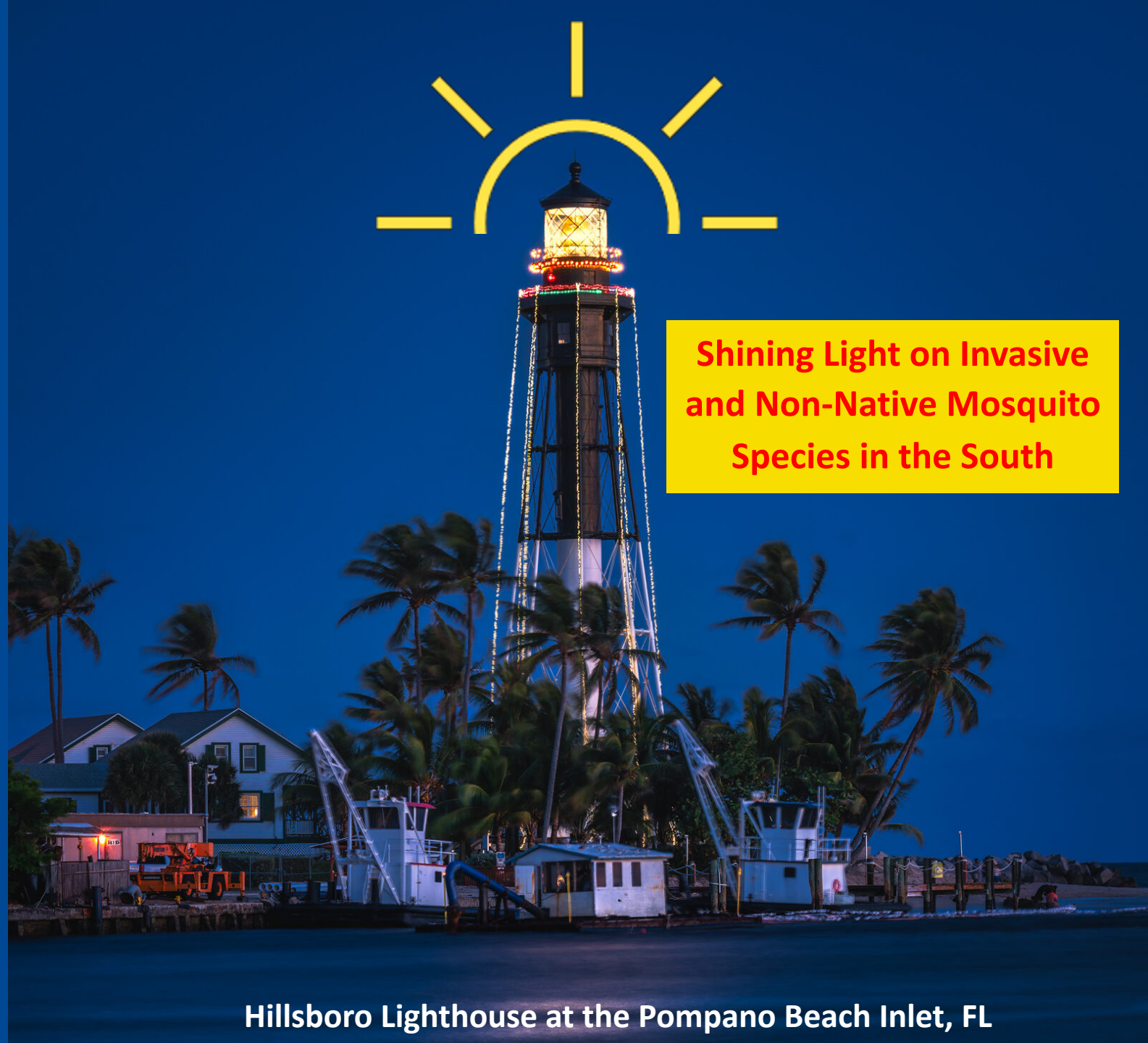
Michael T. Riles

Co-Director

Jekyll Island Georgia, Georgia Mosquito Control Association Conference 2023

Contributors: Bryan V. Giordano, Michael T. Riles, Benjamin Allen, Ana L. Romera-Weaver, Yoosook Lee

Biodiversity Enhancement And Control Of Non-native Species



Shining Light on Invasive and Non-Native Mosquito Species in the South

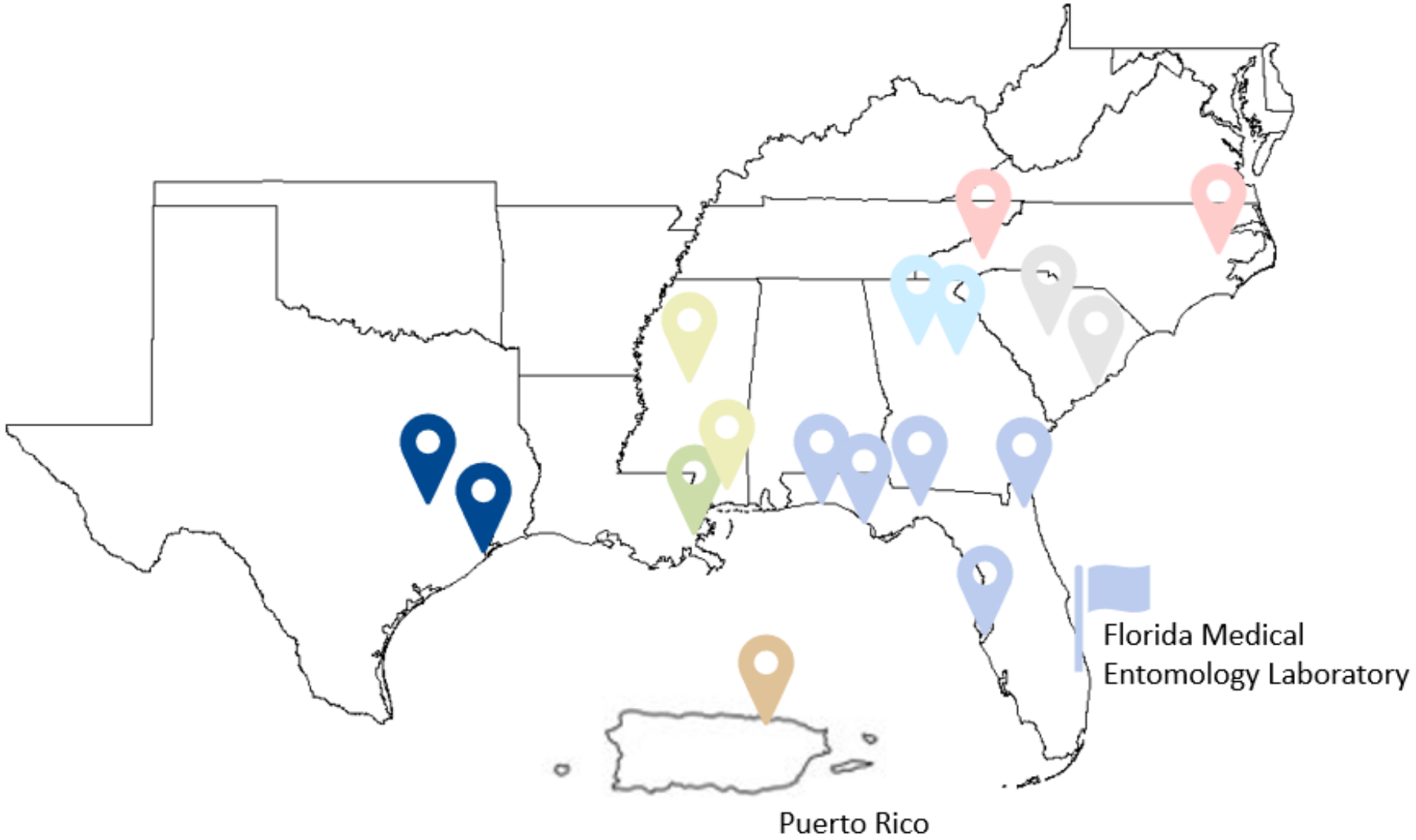
Hillsboro Lighthouse at the Pompano Beach Inlet, FL

Board of Directors 2023

We Are…

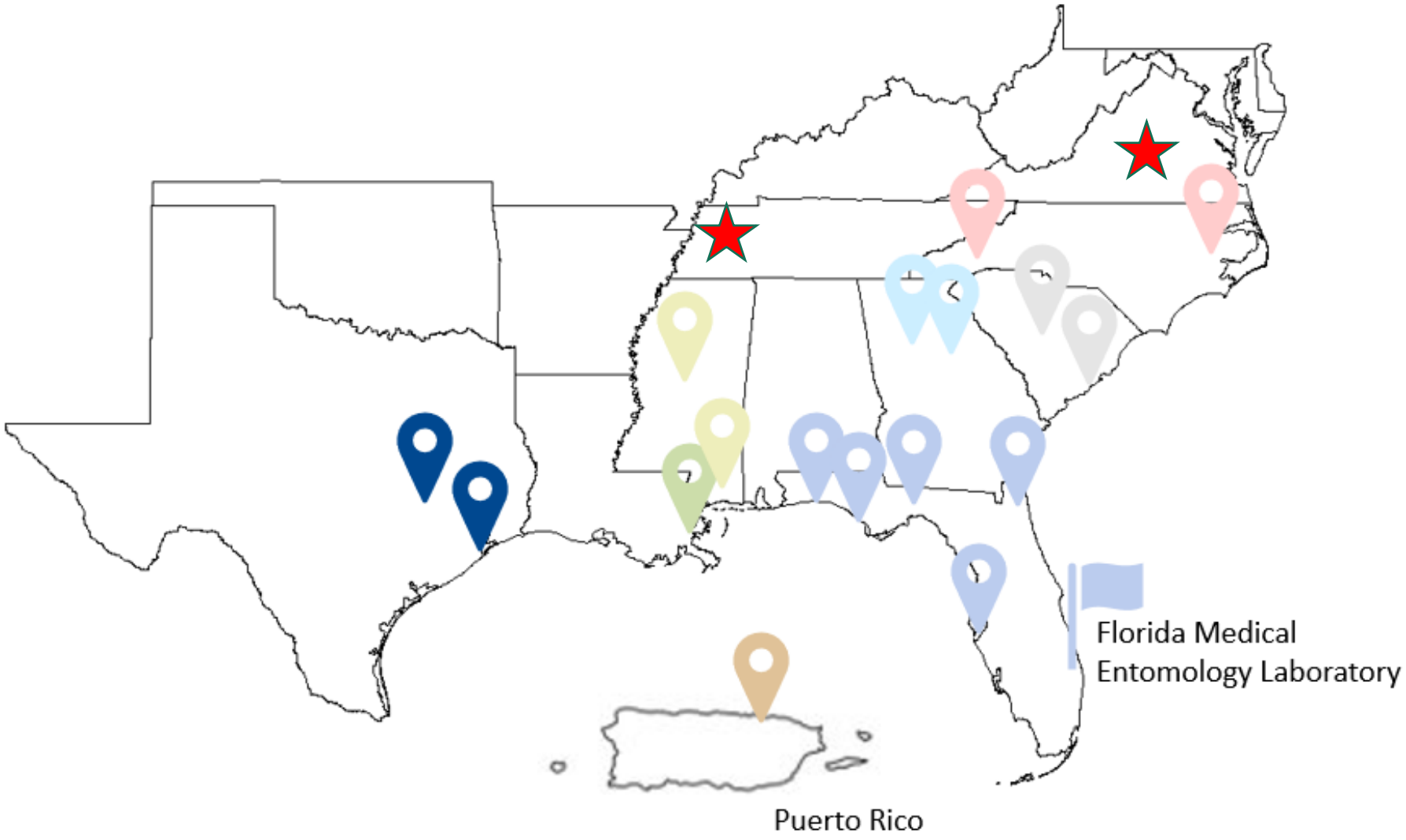
- Mosquito Control Professionals
- Private Pest Control
- Public Health Professionals
- Academics (Research and Extension)

2022 Membership

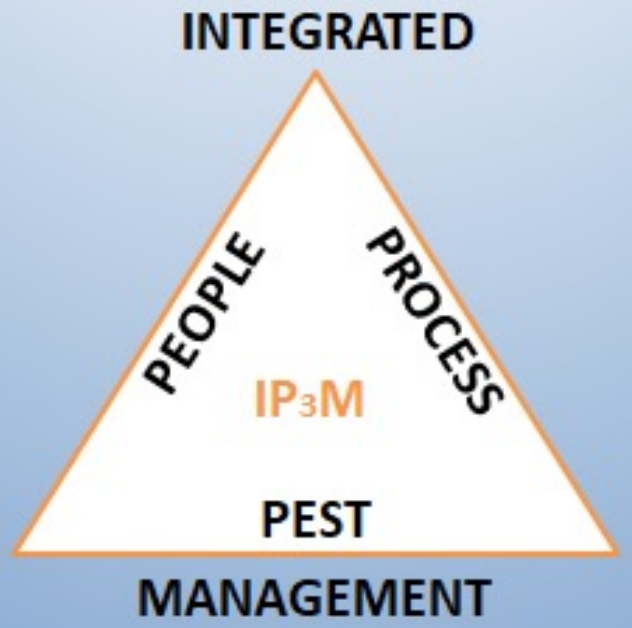


Mosquito BEACONS
Working Group

??



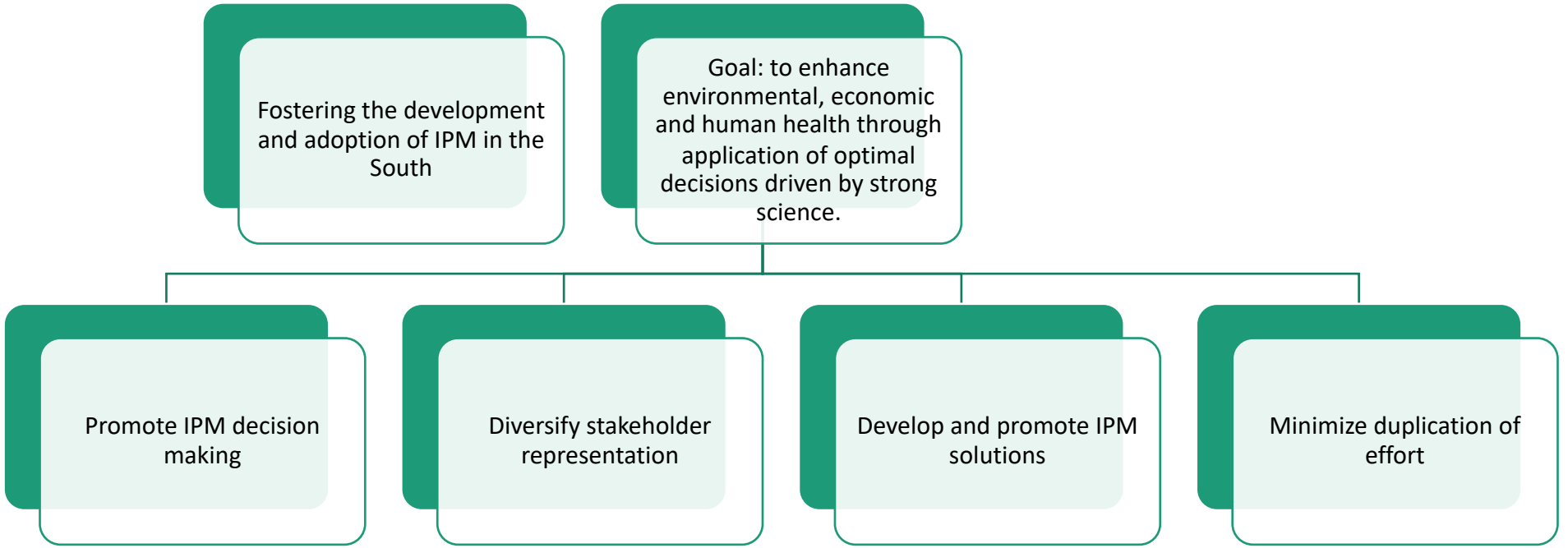
IP_3M



A fundamental understanding of the human element and ecological systems within an area of concern is essential to recognizing reasons behind pest issues, the solutions for controlling them, and the implications of those actions.

Southern IPM Center

USDA



We are supported by the Southern IPM Center (Project S21-002) as part of the USDA National Institute of Food and Agriculture Crop Protection and Pest Management Regional Coordination Program (Agreement No. 2018-70006-28884).

Southern

FRIENDS OF IPM AWARDS

2022

2022 Pulling Together Award

Mosquito BEACONS Working Group

https://fmel.ifas.ufl.edu/invasivemosquito/

THE MOSQUITO BEACONS WORKING GROUP

ABOUT THE BEACONS WORKING GROUP

The Mosquito Biodiversity Enhancement and Control of Non-native Species (BEACONS) working group has members from Louisiana, Mississippi, Georgia, Florida, and North and South Carolina, and consists of academic researchers, mosquito control personnel and senior management, private pest control, state public health and agriculture entities, and the Centres for Disease Control and Prevention.

We are a multi-state committee dedicated to providing leadership on invasive mosquito species in the southern region. The overall goal of our working group is to increase the capacity for non-native and invasive mosquito surveillance and control across our region, while also raising awareness of new and potential introductions.

Caption: ***Culex coronator*** is a highly invasive Neotropical species that has been introduced to Florida and the southeastern United States. (Photo Credit: L. E. Reeves).

UF IFAS UNIVERSITY of FLORIDA **Blogs**

About

Agriculture | Natural Resources | Home Landscapes | Work & Life | 4-H & Youth

Home » UF/IFAS Entomology And Nematology Department » IPM Working Group Hosts Multi-State Workshop On Invasive Mosquitoes

IPM Working Group Hosts Multi-State Workshop on Invasive Mosquitoes

Author Profile

bryangiordano

Bryan is a founder of the

BEACONS Dashboard Map

Contributors:

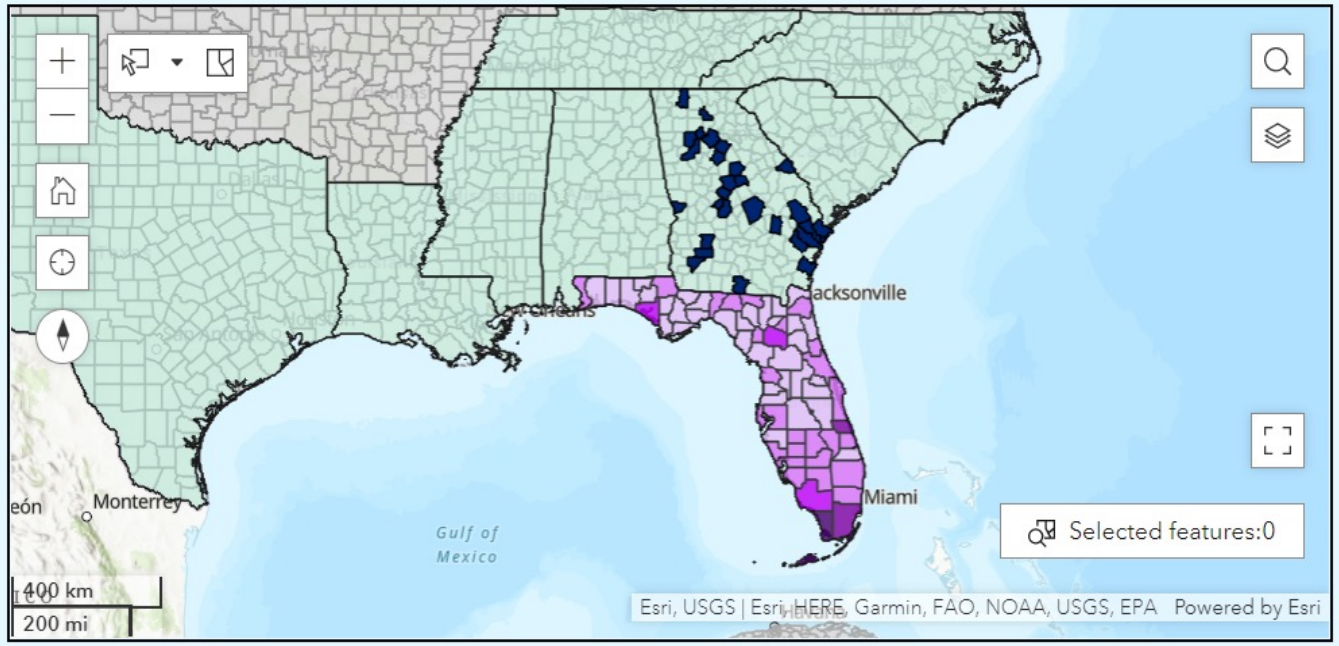
UF IFAS UNIVERSITY of FLORIDA

MENU

THE MOSQUITO BEACONS WORKING GROUP

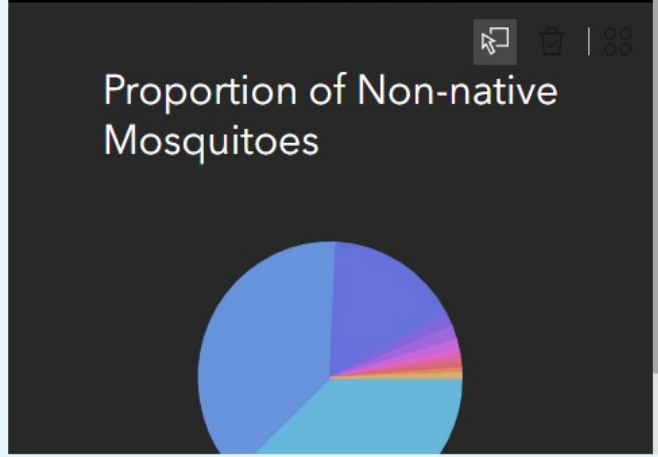
ABOUT THE BEACONS WORKING GROUP

The Mosquito Biodiversity

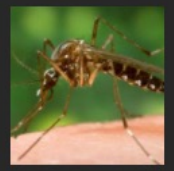


Invasives_all_FL

Apply Reset



Aedes aegypti



"In the early 1900s, *Aedes aegypti* distribution extended from the southern United States down to Argentina. The mid-1900s saw the development of a

UF IFAS Featured Creatures

Biology of Non-native Mosquitoes

Search

Mosquito Species	Behavior	Larval Habitat	Pre
Aedes aegypti	Day time biters	Natural and artificial conta…	Ma
Aedes albopictus	Crepuscular biters	Natural and artificial conta…	Ma

THE MOSQUITO BEACONS WORKING GROUP

The BEACONS Working Group is collecting information pertaining to the distribution of invasive and non-native species of interest. Please use this form to submit the date, locality, coordinates, and collection method if known.

MOSQUITO BEACONS DATA SUBMISSION

Invasive and Non–Native Mosquito Species Submissions

Agency Name *

First

Data Manager *

First Last

Email *

How many species are you reporting? *

One

BEACONS Working Group Objectives

STAKEHOLDER MEETINGS

SURVEILLANCE CAPACITY SURVEY

STAKEHOLDER ENGAGEMENT

STAKEHOLDER MEETINGS

- **Identify priorities** for invasive species surveillance, control, and research activities
- **Recognize gaps** in invasive species knowledge and surveillance activities
- Multi-state and -county collaborations influenced by stakeholder priorities and needs

STAKEHOLDER ENGAGEMENT

- Website and printed educational materials
  - Educate public on invasive mosquito bionomics
  - Provide resources for mosquito control and public health agencies

- Workshop in dashboard capabilities including data management, analysis, and visualization techniques
  - Increased knowledge of on-line data management tools and the benefits of real-time data reporting

SURVEILLANCE CAPACITY SURVEY

- Describe gaps and barriers to invasive species surveillance
- Summarize invasive species surveillance efforts across the Southern region
- Identify priority areas for improved surveillance regimes
- Results of the survey will inform about knowledge gaps and deficiencies in coordinated invasive species surveillance efforts

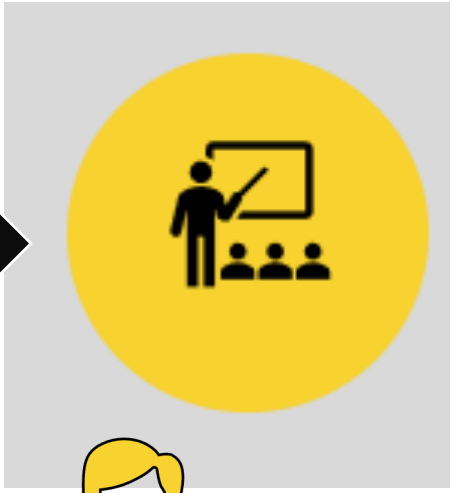
OBJECTIVES 1&2

TASK FORCES

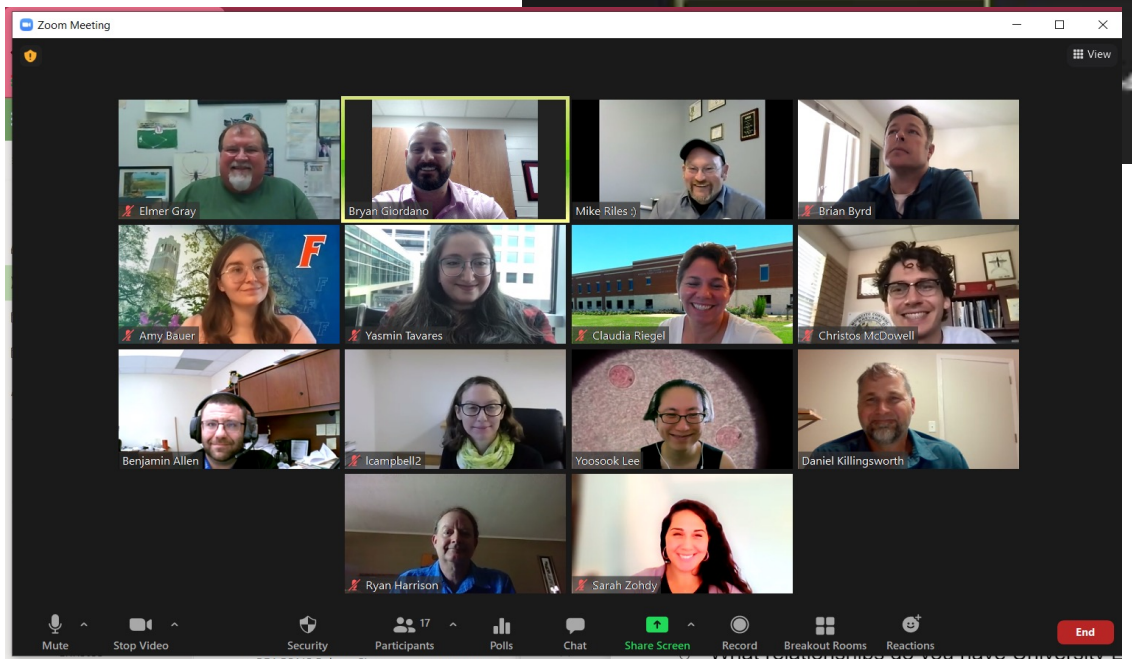
OBJECTIVE 3

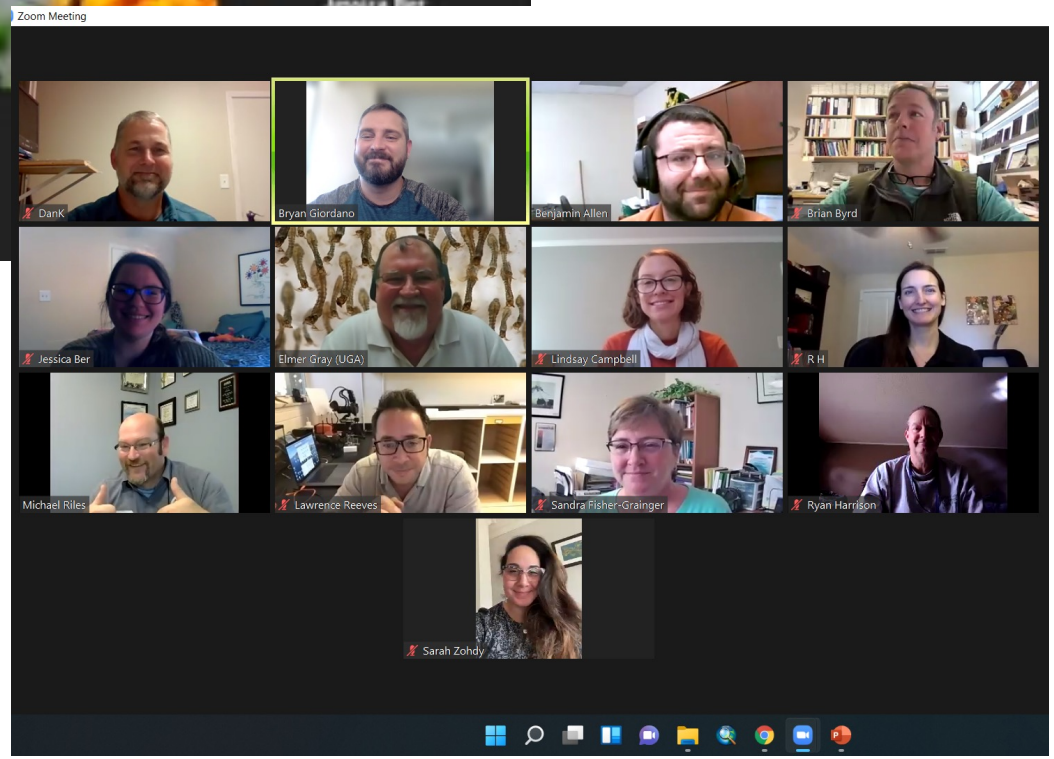
STAKEHOLDER PRIORITIES AND NEEDS

NEW RESOURCES/ TRAINING/ PROJECTS TO PROMOTE IPM



Stakeholder Meetings





What is being done?

- Currently no national contingency plans in place for invasive mosquitoes
- Surveillance and control are regional or local
- Few programs share data or utilize database
- Training opportunities are sparse
- New discoveries are delayed by publication wait times
- Scientific publications / news stories often don't include key morphological characteristic required for identification

Which in turn means…

- Surveillance personnel don’t know what to look out for
- Even once aware of the problem, finding information and updating identification is difficult
- Large lag-times between introduction and identification
- Unchecked range expansions.

Surveillance Capacity Survey

Participating States: AL, LA, MS, GA, FL, NC, SC

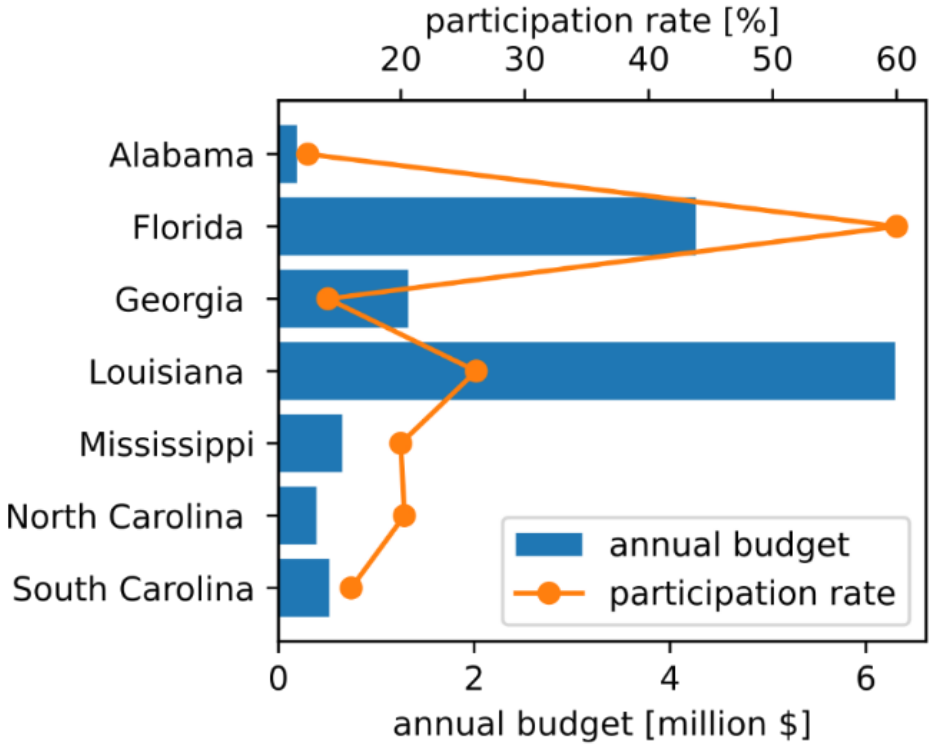
No. Programs Contacted: 323

Total No. Responses: 106

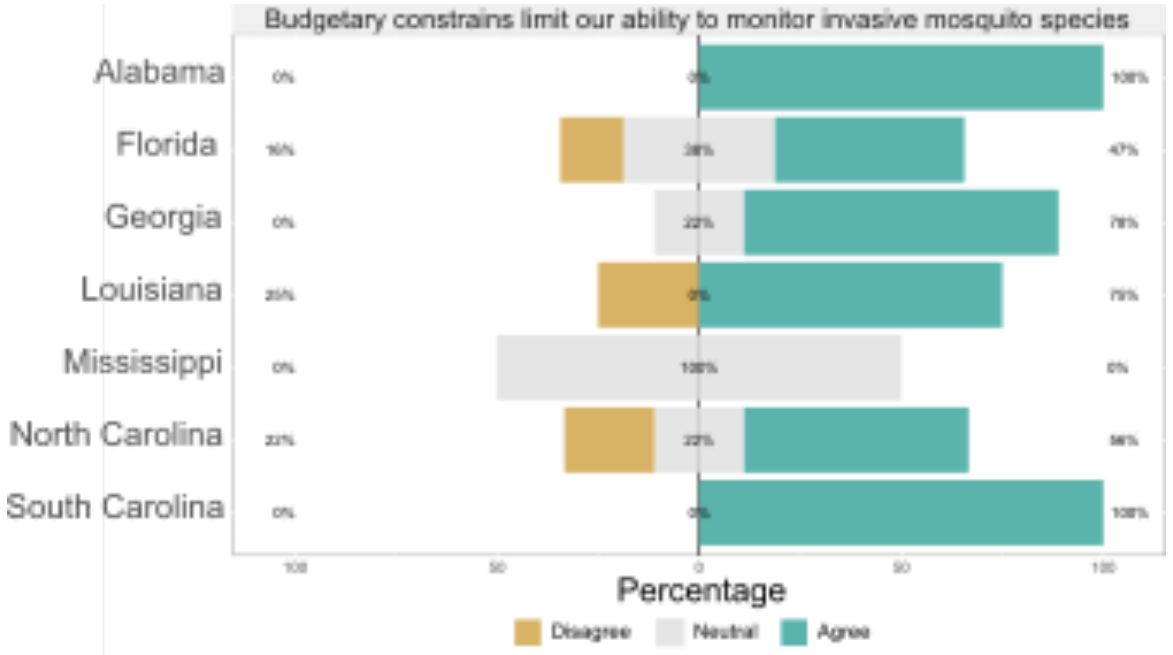
Total No. Complete Responses: 92

IRB Study Approval: 202101286

Q: What is your budget constraints to monitor non-native species

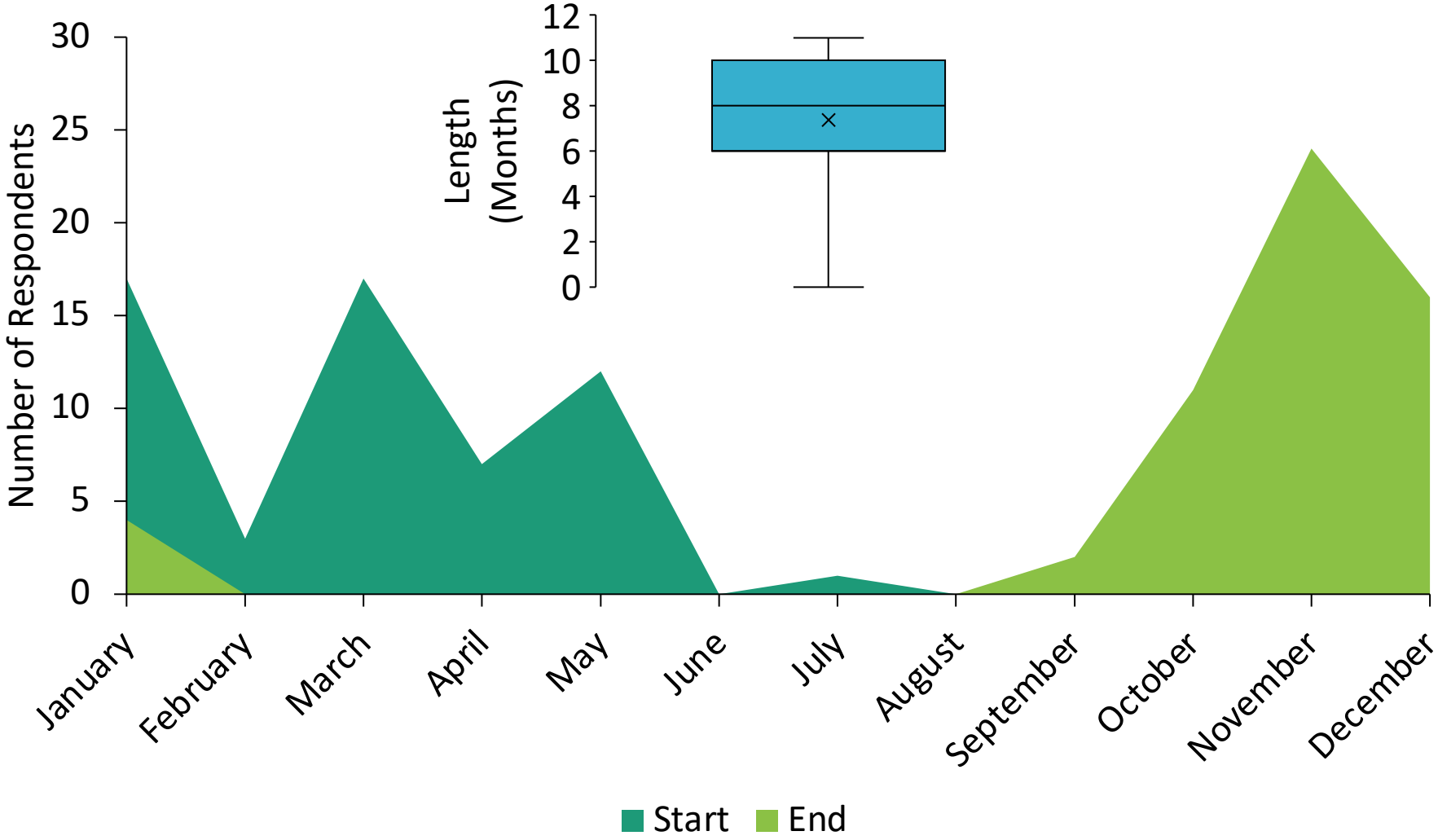


A: Average annual budget for mosquito surveillance and control programs by state (blue bar) and survey participation rate by state (orange line).

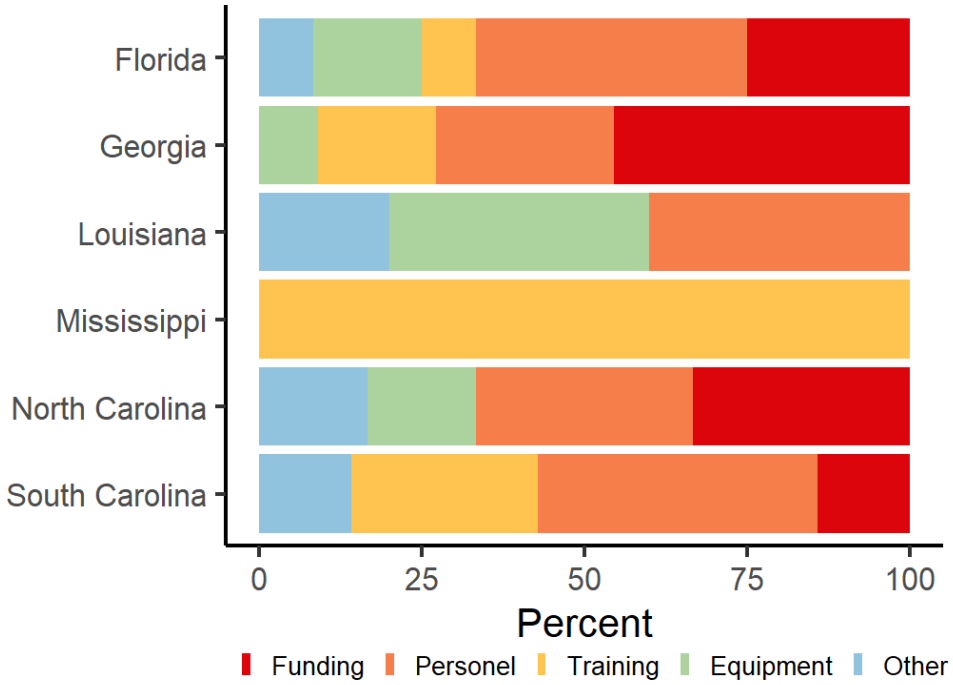


B: distribution of responses from states on if budgetary constraints limit their ability to monitor and control invasive mosquito species.

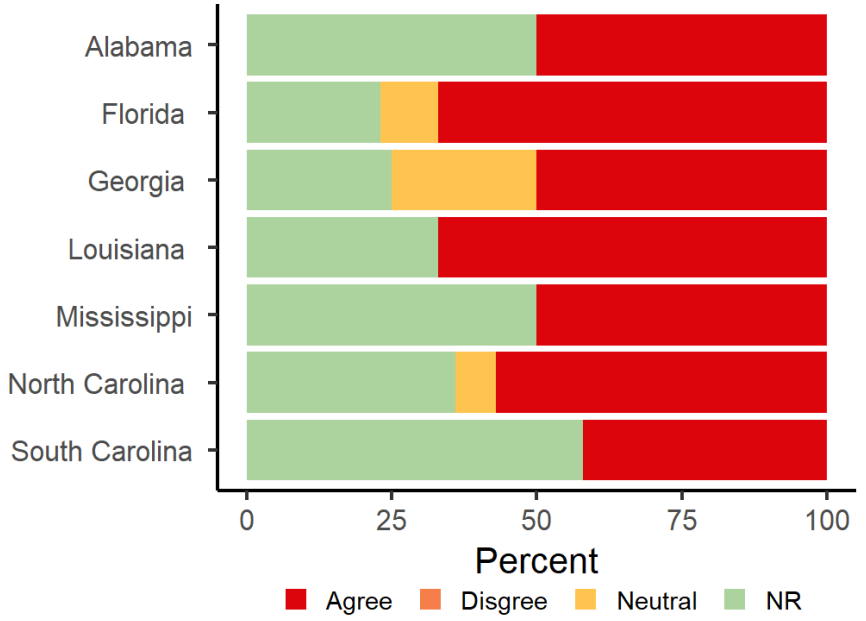
Q: Please indicate when your start and end surveillance



Q: Collection Methods and Training

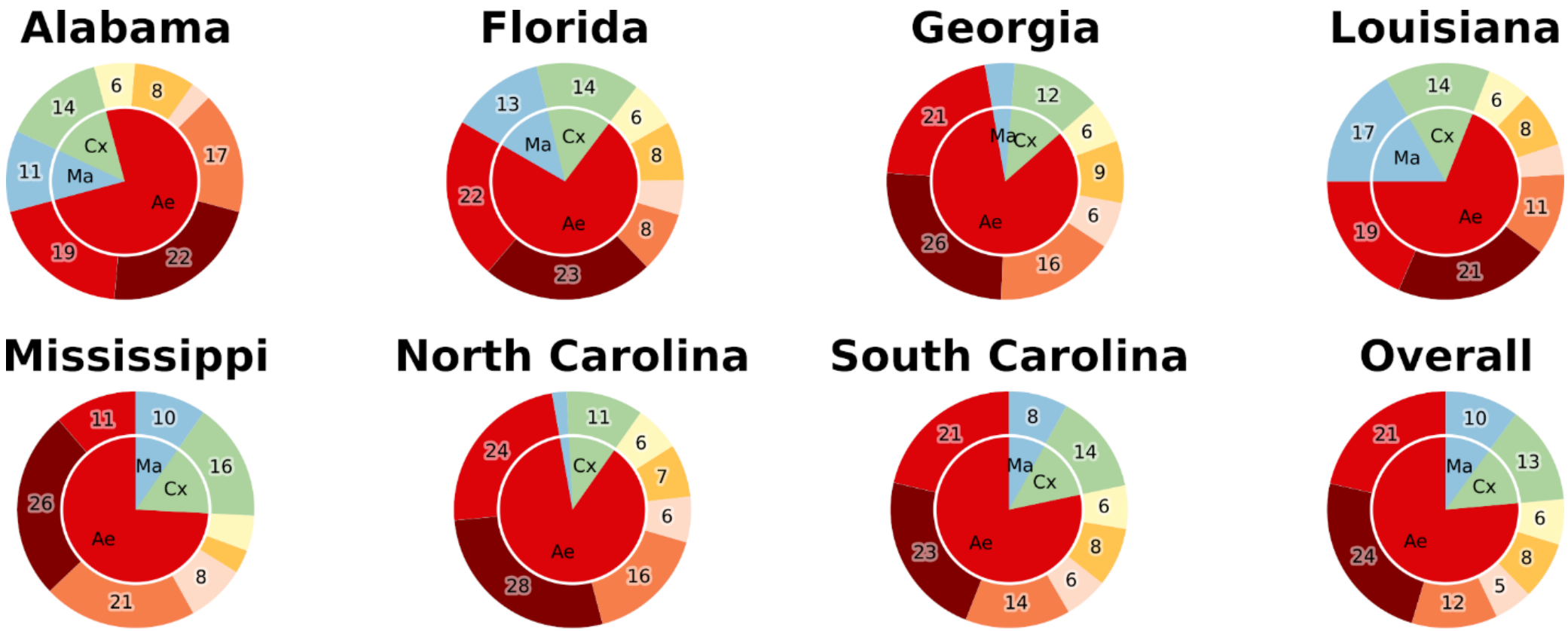


What programs indicated they need to improve their surveillance and control capacity



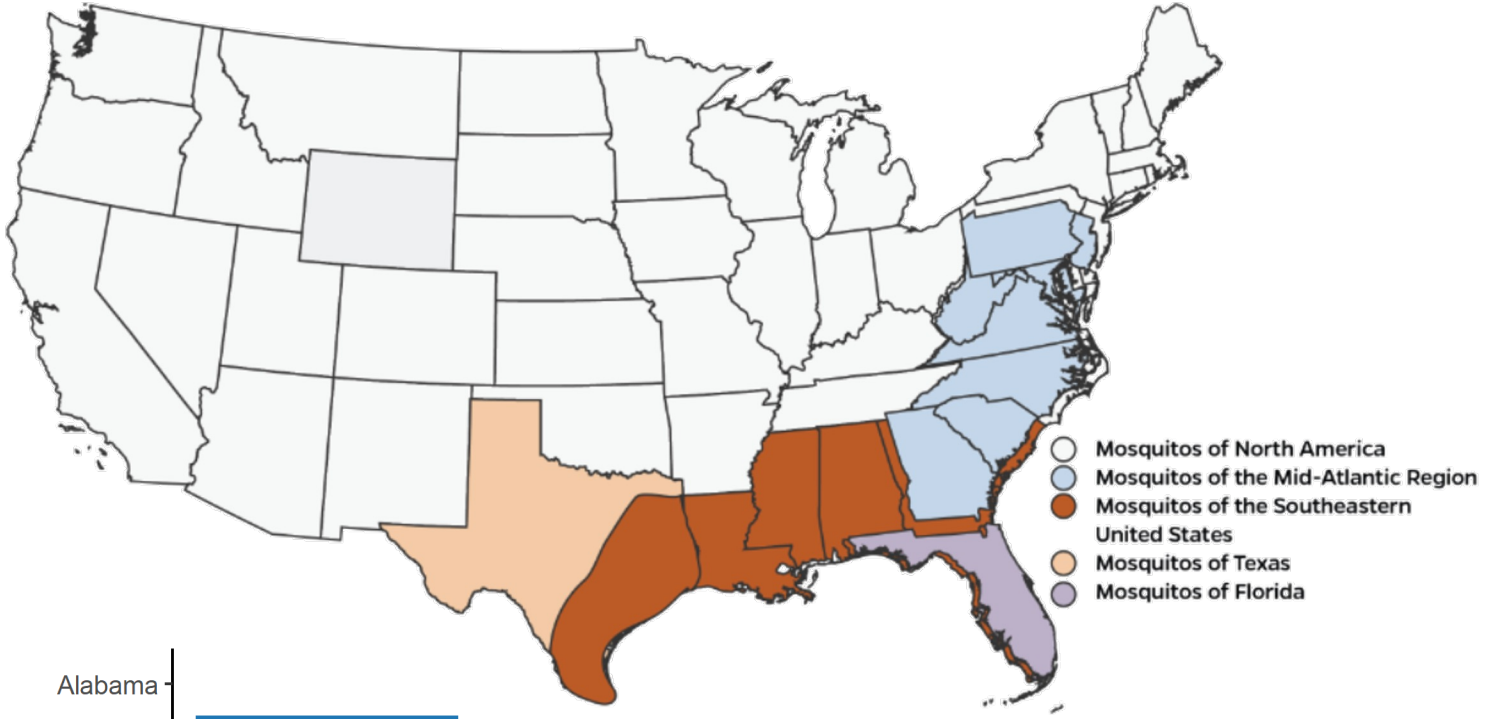
A proportion of responses to the statement of “My agency has access to mosquito traps required to monitor invasive mosquito species” by state.

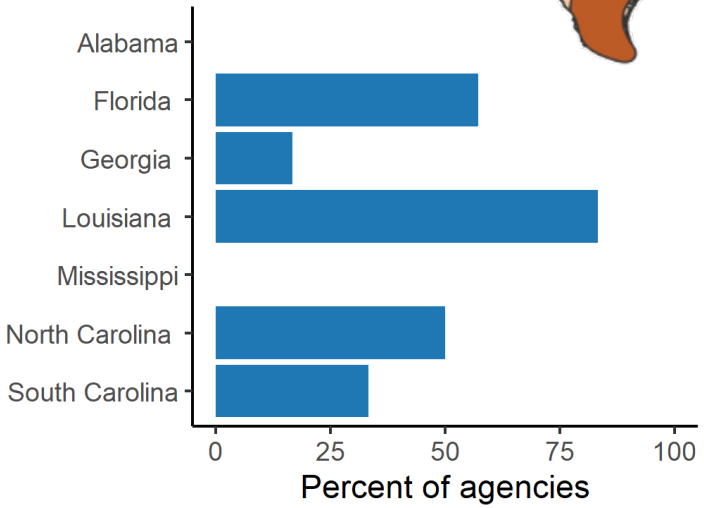
Q: Most important invasive species in the southern region by state



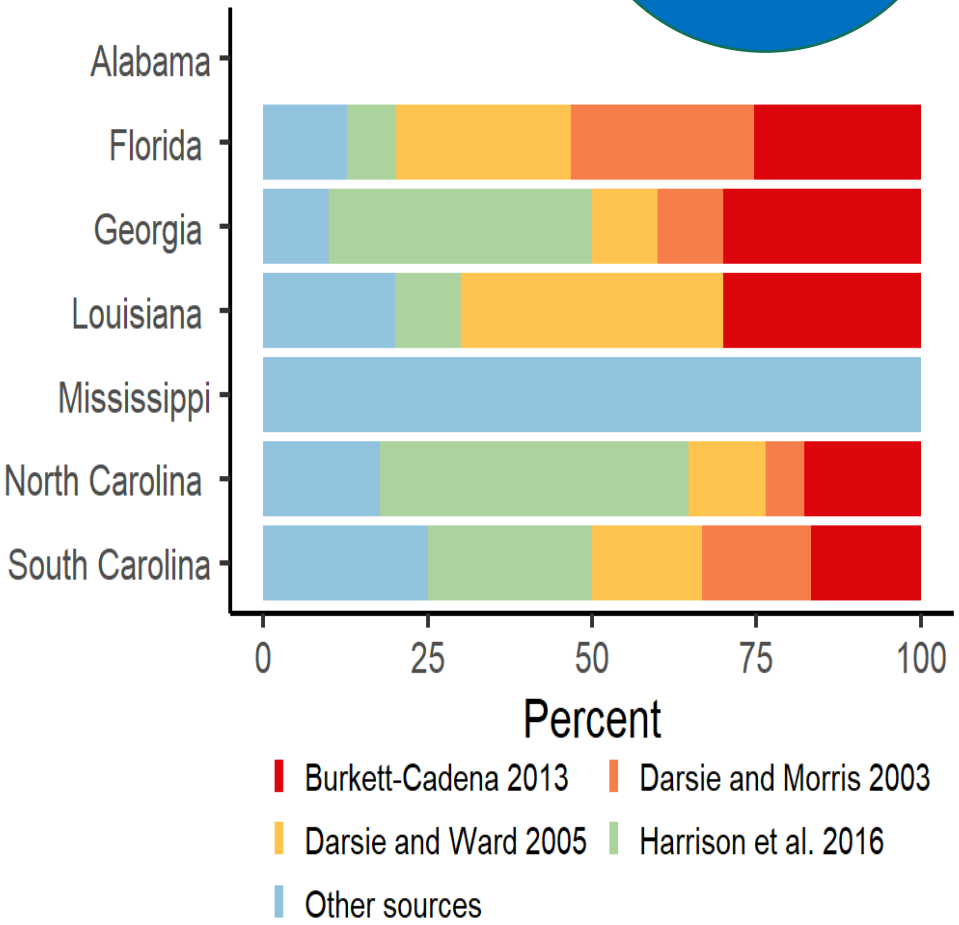
MOSQUITO MORPHOLOGICAL IDENTIFICATION KEYS BY REGION

We have highlighted the geographic areas that pertain to the dichotomous keys listed below.



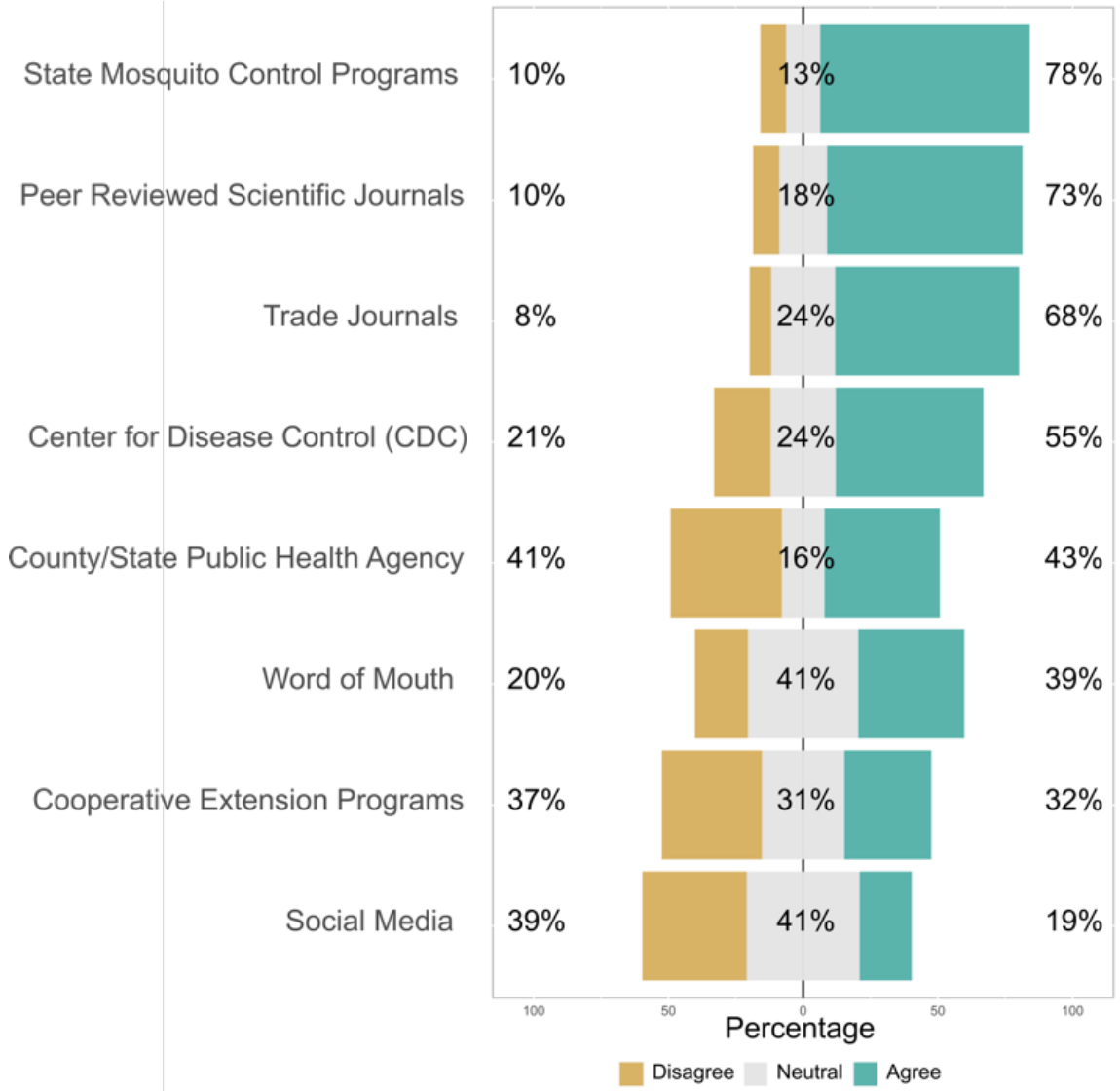


Percent of agencies in each state that have at least one expert mosquito identification specialist.



The proportion of each source used for mosquito identification in each state.

Q: What Information Resources Are Available?

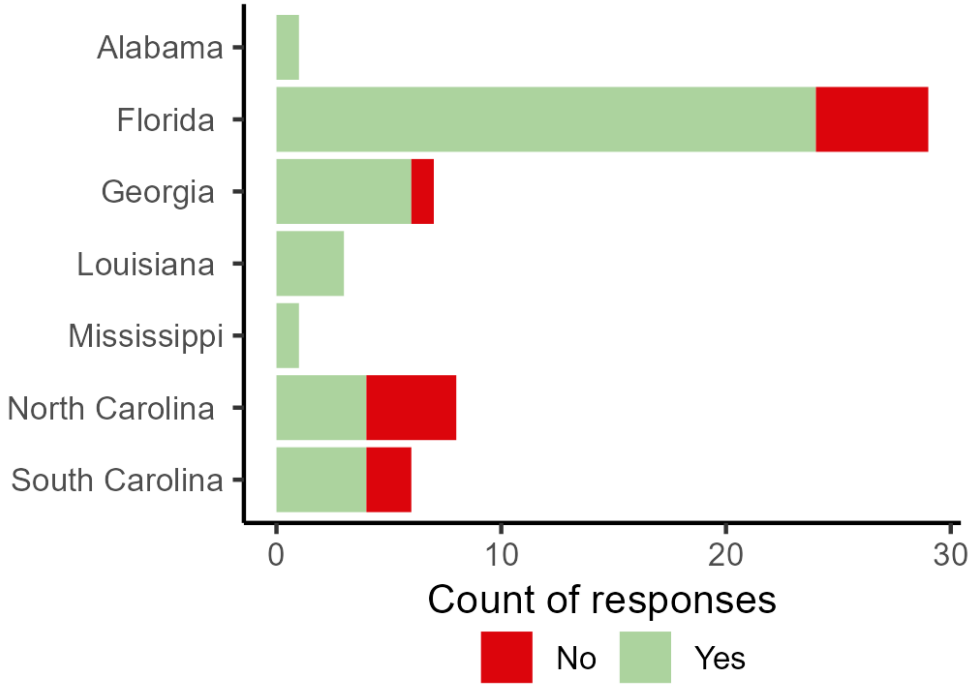


Sources of information used across the surveyed agencies

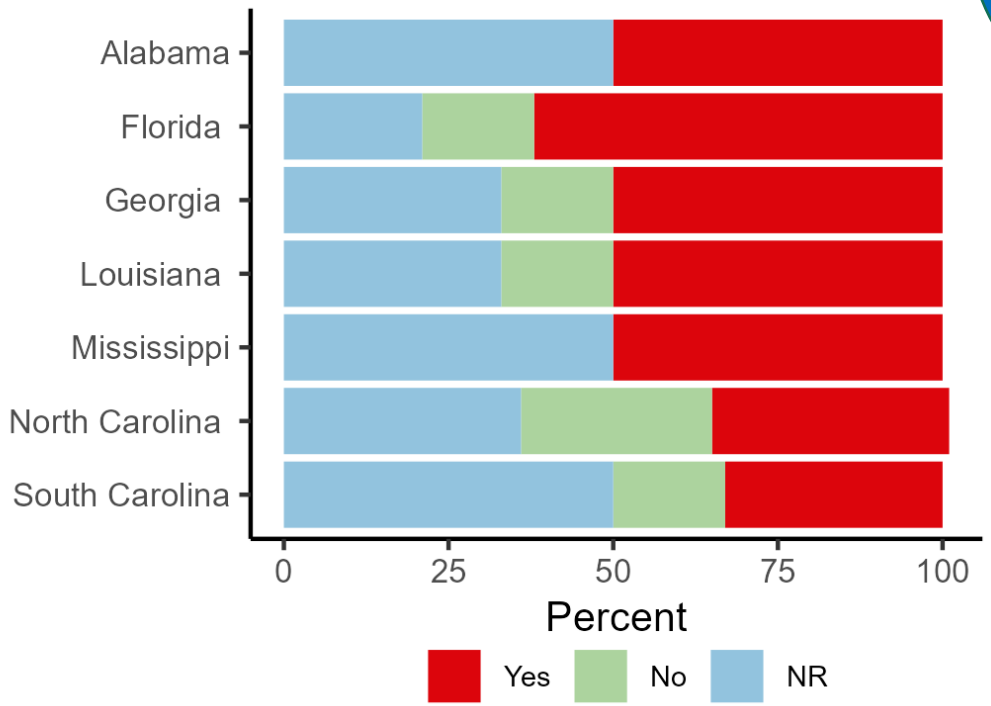
Percentages were calculated from the responses to the use of each information source :

“disagree” “neutral” “agree”

Q: Information and data sharing



The distribution of responses indicating an importance of sharing data with neighboring or regional agencies and if they currently share data with neighboring or regional agencies.



Percent of agencies by state that share collection data with neighboring or regional agencies.

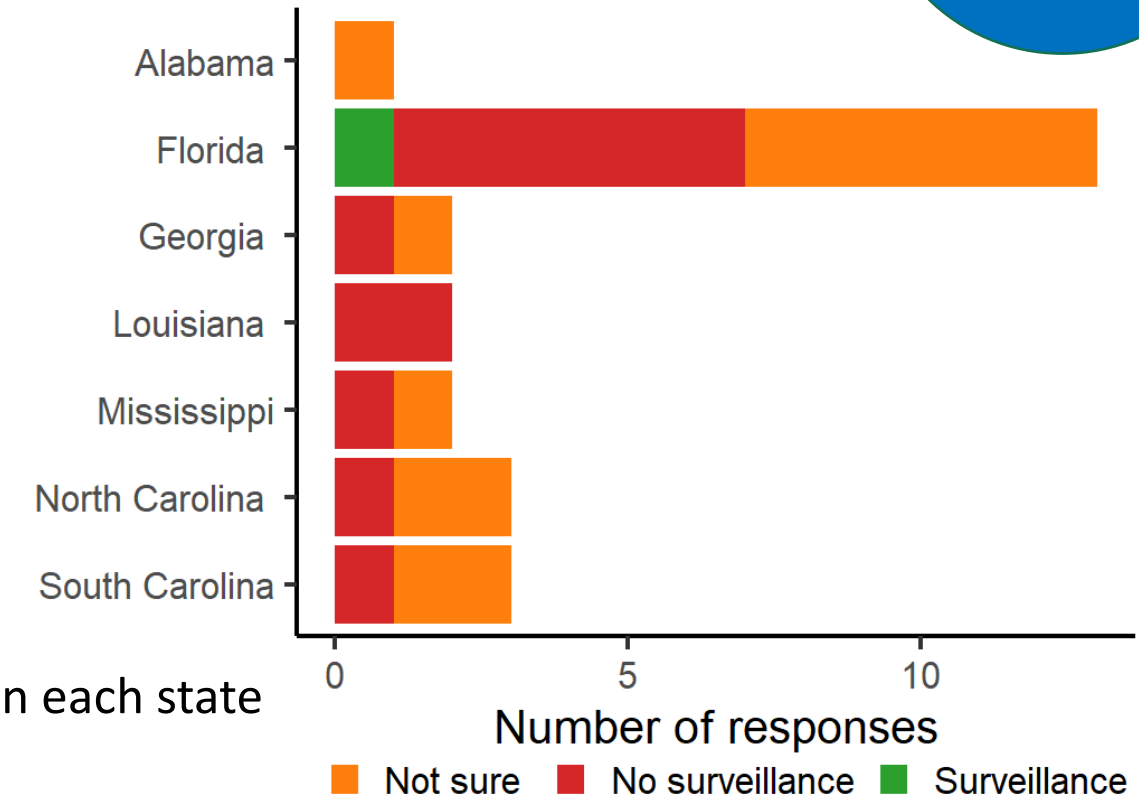
Q: Port of Entry Surveillance?

26 of 90 (~29%) respondents serve a region with an active port, airport, or ground shipping yard

But only **7 programs** conduct surveillance in these areas

Citing Reasons:

- Lack of communication
- Security clearance / jurisdiction
- Staffing / budget
- No reason or precedence to survey



The distribution of surveillance at port authorities within each state indicating whether it is:

- Unsure of the status of surveillance: (Not sure)
- No surveillance occurs at the port authority: (No surveillance)
- Surveillance occurs at the port authority: (Surveillance)

Suggested protocol (minimum standard) for port surveillance (professional perspective)

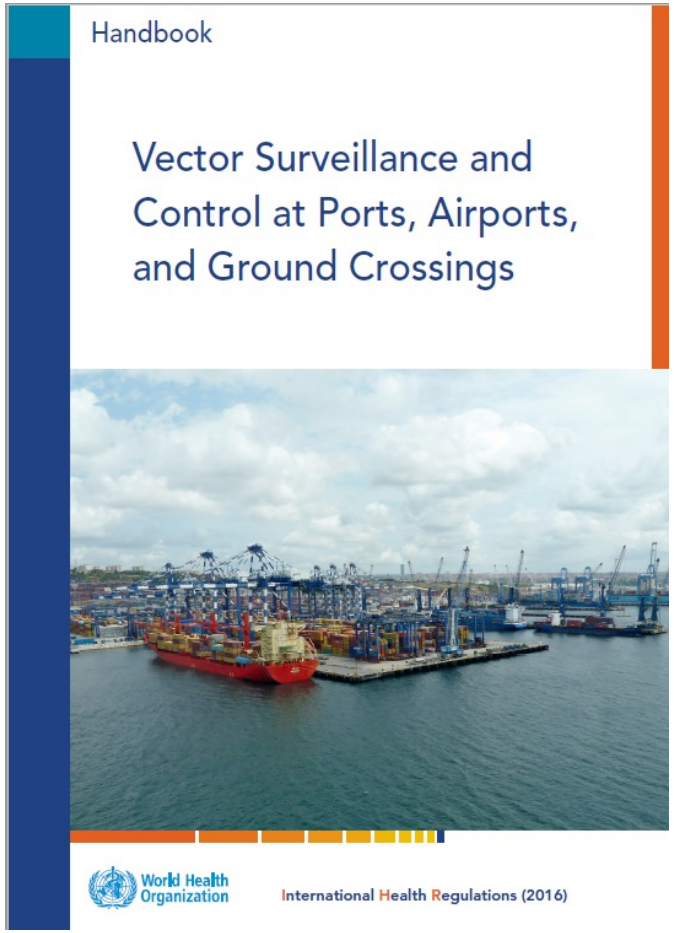
GOAL: SYSTEMATIC AND CONSISTENT SURVEILLANCE INSIDE PORT AUTHORITIES

STAGE 1. SURVEILLANCE OUTSIDE (SURROUNDING) OF PORT AUTHORITIES

STAGE 2: ESTABLISH CONNECTION WITH PORT AUTHORITY

STAGE 3: SURVEILLANCE INSIDE PORT AUTHORITIES

STAGE 4: DATA SHARING WITH LOCAL MOSQUITO CONTROL AUTHORITY



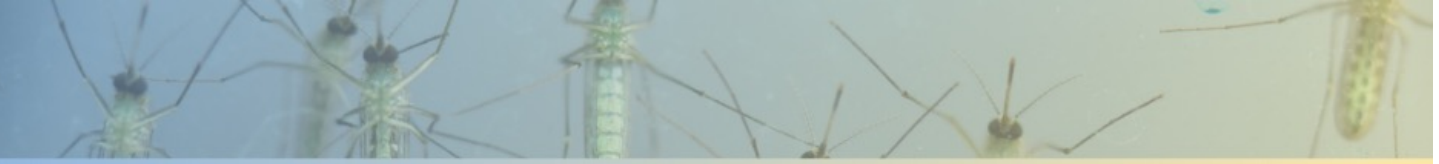
Engaged with the Federal Integrated Pest Management Coordinating Committee


BEACH MOSQUITO


BEACH MOSQUITO
CONTROL DISTRICT


509


EntoExchange
Identification and Specimen Network
TOX
TOXORHYNCHITES
THE TERMINATOR
NO CREAMS · NO CHEMICAL
BUG BITE
I'm not a cream. I use suction.
AMGUARD
AMCA
BEACONS
BEACONS Dashboard Map
THE MOSQUITO BEACONS WORKING GROUP
We welcomed graduate students and mosquito control personnel from Alabama, Mississippi, Louisiana, Florida, Georgia, and South Carolina



Advanced Mosquito Identification Course

New Orleans, Lousiana

Meeting Agenda

BEACONS

City of New Orleans
Mosquito, Termite & Rodent Control

September 11:

1:00 - 1:15	Welcome, Introduction, & Opening Survey
1:15. - 1:45	Mosquito Biology
1:45 - 2:30	Vector-Borne Diseases
2:30 - 3:30	Species Identification via Genetic Analysis
3:30 - 5:30	QGIS for Vector Control Operations
5:30 - 5:45	Closing Remarks & Dismissal

September 12:

8:00 - 8:15	Welcome & Daily Agenda
8:15 - 8:45	Genus Identification
8:45 - 9:00	Mounted Mosquito Samples Workshop
9:00 - 10:00	Common Species of the Gulf South Identification
10:00 - 10:15	Break
10:15 - 11:30	Common Species of the Gulf South Identification
11:30 - 12:00	Lunch
12:00- 12:45	Common Species of the Gulf South Identification
12:45 - 3:45	Invasive Mosquito Species Identification
3:45 - 4:15	Operational Integrated Mosquito Management
4:15- 4:30	Closing Remarks & Dismissal

Please note: Daily schedules are subject to change. Changes may occur up until the week of the meeting.

Register Now:
https://forms.office.com/g/i6Epqr2Er1

Cost: $150
(Lunch Included)

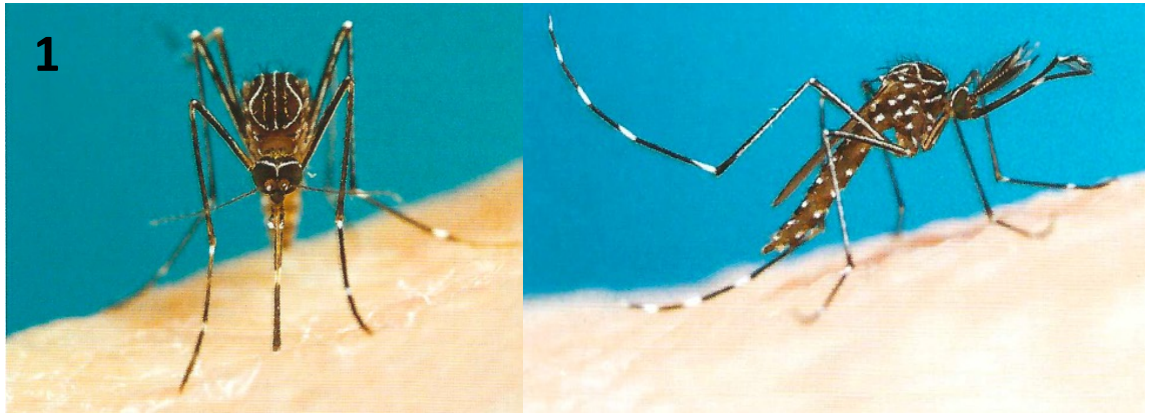
Questions:
Alex Pavlakis
Alexandros.pavlakis@nola.gov
504-607-2361

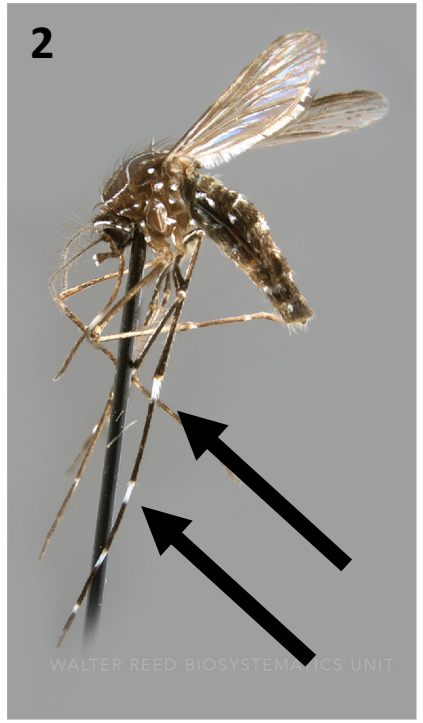
Collaboration with the CDC Center for Excellence NOLA

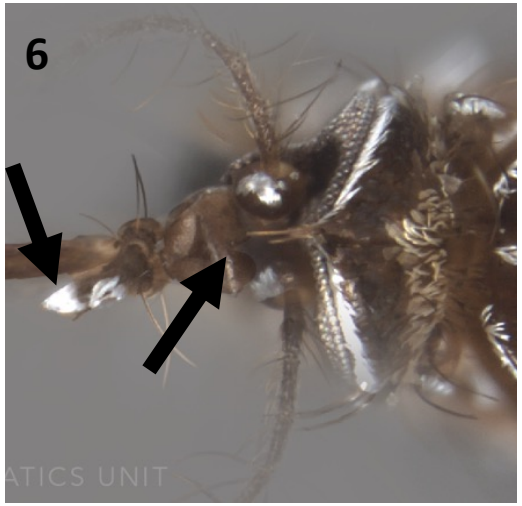
September 11-12, 2023, New Orleans
October 22-23, 2023, Dallas TX
Alabama/ Mississippi TBA in 2024
Future workshop in Virginia Spring 2025 ??

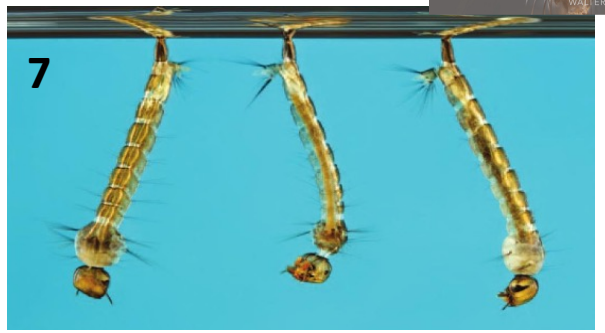
Mosquito BEACONS Working Group

Aedes notoscriptus









1. Female & Male Small to mid-sized species; Integument can vary in color form reddish brown to dark brown to black
2. Fe-II and Ti-III with anterior lines of pale scales along nearly whole length

   Hind tarsi with wide bands bright silvery whitish scales
3. Proboscis dark-scaled with median pale ring

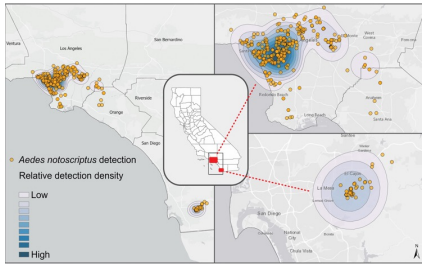
   Wings scales all dark dorsally
4. Scutum with lyre-shaped lateral silvery lines
   - Narrow median silvery lines and anterior sublateral golden lines of scales
   - Postpronotum with small distinct lower patch of silvery scales
5. Small patches of silvery scales throughout thoracic area
6. Pedicle not scaled exteriorly only interiorly. Palps tipped with silvery scales
7. Terminal segments Larvae: Comb scales in irregular triangular patch; siphon not pilose; siphonal acus large and broadly joined to siphon; seta 1-S short, <0.5 x length of siphon

Mosquito BEACONS Working Group

Aedes notoscriptus

Native Range

Invasive Range



- Established in New Zealand around 1920
- Migrated north into South-east Asia & South Pacific Islands
- Established in 3 counties in southern California 2014-present time
- Cryptic in morphology regionally suggesting a diverse phenotypic morphologic complex

Larval Habitat

- Wide range of artificial & natural containers
- Bamboo stumps, leaf axils, rock pools, palm fronds
- Containers made of wood, concrete, plastic and metal

Dispersal Strategies

- Container breeders that use diapausing eggs
- Spread by humans along shipping routes

Collection Methods

- CDC trap with CO2 and Octenol or BG Lure
- BG Sentinel
- Autocidal Gravid Traps
- Gravid Traps

Host Biting Preference

- Humans, domestic pets, birds, marsupials, bats

Pathogen Transmission

- Barmah Forest Virus
- Chikungunya virus (CHIKV)
- Dengue virus (DENV)
- Ross River Virus
- Zika (ZIKV)
- *Dirofilaria* (dog heartworm parasite)

Mosquito BEACONS Working Group

Culex coronator

1

1. The adult mosquito is medium sized, drab and brownish

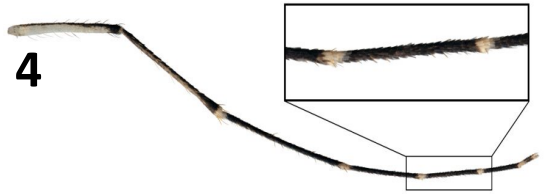
2

2. The head has dark erected forked scales dorsally. The occiput has narrow golden scales and broad white scales laterally. The proboscis is mostly covered in dark scales, with a ventral median area of pale scales that does not form a complete ring (arrow)

3

3. The veins of the wings are covered in narrow dark scales

4

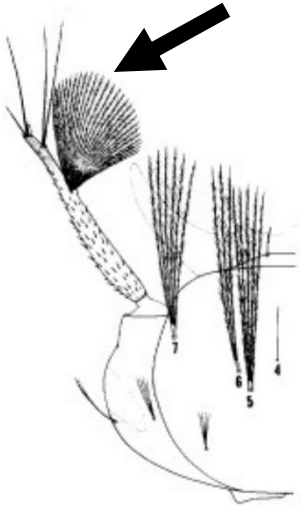


4. The hind tarsomeres on the legs are ringed with distinct basal and apical bands

5

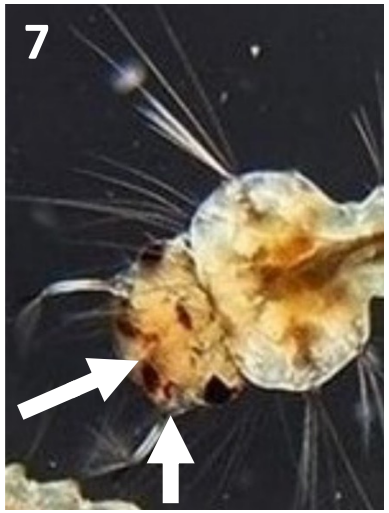
5. Immature four instar larva

6



6. The antennal turf of the head is located on a constriction near the outer third (arrow), with the shaft spiculated basally

7

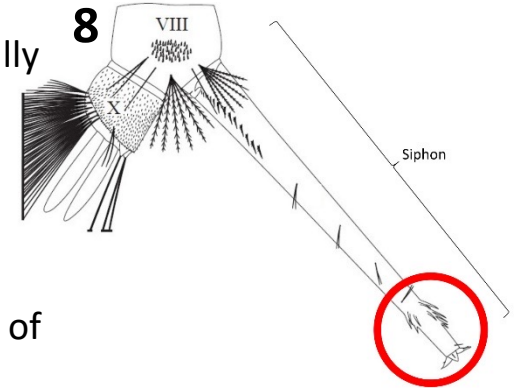


Upper hair

Lower hair

7. The larva head has 4 or 5 upper hairs and 3 or 4 lower hairs

8

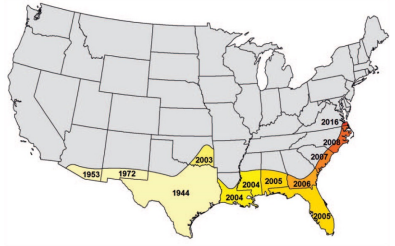


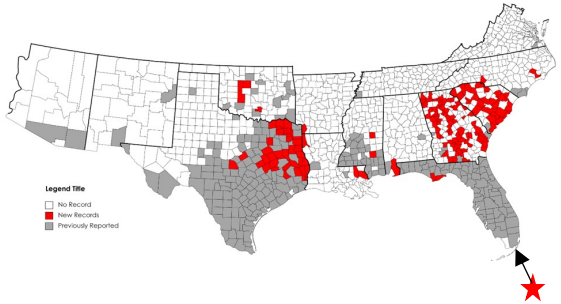
8. The siphon is long and thin with four double siphonal turfs beyond the pecten. Most specimens have a crown of prominent spines.

Mosquito BEACONS Working Group

Culex coronator

Native (Red) and Invasive (other colors) Range





Larval Habitat

- Lay rafts of eggs in diverse natural and artificial microhabitats
- Natural habitats: swales, roadside ditches, animal water troughs, forest ponds, and rock pools
- Artificial water-holding containers: trash cans, car tires

Dispersal Strategies

- Highly adaptable to artificial container breeding in urban areas
- Eggs and larvae commonly found in used tires
- Car tire transportation is thought to be an important dispersal mechanism

Collection Methods

- CDC light traps
- Biogents Sentinel traps
- Gravid traps
- Larval surveys

Host Biting Preference

- Predominantly nocturnal
- Blood feed primary upon large mammals such as white-tailed deer and horses
- Opportunistically feed on birds
- Will also bite humans

Pathogen Transmission

- St Louis encephalitis virus (Aitken et al. 1964, Turell et al. 2005)
- Venezuelan equine encephalitis virus (Burguete et al. 1973)
- West Nile virus (Mackay 2007, Kelly et al. 2008, Unlu et al. 2010)
- Zika virus (rare, Elizondo-Quiroga et al. 2018)

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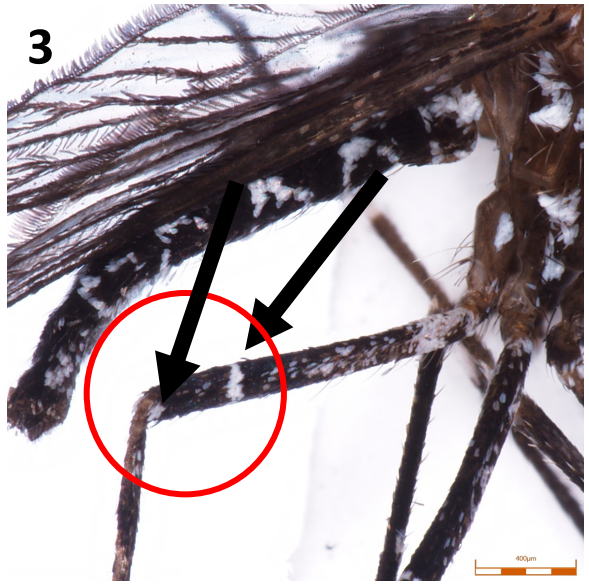
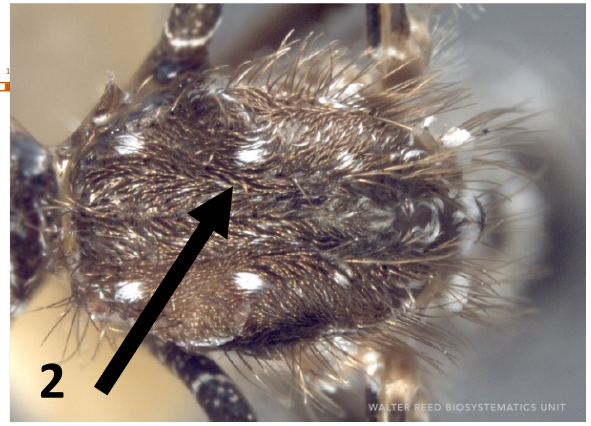
Aedes vittatus



1. Small to medium dark scaled species with pale scales throughout
2. Scutum: 3 pairs of distinct, small, white spots of narrow scales on anterior two-thirds of scutum
3. Tibia dark, with sub-basal white spot and white band approximately level with basal third of Ti-I, Ti-II, and at mid-point of Ti-III



4. Mesopostnotum and prespiracular area bare
5. Proboscis dark with sporadic pale scales; clypeus w/ bilateral small patches of narrow pale scales; palps pale scales at tip and band half-way; pedicle w/ ext/int pale scales
6. Abdomen Te-I large median white spot; basal white bands w/ lateral curved white markings: disparate from bands

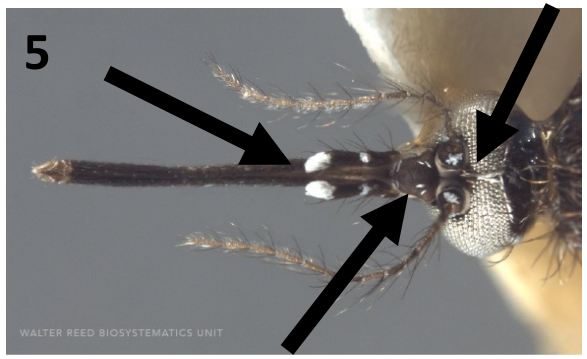
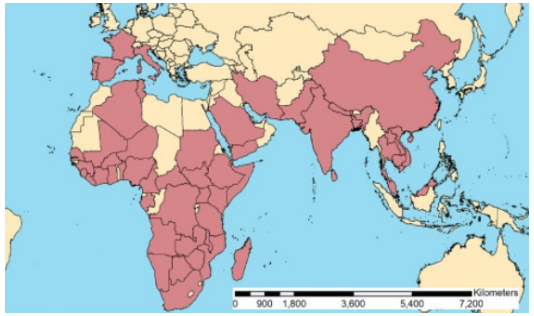


Photo Credit: David Pecor WRBU; 1-4 original 2 specimens in the Americas

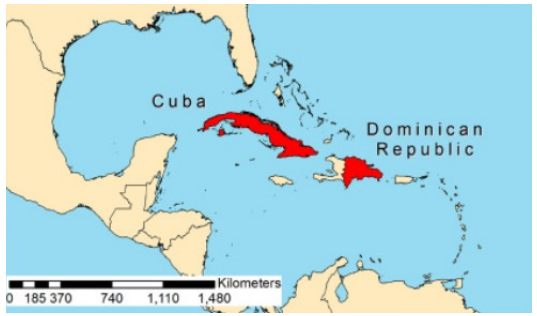
Mosquito BEACONS Working Group

Aedes vittatus

Native Range



Invasive Range (as of 2021)



Larval Habitat

Variety of natural and artificial containers:

- rock pools
- tree holes
- hoofprints
- domestic containers

Dispersal Strategies

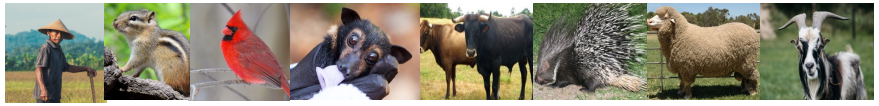
- Egg desiccation tolerance
- Caribbean introductions are speculated to have occurred via shipping container transport to and between islands

Collection Methods

- Like other invasive *Aedes* they are not commonly collected using CDC light traps
- Surveying potential production sites (artificial and manmade containers) is necessary
- More surveillance data in invasive range (Caribbean) is needed to predict production sites in North America

Host Biting Preference

- Opportunistic feeders:
  - Non-Human Primates
  - Domestic Animals
  - Rodents
  - Humans
  - Bats
  - Birds

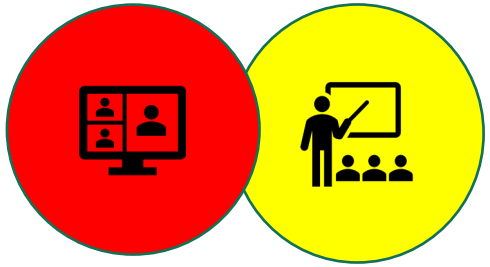


Pathogen Transmission

- Babanki virus
- Bunyamwera virus
- Chikungunya virus
- Dengue viruses
- Middleburg virus
- Semliki Forest virus
- Saboya virus
- Wesselsbron virus
- Yellow Fever virus
- Zika virus

Container inhabiting *Aedes*
Info posters!!

Combined species
Single species
In Spanish



Other Stakeholder Engagement

November 2022 FMCA BEACONS Poster Presentation
Jan 2023 MAMCA Dr. Ben Allen Presented
Feb 2023 VMCA MT Riles Presented
March 2023 AMCA Reno NV Poster Presentation MT Riles

- Booth Collaboration with Ento Exchange & Dan Killingsworth

May 2023 Survey of Invasive Mosquito Species in the southern US Yoosook Lee
May 2023 Year 3 Q1 Stakeholder Meeting Zoom ☺
June 2023 BEACONS Meet w/ CDC and SIMPC IPM Strategy *Anopheles*
December 2023 BEACONS Year 3 Q2 Stakeholder Meeting

Submitted 1 Full Day Advanced Identification Course for Dodds Short Courses
January 29 through February 2
MT Riles & Dr. B Girodano

Developing a low-cost mosquito trap to improve detection of invasive mosquitoes in the southeastern USA

PI's Lee, Bryd and Campbell
Killingsworth and Allen
Awarded in 2023
USDA-NIFA-CPPM-009483

Figure 6. Proposed study sites for novel trap design evaluations (black circle).

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Disseminating the information gathered

Published works

Seok S, Kim Z, Nguyen VT, Lee Y. The potential invasion into North America and Europe by non-native mosquito *Aedes koreicus* (Diptera: Culicidae). J Med Entomol. *** Accepted ***

Nguyen VT, Romero-Weaver AL, Wang X, Tavares Y, Bauer A, McDowell RC, Dorsainvil C, Eason MD, Malcolm AN, Raz CD, Byrd BD, Riegel C, Clark M, Ber J, Harrison R, Evans C, Zohdy S, Allen B, Campbell LP, Killingsworth D, Grey EW, Riles M, Lee Y, Giordano BV. Survey of mosquito surveillance and control capacity in the southern United States reveals training gaps and resource needs. J Am Mosquito Cntrl Assoc. 2023. 39 (2): 108–121. doi: 10.2987/22-7107.

Kondapaneni, R.; Malcolm, A.N.; Vazquez, B.M.; Zeng, E.; Chen, T.-Y.; Kosinski, K.J.; Romero-Weaver, A.L.; Giordano, B.V.; Allen, B.; Riles, M.T.; et al. Mosquito Control Priorities in Florida—Survey Results from Florida Mosquito Control Districts. Pathogens. 2021, 10, 947, doi:10.3390/pathogens10080947. PMCID: PMC8401384.

Giordano BV, Cruz A, Pérez-Ramos DW, Ramos MM, Tavares Y, Caragata EP. Mosquito communities vary across landscape and vertical strata in Indian River County, Florida. Pathogens. 2021, 10, 1575. https://doi.org/10.3390/pathogens10121575. PMCID: PMC8708810.

Seok S, Jacobsen CM, Romero-Weaver AL, Wang Xiaodi, Nguyen VT, Collier TC, Riles MT, Akbari OS, Lee Y. Complete mitogenome sequence of *Aedes (Hulecoeteomyia) japonicus japonicus* from Hawai'i Island. Mitochondrial DNA Part B Resourc. 8:1, 64-68, DOI: 1080/23802359.2022.2161328

Romero-Weaver AL, Reeves LE, Riles MT, Lee Y, Giordano BV. A concise guide on the bionomics and key morphological characteristics for identifying *Culex coronator* (Dyar & Knab, 1906) – an invasive mosquito species from neotropics. EDIS, 2022, University of Florida. ENY-2093. DOI: doi.org/10.32473/edis-IN1385-2023

Romero-Weaver AL, Riles MT, Sloyer K, Lee Y, Campbell LP, Giordano BV. A concise guide on the bionomics and key morphological characteristics for identifying *Aedes pertinax* (Grabham, 1906) – an invasive mosquito species from neotropics. Ask IFAS. ENY2100 DOI: doi.org/10.32473/edis-IN1405-2023

Thanks to our Funders

Southern IPM Center

USDA

UF IFAS UNIVERSITY of FLORIDA

Florida Medical Entomology Laboratory

Participating Agencies

Beach Mosquito Control District

Centers for Disease Control and Prevention

Charleston County Mosquito Control District

South Carolina Department of Health & Environmental Control

City of Jacksonville Mosquito Control

Collier County Mosquito Control

Environmental Security Pest and Lawn

Florida Department of Agriculture and Consumer Services

Florida Mosquito Control Association

Georgia Department of Public Health

Georgia Mosquito Control Association

Virginia Mosquito Control Association

Louisiana Mosquito Control Association

New Orleans Mosquito & Termite Control Board

North Carolina Mosquito and Vector Control Association

University of Florida

University of Georgia

University of South Florida

University of Southern Mississippi

Western Carolina University

Texas A&M University

Puerto Rico Vector Control Unit

University of South Florida


Questions?