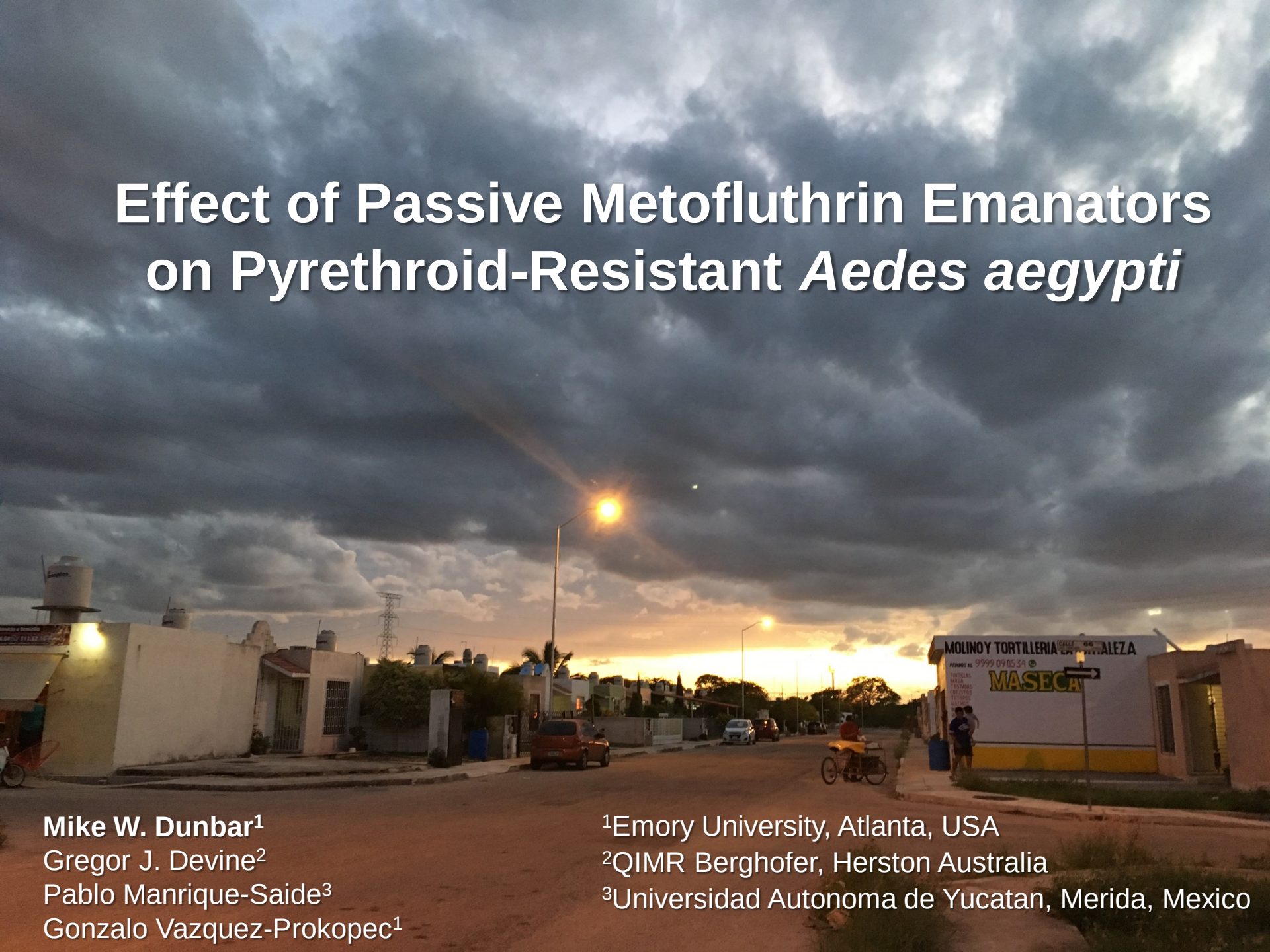
Effect of Passive Metofluthrin Emanators on Pyrethroid-Resistant *Aedes aegypti*



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Pablo Manrique-Saide[3]
Gonzalo Vazquez-Prokopec[1]

[1]Emory University, Atlanta, USA
[2]QIMR Berghofer, Herston Australia
[3]Universidad Autonoma de Yucatan, Merida, Mexico

Managing *Aedes*-Borne Diseases

Current tools targeting *Aedes aegypti*

- Vary in efficacy
- Transient or localized epidemiologic impacts
- Complicated by insecticide resistance

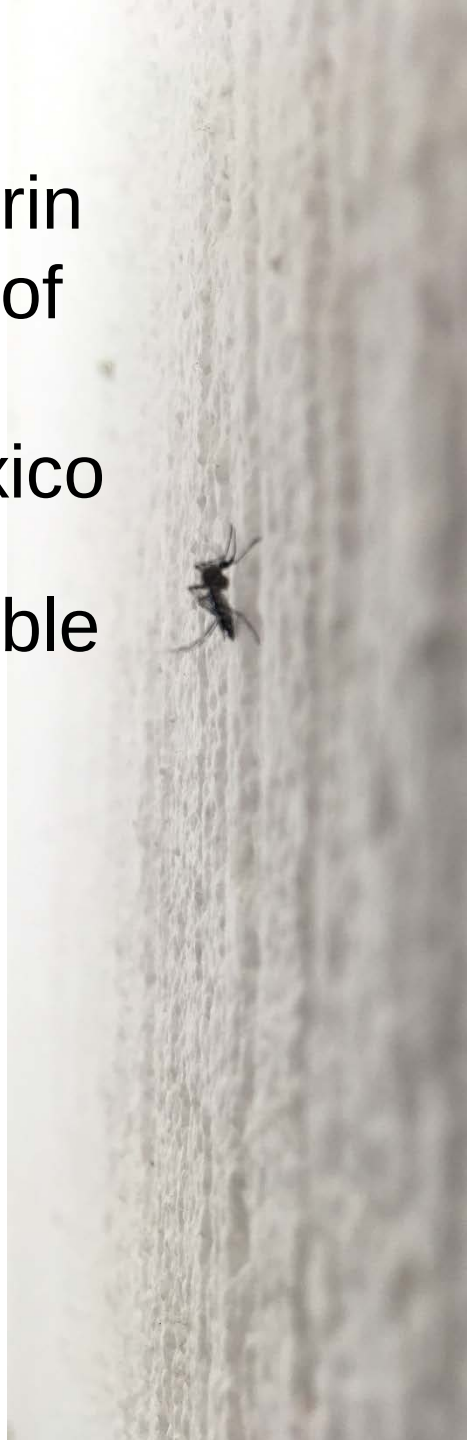
Potential new tool-

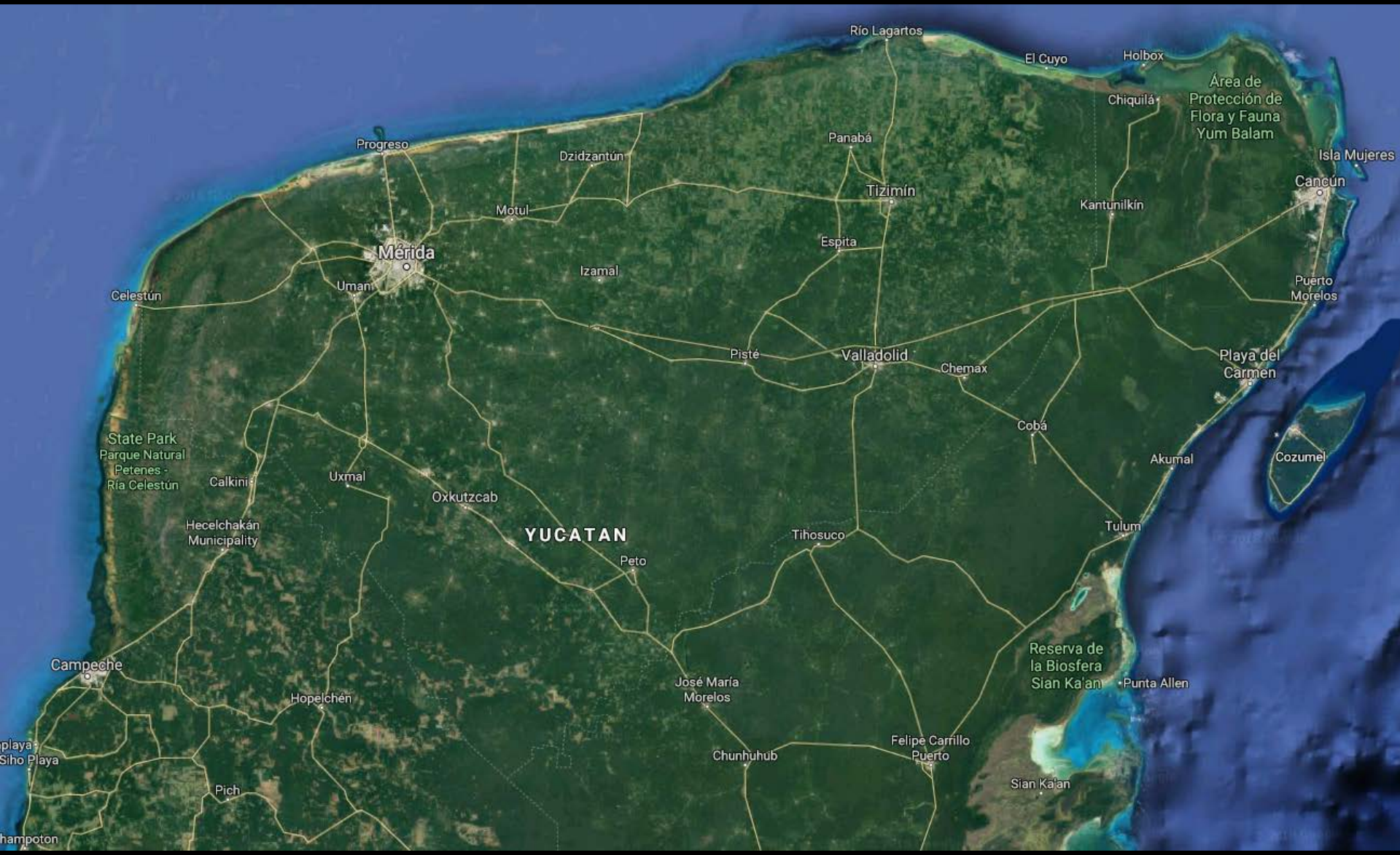
- Indoor deployment of passive emanators w/ metofluthrin

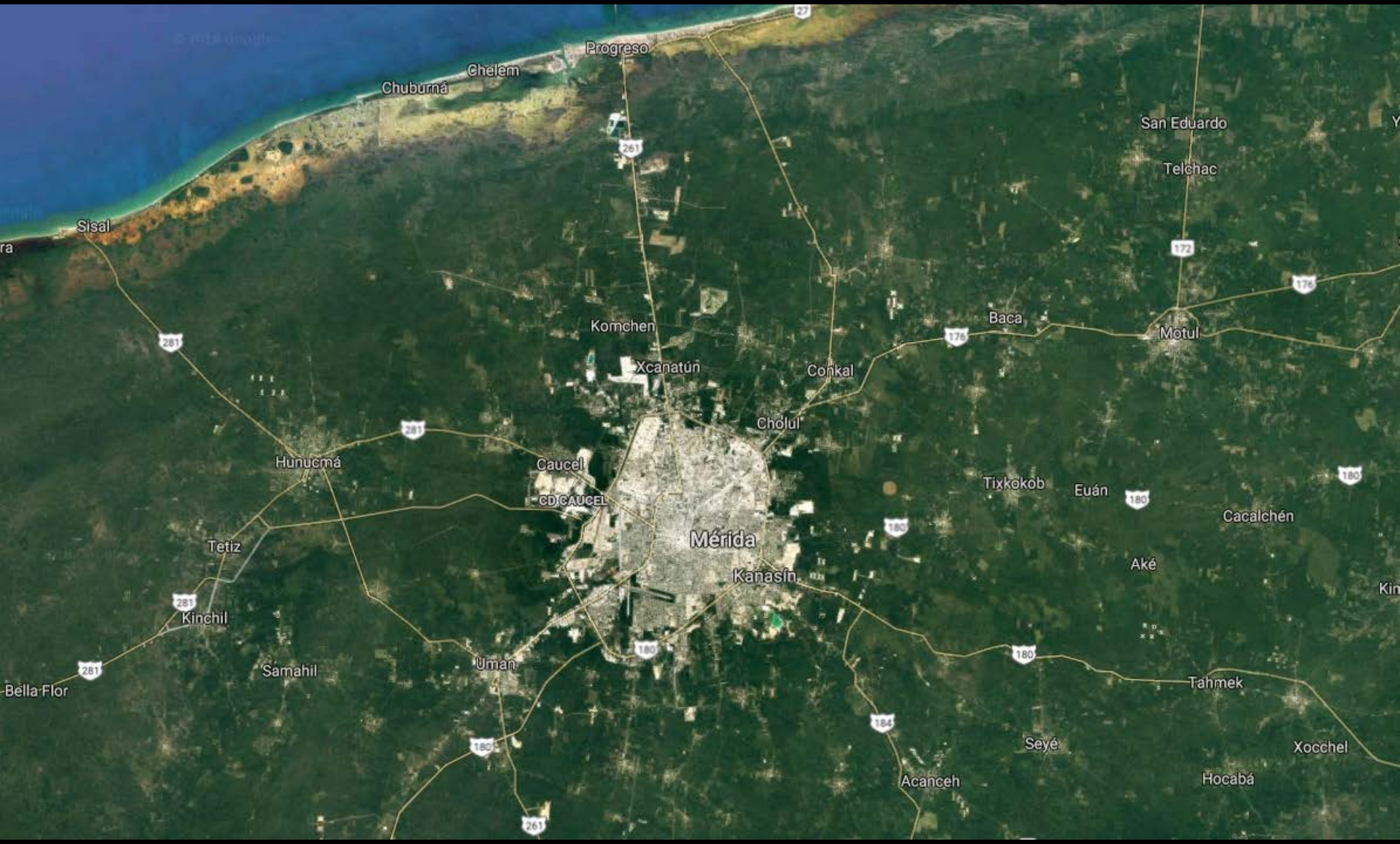
Objectives

Determine whether exposure to metofluthrin emanators affects landing and mortality of locally-derived *Ae. aegypti* strains in experimental houses within Mérida, Mexico

Compare response of pyrethroid-susceptible and pyrethroid-resistant strains




Río Lagartos
El Cuyo
Holbox
Área de Protección de Flora y Fauna Yum Balam
Chiquilá
Progreso
Dzidzantún
Panabá
Isla Mujeres
Cancún
Tizimín
Kantunilkín
Motul
Mérida
Espita
Izamal
Uman
Celestún
Puerto Morelos
Pisté
Valladolid
Chemax
Playa del Carmen
Cobá
State Park
Parque Natural Petenes - Ría Celestún
Calkini
Uxmal
Oxkutzcab
Akumal
Cozumel
Hecelchakán Municipality
YUCATAN
Tihosuco
Tulum
Peto
Campeche
Reserva de la Biosfera Sian Ka'an
Punta Allen
José María Morelos
Hopelchén
Felipe Carrillo Puerto
Chunhuhub
Pich
Sian Ka'an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Chuburná
San Eduardo
Telchac
Sisal
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Xcanatún
Conkal
Baca
Motul
Cholul
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Caucel
CD CAUCEL
Tixkokob
Euán
Cacalchén
Mérida
Tetiz
Aké
Kanasín
Kinchil
Samahil
Uman
Bella Flor
Tahmek
Seyé
Xocchel
Acanceh
Hocabá
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281
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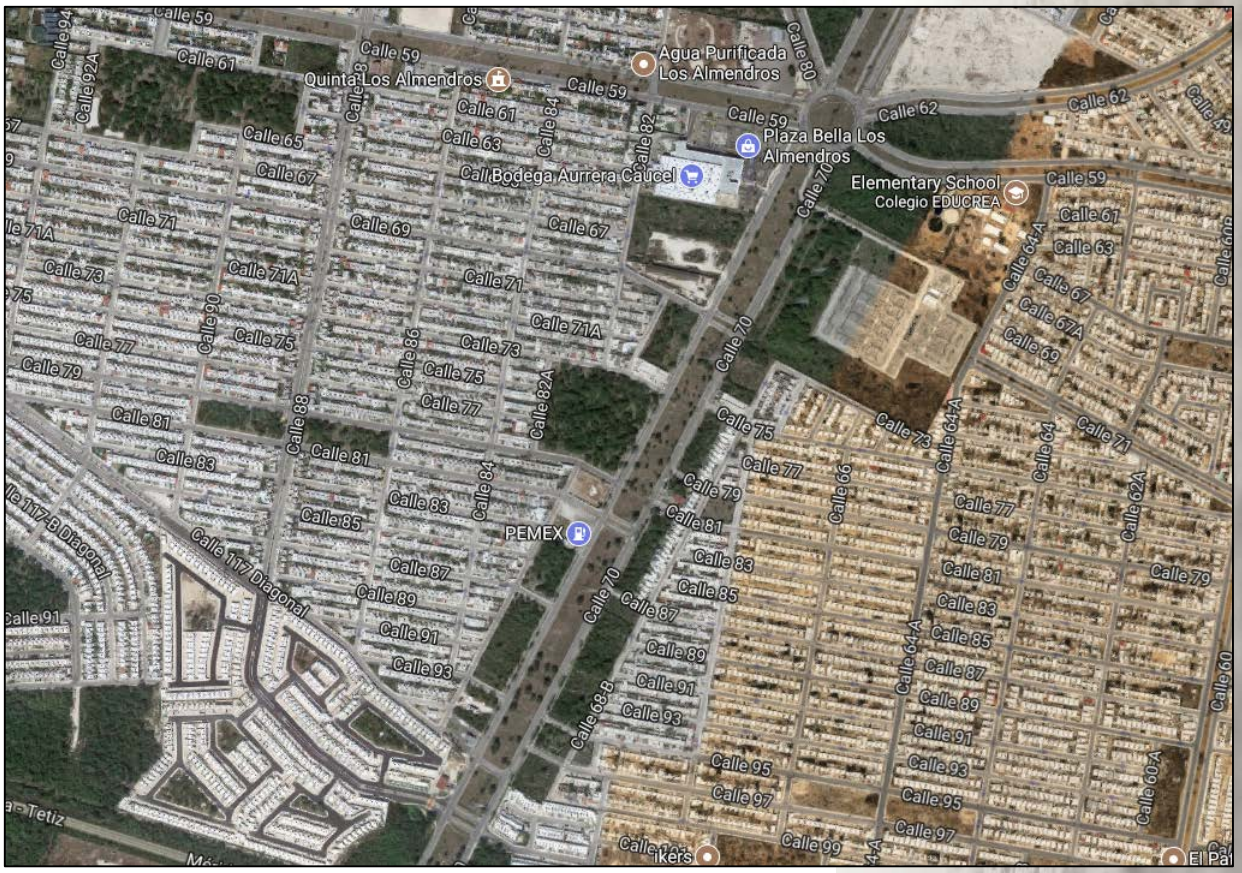
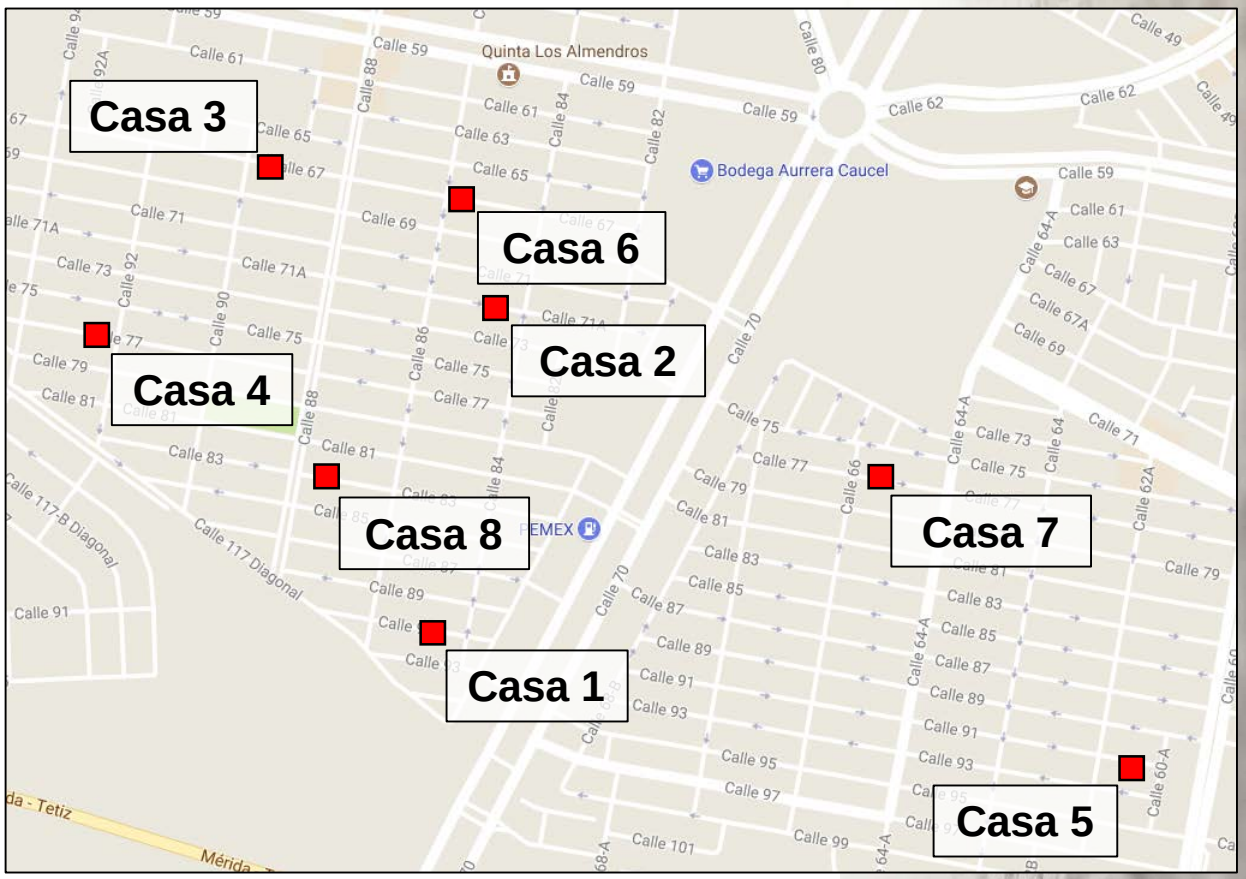
176
180
184

Rented Houses within Mérida, MX



Rented Houses within Mérida, MX



Rented Houses within Mérida, MX

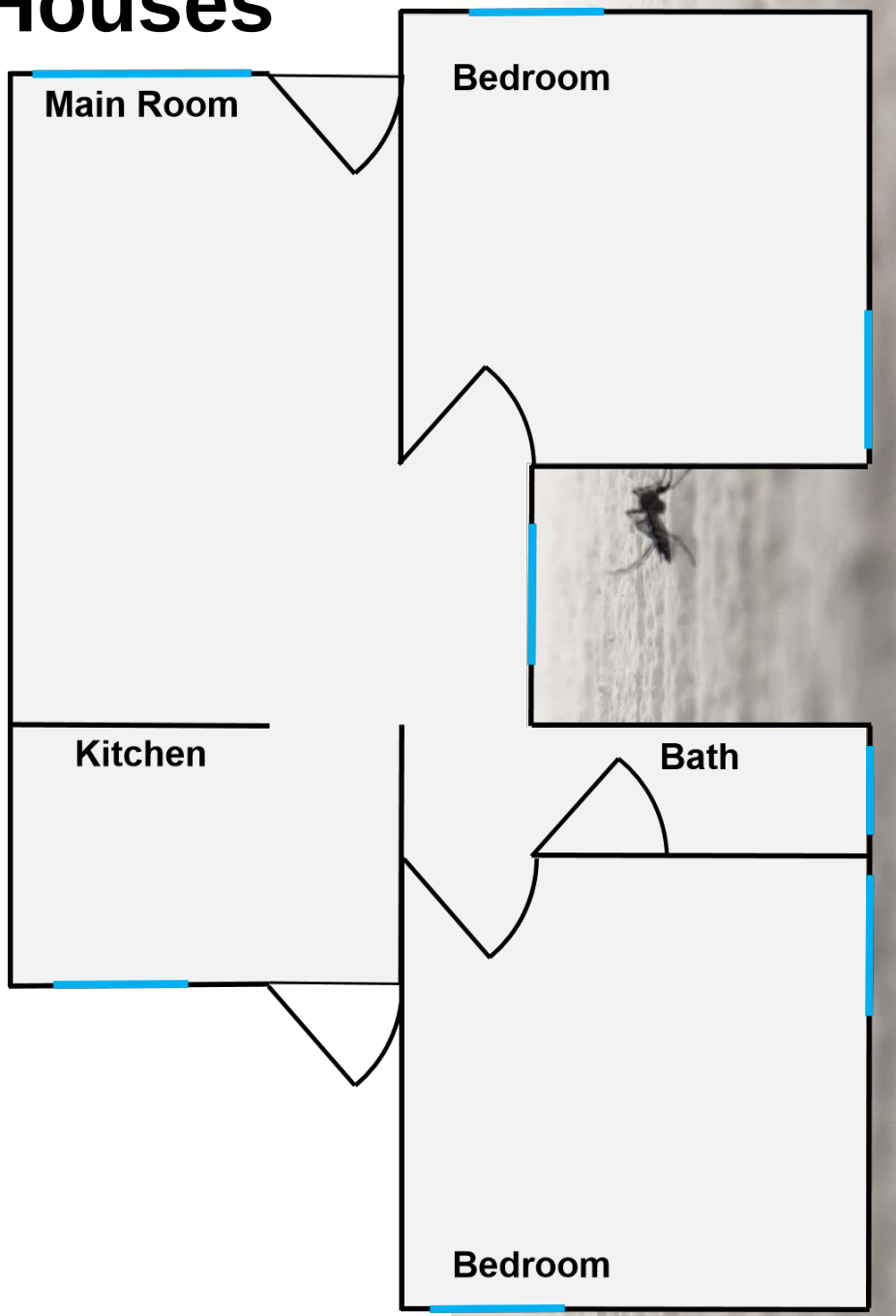
Creating Experimental Houses

Size: 144.5 ± 7.12 m^3

-2 Bedrooms

-1 Bathroom

-1 or 2 living rooms



Creating Experimental Houses

Size: 144.5 ± 7.12 m^3

-2 Bedrooms

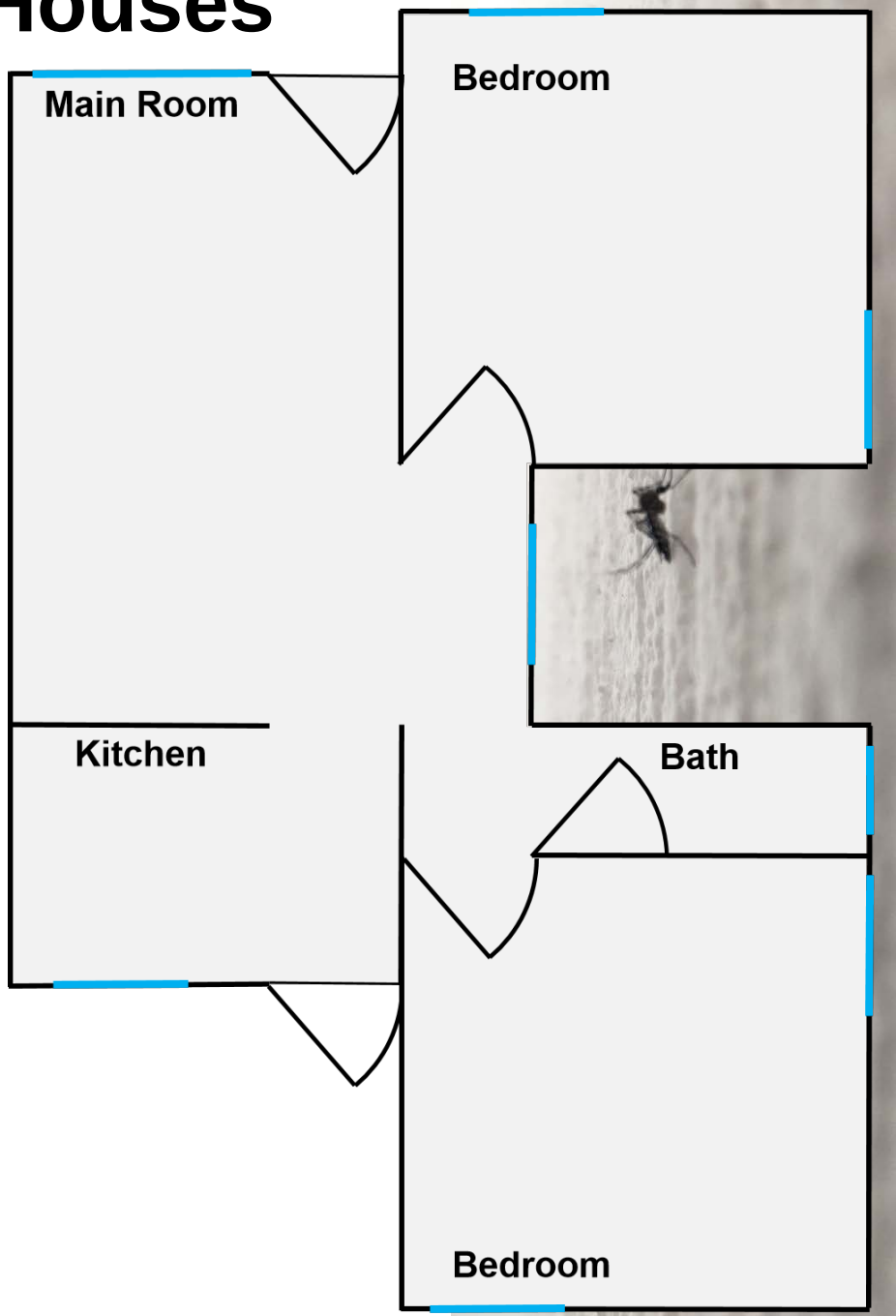
-1 Bathroom

-1 or 2 living rooms

Windows closed

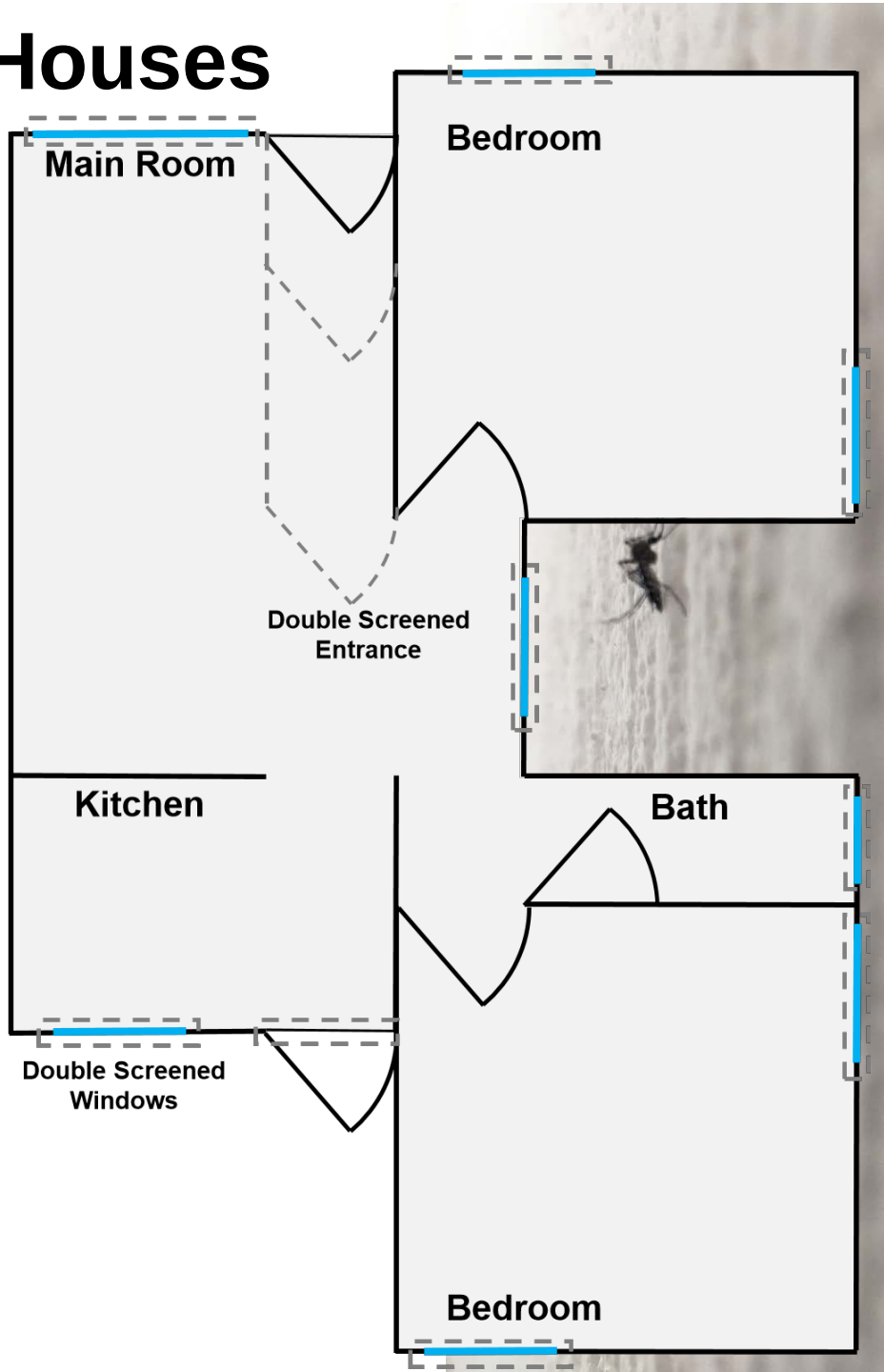
Temp range: 29-34C

Humidity range: 62-82%



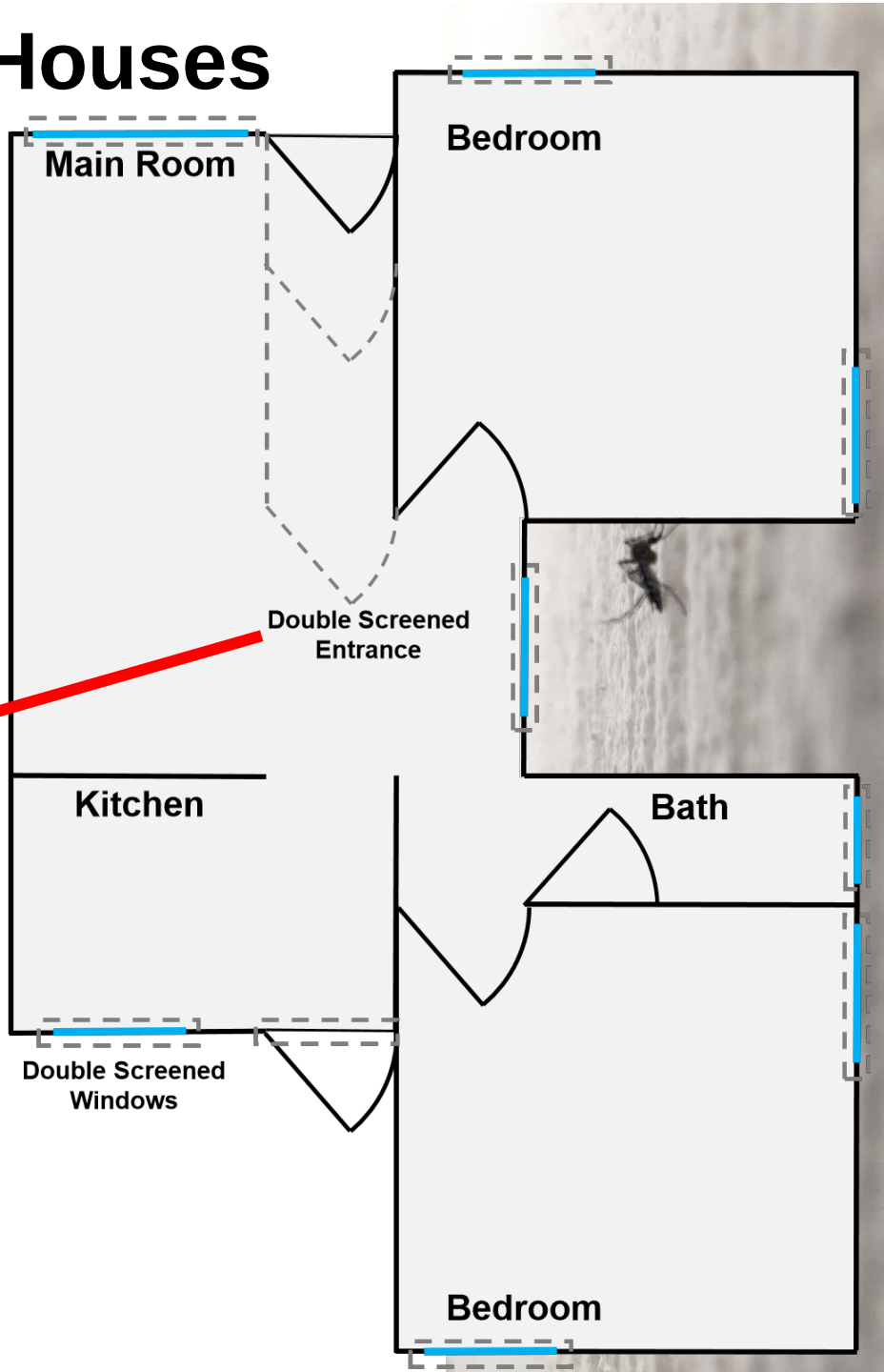
Creating Experimental Houses

Sealing the Houses



Creating Experimental Houses

Sealing the Houses



Creating Experimental Houses

Sealing the Houses

Screened the inside and outside of all windows and doors

Screening the windows

Sealing the doors and other furniture

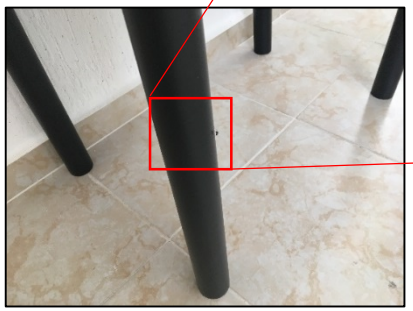
Sealing the Experimental Houses

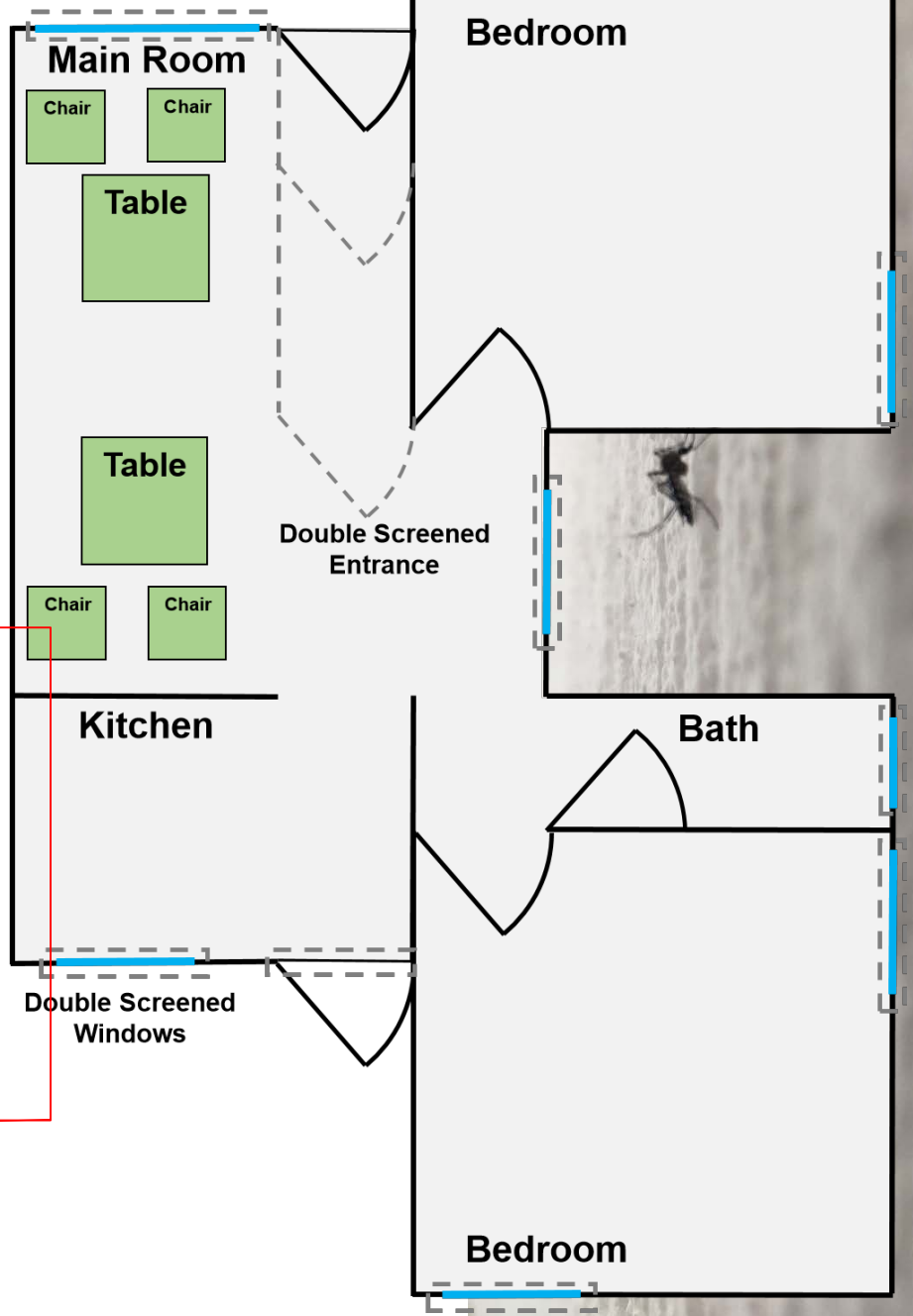
Screened all drains w/in the houses

Creating Experimental Houses

Standardize furniture

- -Main/Living rooms
  - 2 tables (black plastic)
  - 4 chairs (2 white & 2 dark colored)

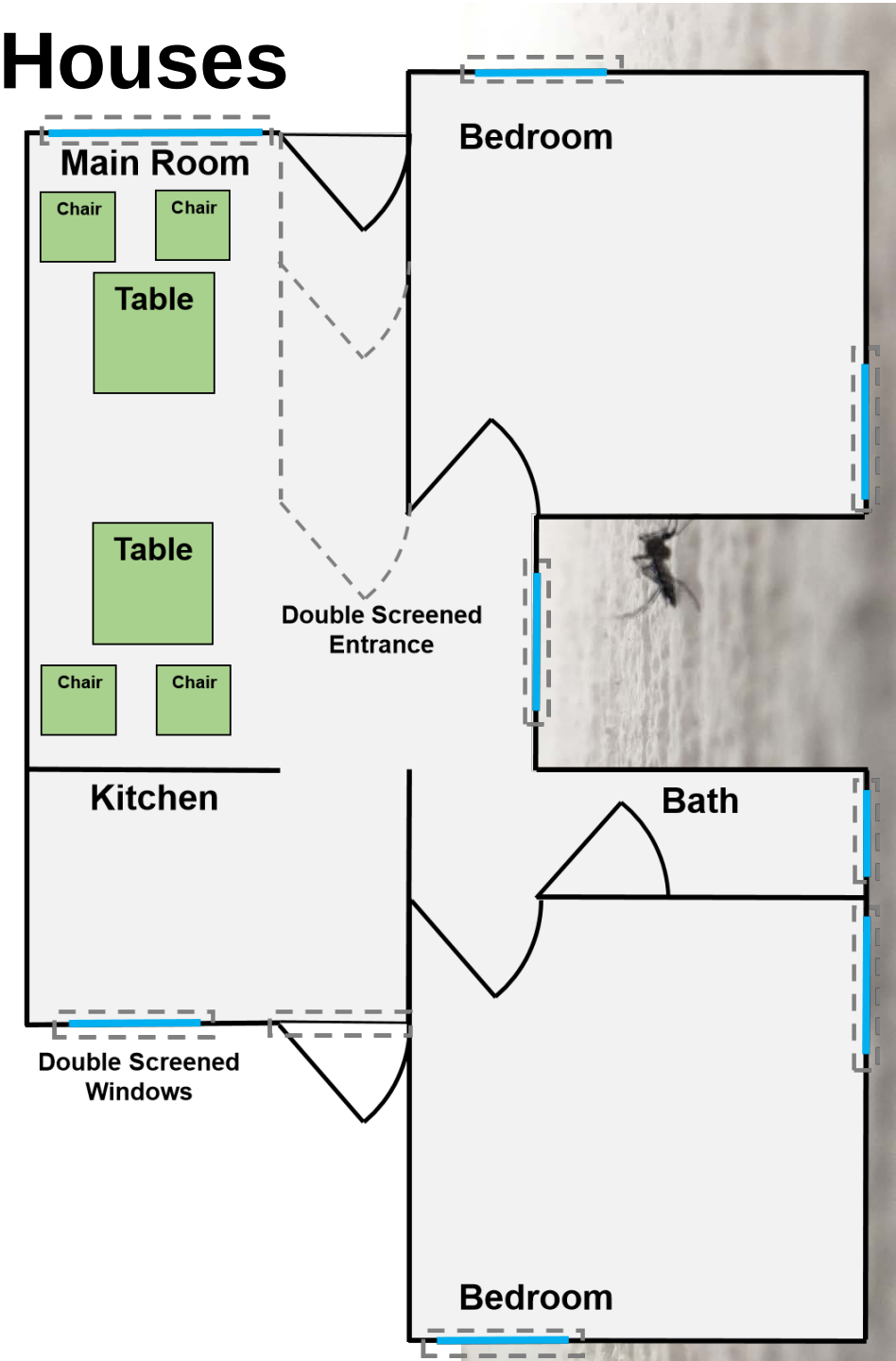




Creating Experimental Houses

Standardize furniture

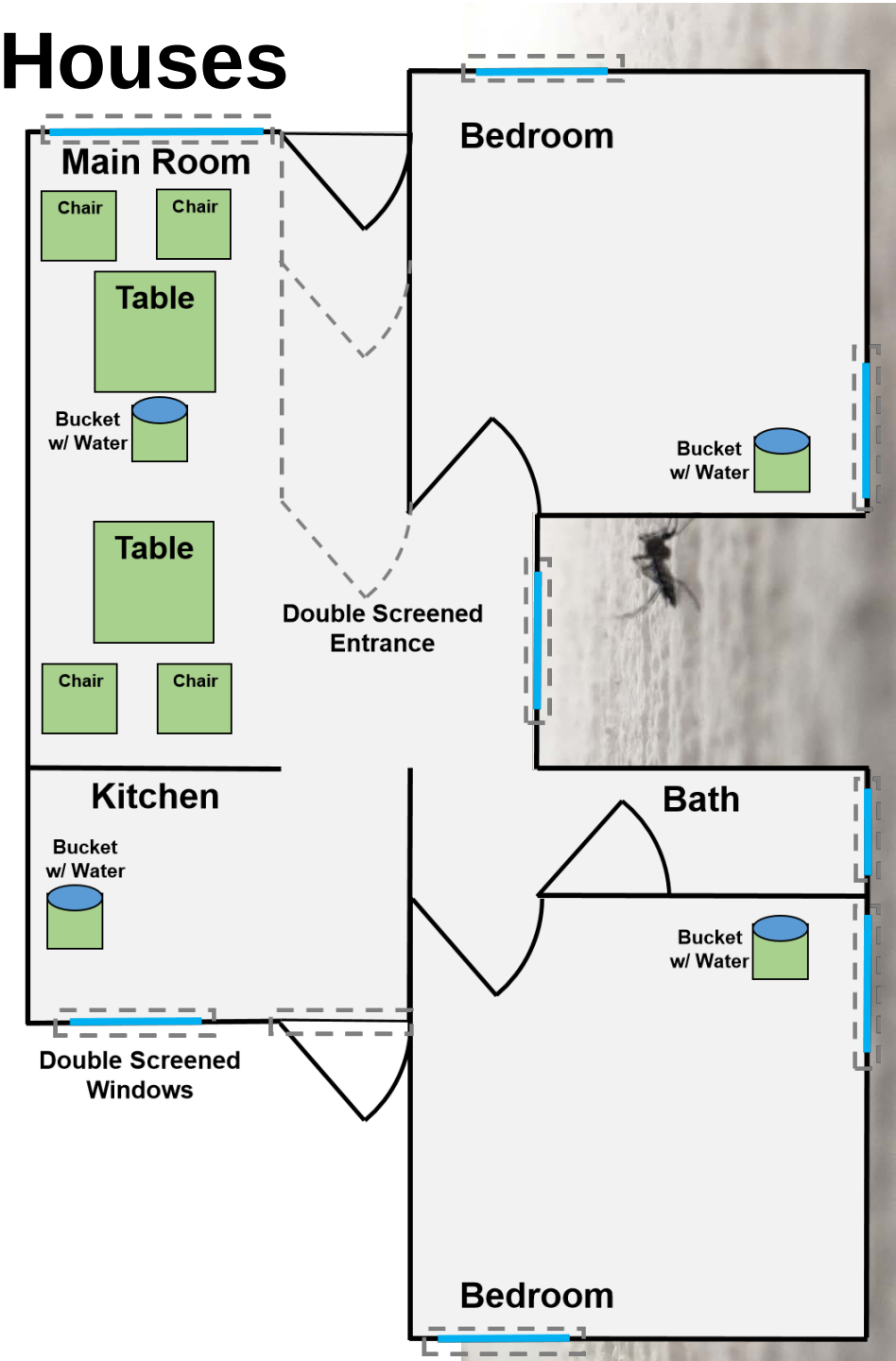
- -Main/Living rooms
  - 2 tables (black plastic)
  - 4 chairs (2 white & 2 dark colored)
- -Ant baits at each entrance



Creating Experimental Houses

Standardize furniture

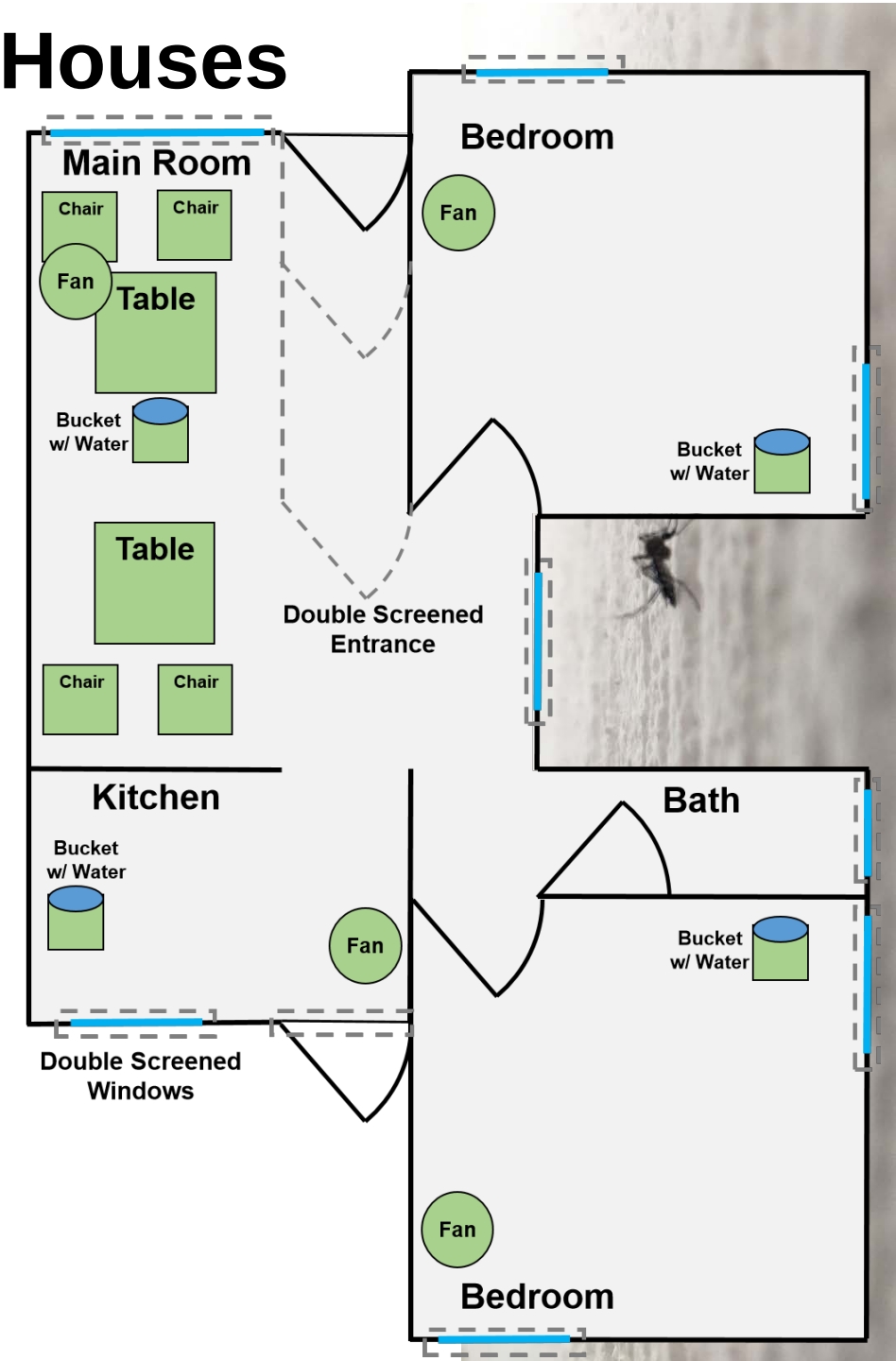
- -Main/Living rooms
  - 2 tables (black plastic)
  - 4 chairs (2 white & 2 dark colored)
- -Ant baits at each entrance
- -Buckets of water w/ cloth



Creating Experimental Houses

Standardize furniture

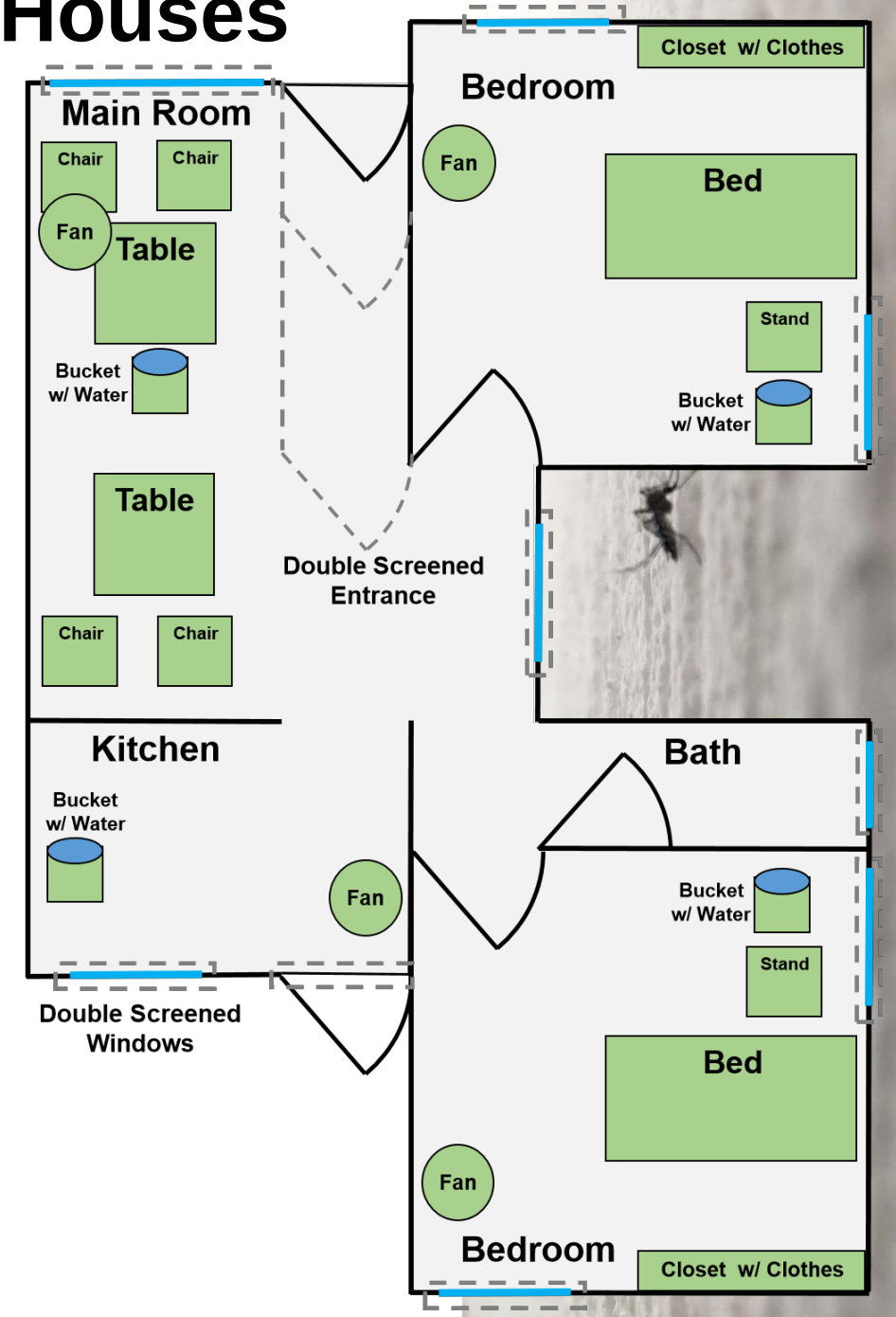
- -Main/Living rooms
  - 2 tables (black plastic)
  - 4 chairs (2 white & 2 dark colored)
- -Ant baits at each entrance
- -Buckets of water w/ cloth
- -Oscillating fans



Creating Experimental Houses

Standardize furniture

- -Bedrooms
  - 1 bed (PVC & black cloth)
  - 1 small table (black plastic)
  - 6 hung clothes
    - (3 white shirts & 3 colored shirts)




Double sealed window
Clothes
Fan
Bucket w/ water
Bed
Nightstand

Passive Emanators

Treatments

SumiOne® passive emanator (Sumitomo)

- 10% metofluthrin-impregnated mesh (16 x 9.5 cm)
  - Act as confusant rather than repellent
- Can be rapidly deployed indoors
  - Potential large-scale implementation
- Require no heat or power

Passive Emanators

Treatments

SumiOne® passive emanator

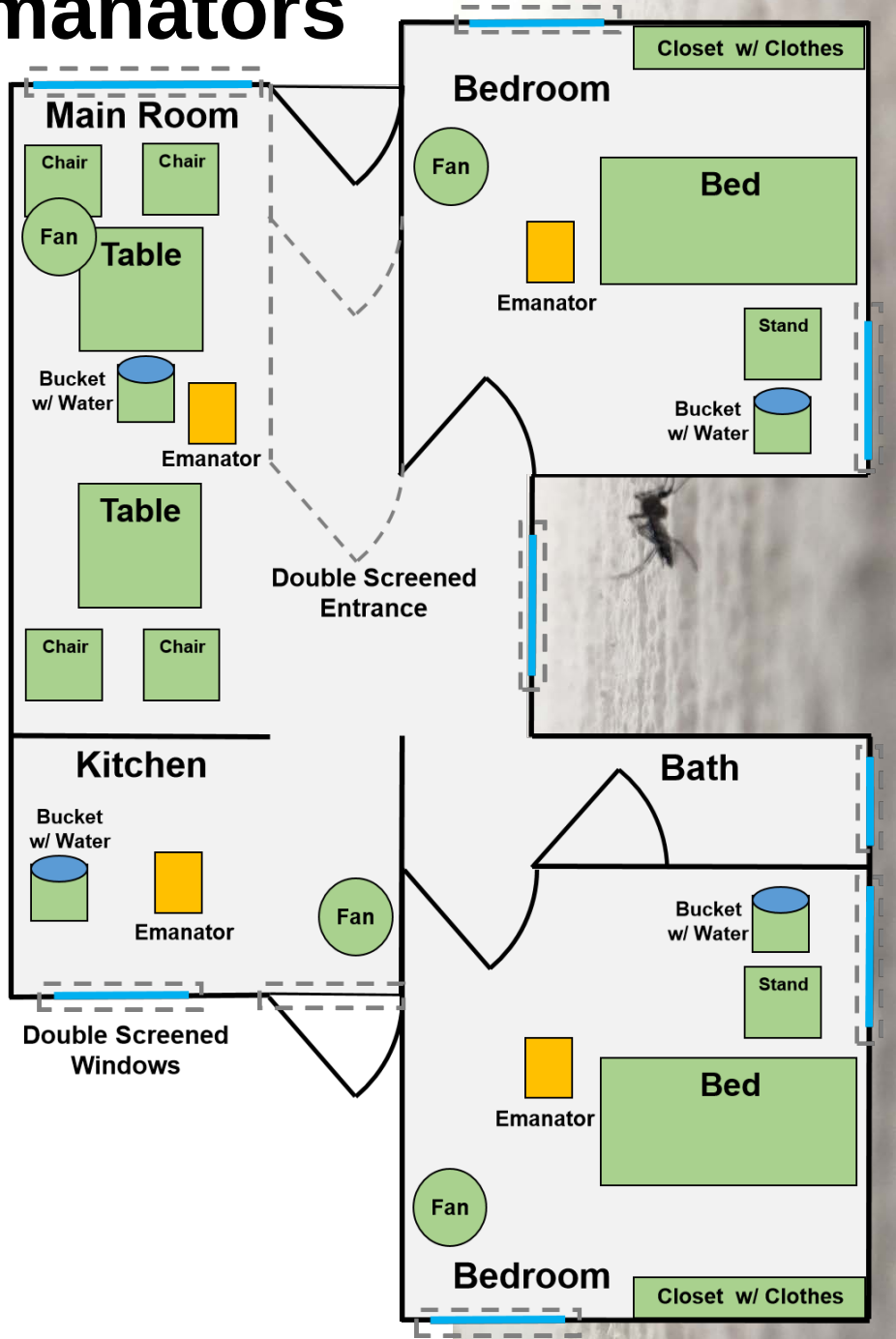
1- Control

0 emanators / room

2- Emanators

n = 1 emanators / room

[n = 4 emanators / house]



Aedes aegypti Strains Tested

Susceptible Strains

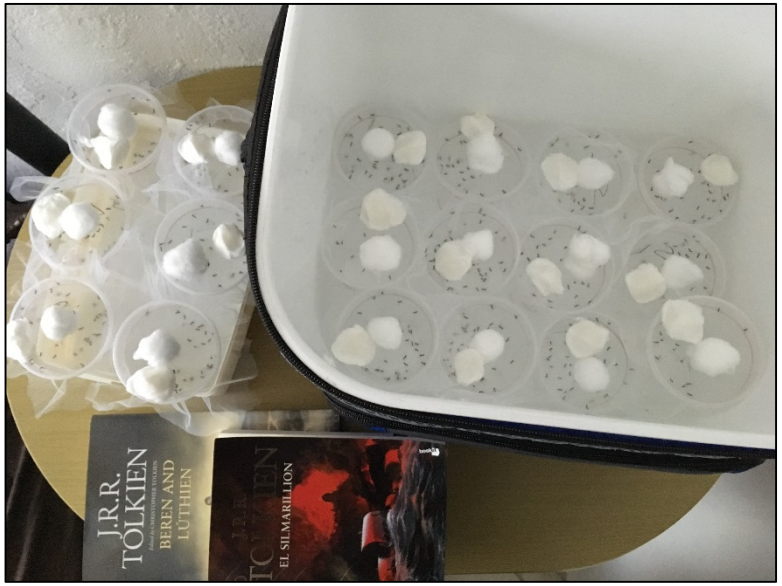
1- New Orleans (NO); Laboratory-derived

2- Cienega de Flores (CdF); Field-derived

Pyrethroid-Resistant Strains

3- Itzincab (ITZ); Field-derived

4- Juan Pablo (JP); Field-derived



Experimental Design

Released n = 25 female *Ae. aegypti* / house

- 3-7 days old

Experimental Design

Released n = 25 female *Ae. aegypti* / house

3-7 days old

<u>Landing counts</u>

1. 30 minutes after release (Baseline, no emanators)

Experimental Design

Released n = 25 female *Ae. aegypti* / house

3-7 days old

<u>Landing counts</u>

1. 30 minutes after release (Baseline, no emanators)

Add emanators

Experimental Design

Released n = 25 female *Ae. aegypti* / house

3-7 days old

<u>Landing counts</u>

1. 30 minutes after release (Baseline, no emanators)

   Add emanators

2. 60 minutes after release (30 min exposure)

Experimental Design

Released n = 25 female *Ae. aegypti* / house

3-7 days old

<u>Landing counts</u>

1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

Experimental Design

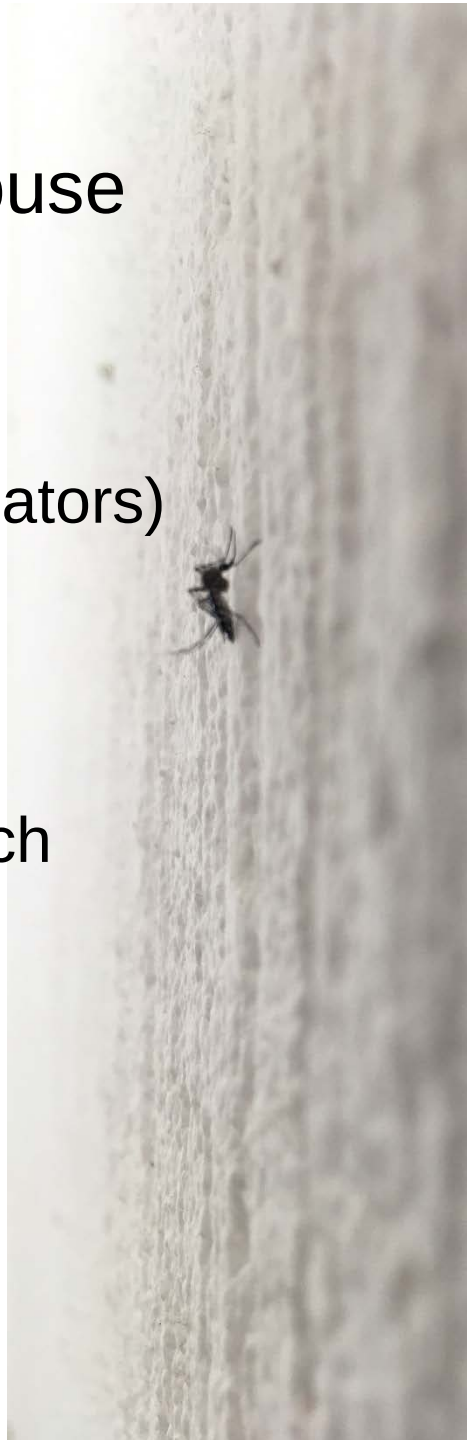
Released n = 25 female *Ae. aegypti* / house

3-7 days old

<u>Landing counts</u>

1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

n = 4 counts / sampling period; 2 minutes each



Experimental Design

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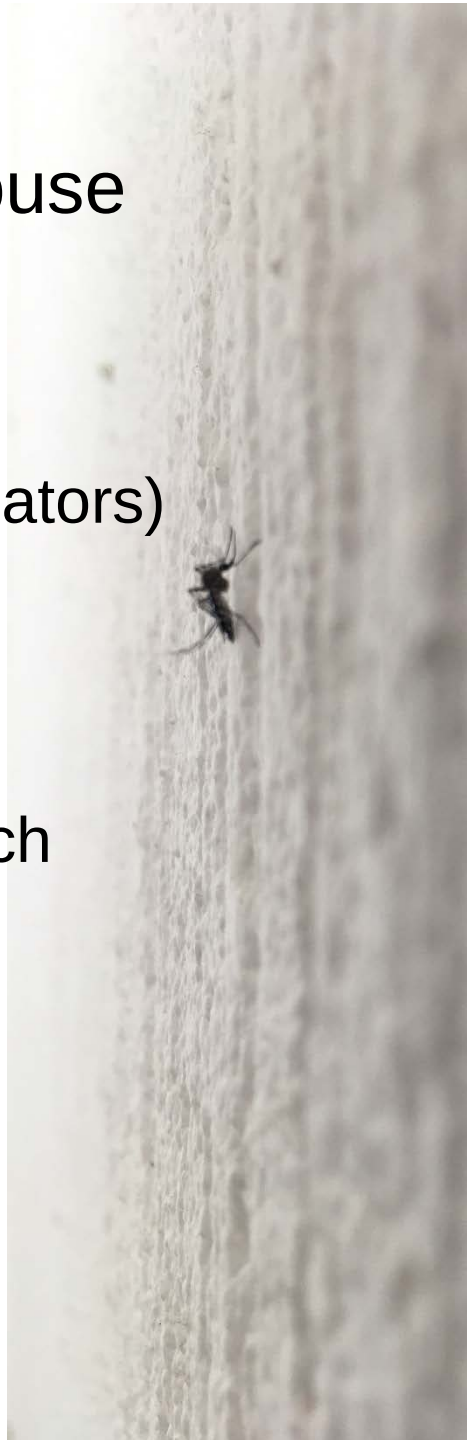
<u>Landing counts</u>

1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

n = 4 counts / sampling period; 2 minutes each

Mosquitoes not allowed to feed



Experimental Design

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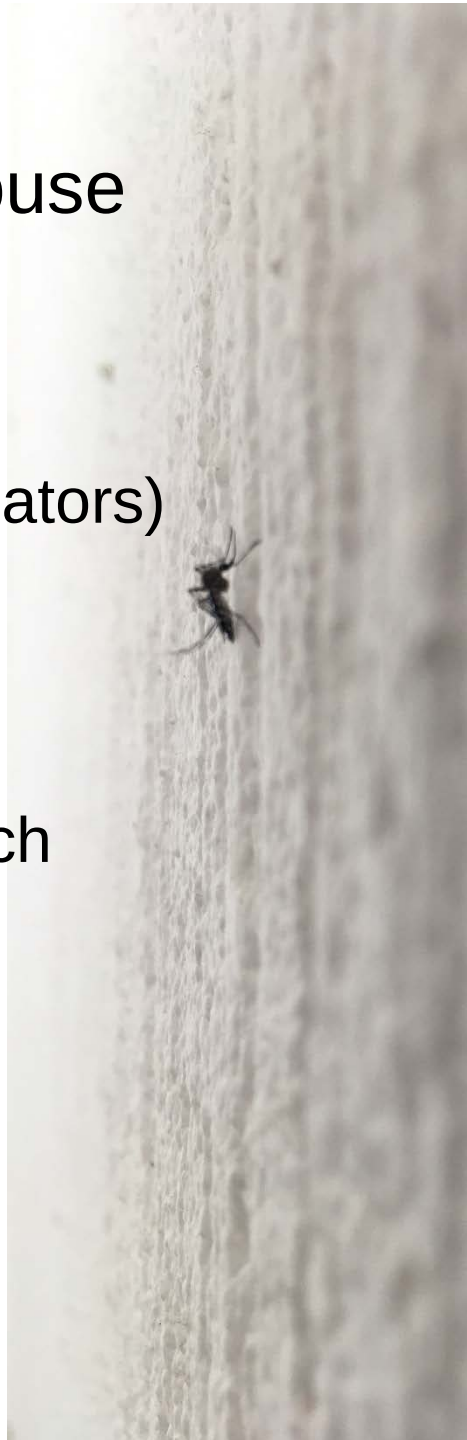
3-7 days old

<u>Landing counts</u>

1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

n = 4 counts / sampling period; 2 minutes each
Mosquitoes not allowed to feed
Counted landings from feet to knees



Experimental Design

Released n = 25 female *Ae. aegypti* / house

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<u>Landing counts</u>

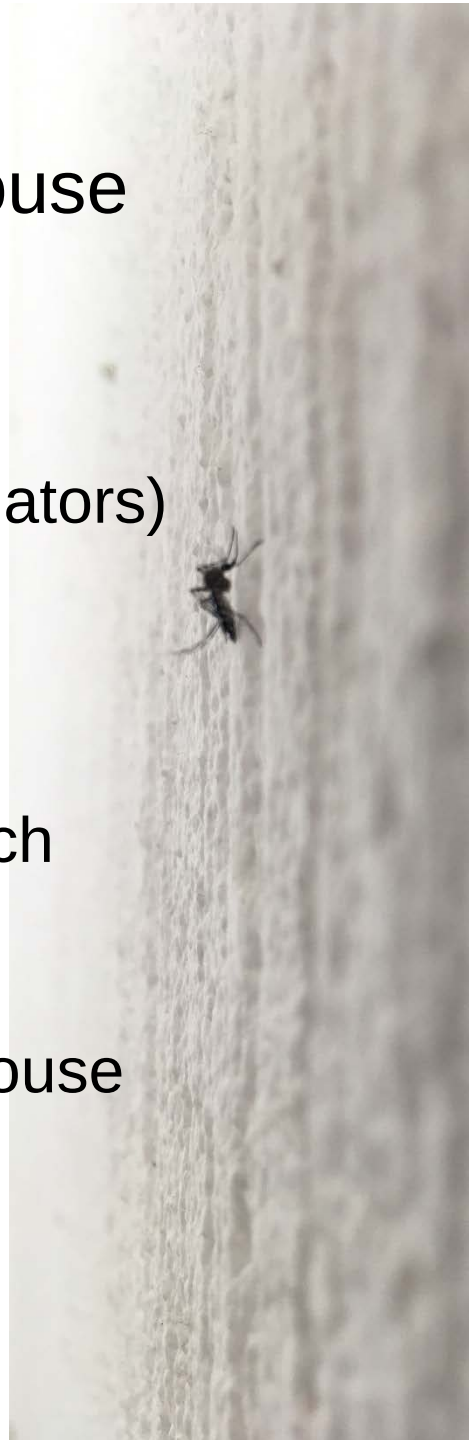
1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

n = 4 counts / sampling period; 2 minutes each

Mosquitoes not allowed to feed

Counted landings from feet to knees

Personnel kept consistent within room and house



Experimental Design

Released n = 25 female *Ae. aegypti* / house
3-7 days old

Landing counts

1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

Mortality

Collected live and dead mosquitos after 24 hours

Experimental Design

Released n = 25 female *Ae. aegypti* / house
3-7 days old

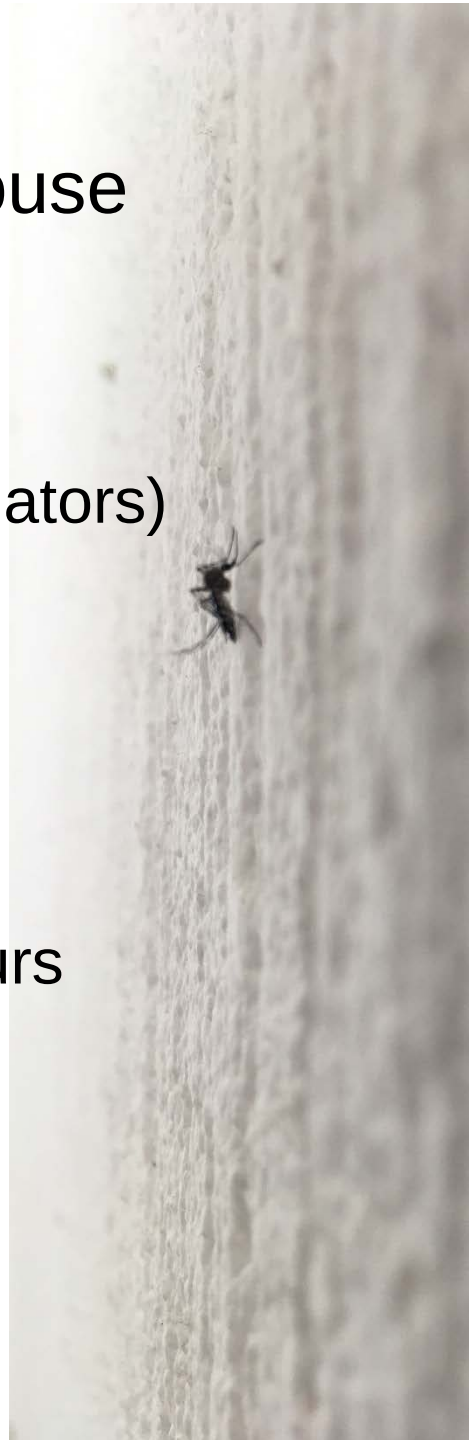
Landing counts

1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

Mortality

Collected live and dead mosquitos after 24 hours

Experiment repeated 3 times



Experimental Design

Released n = 25 female *Ae. aegypti* / house

3-7 days old

Landing counts

1. 30 minutes after release (Baseline, no emanators)
   Add emanators
2. 60 minutes after release (30 min exposure)
3. 24 hours after release (24 hr exposure)

Mortality

Collected live and dead mosquitos after 24 hours

Experiment repeated 3 times

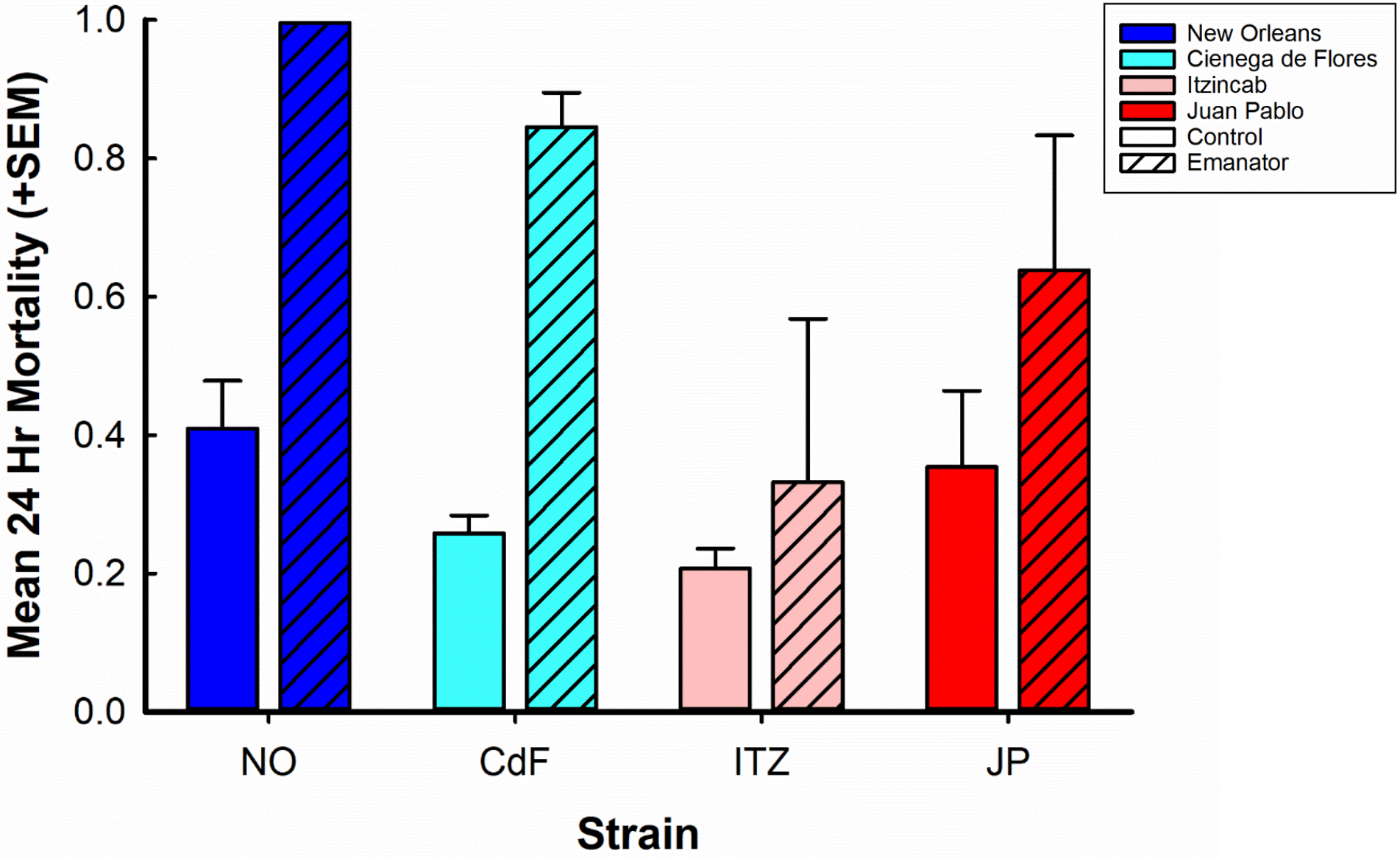
Each repetition contained 8 houses

Each strain in 2 houses

Strains within 1 control & 1 emanator house

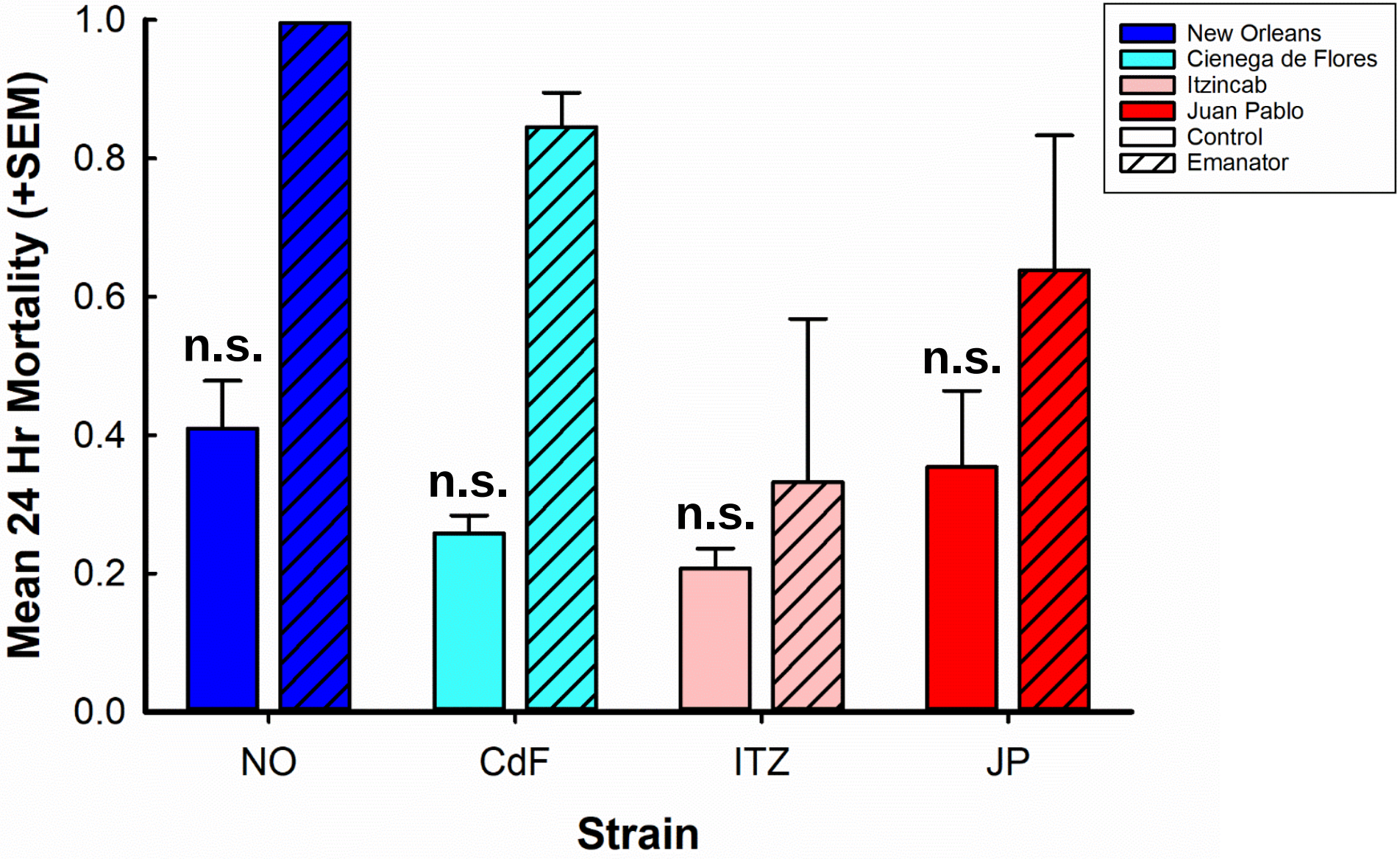
Emanator Mortality

Significantly Greater Mortality with Emanators



Preliminary Data

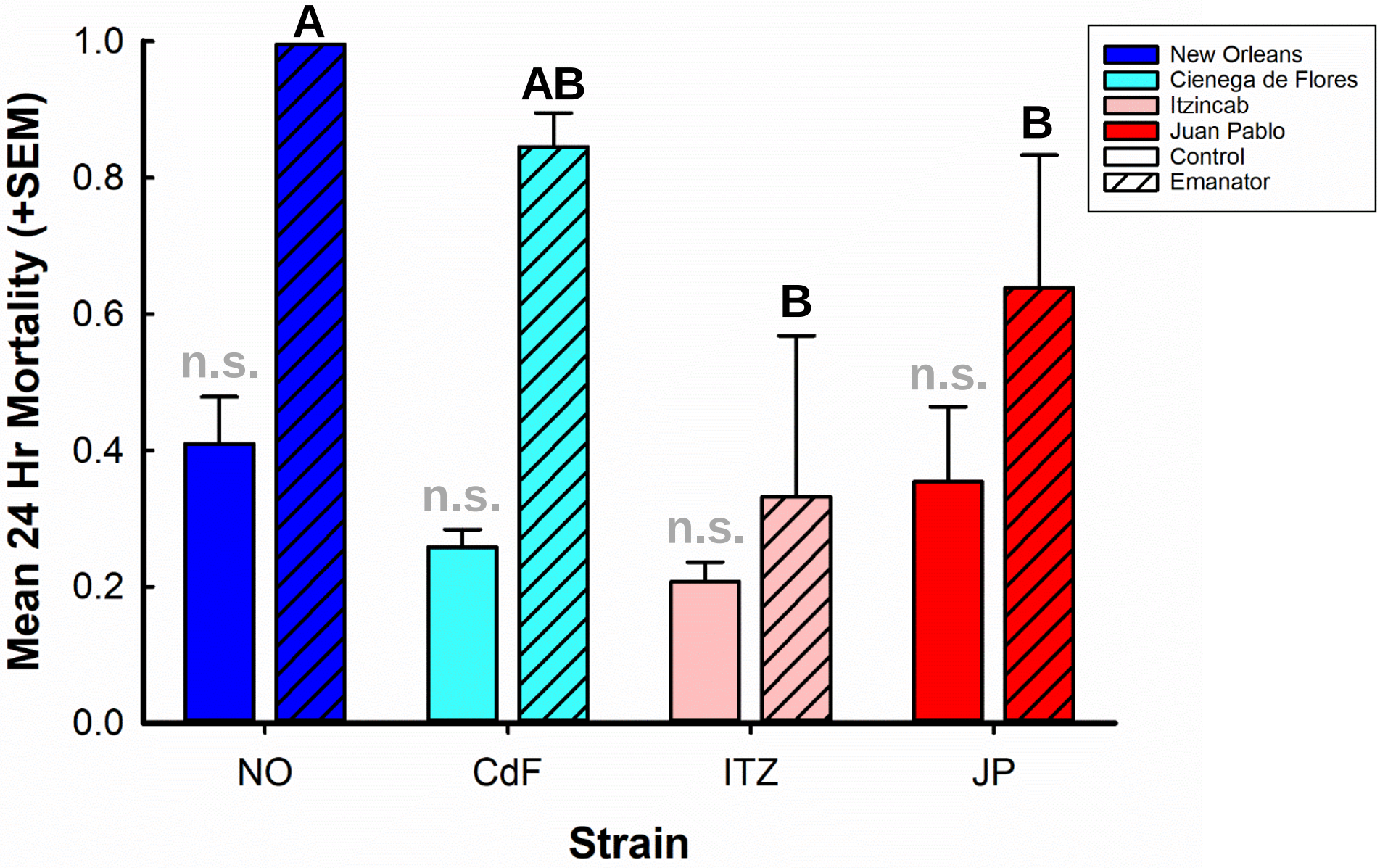
Mortality Similar Among Control Houses



Treatment*Strain $F = 3.9$; df = 3,16; $P = 0.028$

Preliminary Data

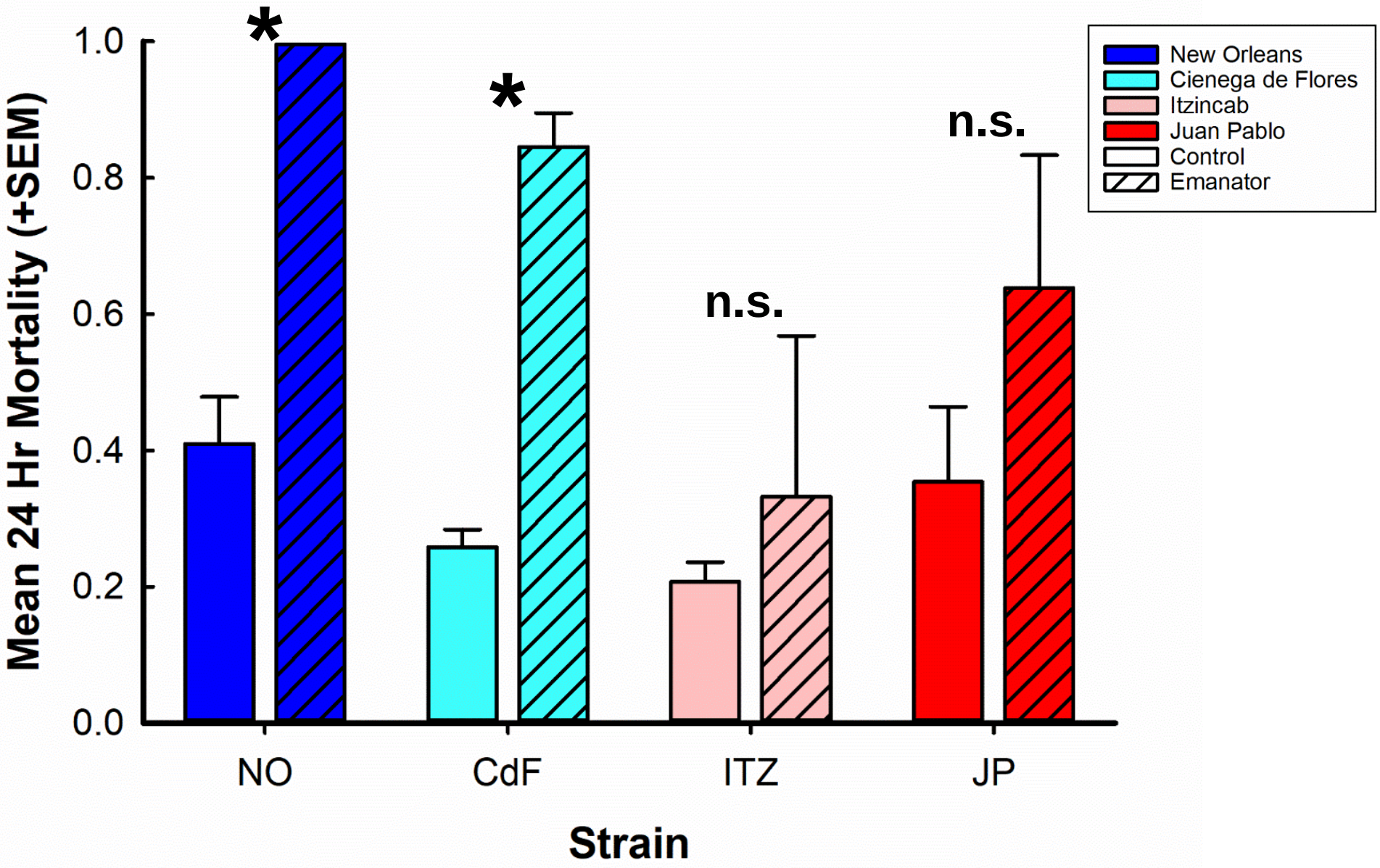
Significantly Greater NO Mortality w/ Emanators



Treatment*Strain $F = 3.9$; df = 3,16; $P = 0.028$

Preliminary Data

Resistant Strain Mortality did Not Differ

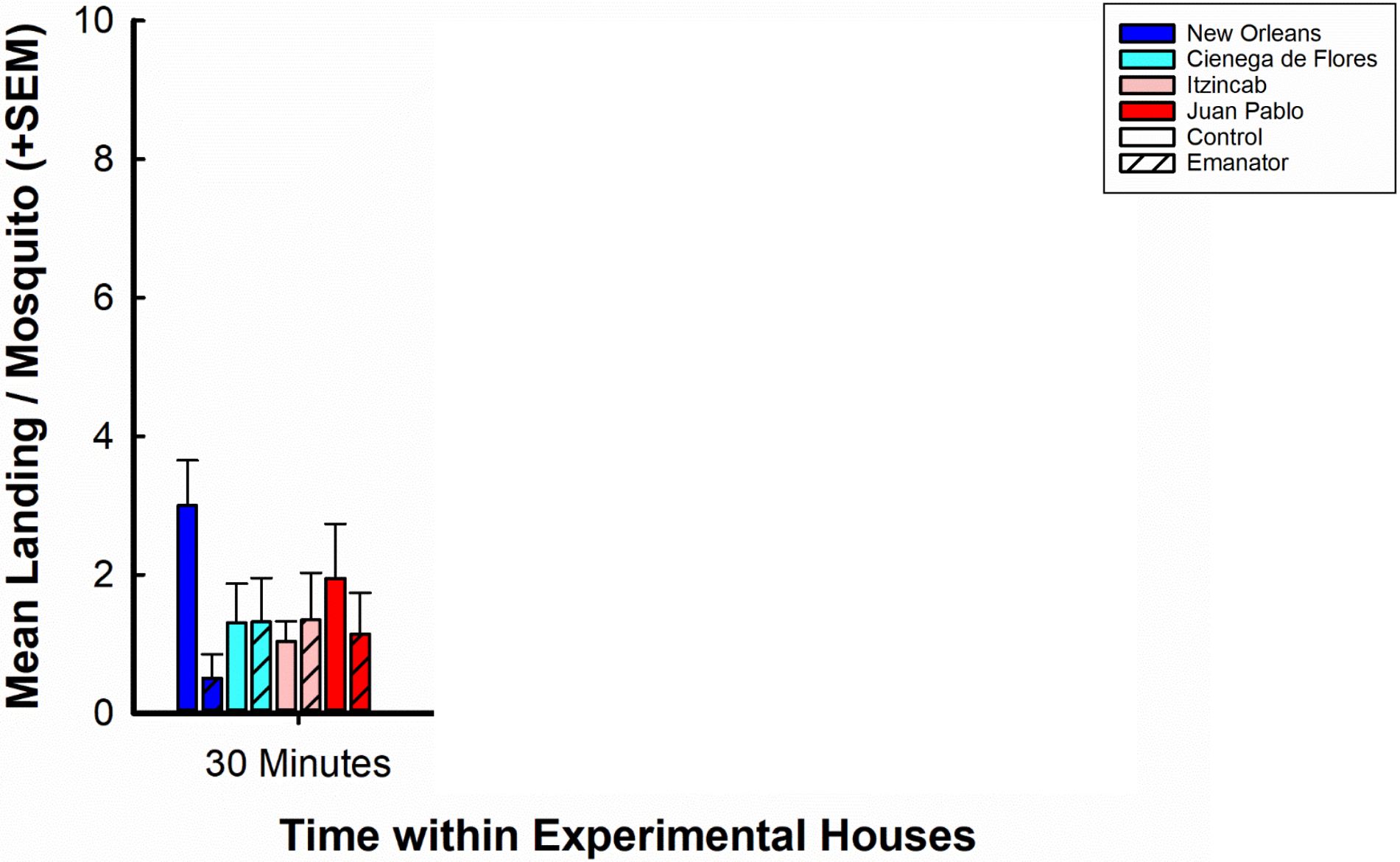


Treatment*Strain F = 3.9; df = 3,16; P = 0.028

Preliminary Data

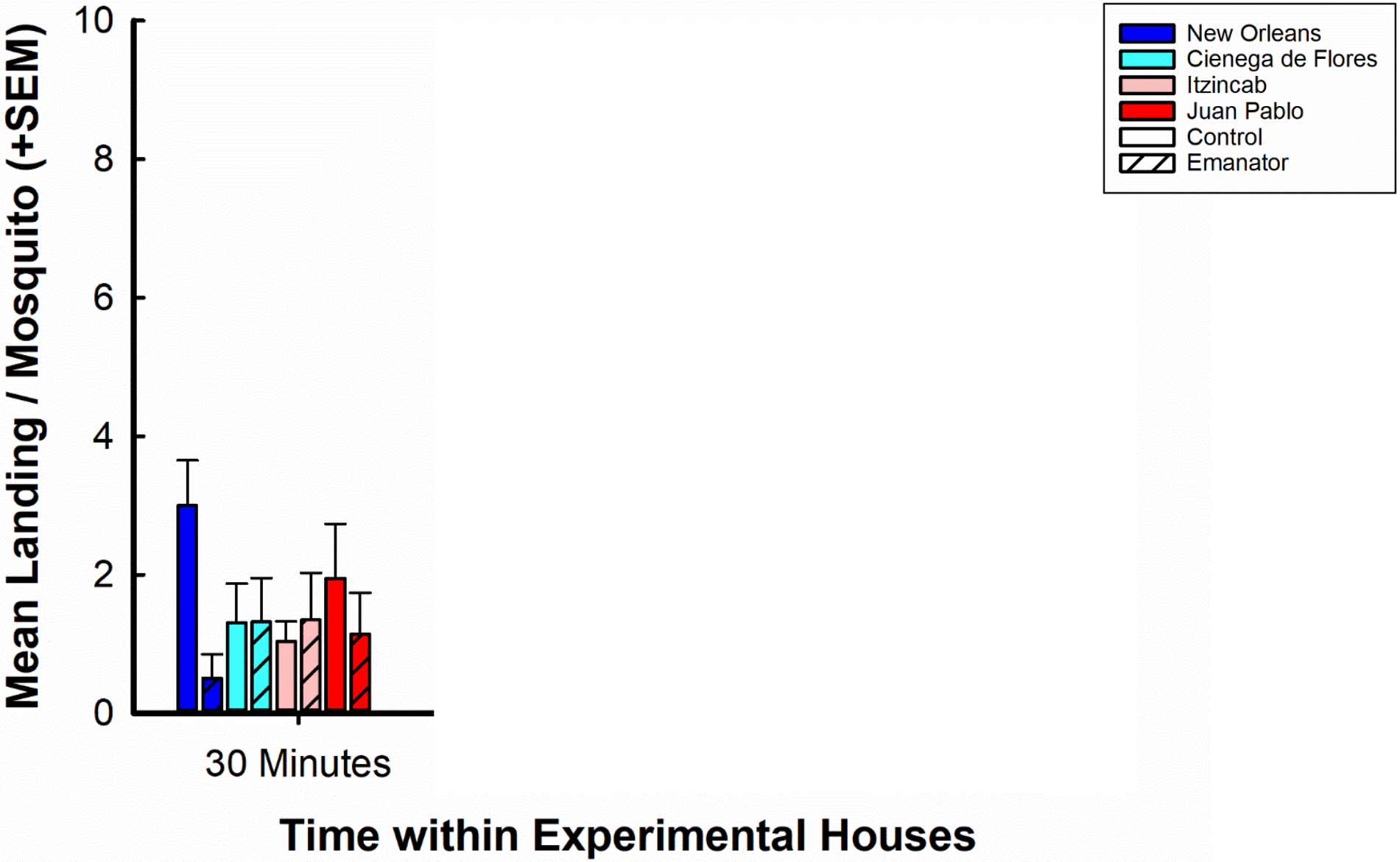
Landing Counts

No Difference in Landings at Baseline



Preliminary Data

No Difference in Landings at Baseline

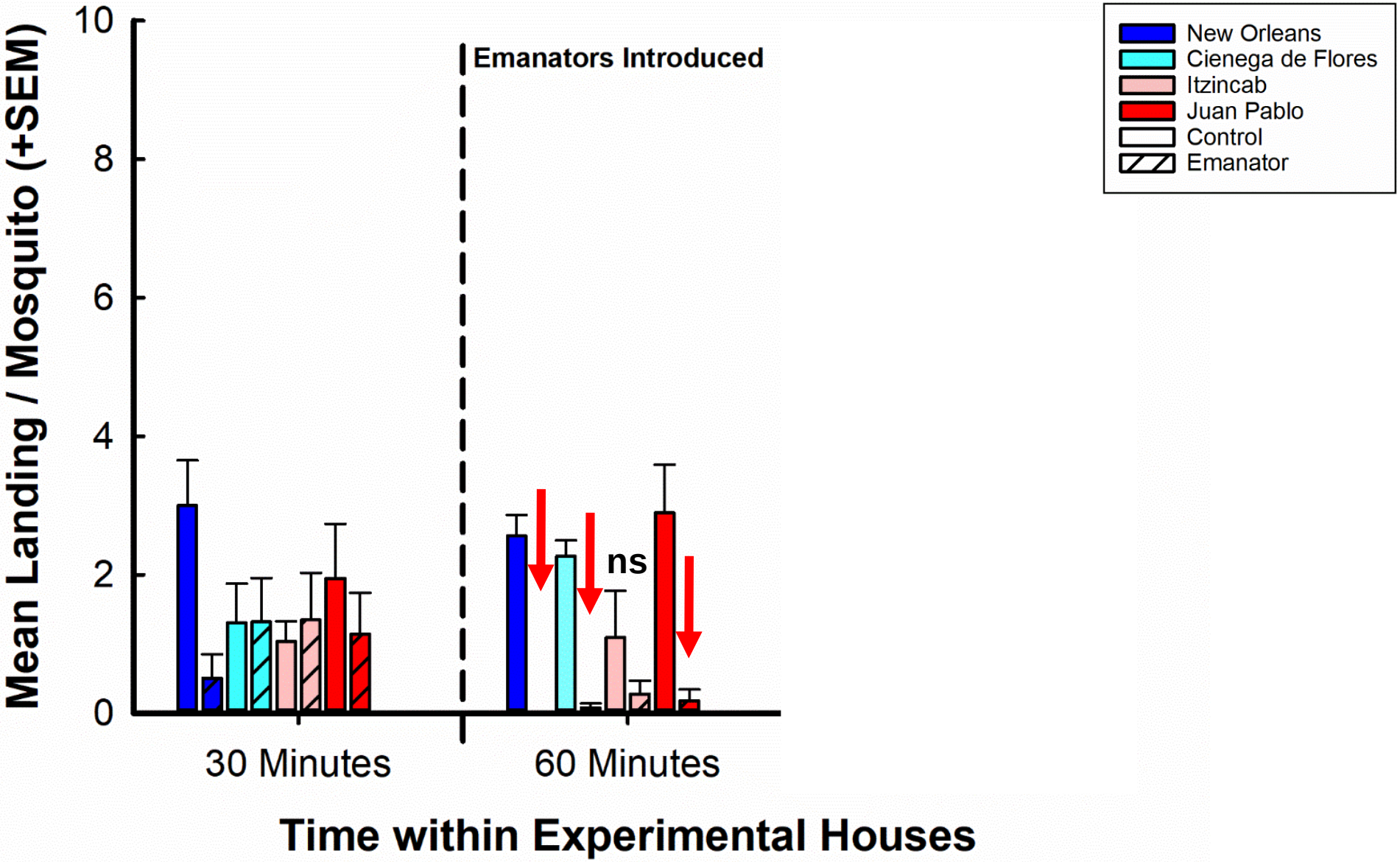


Time within Experimental Houses

Treatment*Strain $F = 1.5$; df = 3,16; $P = 0.25$

Preliminary Data

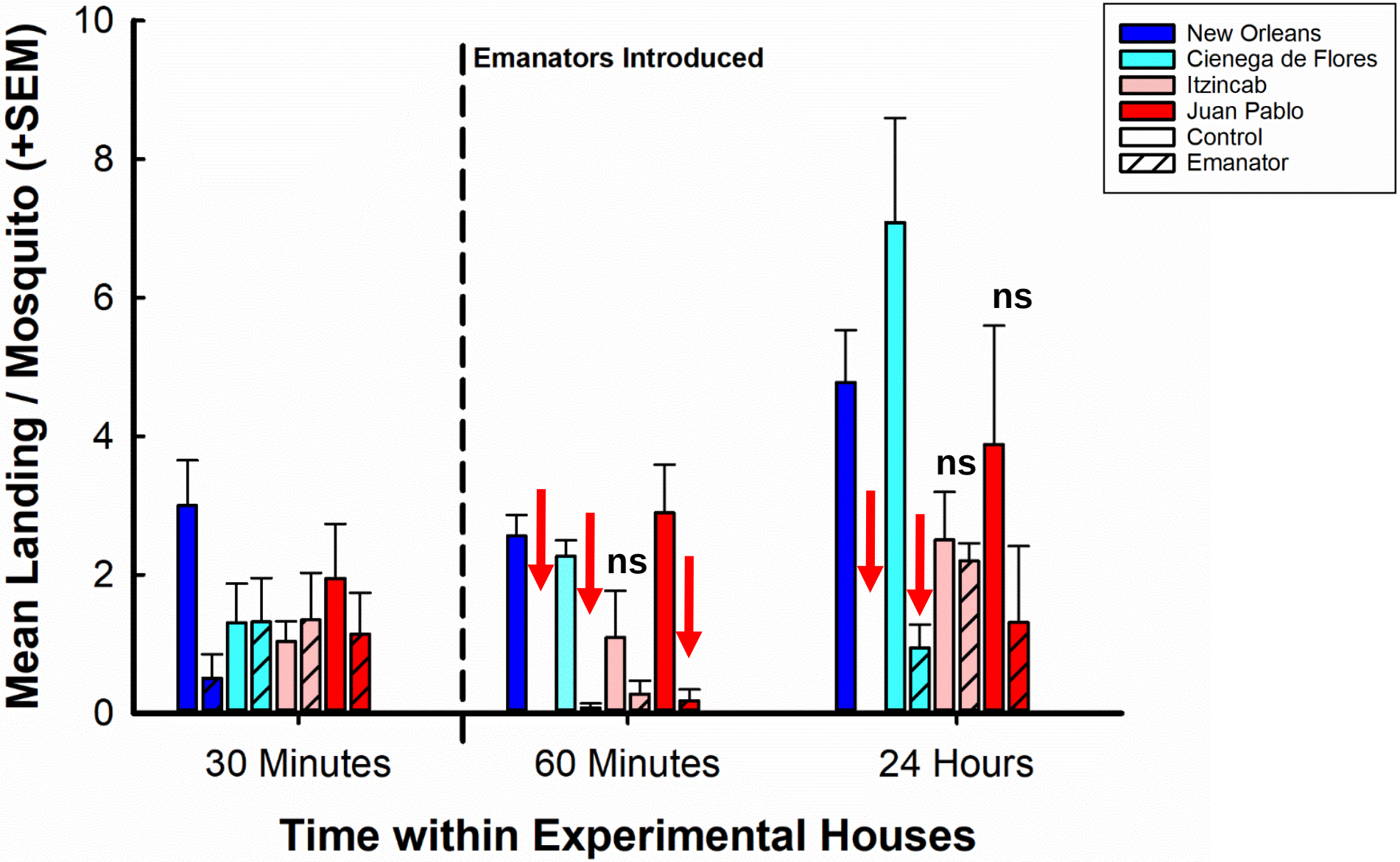
Landings Significantly Reduced Initially



Treatment*Strain $F = 3.6$; df = 3,16; $P = 0.036$

Preliminary Data

No Differences in Resistant Strains Landing



Treatment*Strain $F = 4.9$; df = 3,16; $P = 0.013$

Preliminary Data

Metofluthrin Emanators Affect *Ae. aegypti*

Emanators significantly increased mortality
- For susceptible NO strains only
- No difference with pyrethroid-resistant strains

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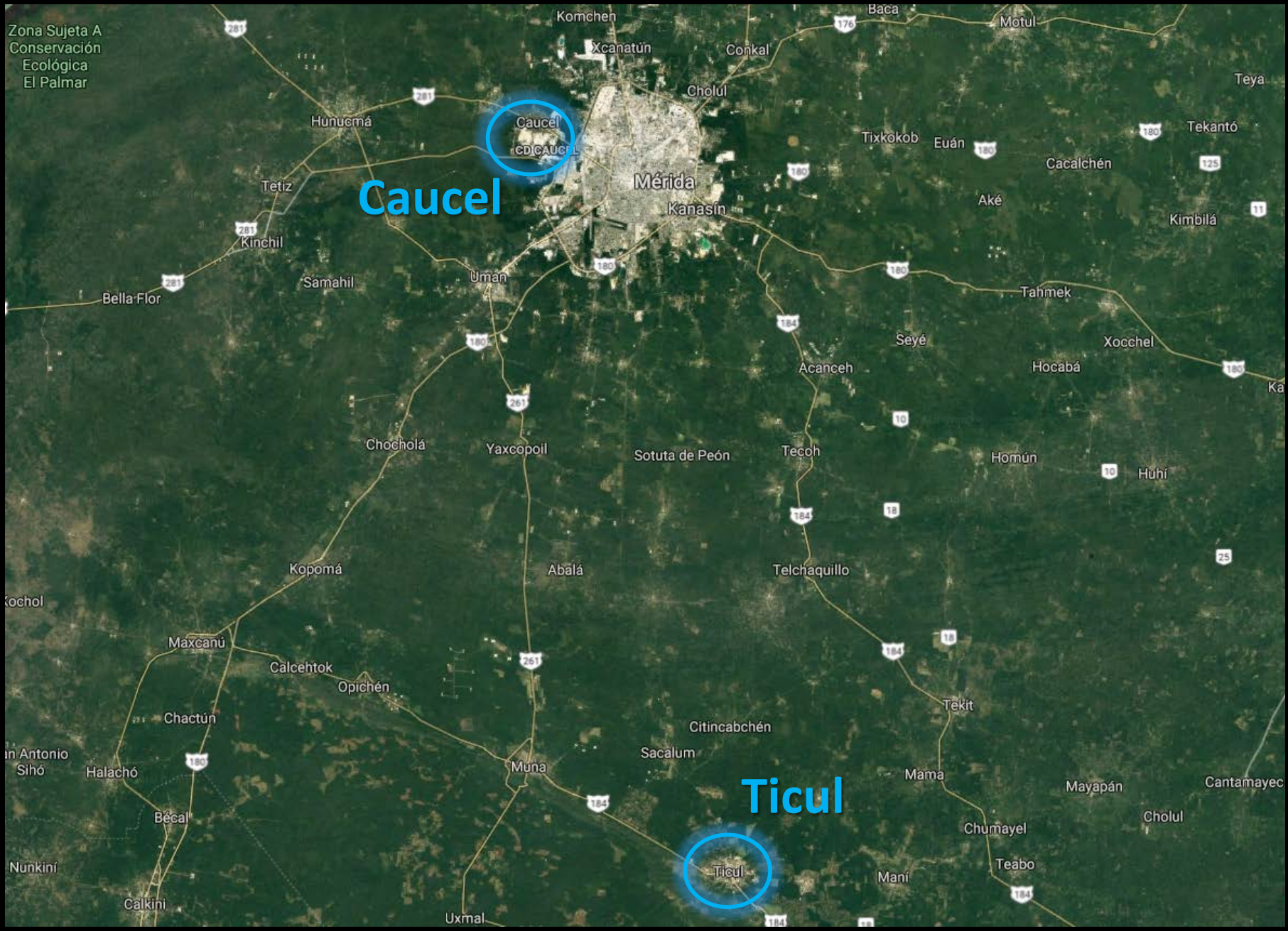
Landings significantly reduced with emanators
- Initially both susceptible and resistant strains
- Resistant stains landings increased after 24hrs

Metofluthrin Emanators Affect *Ae. aegypti*

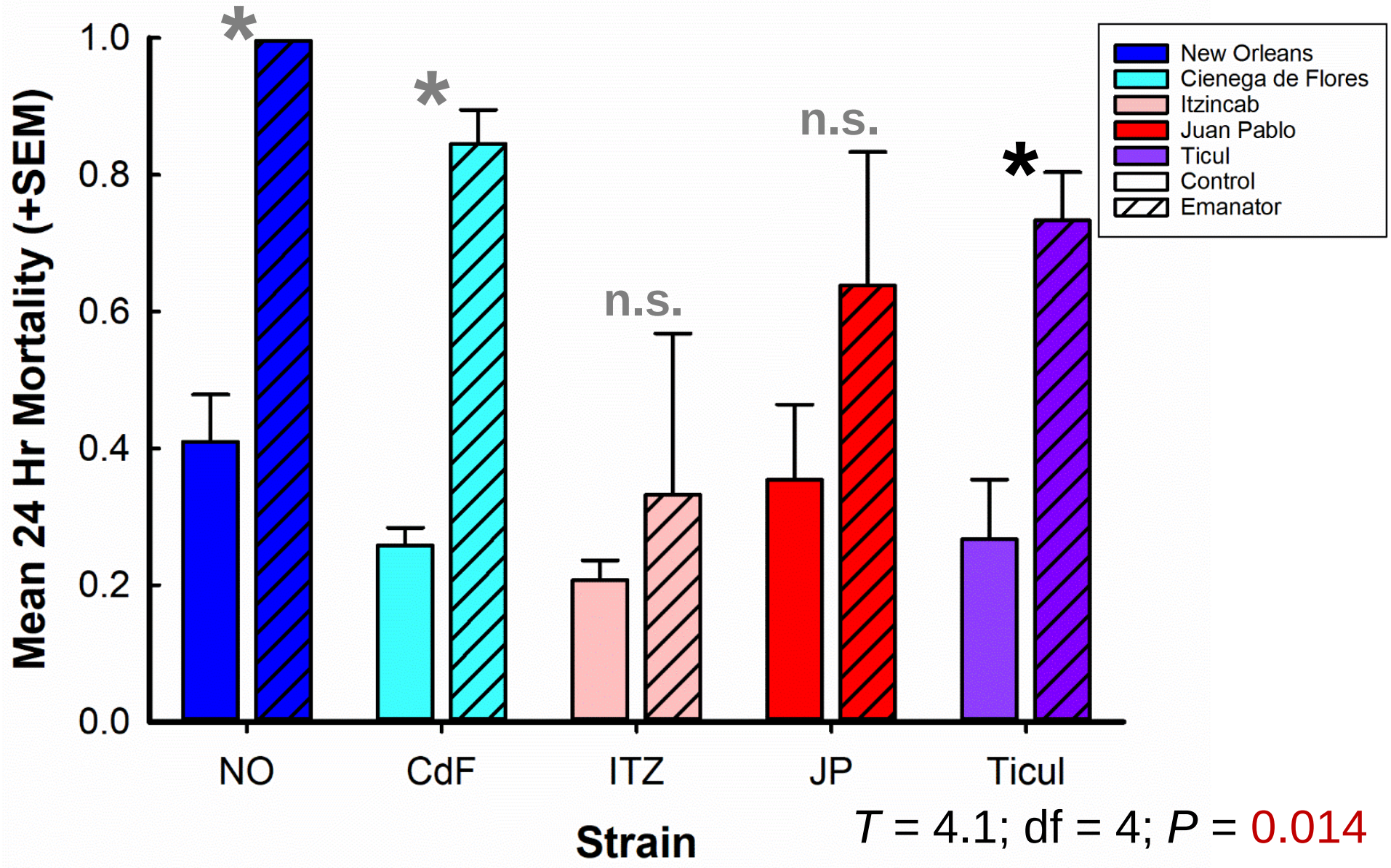
Emanators significantly increased mortality
- For susceptible NO strains only
- No difference with pyrethroid-resistant strains

Landings significantly reduced with emanators
- Initially both susceptible and resistant strains
- Resistant stains landings increased after 24hrs

Start testing emanators in the field


Caucel
Ticul
Zona Sujeta A Conservación Ecológica El Palmar
Komchen
Xcanatún
Conkal
Cholul
Baca
Motul
Teya
Hunucmá
Caucel
CDICAUCEL
Mérida
Kanasín
Tixkokob
Euán
Tekantó
Cacalchén
Aké
Kimbilá
Tetiz
Kinchil
Samahil
Umán
Bella Flor
Tahmek
Seyé
Xocchel
Acanceh
Hocabá
Chocholá
Yaxcopoil
Sotuta de Peón
Tecoh
Homún
Huhí
Kopomá
Abalá
Telchaquillo
Maxcanú
Calcehtok
Opichén
Chactún
Tekit
Citincabchén
Sacalum
Muna
Halachó
Becal
Mama
Mayapán
Cantamayec
Cholul
Chumayel
Teabo
Nunkiní
Calkiní
Ticul
Maní
Uxmal

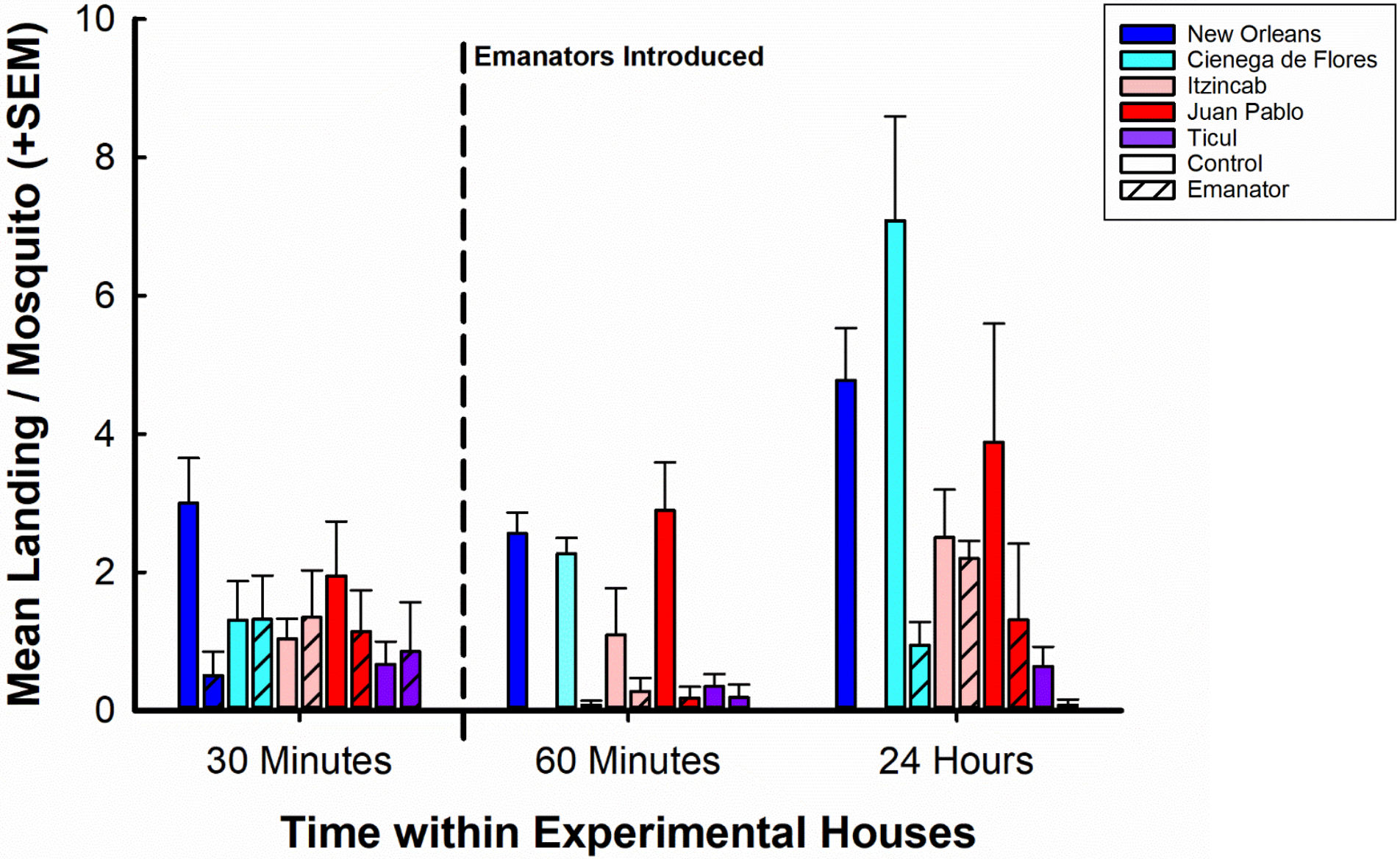
Test Ticul Strain within Experimental Houses



$T = 4.1$; df = 4; $P = 0.014$

Preliminary Data

Test Ticul Strain within Experimental Houses



Preliminary Data

Placing Emanators within Homes

Identified 200+ households in Ticul

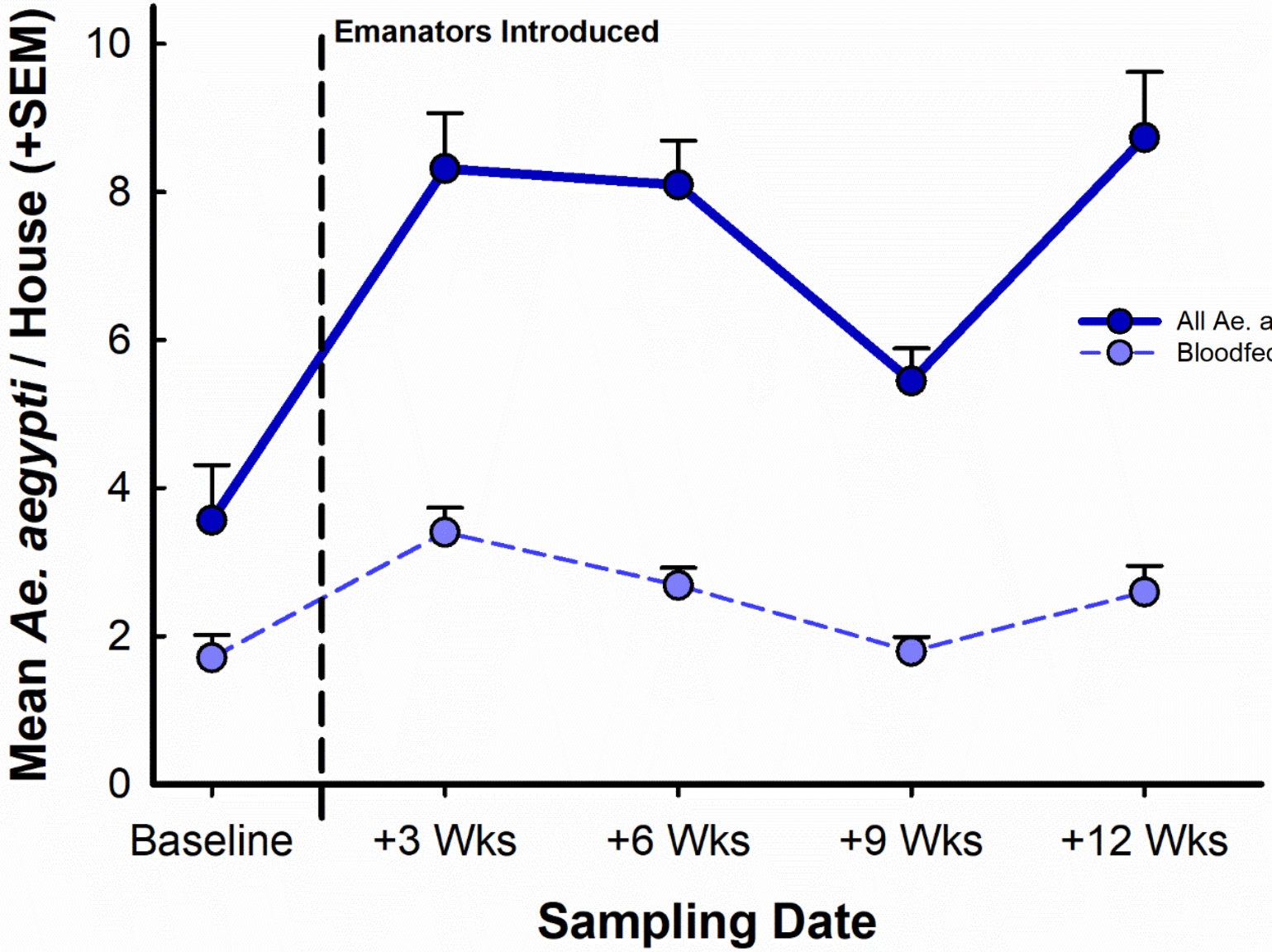
- n ≈ 100 Control & n ≈ 100 Emanator

Collected Mosquitoes

- Baseline, no emanators
  - Add emanators
- Every 3 weeks
  - Change emanators

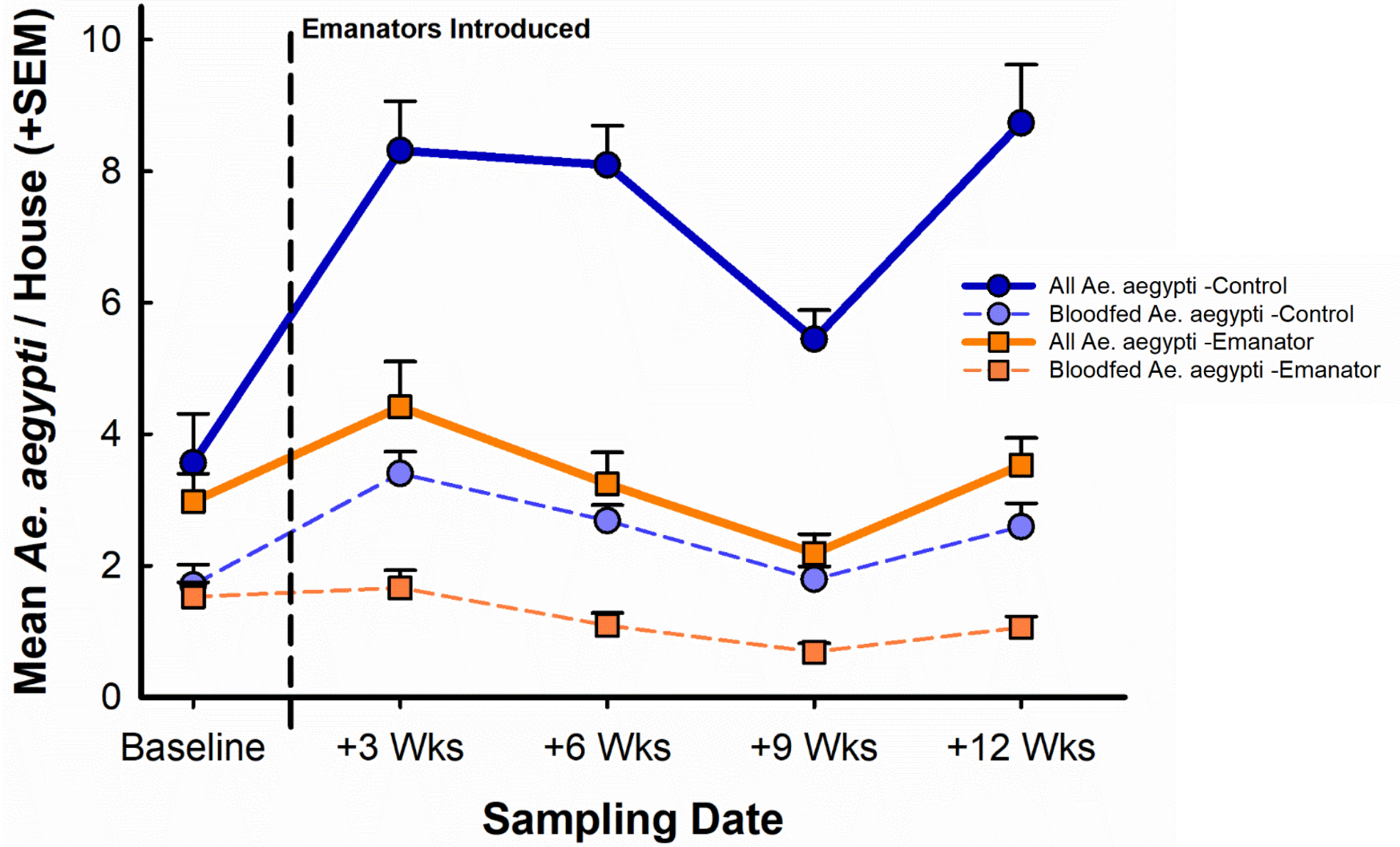

YUCATÁN
PRIMERO

Field Collections from Ticul Homes



Preliminary Data

Field Collections from Ticul Homes



Preliminary Data

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Sumitomo provided metofluthrin-treated emanators (SumiOne®)