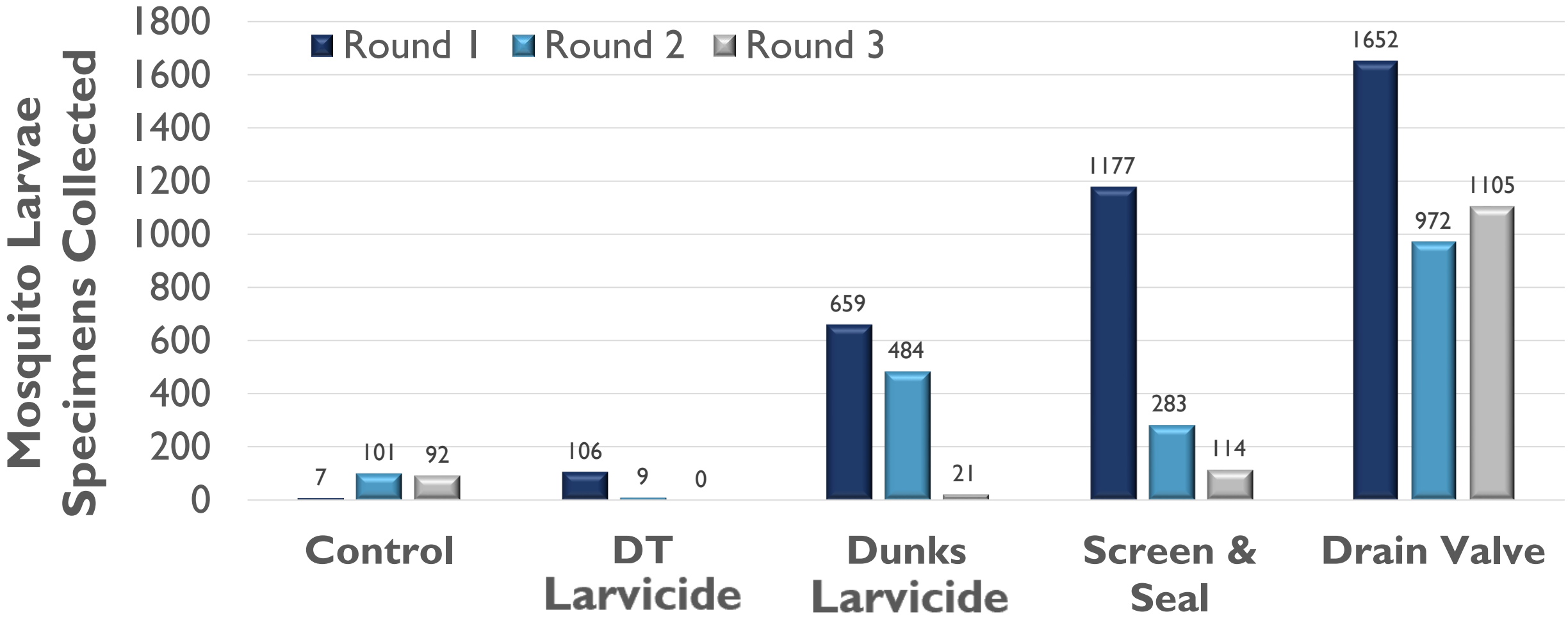
ADULT RESULTS BY SPECIES

Species	Round		
	1	2	3
Aedes albopictus	901	559	472
Aedes hendersoni	-	-	-
Aedes japonicus	6	11	1
Aedes triseriatus	2	2	0
Aedes vexans	-	4	1
Anopheles crucians	2	-	-
Anopheles punctipennis	12	3	1
Anopheles quadrimaculatus	-	-	2
Culex erraticus	38	12	18
Culex pipiens	121	219	215

Species	Round		
	1	2	3
Culex restuans	53	15	7
Culex salinarius	31	27	17
Culex territans	3	-	-
Psorophora ciliata	-	-	2
Psorophora columbiae	-	1	-
Psorophora ferox	-	7	-
Psorophora howardii	-	1	1
Coquillettidia perturbans	-	-	2
Orthopodomyia signifera	1	1	7
Toxorhynchites rutilus	-	-	-

RESULTS – LARVAE COLLECTED FROM STORAGE TANKS



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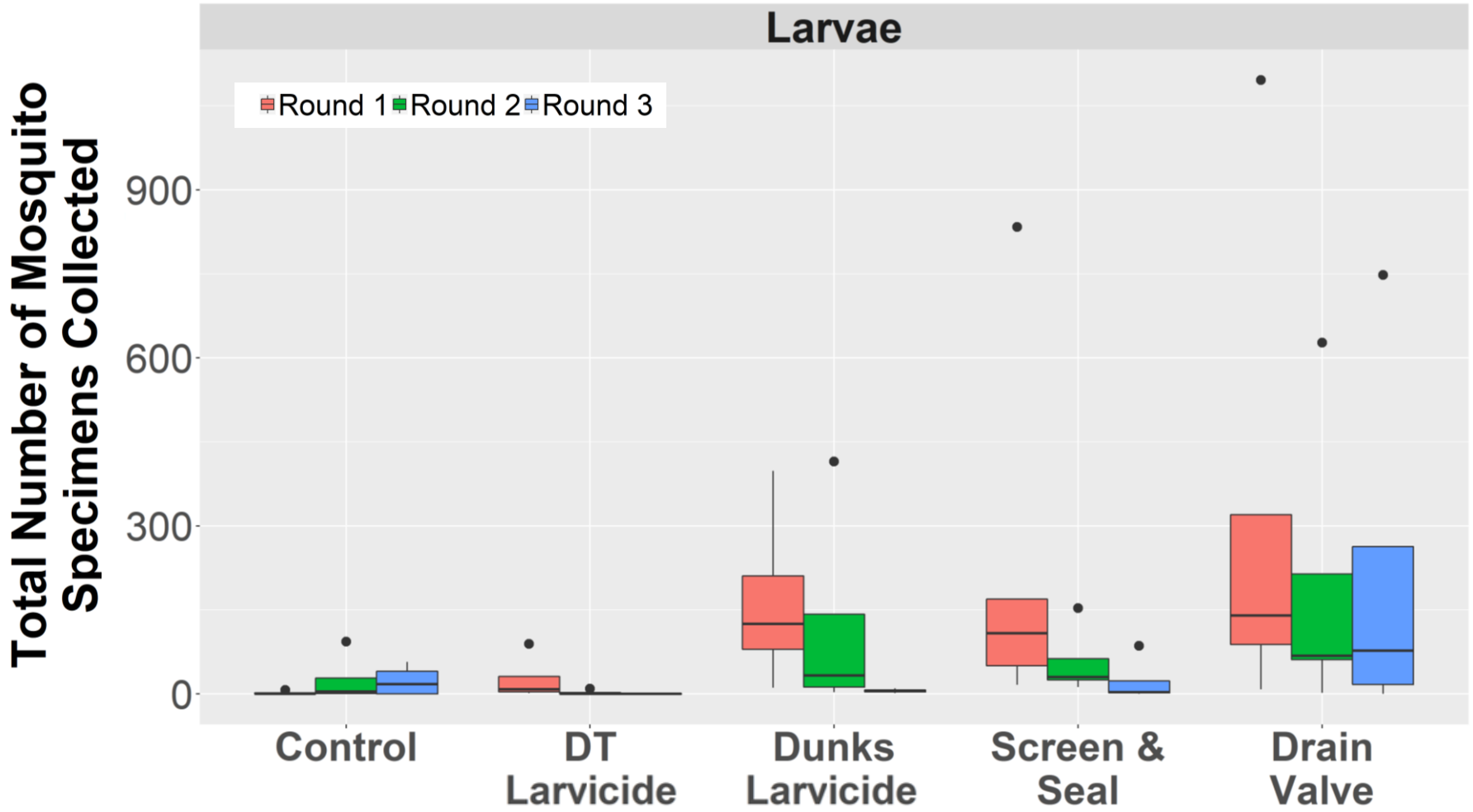

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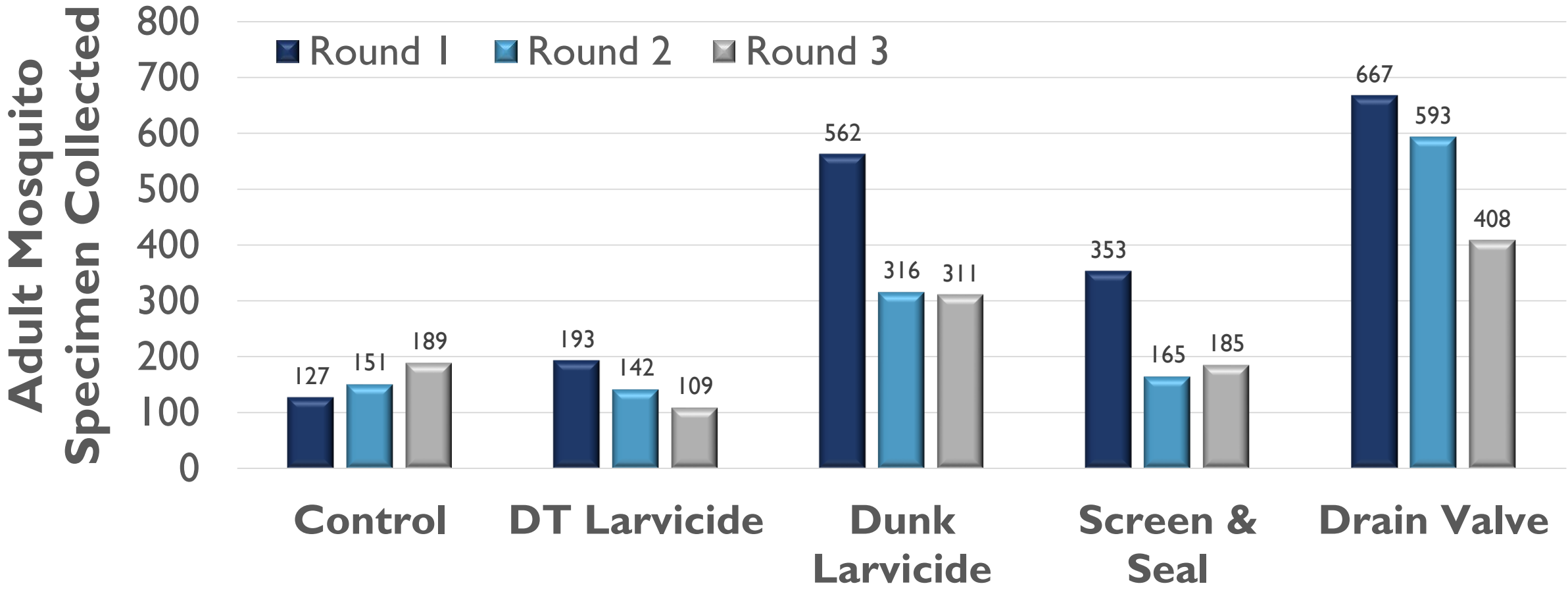
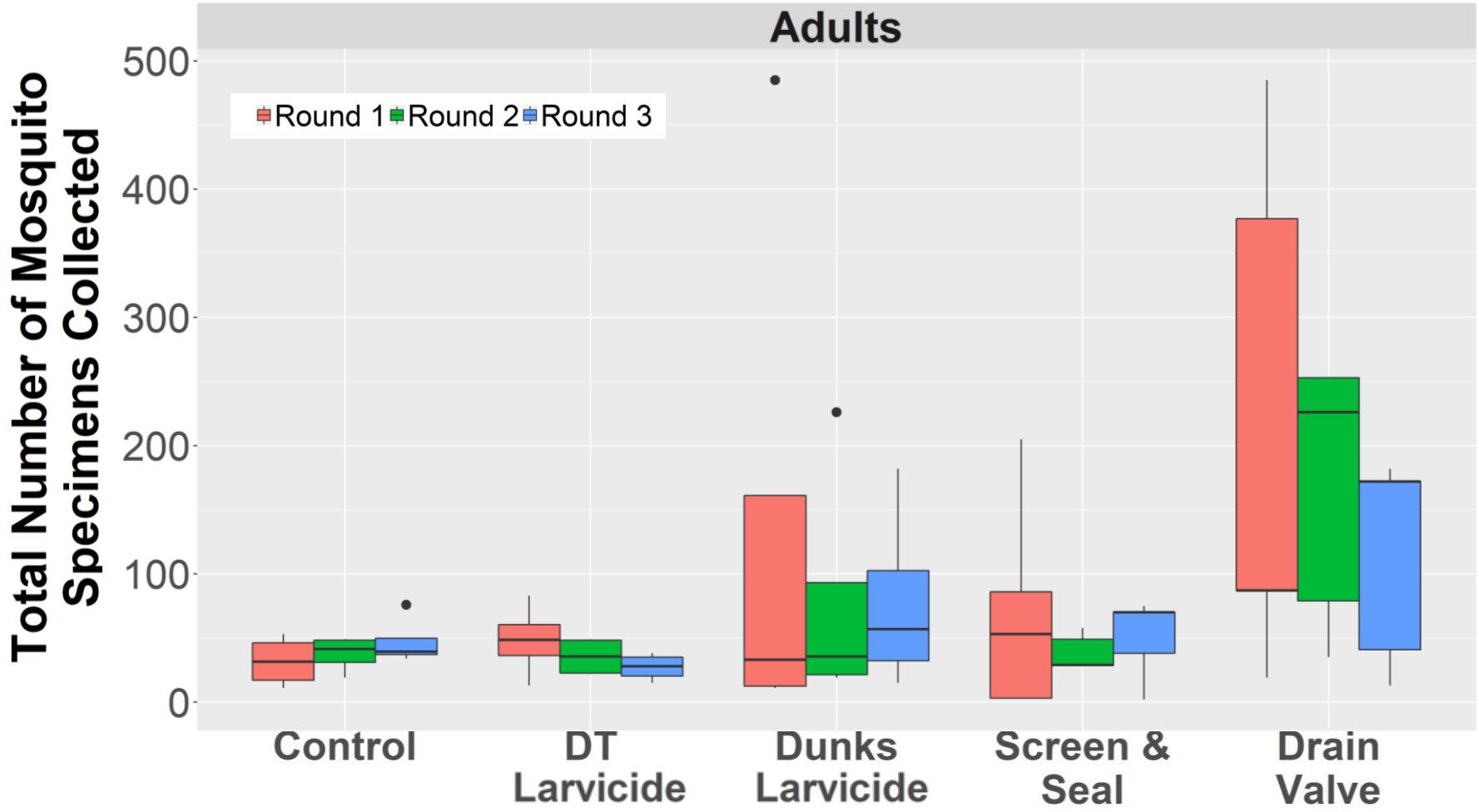
RESULTS – ADULTS COLLECTED FROM SITES



RESULTS – ADULTS COLLECTED FROM SITES



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PRELIMINARY CONCLUSIONS

Natular® DT Larvicide > Mosquito Dunks®>

Screen and Seal > Weekly Drain

- **DT Larvicide, Dunks Larvicide, and Screen/Seal treatments provided significant reductions in larval populations**

- There are pros and cons to each method of treatment
  - Cost
  - Frequency of deployment
  - Complexity of deployment

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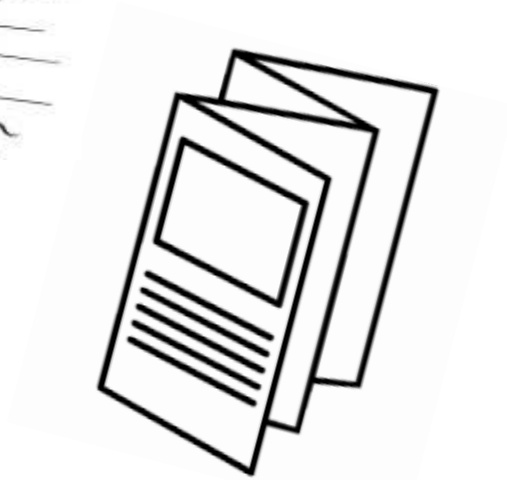
FUTURE DIRECTIONS

- More statistical analyses
- Developing recommendations for RWH system owners
- Publishing work in several formats
  - (extension fact sheet, peer-reviewed journal article)



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- Longwood PRISM Program (2017, 2019)
- Longwood Faculty Research Development Grants (2017, 2019)
- Virginia Academy of Science (2017)
- Longwood University Office of Student Research (2017, 2019)
- City of Chesapeake, VA (2019)

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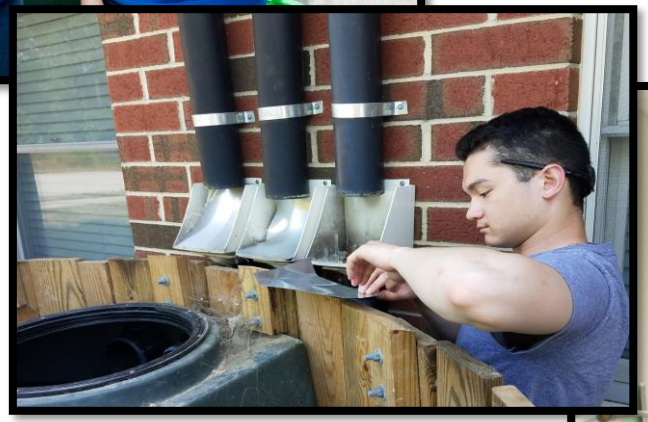
- Charlotte Pfamatter
- Kaitlyn Dobyns & Kyrsten Gage
- All RWH system owners
- Mitch Woodward
- Shawn Kennedy
- Dr. David Lehr
- Janice Pulver, Betsy Hodson

THANK YOU!

QUESTIONS/MORE INFO?

geekd@longwood.edu



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