Update on USA autocidal Aedes field trials, including regulatory activities

Stephen Dobson

December 5, 2017
Technical Advisory Group on Entomology in Public Health and Vector Control (TAG PHEVC)

Washington D.C., USA

Year	*Ae. aegypti*		*Ae. albopictus*	
	Wolbachia	**ADAM**	**Wolbachia**	**ADAM**
2014			KY	KY
2015		CA	KY, CA, NY	KY, CA
2016	CA	CA, FL	EPA Evaluation	FL, CA
2017	CA, FL	EPA Evaluation	*Section 3*	EPA Evaluation

Autocidal Approaches

Classical Genetics

(Female Killing Translocations, etc.)

Classical **Sterile Insect Technique** via irradiation

Wolbachia

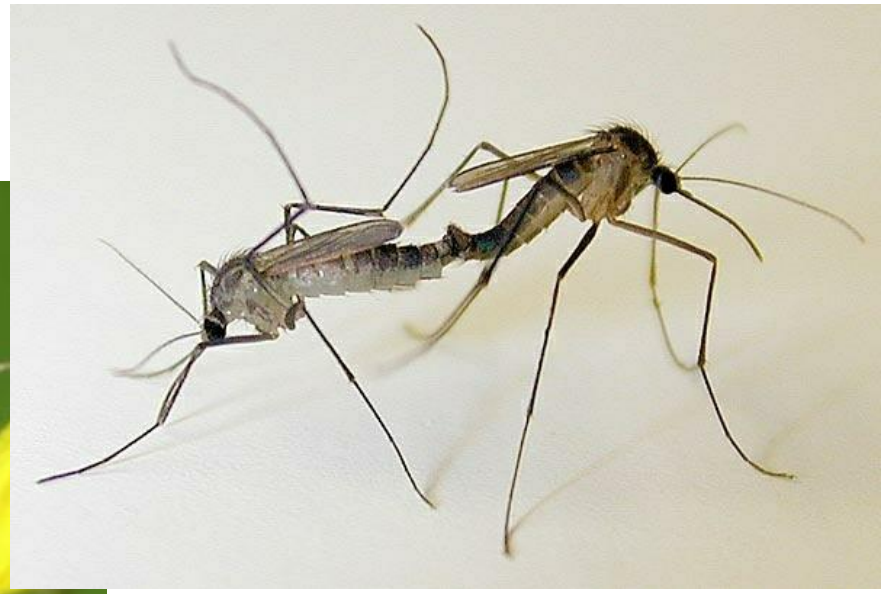
Population replacement

Population suppression

Genetic Modification

RIDL suppression

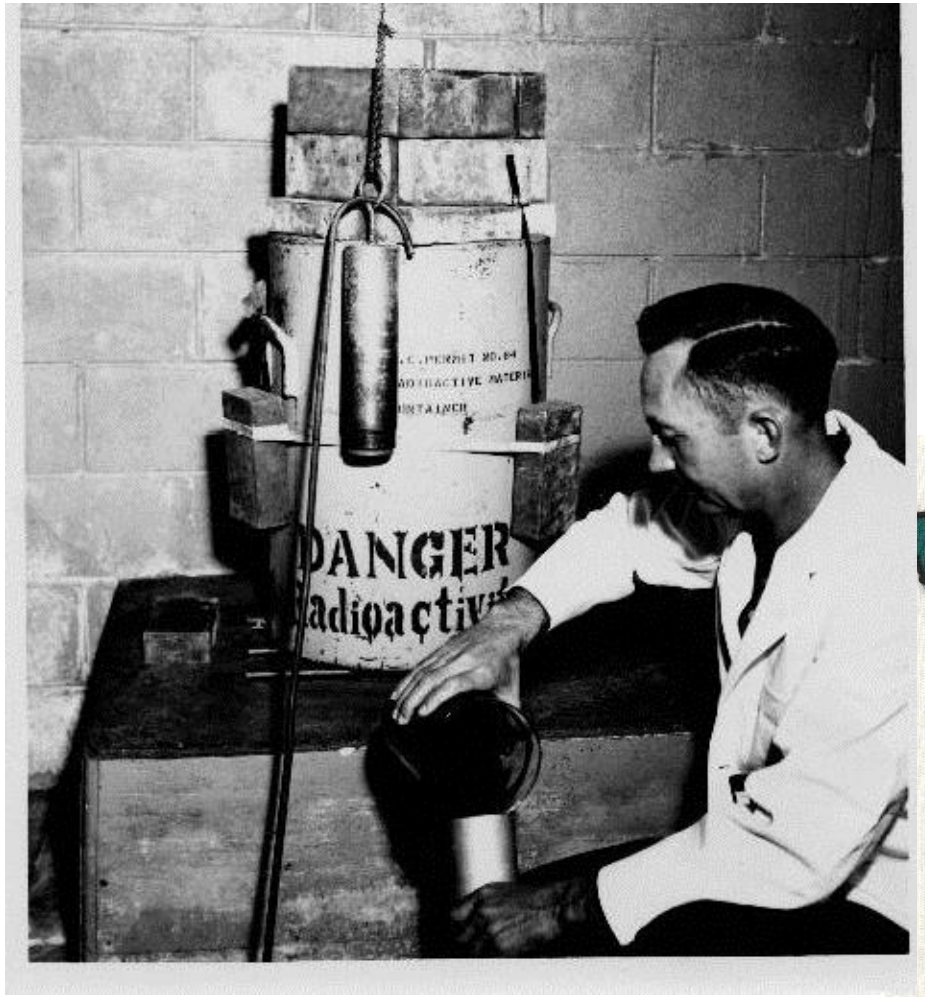
Male mosquitoes are good at finding females



Male mosquitoes don’t bite people…

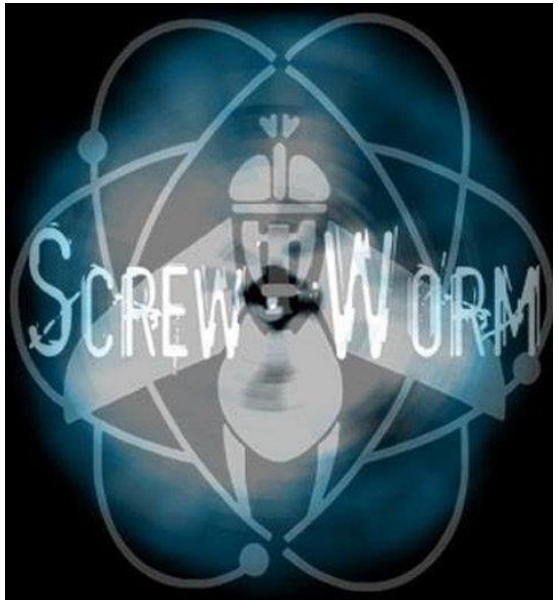
…or transmit pathogens that cause human disease

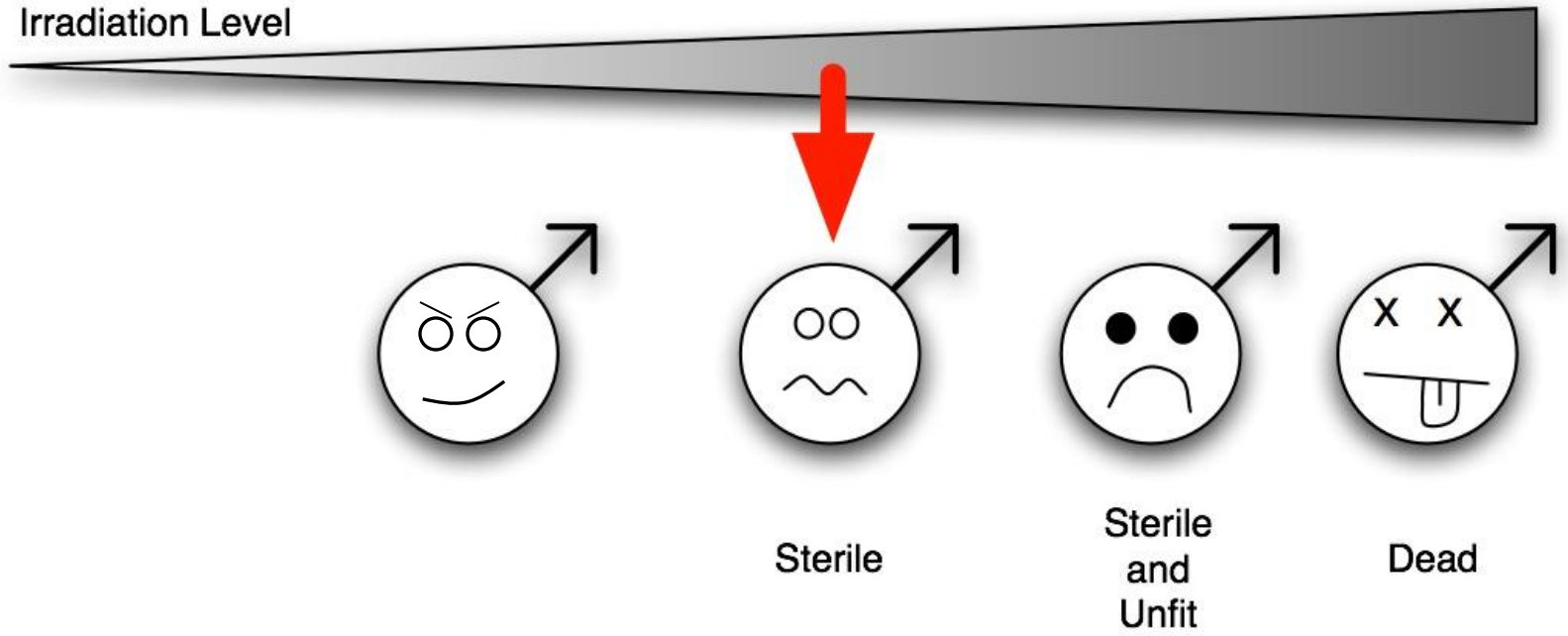
Sterile Insect Technique



Classical **Sterile Insect Technique** via Irradiation … several success stories in agriculture.

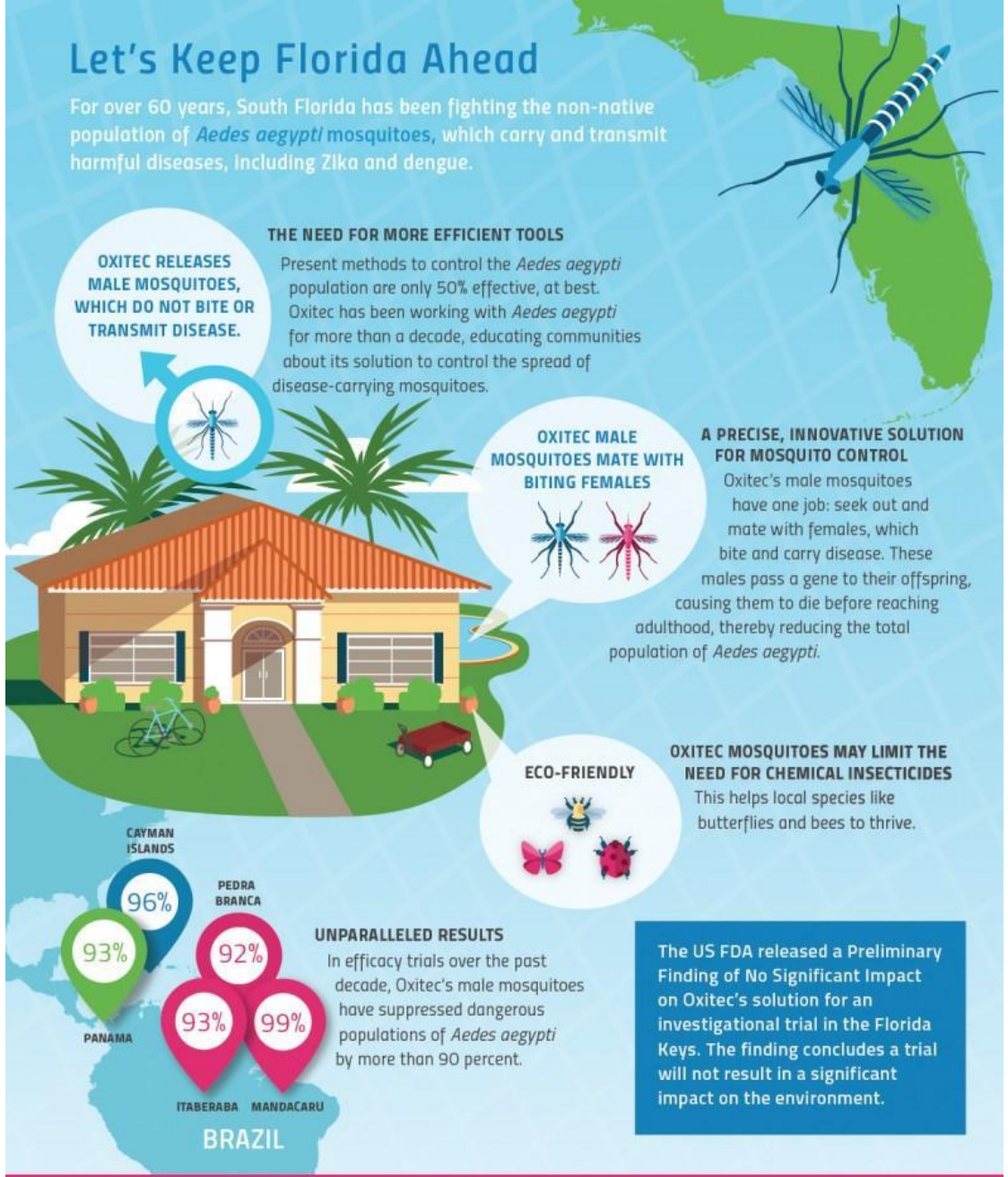
- Screw Worm Fly
- Mediteranean Fruit Fly
- Pink Boll Worm




Irradiation Level
Sterile
Sterile and Unfit
Dead

Let's Keep Florida Ahead

For over 60 years, South Florida has been fighting the non-native population of *Aedes aegypti* mosquitoes, which carry and transmit harmful diseases, including Zika and dengue.



THE NEED FOR MORE EFFICIENT TOOLS

Present methods to control the *Aedes aegypti* population are only 50% effective, at best. Oxitec has been working with *Aedes aegypti* for more than a decade, educating communities about its solution to control the spread of disease-carrying mosquitoes.

A PRECISE, INNOVATIVE SOLUTION FOR MOSQUITO CONTROL

Oxitec's male mosquitoes have one job: seek out and mate with females, which bite and carry disease. These males pass a gene to their offspring, causing them to die before reaching adulthood, thereby reducing the total population of *Aedes aegypti*.

OXITEC MOSQUITOES MAY LIMIT THE NEED FOR CHEMICAL INSECTICIDES

This helps local species like butterflies and bees to thrive.

UNPARALLELED RESULTS

In efficacy trials over the past decade, Oxitec's male mosquitoes have suppressed dangerous populations of *Aedes aegypti* by more than 90 percent.

The US FDA released a Preliminary Finding of No Significant Impact on Oxitec's solution for an investigational trial in the Florida Keys. The finding concludes a trial will not result in a significant impact on the environment.

Learn more about eco-friendly mosquito control in Florida

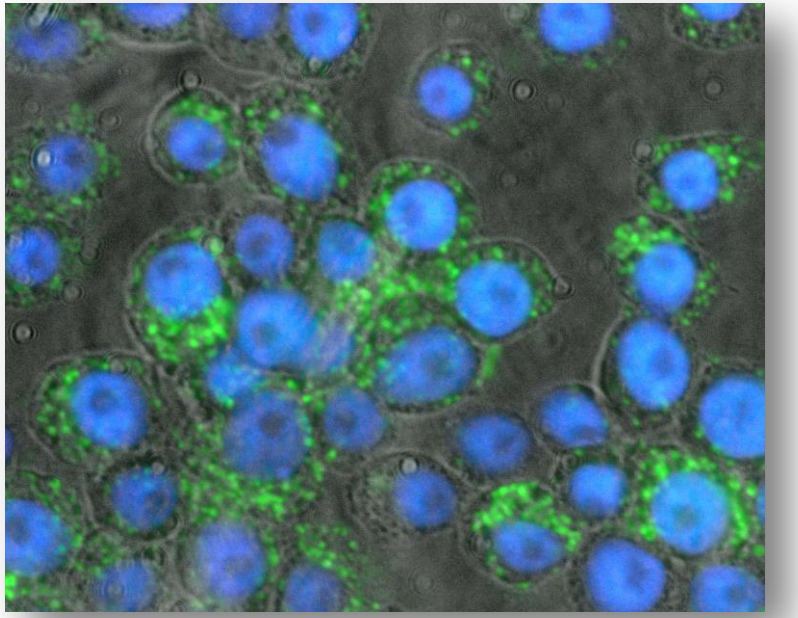
oxitec.com | info@oxitec.com | @oxitec | facebook.com/oxitec

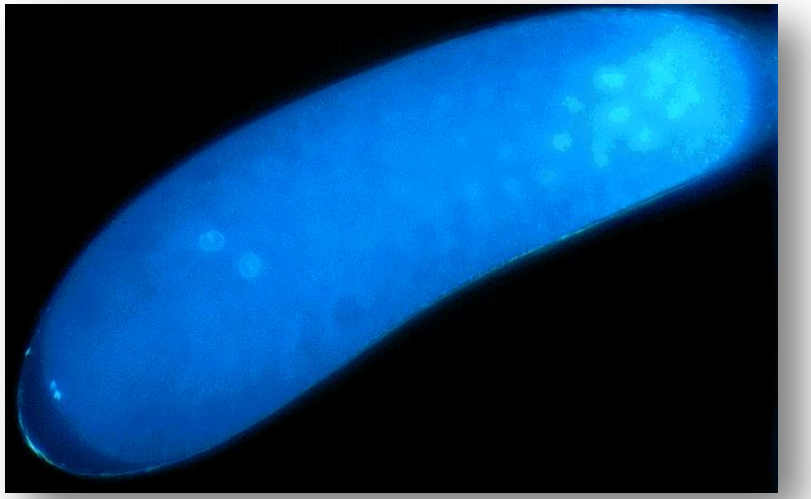
OXITEC

SOURCES: Center for Disease Control | World Health Organization | Florida Department of Health | U.S. Food & Drug Administration Center for Veterinary Medicine

OXITEC

Part I – Background Information; Wolbachia Characterization





Wolbachia-based Strategies

- Population Replacement
  - Release of *Wolbachia* infected **females**
  - Goal: **NOT intended as a pesticide**; no reduction of the *Ae. aegypti* population
  - Goal: **infect local populations** of mosquitoes with *Wolbachia*, which is intended to interfere with virus transmission

- Wolbachia Suppression
  - Release of *Wolbachia* infected **males**
  - Goal: **reduce mosquito densities** with sterile male releases (similar to insecticides)
    - *Aedes albopictus*
    - *Aedes aegypti*

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Self-sustaining **Potential virus selection** **Other viruses?**

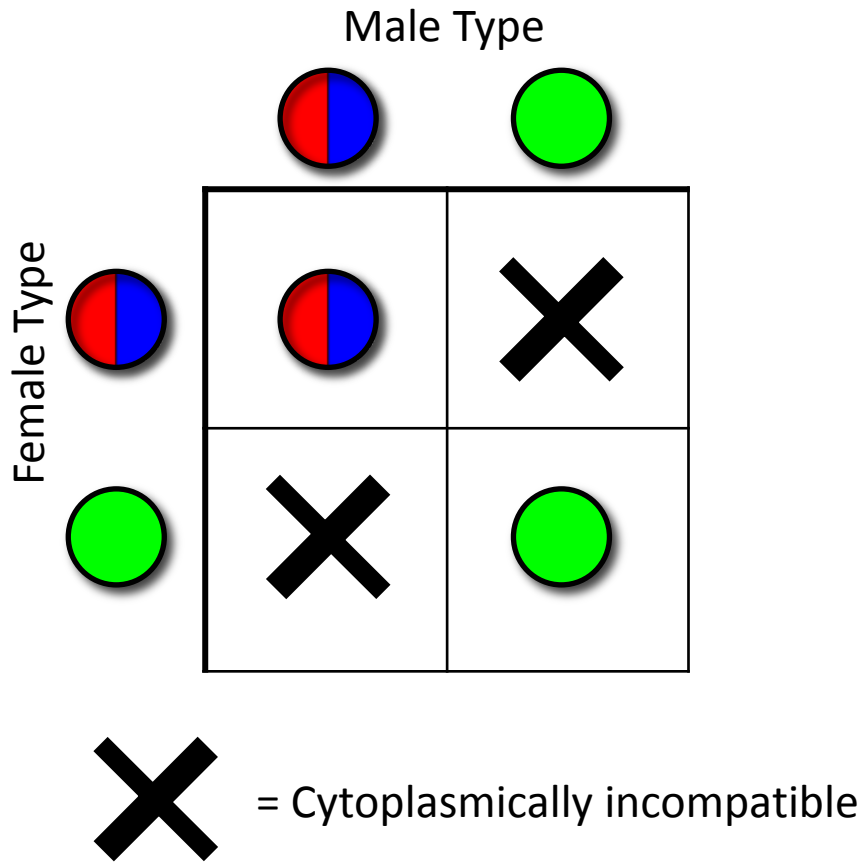
Interference: Fitness Costs

- Wolbachia Suppression
  - Release of *Wolbachia* infected **males**
  - Goal: **reduce mosquito densities** with sterile male releases (similar to insecticides)
    - *Aedes albopictus*
    - *Aedes aegypti*

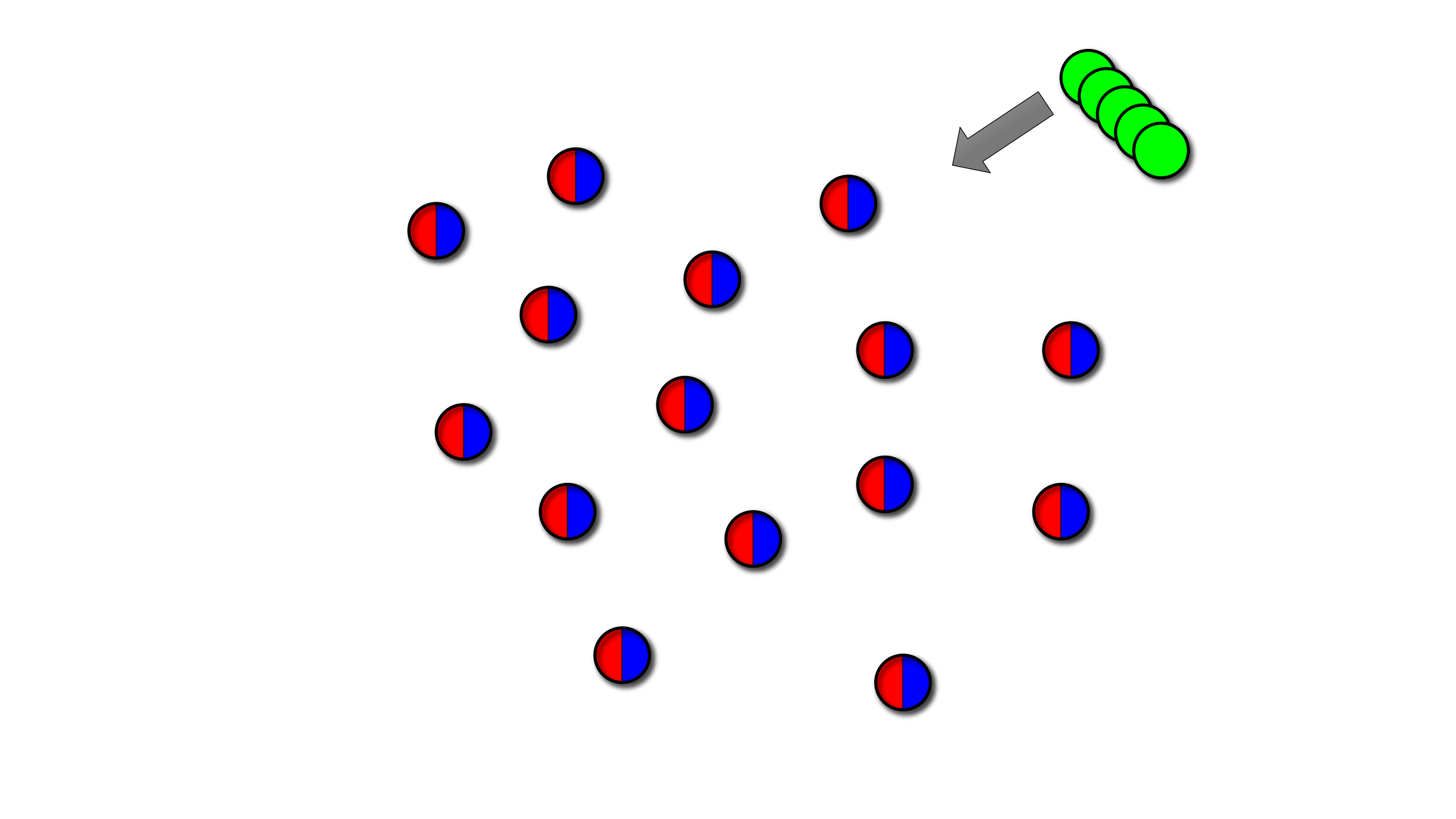
Not self-sustaining (unless achieve elimination)

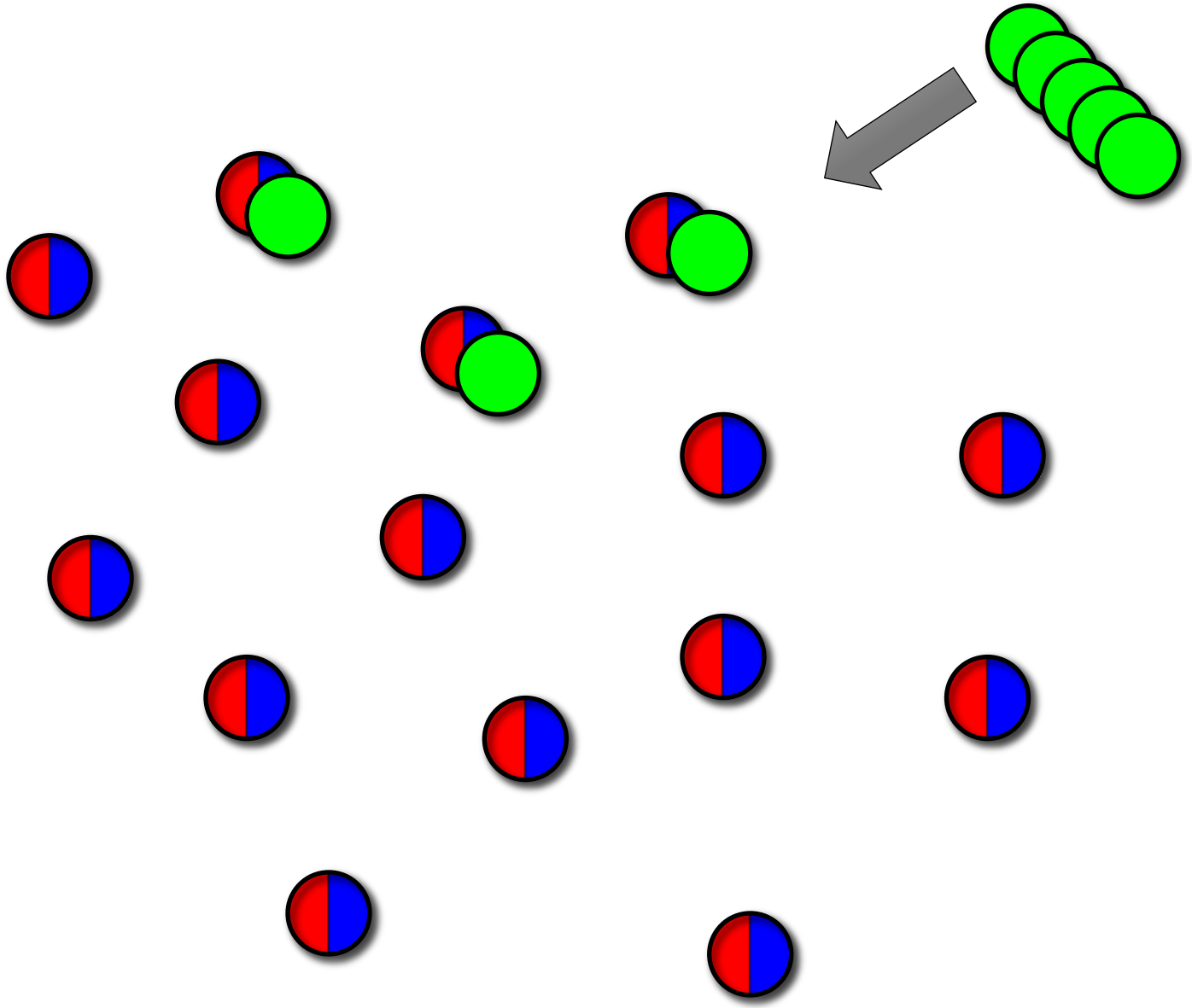
Successful examples of SIT

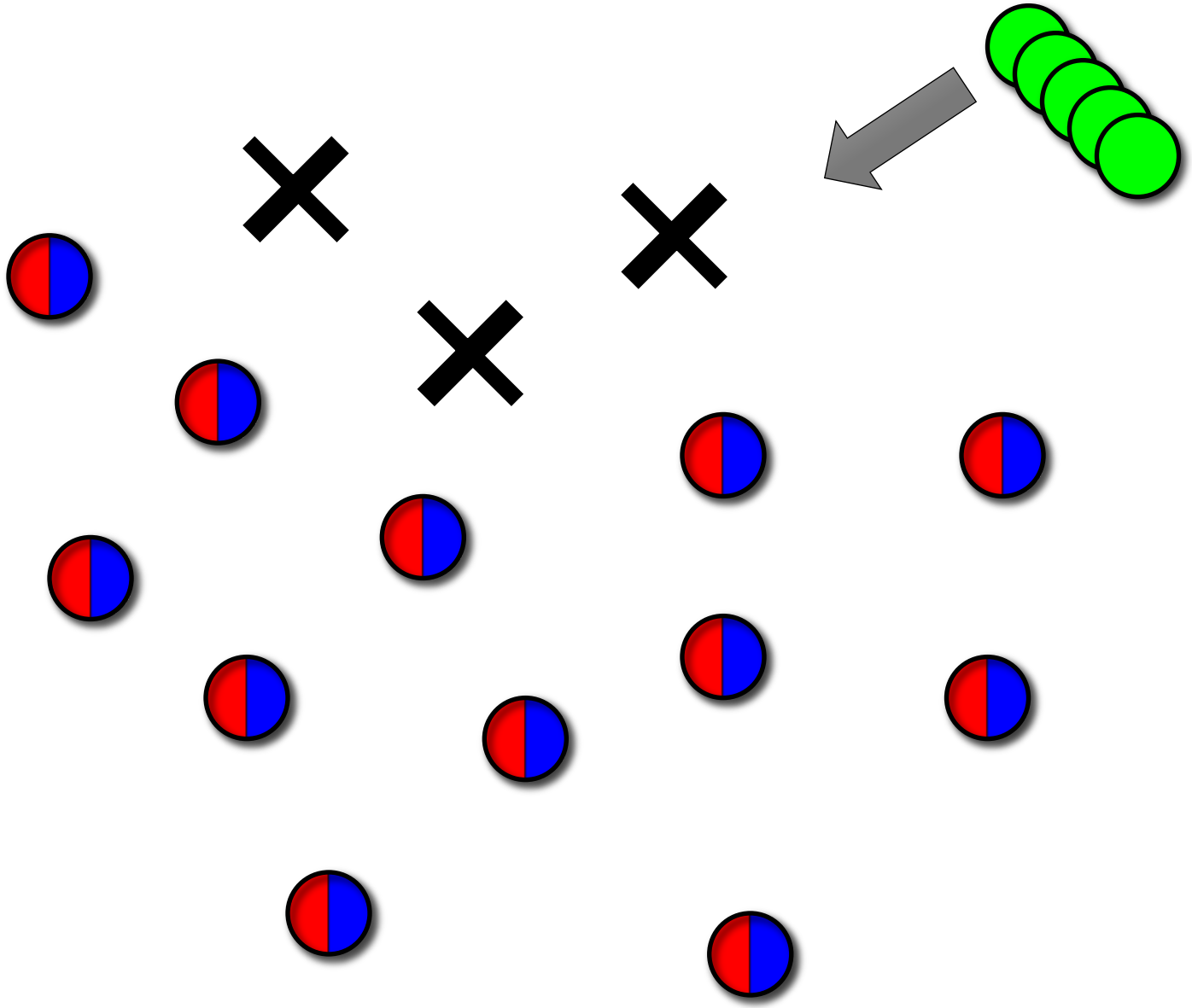
Wolbachia does not negatively effect male fitness

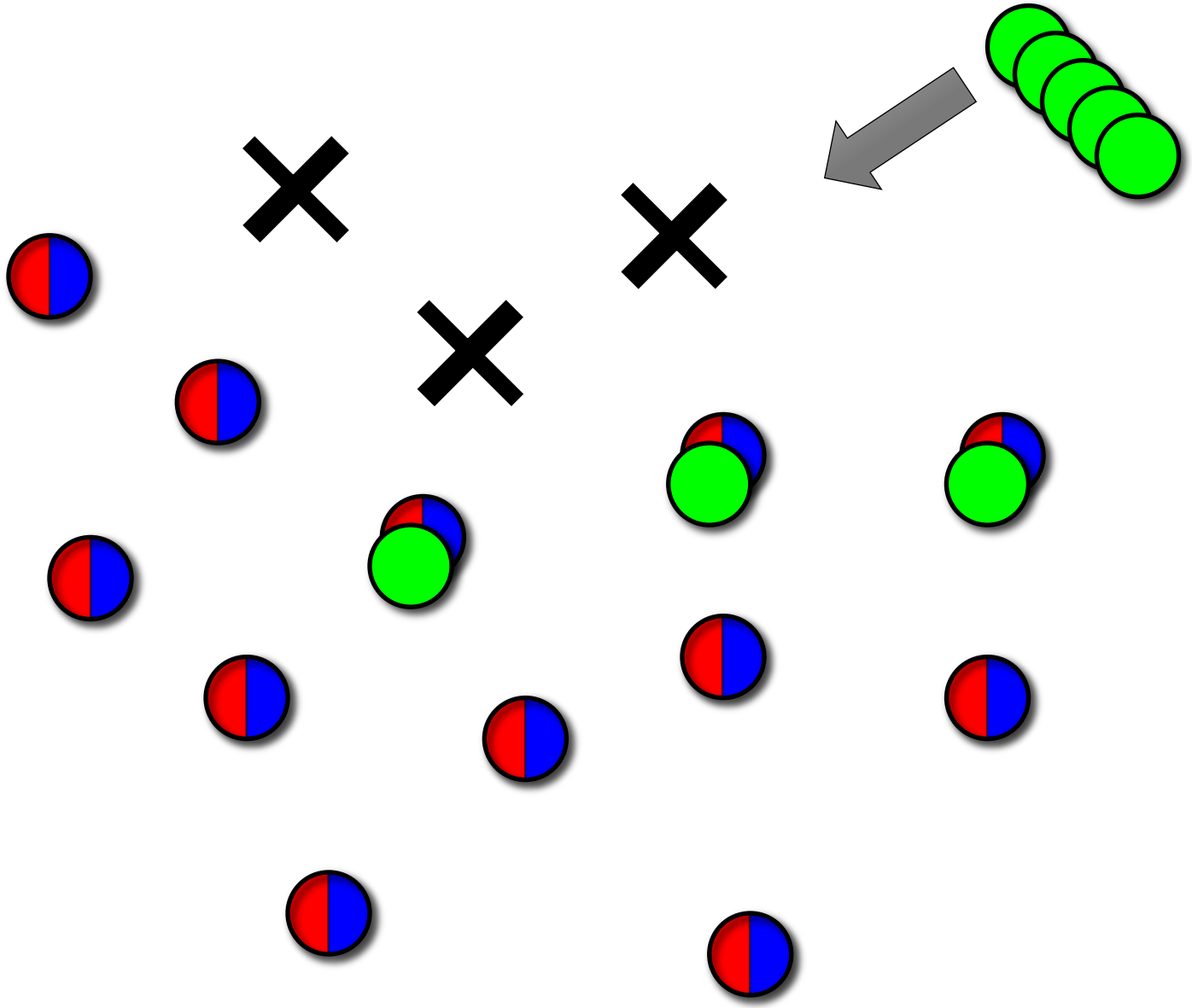


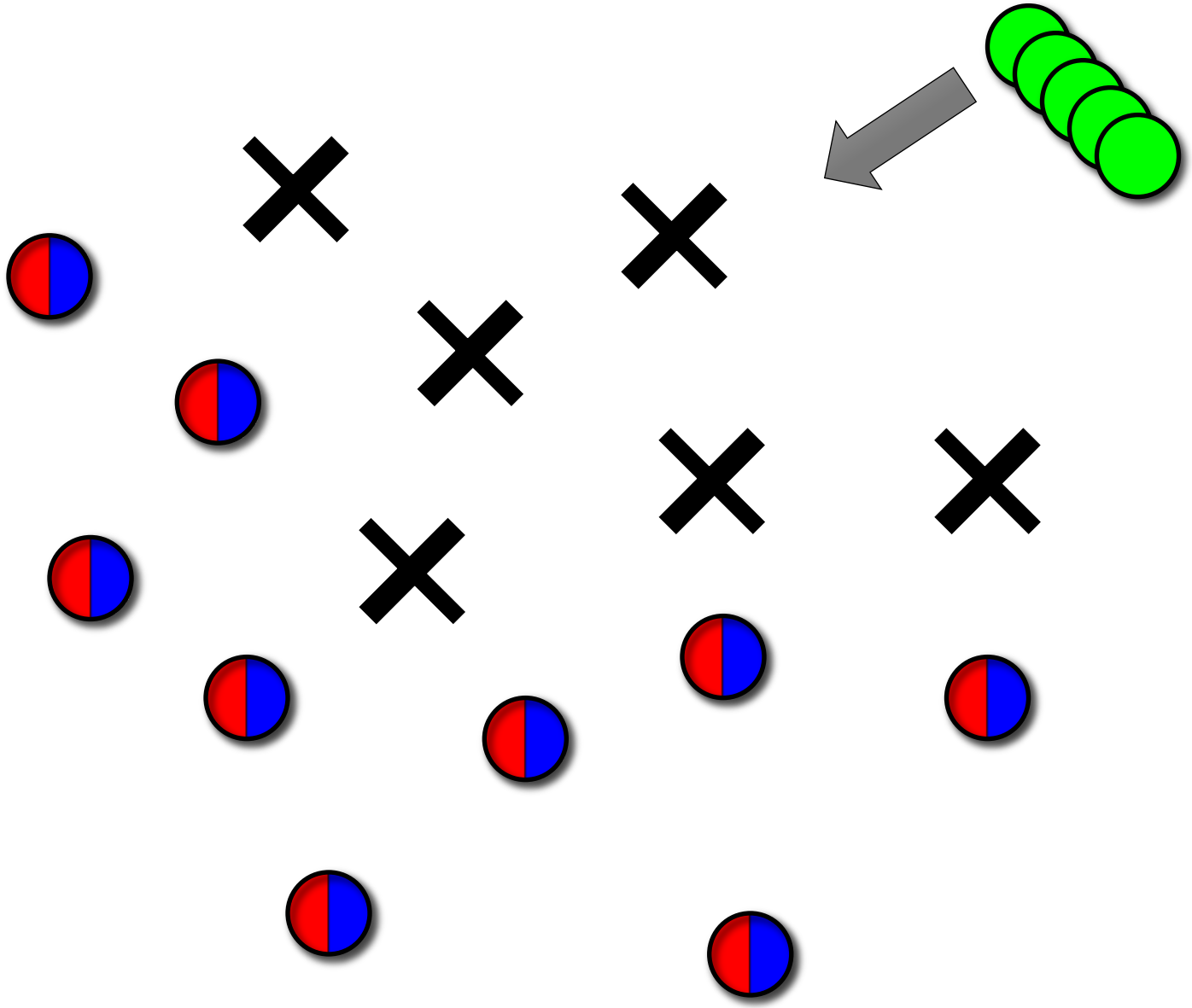
We’re Done with Injections!!

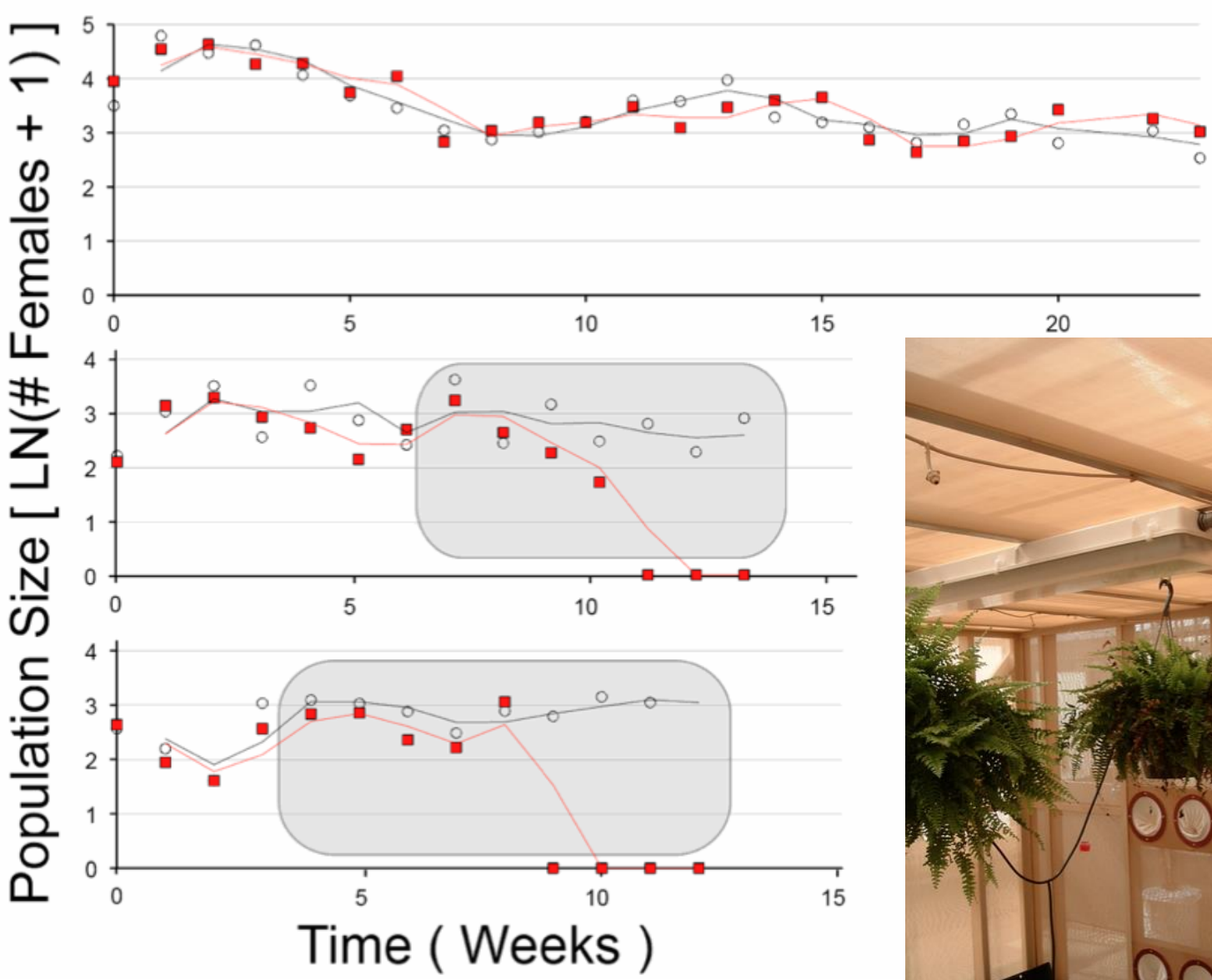











Population Size [LN(# Females + 1)]
Time (Weeks)
0
1
2
3
4
5
0
5
10
15
20

Regulatory Consideration – Wolbachia Microbial Pesticide

U.S. ENVIRONMENTAL PROTECTION AGENCY

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Biopesticides and Pollution Prevention Division Contacts

Biopesticides and Pollution Prevention Division (BPPD) is responsible for all regulatory activities associated with biologically-based pesticides. BPPD activities also include work to reduce pesticide risks by promoting integrated pest management and coordinating the Pesticide Environmental Stewardship Program and Strategic Agricultural Initiative.

Name	E-Mail	Phone	Area of Responsibility
Division Director's Office Fax: 703-308-7026			
Keith Matthews	matthews.keith@epa.gov	703-308-8712	Director
Mike McDavit	mcdavit.michael@epa.gov	703-305-7761	Associate Division Director

Questions/Comments?

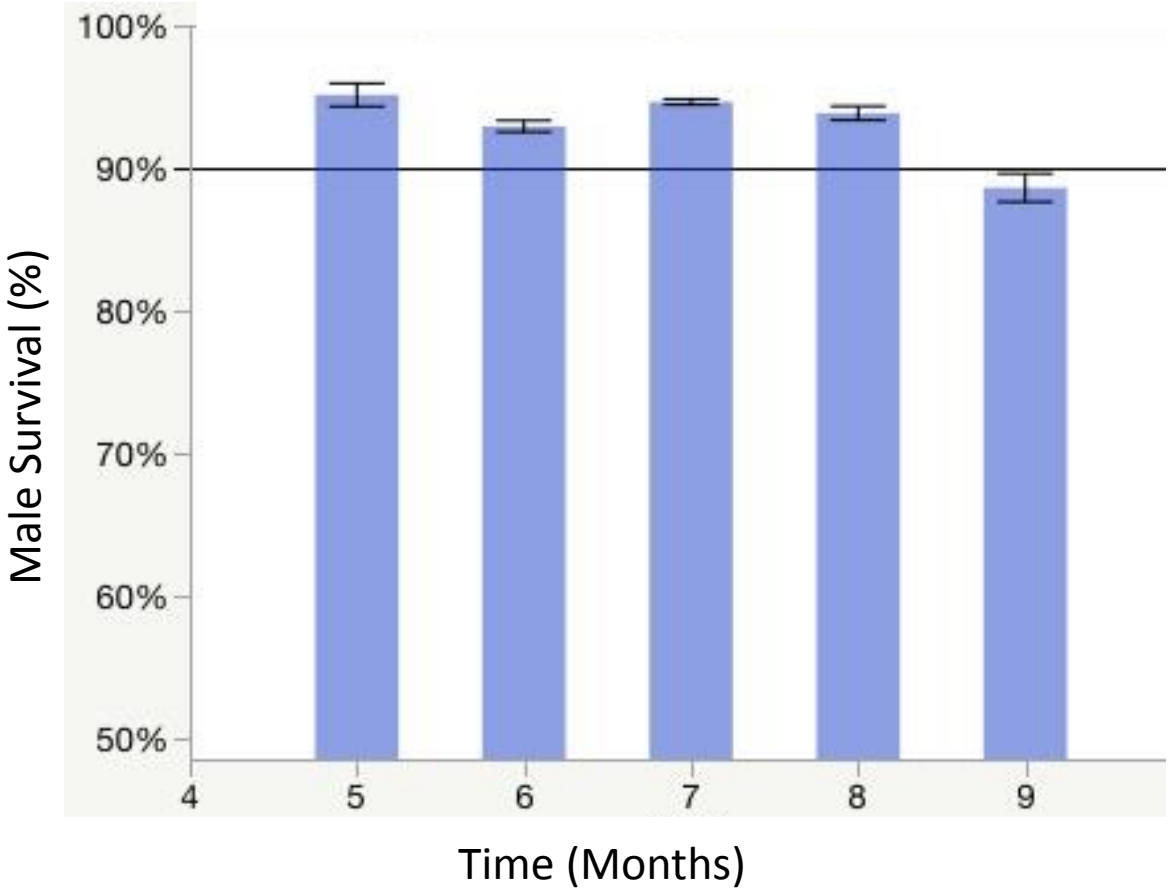
- Ask a question/make a comment
- Pesticide issues where you live
- Employee Directory

http://www.epa.gov/oppbppd1/biopesticides

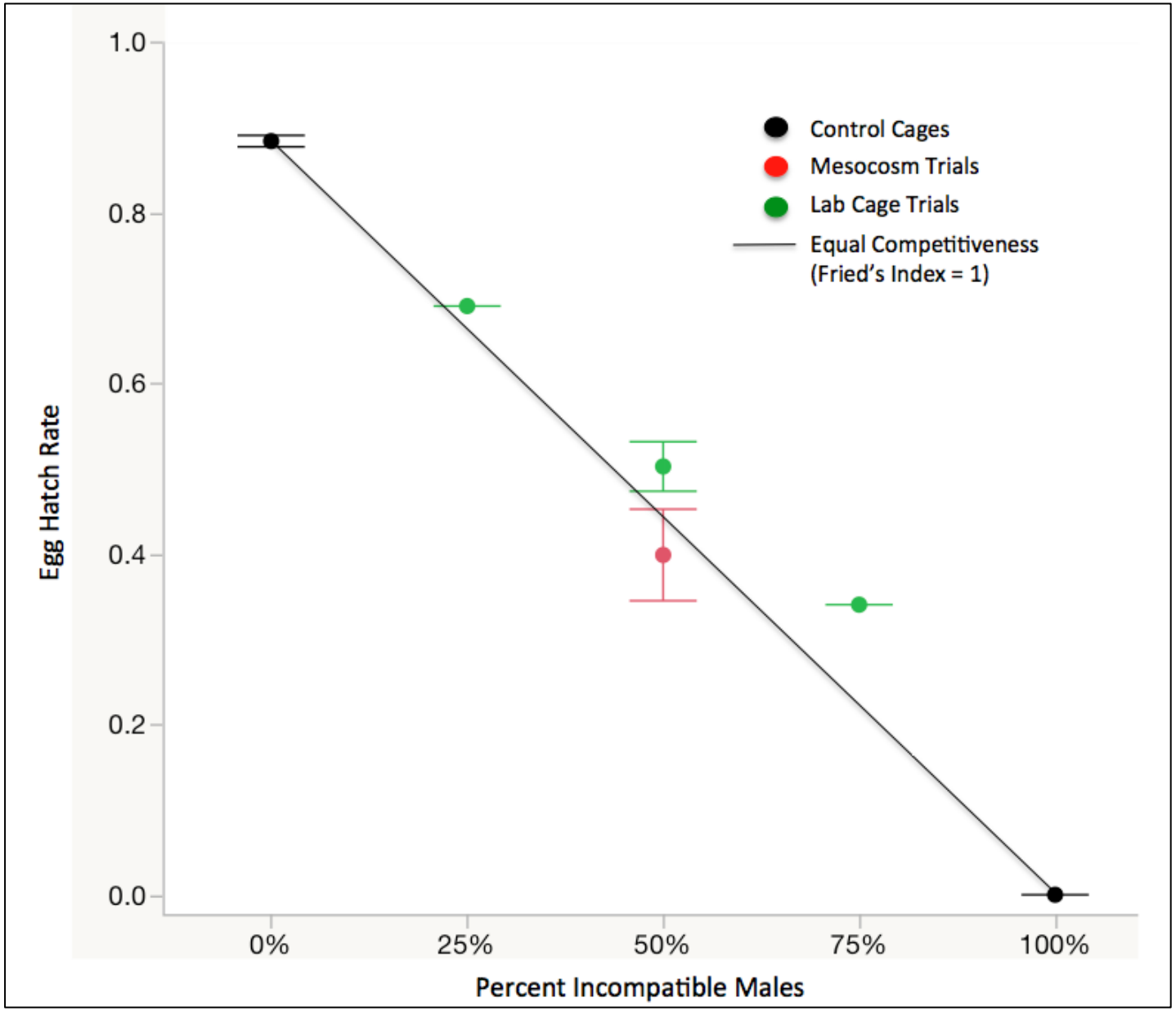
Field Trial Logistics – 2016 *Ae. aegypti*

WB1 Male Survival (Shipping)

- Mortality tracked with each shipment
  - Number of dead counted per tube

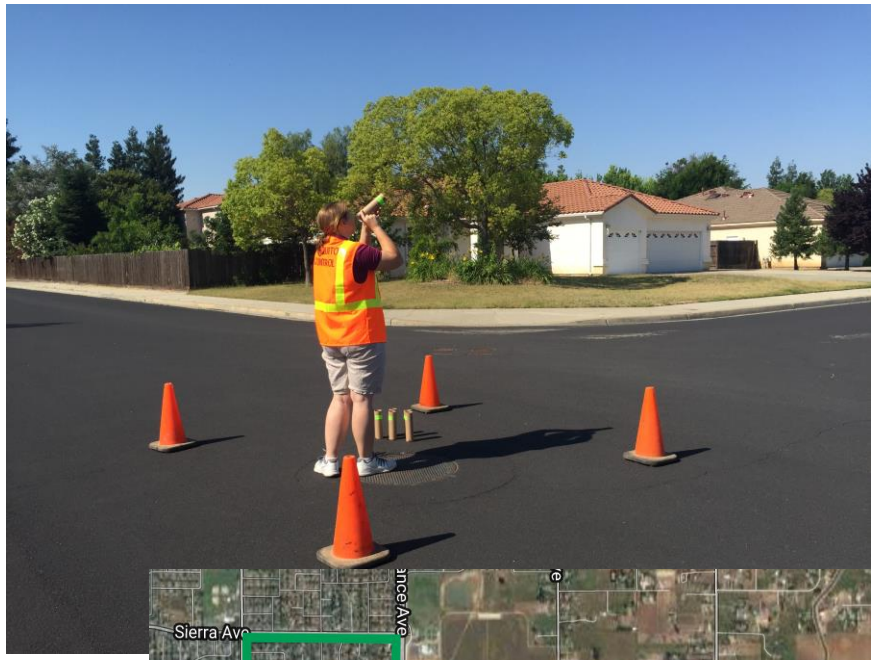


WB1 Strain Male Competitiveness



WB1 Clovis Trial: Year 1 Range Finding

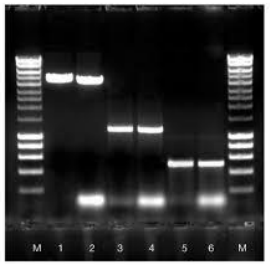
- Mark Release Recapture (MRR)
  - Early May
- WB1 Releases
  - Start of male releases: Late May
  - Produced in Lexington, KY
  - 40,000 WB1 males per week
    - 2 releases of 20k
  - Road release points
- Release Area (~40 hectares)
  - 1k WB1 males/ha/wk
- Monitoring
  - BG + AGO traps
  - Ovitraps



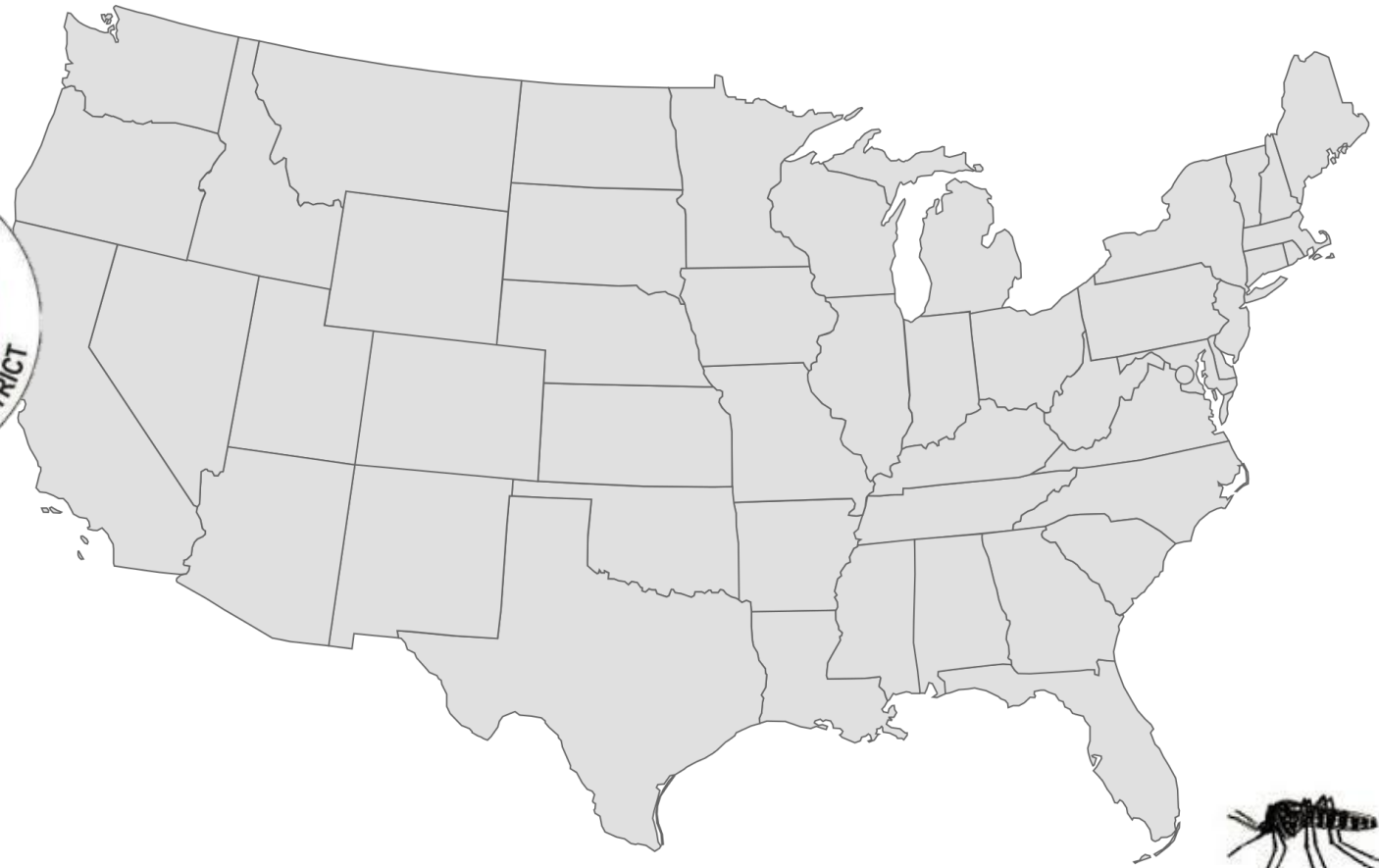
- Female Contamination
  - Inspection of shipping tubes
    - No females identified

- Field Samples
  - Eggs from ovitrap samples
    - Larvae reared to adults and screened (PCR) for *Wolbachia* infection

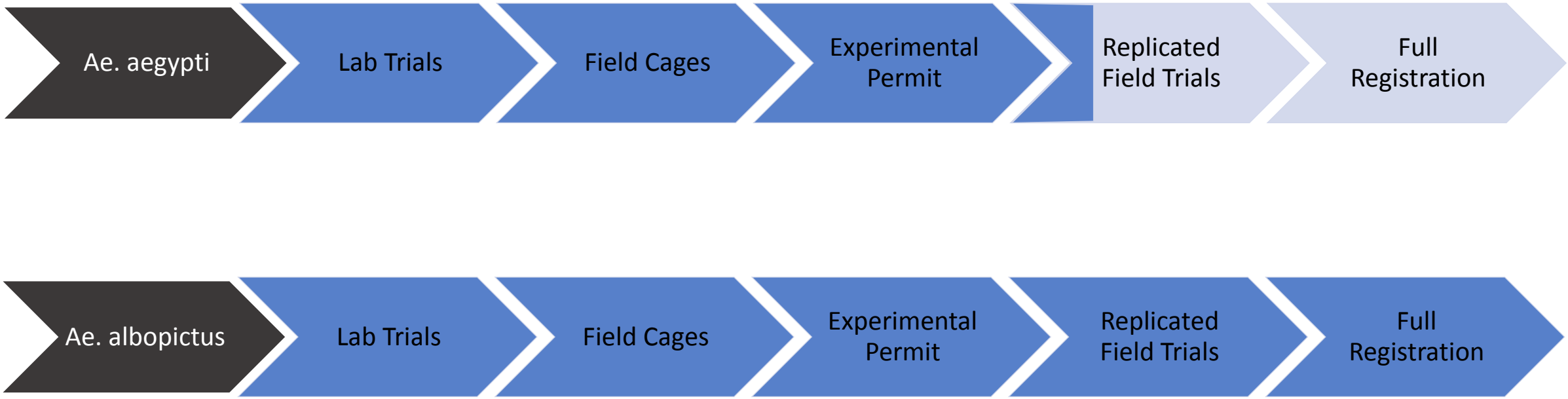
- Screened (PCR) BG samples for *Wolbachia* infection
  - Estimate WB1 ratio



CONSOLIDATED MOSQUITO ABATEMENT DISTRICT

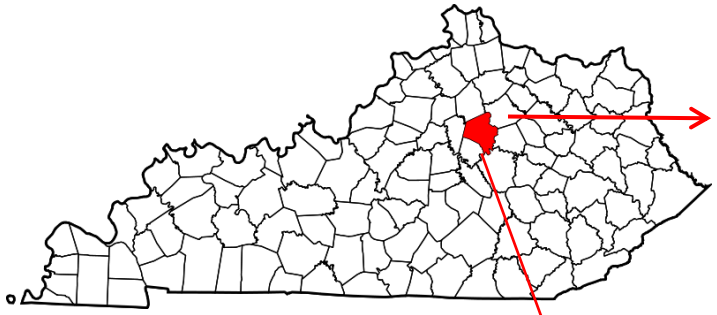


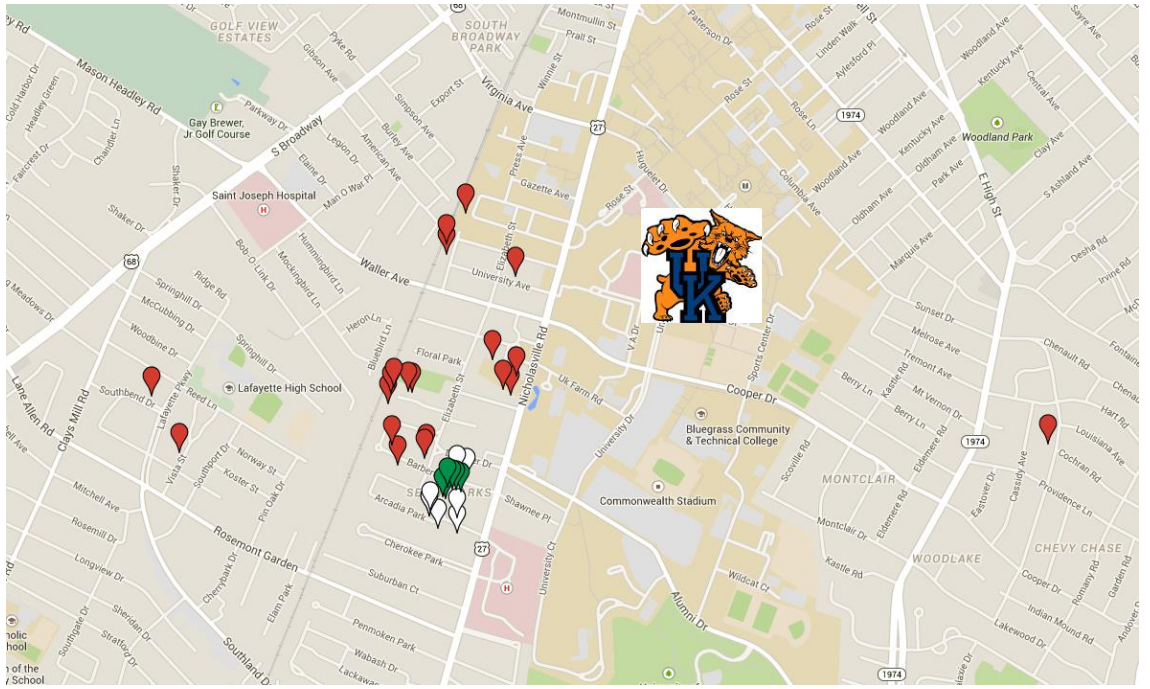
FLORIDA Mosquito Control DISTRICT KEYS

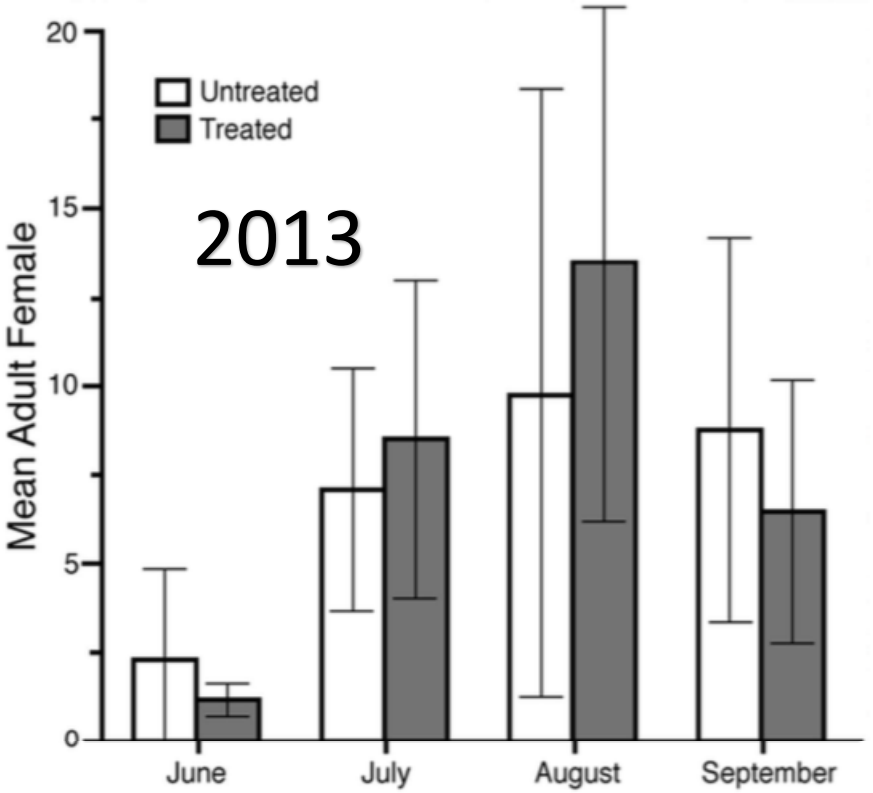

Ae. aegypti
Lab Trials
Field Cages
Experimental Permit
Replicated Field Trials
Full Registration
Ae. albopictus
Lab Trials
Field Cages
Experimental Permit
Replicated Field Trials
Full Registration

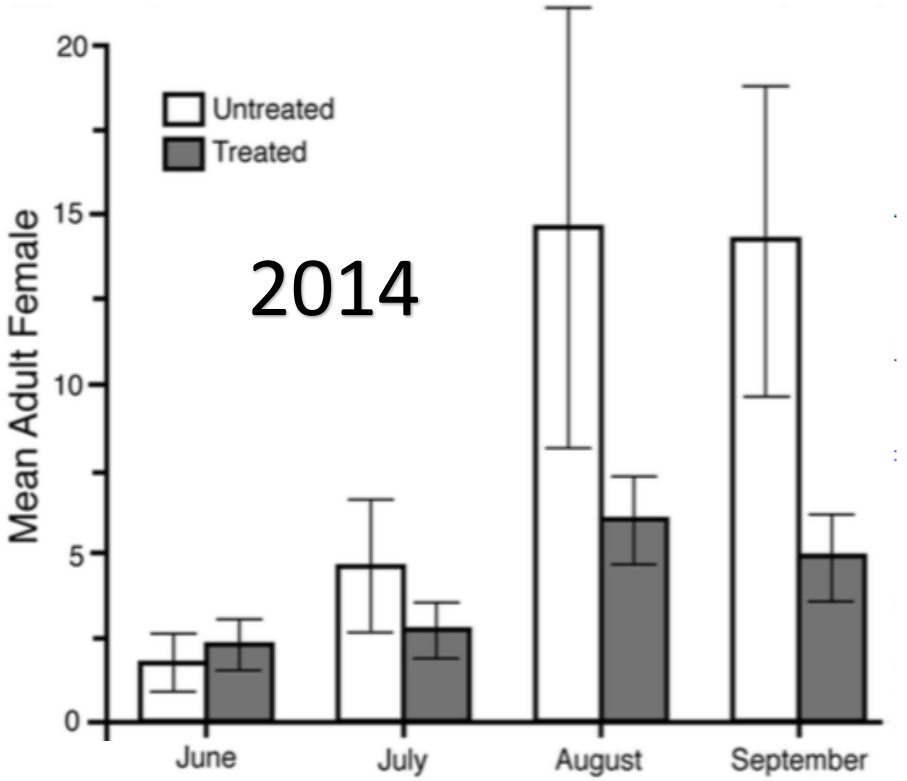
Field Sites

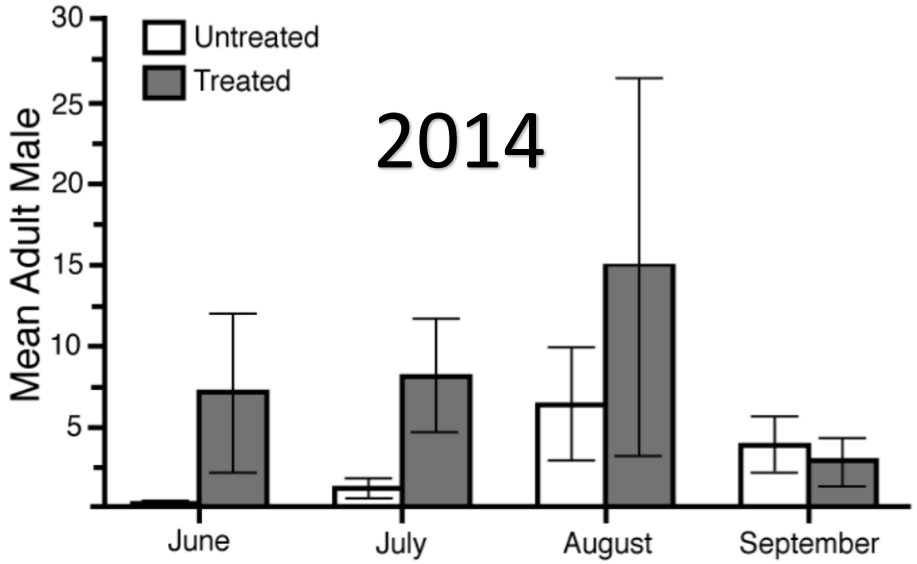
- Lexington, Kentucky
  - 20-40 sites
  - Monitoring since 2012
  - One BG trap per house
  - Two ovitraps per house
  - May - October











SCIENTIFIC REPORTS

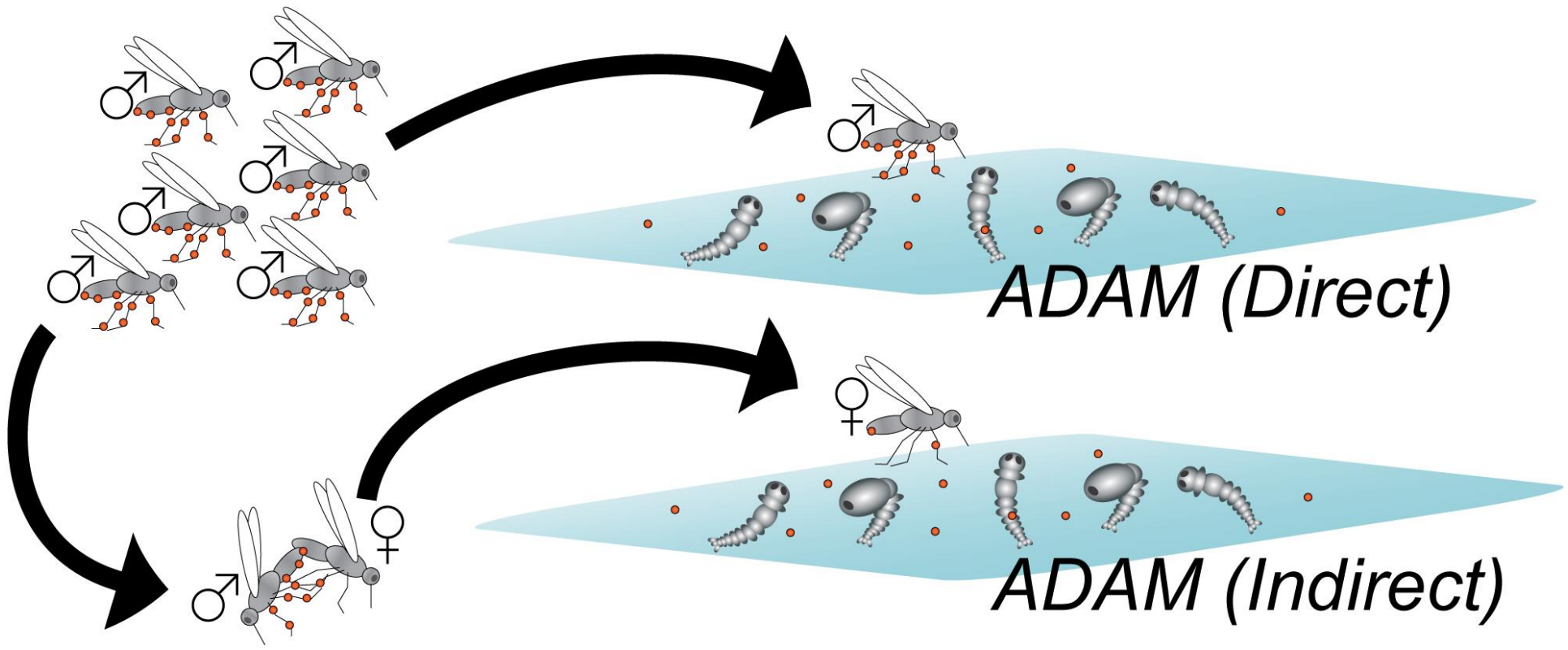
Female Adult *Aedes albopictus* Suppression by *Wolbachia*-Infected Male Mosquitoes

James W. Mains[1], Corey L. Brelsfoard[1], Robert I. Rose[2] & Stephen L. Dobson[1,3]

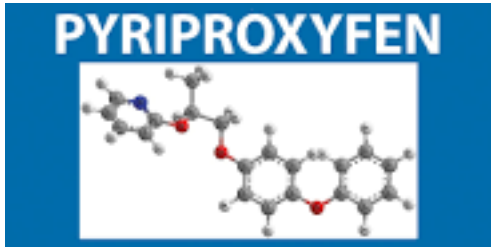
SCIENTIFIC REPORTS | 6:33846 | DOI: 10.1038/srep33846

Auto-Dissemination by Autocidal Males

(ADAM)



Pyriproxyfen (PFF)

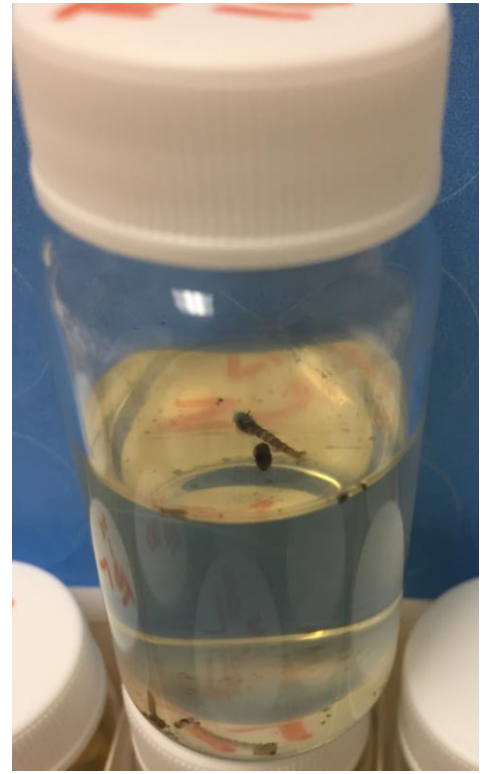


- Juvenile hormone analogue
- Pupacide

Esteem®

35 WP

VALENT

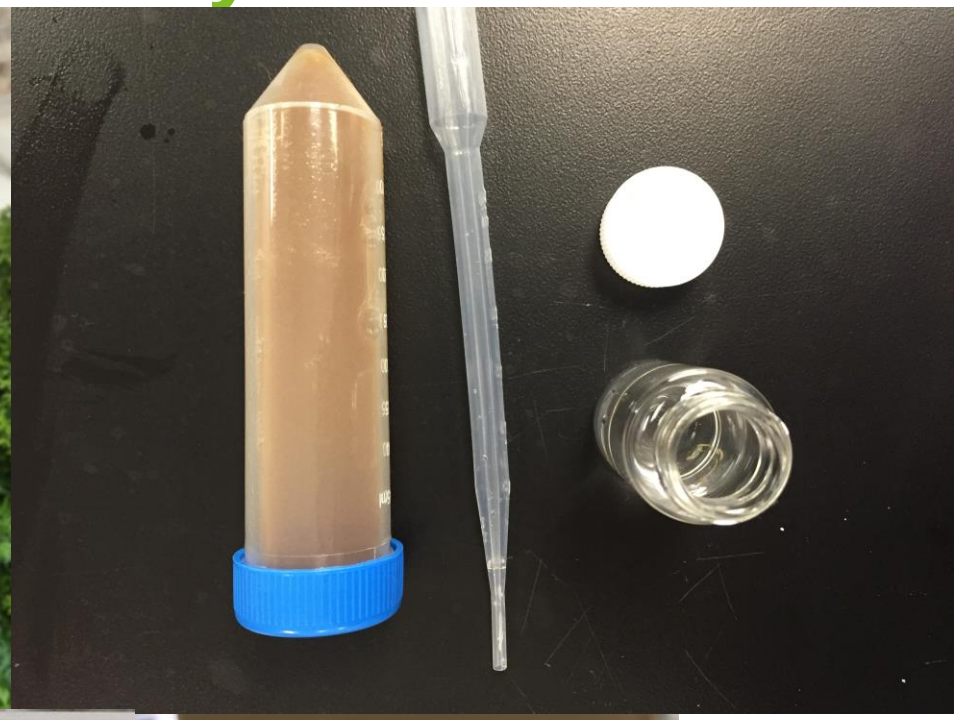



Bluewater In The Keys
Ovi 10
Ovi 9
BG 3
Ovi 6
BG 2
Ovi 5
Ovi 3
BG 5
Florida Buoys
Ovi 8
Ovi 1
Ovi 7
BG 1
Ovi 2
Ovi 4
BG 4
Neighborhood
Ali'i Keys Rental

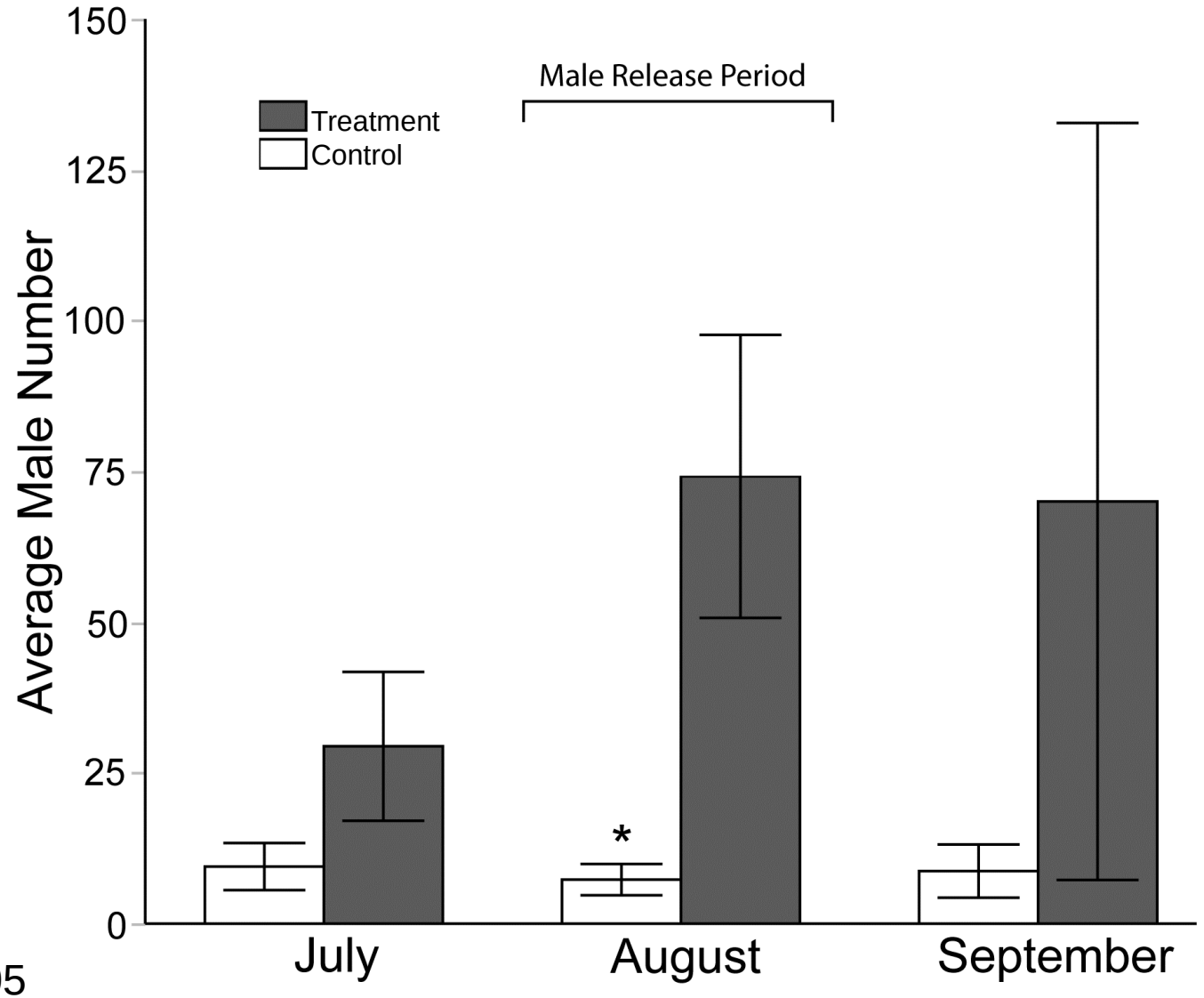
~3 Acres


YAMAHA
135
MERCURY

Bioassay Protocol

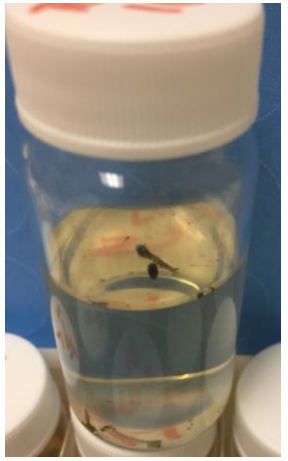


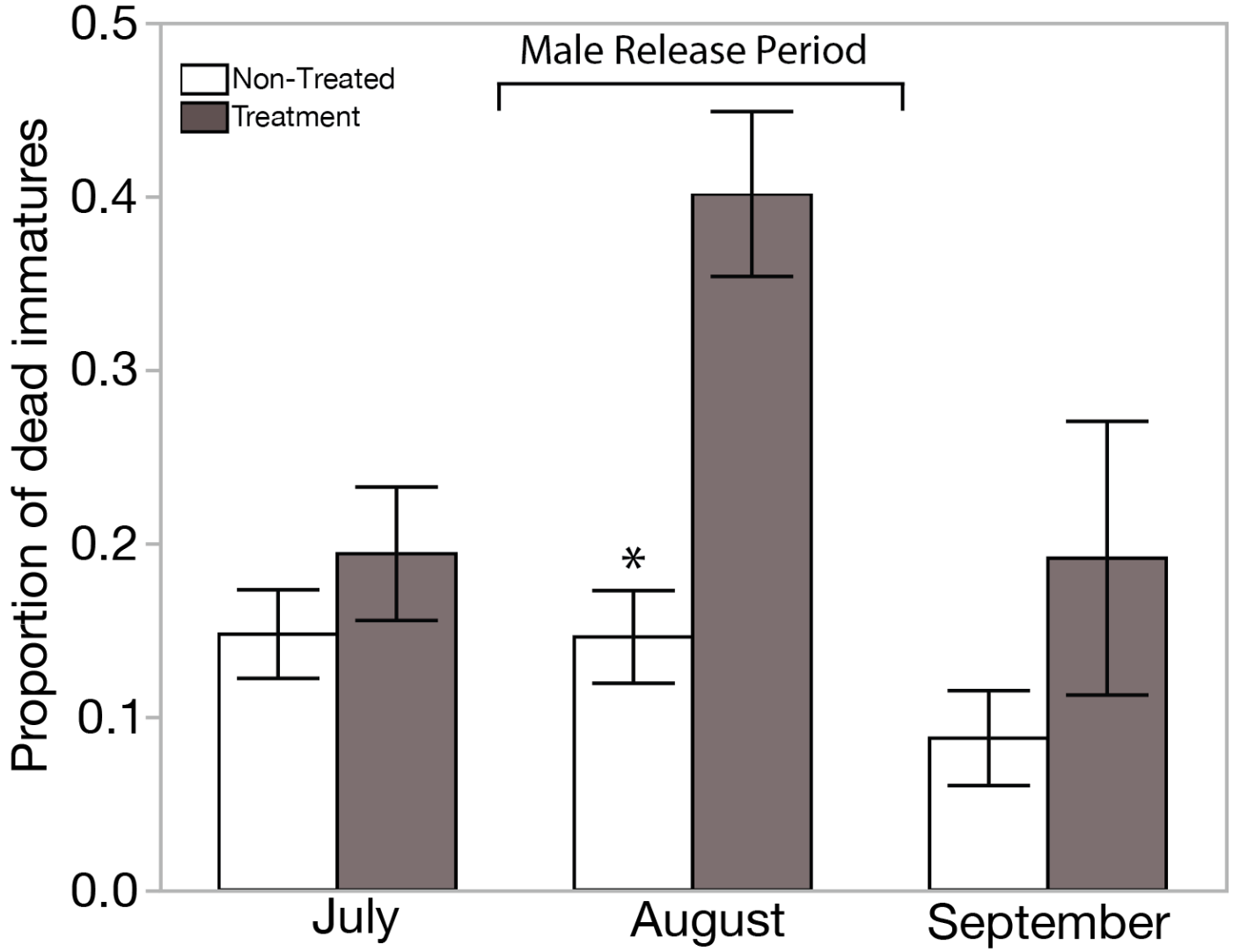
Male BG Collection Data



* = P < 0.05

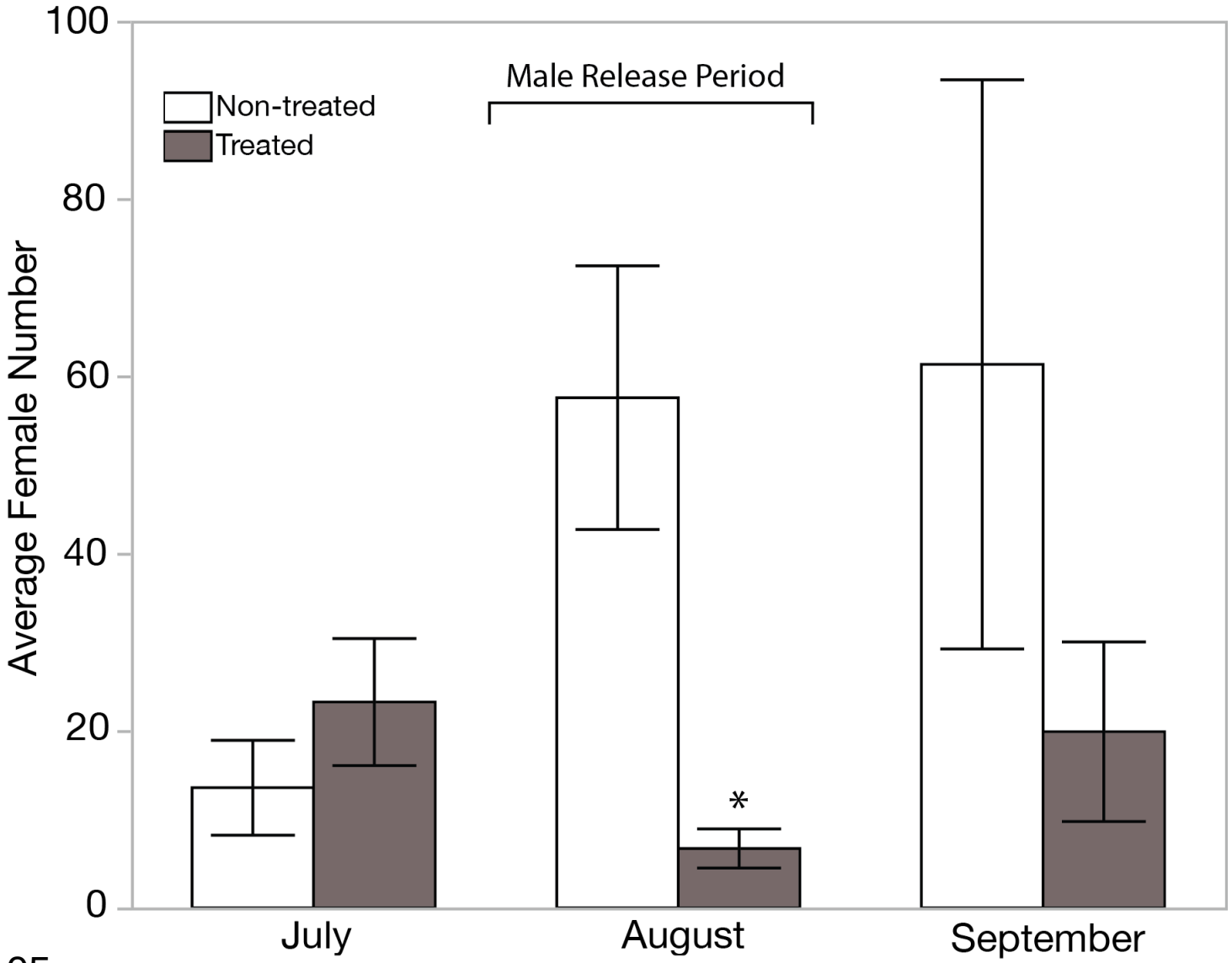
Bioassay Data





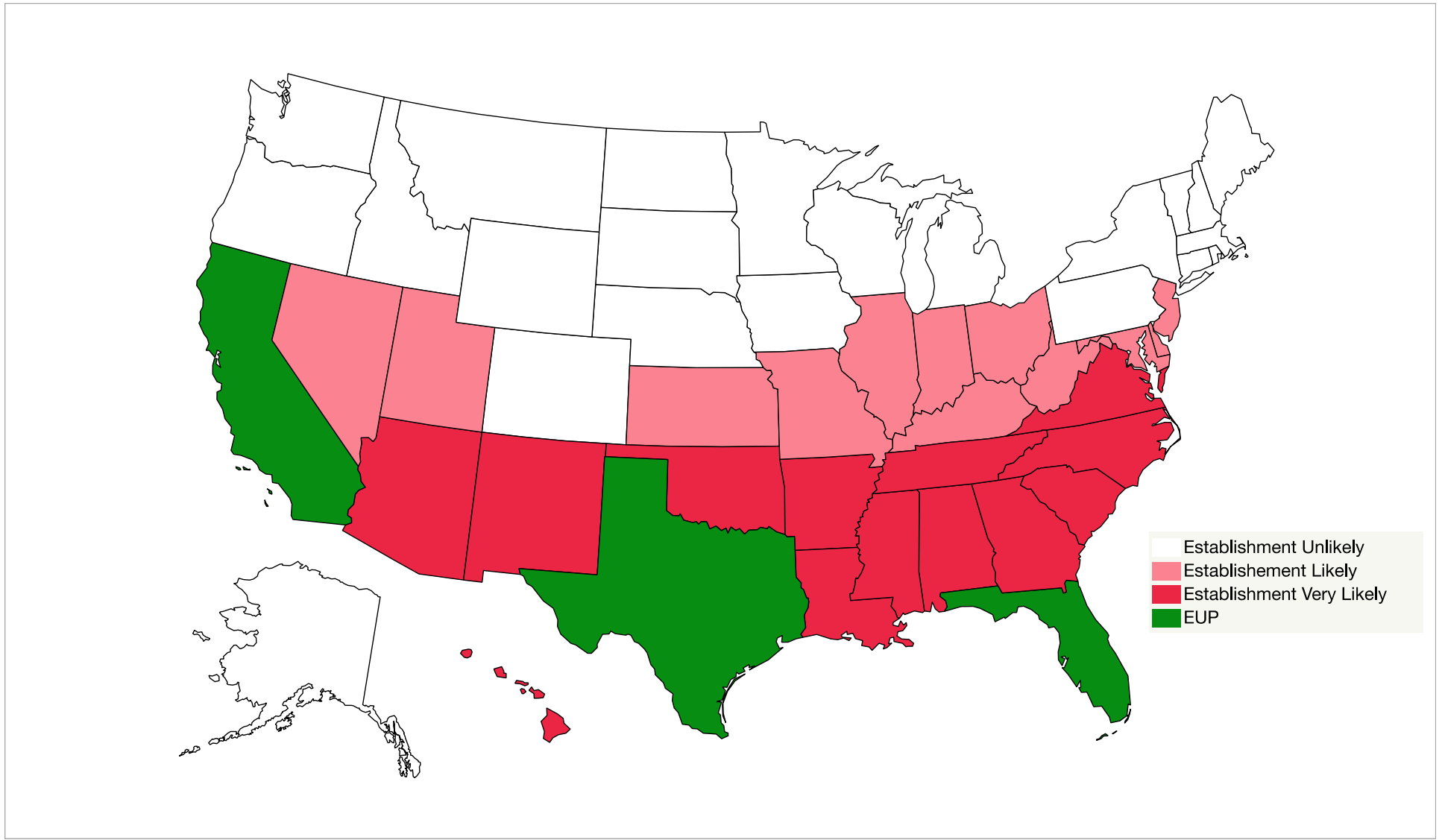
* = P < 0.05

Female BG Collection Data

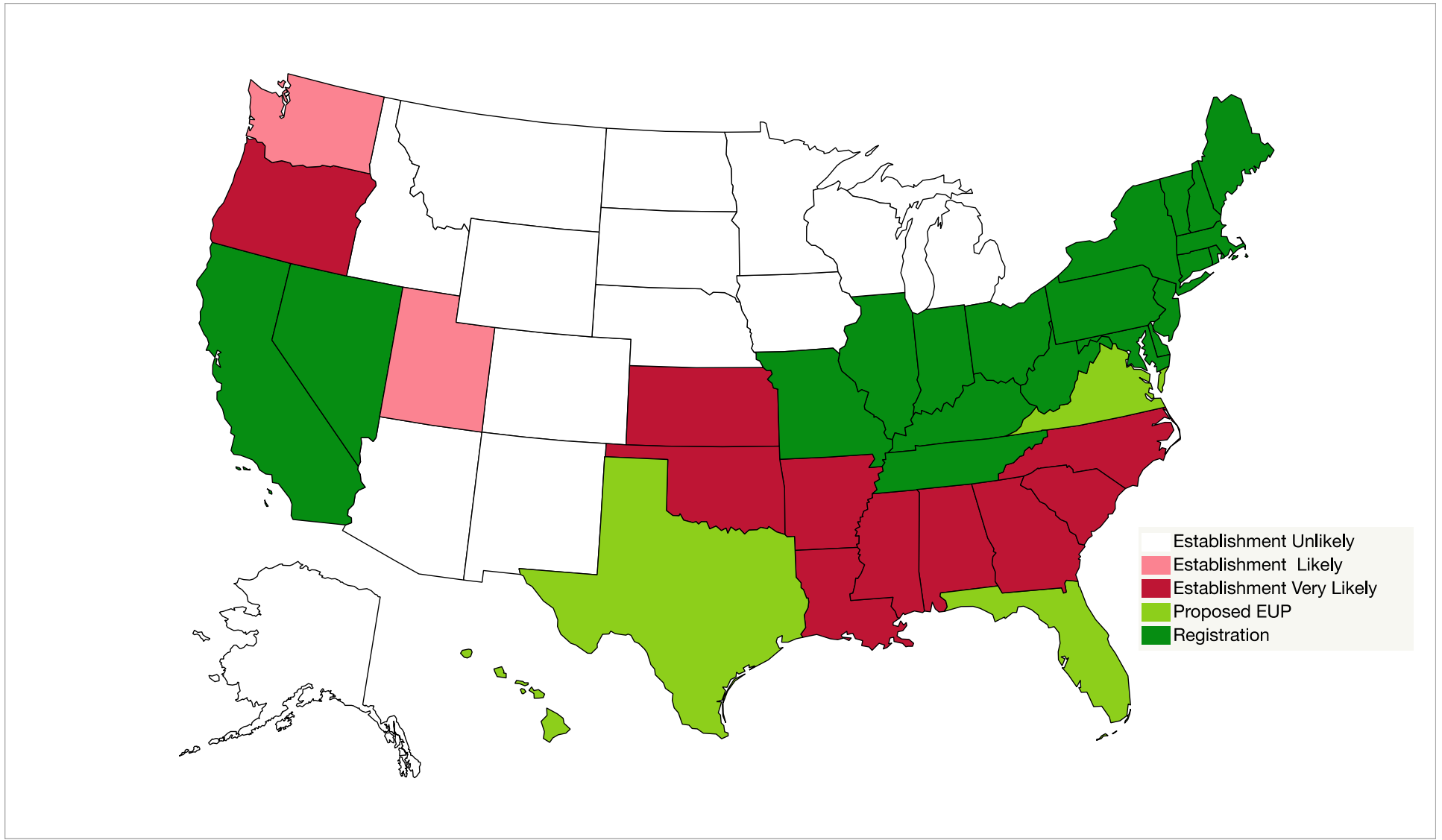


* = P < 0.05

Aedes aegypti Distribution Map



Aedes albopictus Distribution Map



Robert 'Bob' Rose, PhD

MOSQUITO mate
Lexington, Kentucky

SUMITOMO CHEMICAL

NIH National Institute of Allergy and Infectious Diseases
Leading research to understand, treat, and prevent infectious, immunologic, and allergic diseases.

KENTUCKY SCIENCE & TECHNOLOGY CORPORATION | KSTC

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