NEW ORLEANS MOSQUITO, TERMITE, AND RODENT CONTROL BOARD

2023 ANNUAL REPORT

Aedes aegypti

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DIRECTOR'S REPORT

Report on the Activities of the
City of New Orleans Mosquito, Termite, and Rodent Control Board
January 1 - December 31, 2023

The City of New Orleans Mosquito, Termite, and Rodent Control Board had an eventful year with the hiring of new employees, preparing the Bell 505 helicopter for operations, working towards increased biosafety status, and being awarded the Centers for Disease Control and Prevention's Vector-borne Disease Training, Assessment and Partnering award. These projects advance the program so that high quality vector and pest control can be provided to the citizens and visitors of New Orleans.

Louisiana had a tremendous drought in 2023 that impacted the mosquito population for most of spring and summer. We had record low numbers of mosquitoes collected in our traps and an extremely low incidence of arboviruses in mosquito pools submitted. Rain and tidal events in the second week of October set up the conditions for record numbers of floodwater mosquitoes in the third quarter of the year. It was only at the very end of the year with cold temperatures that the region had some relief.

Details of our 2023 activities and accomplishments can be found in this report.

Respectfully submitted,

Claudia Riegel

Dr. Claudia Riegel
Director

OPERATIONS AND FACILITIES

CLAUDIA RIEGEL, Ph.D.

Director

Employees

This May we sadly bid farewell to Dr. Jennifer Breaux, Research Entomologist, and head of our mosquito team (Fig. 1). Dr. Breaux joined our department in January 2018. In her time at NOMTRCB, she made several operational improvements in mosquito control and increased our research capacity. She played a vital role in building our current mosquito division and will be missed. Dr. Breaux has moved to Columbus, Ohio, and is still in working with us to complete several research studies. We will continue to collaborate with her in the future.

The NOMTRCB offers summer internships to support surveillance efforts during peak mosquito season. This year we welcomed Abigail Yeboah, David Braunstein, Evan Davies, Jill VanWhy-Spoonmore, and Maddie Fryer to our mosquito team (Fig. 2). Our summer interns assisted with weekly arborvirus surveillance, insectary maintenance, breeding site inspections, and operational research projects.

Evan is currently completing a Master of Science at Louisiana State University's Department of Entomology, with an anticipated graduation date in 2024. Jill completed her Master of Public Health at Tulane's School of Public Health and Tropical Medicine. Both Jill and Evan have joined our staff full-time and are continuing to assist in our weekly operational tasks and research projects. While interning with us, Maddie completed her undergraduate degree at Louisiana State University in

Figure 1. Dr. Jennifer Breaux left NOMTRCB due to family obligations in 2023.

Figure 2. New people that joined the NOMTRCB family in 2023. From left to right, Jill VanWhy-Spoonmore, Evan Davies, Glen Higgins, and Madeline Fryer.

Figure 3. Victor Maurice joined the NOMTRCB in 2022 and will focus most of his time in mosquito management.

Figure 4. Francesco Scattorin joined NOMTRCB in 2022 and will focus on termite management.

Coastal Environmental Science. She is continuing to work with us as a part-time employee as she pursues a Ph.D. at Louisiana State University in their Department of Environmental Sciences.

Figure 5. City of New Orleans Mosquito, Termite and Rodent Control Board staff in December 2023.

We were also happy to welcome Victor Maurice (Fig.3) to our team this year as a Pest Control Inspector 2. Victor has quickly joined in on all aspects of the team including spraying, setting traps, breeding site surveillance, and mosquito identification.

This year we also welcomed Francesco Scattorin to the Termite Division (Fig. 4). Francesco has a diverse background and enthusiasm to learn about termites and pest control. Two students from University of New Orleans, Grant Fletcher and K'Lynn Gillard, worked part time in the laboratory assisting with KDR analysis, DNA extractions, and DNA sequencing. With their help, we are catching up on our backlog of samples and working to undertake new projects.

After three years of looking for an automatic mechanic, Mr. Rasheed Shabazz was hired. He has been conducting an overhaul of all of our vehicles. He will also repair and maintain all spray and specialty equipment. He has a tremendous work ethic and has been getting our fleet in good repair. It has been difficult to purchase vehicles. However, EMD and the CAO's Office placed a large order and we received ten new vehicles with more coming in 2024. NOMTRCB invests much time and funding towards maintenance because without vehicles in good working order, we are not able to do our work in the field.

Erin Cloherty, Ph.D., defended her dissertation at the Entomology Department at Louisiana State University and submitted her dissertation for graduation. Her work provided detailed information about resistance in *Culex quinquefasciatus* in Orleans Parish that will be used to improve operations (Appendix A).

Since 2020 it has been a challenge to find employees to hire. However, in 2023, there was a dramatic shift and NOMTRCB was able to hire many excellent candidates. Thank you to the Finance Department and CAO's office for providing financial support in the General Fund to hire several of these candidates. Other employees were hired with extramural funds generated by the acquisition of grants and product testing. Our staff grew to 45 full-time and part-time employees (Fig. 5).

Operations

Buildings

The Audubon Nature Institute moved their insect rearing facility from the Biolab building after 24 years. With the consolidation of the Aquarium and the Insectarium, they moved their rearing facility from the Biolab to their facilities on the west bank.

The Administration Building roof replacement project was put out to bid three times and in the 4th quarter the contractor was selected. The contract is currently routing and the work is expected to begin in the summer of 2024. The new roof and repairs will strengthen the building and will prevent further moisture intrusion.

American Rescue Plan Act funds were allocated to purchase an automatic extractor and to upgrade the Biosafety Laboratory. The extractor will allow for faster sample processing as we move towards in-house analysis of mosquito pools samples for the presence of arboviruses and to be able to include rodent pathogen surveillance as part of routine operations. The Biosafety Laboratory was acquired from the Louisiana Department of Health nearly ten years ago as a surplus purchase. The building's diesel generator was serviced this year and is fully operational. A contractor inspected the building and provided an estimate of the cost to return the unit into service. The work to get it into service and hire a person to manage the building and conduct laboratory work will continue into next year.

The BioWatch Program will use the BioSafety Laboratory as home base to set up an air-monitoring program during the 2024 Mari Gras season. They just need the laboratory space without the biosafety levels. Run by Federal Homeland Security, the group monitors the air at high impact events to detect select agents and coordinate a response if a bioterrorist event were to happen. For more information, visit www.dhs.gov/biowatch-program.

Bell Textron 505 Helicopter

The CAO's Office and Finance provided funds in 2023 to prepare the helicopter for operations (Fig. 6-7). Spray tanks, helmets, night vision goggles, AgNav and other essential components and accessories were purchased. Maintenance plans with Bell Textron and Safran were established as well as purchasing software to manage scheduled maintenance and repairs. Each step is slow as all of the components are customized to the Bell 505. The tank is expected to be completed in spring of 2024.

Mr. Jeffrey Fletcher (Aviation Supervisor) (Fig. 8) attended a variety of mandatory classes at Bell Textron in Dallas, Texas. He must be certified in use of this model helicopter in order to be in compliance. He was also certified in the use of night vision googles for use in the Bell 505. Training and certification will be an ongoing process.

We continue to work with vendors and surrounding districts as a team so we can learn the successes and pitfalls. The goal is to have the Bell 505 ready for operations in late summer of 2024. The helicopter will be delivered to Arrow Aviation in November for its first maintenance and have the components related to the spray equipment and navigation system installed.

Figure 6. Jeff Fletcher prepared to take the Bell 505 for a weekly maintenance flight.

Figure 7. Aerial view of New Orleans from the Bell 505.

Figure 8. Jeffrey Fletcher flying the Bell 505.

Extramural Funding

The City of New Orleans Mosquito, Termite and Rodent Control Board was awarded a significant grant from the Centers for Disease Control and Prevention (CDC) on July 1, 2023 (Appendix B). The CDC funded the Gulf South Vector Education Centers for Training, Outreach and Resources (VECTOR) Collaborative to increase training opportunities for professionals and students to better prevent and respond to vector-borne diseases. Funding will be provided by grant 1NU50CK000638-01-00.

Specifically, this project will TRAIN and EVALUATE students and professionals (Figs. 9-10). We will create and test educational content that highlights procedural best practices. The core curriculum will be standardized and replicated across the region and will be offered to students, working professionals, and trainees across audiences with diverse backgrounds. This project will break down silos and promote interdisciplinary training and create PARTNERSHIPS through regional and national cooperation that is desperately needed to build resiliency and protect people and animals from vector-borne disease.

Fig. 9. CNO employees received pesticide training.

Fig. 10. LASPCA employees received training about vector-borne diseases.

MOSQUITO CONTROL DIVISION

CYNTHIA HARRISON, PRINCETON KING, ANDRA McCLUE, and ALEXANDROS PAVLAKIS

Service Requests

Pest Control Inspectors in the Mosquito Division respond to service requests placed through the 311 system or directly through phone calls and emails to our department. A total of 260 requests were received during 2023. A similar number of requests were received during 2022, however this year we saw a large increase of requests in October and December. This increase of requests towards the end of the year coincided with the influx of floodwater and permanent water mosquitoes observed in our traps during the same period. The average turnaround for closing requests throughout the year was 3.98 days after the request was received (Fig. 11).

Throughout 2023 we received requests from all 14 city planning districts in Orleans Parish. New Orleans East (9) (20.4%) and Algiers (12.9%) shared the highest number of requests for the year (Fig. 12).

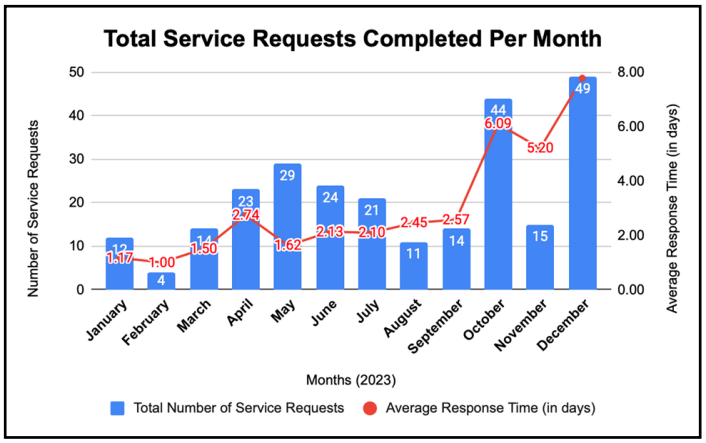


Figure 11. Total number of service requests per month and the average response time (in days) to close the request in 2023.

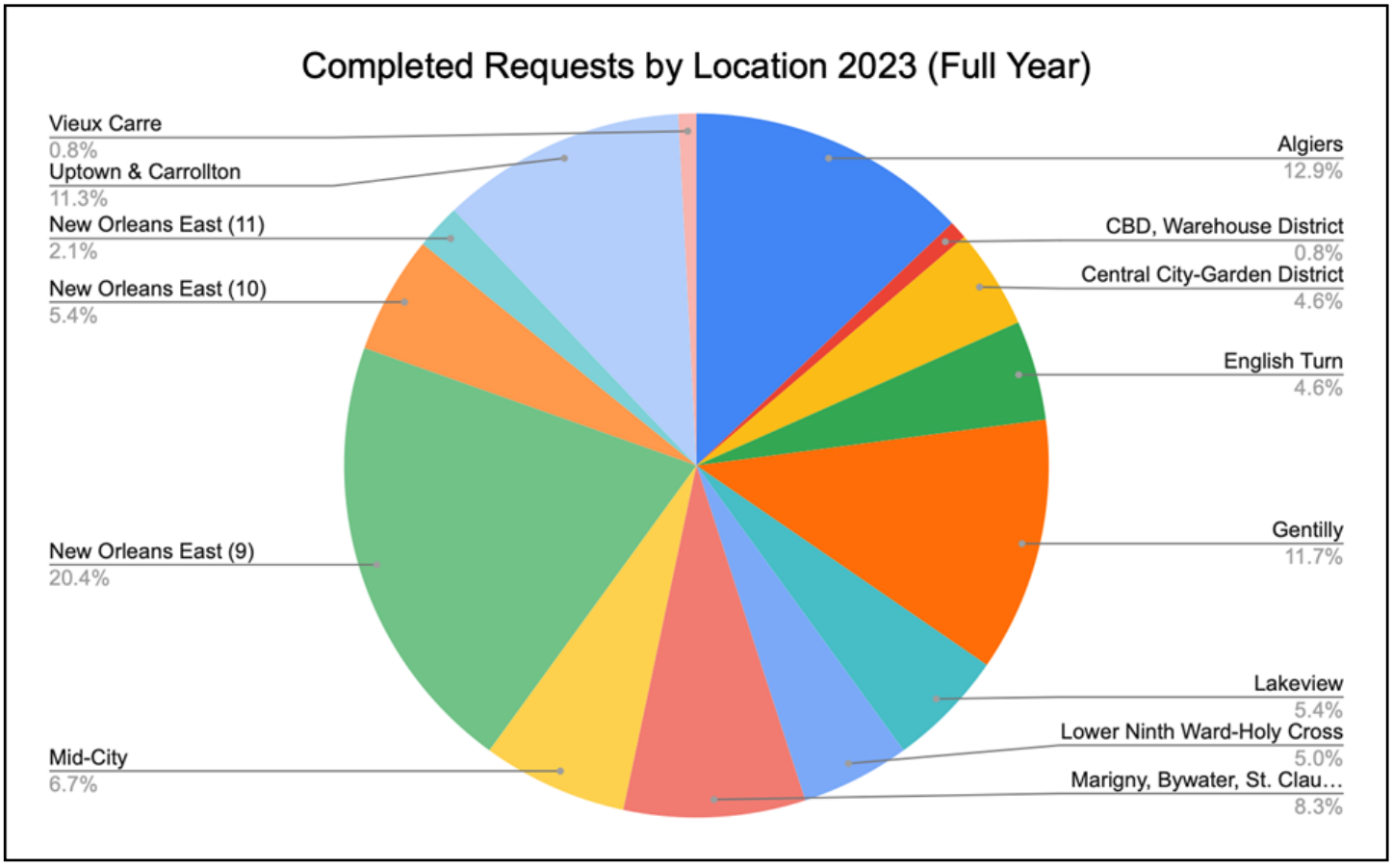


Figure 12 Percent of total service requests by city planning district received in 2023.

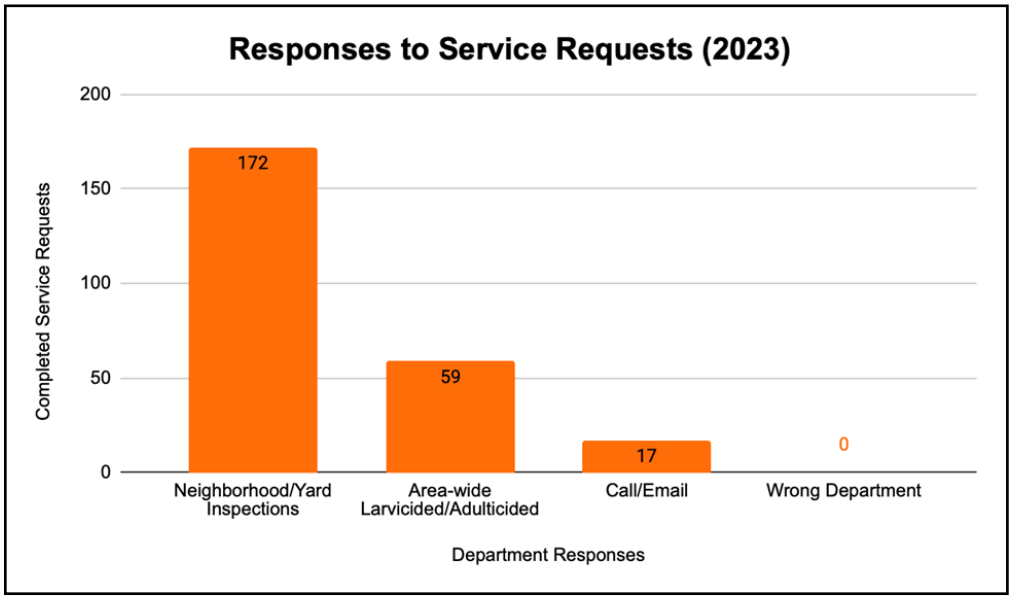


Figure 13. NOMTRCB actions taken in response to resident service requests in 2023.

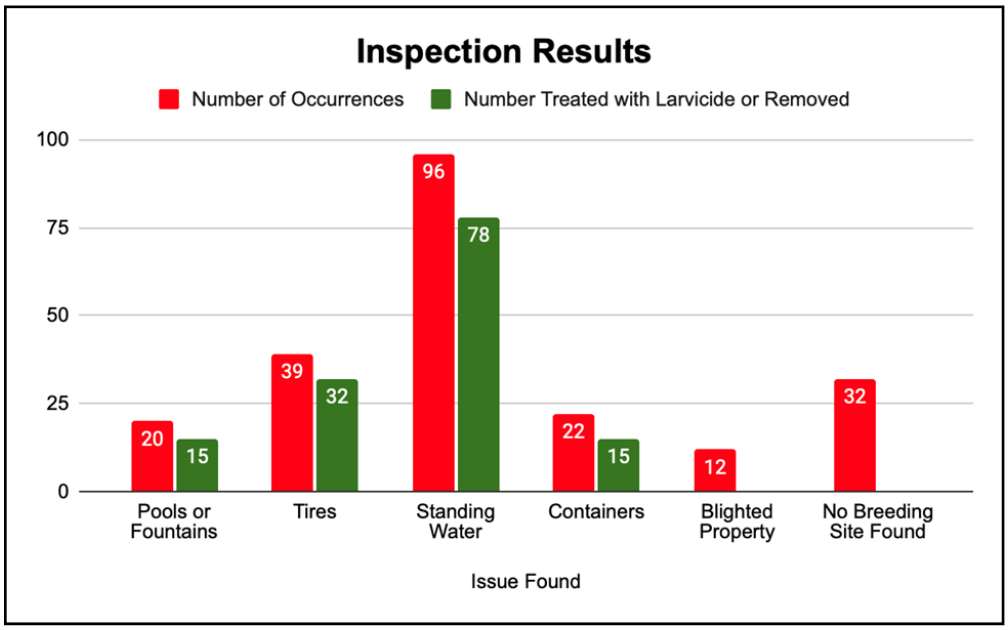


Figure 14. Mosquito breeding sites located and treated during service requests in 2023.

We conducted 172 neighborhood or yard inspections in response to service requests. Other requests were resolved by conducting area-wide larviciding or adulticiding or contacting residents to answer questions and resolve specific issues (Fig. 13).

While conducting yard and neighborhood inspections, our NOMTRCB inspectors reported potential or active breeding sites at 177 requests. Treatments of those sites occurred at 140 of those requests during the time of inspection. Standing water at inspection sites resulting from flooding, infrastructure-related issues, or swales was the major source issue found during inspections. Around 81% of standing water sites were found to be either actively or recently breeding mosquitoes (Fig. 14). Inspectors treated standing water with bacteria-derived larvicides or surfactants and performed source reduction, when possible, by turning over, covering, or removing unmaintained pools, fountains, tires, and containers.

Active breeding sites were added to our comprehensive data set for future reinspection and retreatment, and major breeding sites were reported to external agencies. Twelve blighted properties at or near the request site were observed during our inspections. Roughly 41% of service calls during 2023 requested for either area or yard treatment by our fog truck, which was a significant rise compared to 2022. For around 18% of the total site

inspections, we were unable to locate any specific mosquito breeding problem at or around the caller's address.

Surveillance Program

The NOMTRCB mosquito and arboviral surveillance program is mainly comprised of weekly placement and removal of gravid traps at 46 locations throughout the City of New Orleans (Fig. 15). Our surveillance field and identification crew includes James Beck, Eric Dauzat, Evan Davies, Trevor Dupree, Maddie Fryer, Eric Guidry, Glen Higgins, Victor Maurice, Andra McClue, Alex Pavlakis, Nichelle Rowel, Marie Lai, and Jill VanWhy-Spoonmore, among other auxiliary staff.

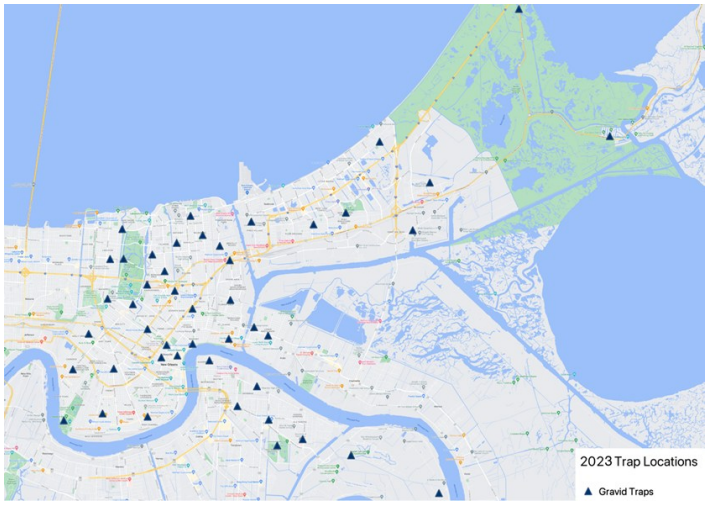


Figure 15. Gravid trap locations in Orleans parish. Each triangle represents the locations where a gravid trap is placed weekly.

Gravid traps (John Hock, Gainesville, FL) target gravid *Culex* females seeking suitable locations to lay eggs. *Aedes albopictus, Aedes aegypti, Aedes vexans, Culex nigripalpus, Culex quinquefasciatus, Culex restuans,* and *Culex salinarius* collected from gravid traps are sorted, pooled, and sent to the Louisiana Disease Diagnostic Laboratory (LADDL) for weekly screening of West Nile virus (WNV), St. Louis encephalitis (SLE), and Eastern equine encephalitis (EEE). NOMTCRB evaluates arboviral results in addition to mosquito counts, service requests, weather, and other factors to determine mosquito control treatment needs, options, and locations.

A total of 2,185 pools were submitted for arbovirus testing in 2023. Pools that are submitted are primarily from our gravid traps, however we also pool specific species of concern from our BG Sentinel II and CDC Light Traps. This year, 3 mosquito pools in Orleans Parish tested positive for arboviruses: two pools for WNV and one pool for EEE (Fig. 16). This was the first incidence of a positive EEE pool in Orleans Parish since

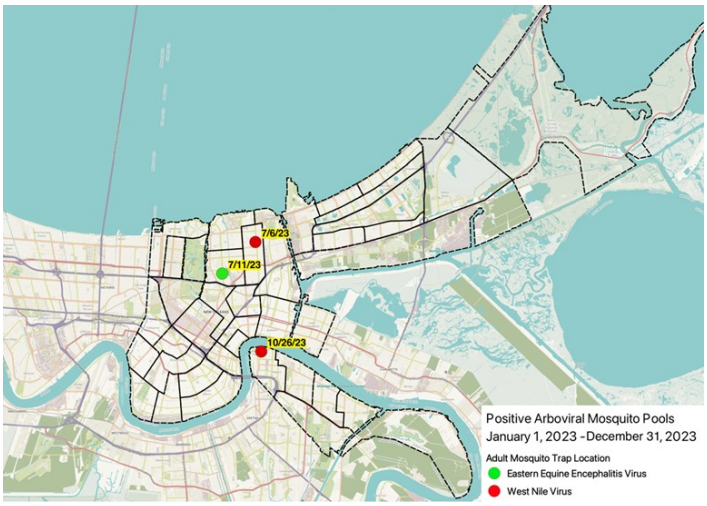


Figure 16. Arbovirus pools detected in Orleans Parish in 2023. Red dots signify the general locations where the WNV pool was detected, the green dot signifies the general location where the EEE pool was detected.

2012. No confirmed locally acquired human arbovirus cases were reported in Orleans Parish. However, we were alerted of a few travel-associated cases of dengue and malaria. Adulticide and larvicide application, community outreach and education, and source reduction (e.g., removal or treatment of tires and other containers) are the primary control strategies for reducing the risk of human infection.

This year, we observed significantly fewer adults of our primary WNV vector, *Cx. quinquefasciatus*, in our gravid traps compared to previous seasons. This trend was also seen by several other vector control agencies in the state. This drop in numbers was most likely due to the drought and high temperatures we experienced during the summer. Our average number of female *Cx. quinquefasciatus* per trap-night this year rarely exceeded our five-year average (Fig. 17).

BG Sentinel II

In 2022, we relaunched our BG Sentinel II traps (BioGents, Regensburg, Germany). We worked on issues with the low catch rates of the target species, *Ae. aegypti* and *Ae. albopictus,* which are the vectors of dengue and Zika viruses. BG traps are considered the "gold standard" for *Aedes* spp. trapping and are proposed to work well even in urban areas. Trap performances prior to our changes last year yielded low *Aedes* spp. numbers while collecting far more *Culex quinquefasciatus*. To remove this redundancy, several of the traps in new locations with appropriate vegetation and shade were placed (Fig. 18). Additionally, thermoses and tubing to the traps to allow us to use dry ice baiting, increasing the performance of the traps were added.

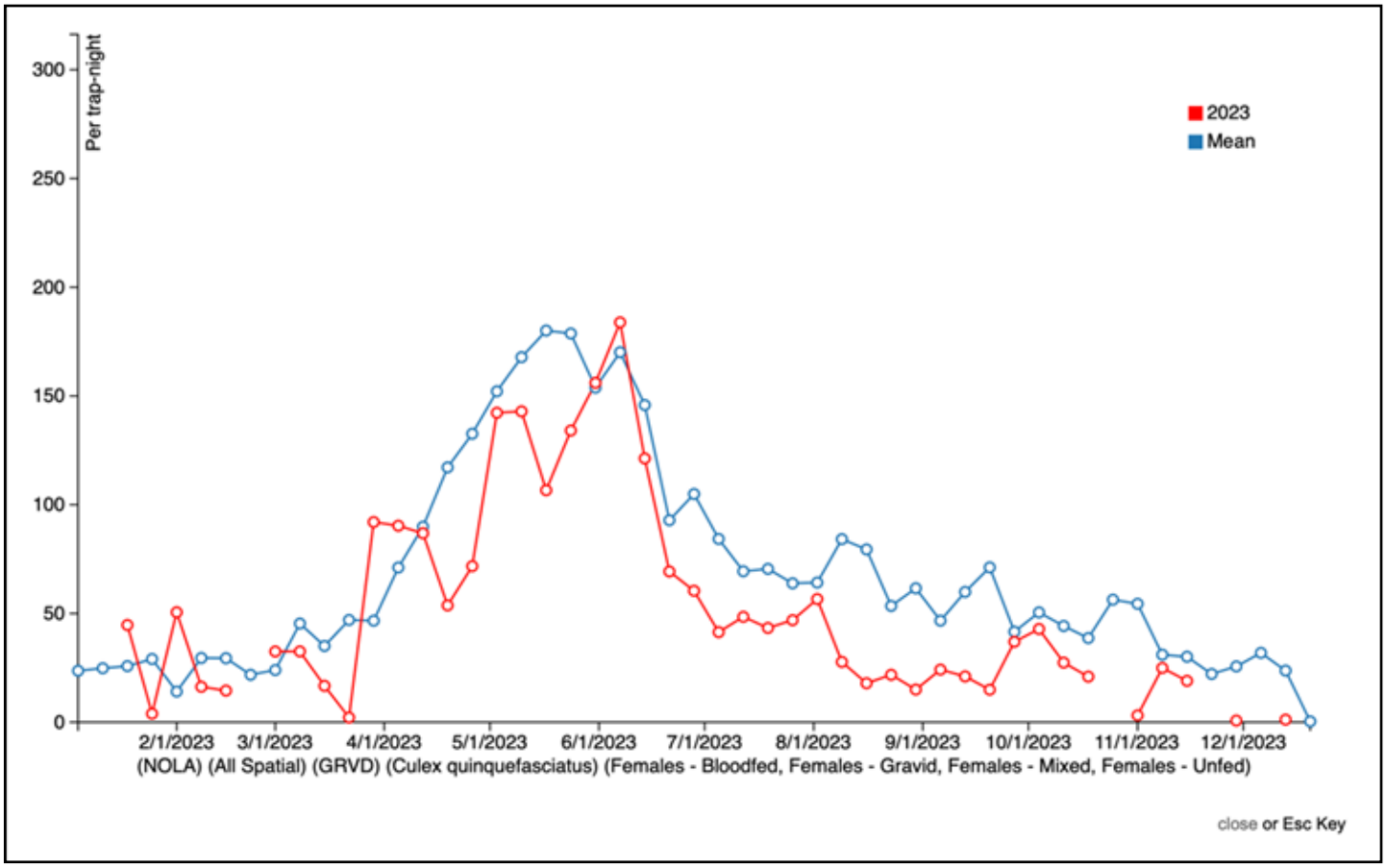


Figure 17. Average female *Culex quiquefasciatus* adults captured per trap-night for the entire year. The red line signifies the average number caught in 2023. The blue line signifies the five-year average (2018-2022).

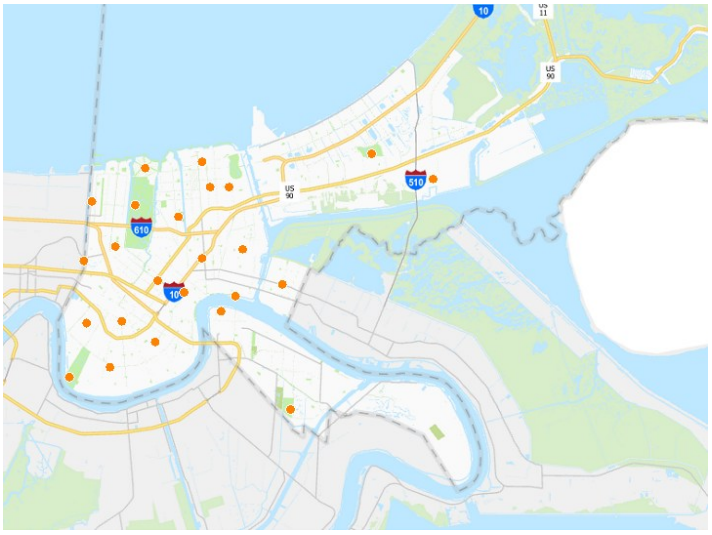


Figure 18. BG Sentinel II Trap Locations in Orleans Parish in 2023.

In 2023, we continued to trap at the same 24 locations around the parish. Trap data over this two-year period were compared to monitor increases of container speciess and other mosquito species caught in the traps. Results helped indicate specific areas that were experiencing higher than usual counts of these specific species so that we could better target mosquito abetment efforts. We plan to expand our BG Sentinel II trapping efforts in 2024 by adding several new trapping sites.

Gentilly Resilience District

NOMTRCB performs biological monitoring via surveillance of mosquitoes and rodents at green infrastructure (GI) sites for the Gentilly Resilience District (GRD). The GRD is a city project funded by the US Department of Housing and Urban Development National Disaster Resilience Competition. This project seeks to install small and large-scale green infrastructure at numerous sites in the Gentilly area of New Orleans to mitigate flood risk while simultaneously providing greater neighborhood benefits. The role of NOMTRCB, in partnership with the Tulane Bywater Institute, is to evaluate potential vector-borne disease or other public health risks due to water retention sites and altered drainage regimes resulting from GI implementation. This year, NOMTRCB is monitoring 16 GI sites bi-weekly with our CDC Light traps. Some of these projects have already been constructed, while others are still in the process of being built. Our GI field and identification team includes Eric Dauzat, Eric Guidry, and James Beck. As some of the large-scale sites are anticipated to begin

construction this year, we are working closely with the Tulane Bywater Institute and other collaborators to plan our continuing monitoring efforts of these sites during and after their installation. We plan to add water level and larval surveillance after rain events at all completed sites to our program in 2024.

Our outreach teams participated in community events for the Gentilly Resilience District (GRD). The St. Anthony Green Streets event provided an opportunity for us to answer questions from residents about home and neighborhood pest management, and to make our services more visible. The Dillard Wetlands event included discussion with project managers and residents about ecologically sound green infrastructure, and to help inform design elements that limit attractiveness to pest populations. NOMTRCB representatives also participate in Resilience Design Review Committee (RDRC) meetings for large-scale projects such as Dillard Wetlands, City Park/Lakeview, St. Anthony Green Streets, and Mirabeau Gardens, among others. Our role in these meetings is to identify proposed design elements that create conducive conditions for rodent or mosquito breeding and to suggest mitigation strategies for inclusion in design plans.

VectorSurv Reporting System

All vector control districts in Louisiana moved to begin using the VectorSurv gateway for arbovirus surveillance starting in January of this year. This system is used by several other states, including California and Arizona. All arbovirus pool submissions for the state were conducted using the VectorSurv gateway. This shift allowed all districts to continue to submit their arbovirus testing pools in a centralized system while also allowing districts to utilize VectorSurv's calculators and spatial tools to better visualize arbovirus activity and vector abundances in the state. By using VectorSurv, data-sharing between parishes can be optimized.

To take full advantage of all the tools VectorSurv offers, we uploaded all our current and historic trapping records into the system, including our arbovirus pools, test results, and trap abundances. All our available trapping records and arbovirus presence data from 2012 to 2023 was uploaded into the system. By doing so, our department can easily track, visualize, and compare adult abundances and arbovirus activity to assist in our decision-making processes. We hope to continue utilizing VectorSurv's full capabilities by uploading our historic insecticide resistance and area-wide abatement data in the next year.

Testing *Anopheles* for Malaria

In 2023, we gained the ability to test our locally caught *Anopheles* mosquitoes for malaria in our laboratory. This summer, four states—Texas, Florida, Maryland, and Arkansas—reported local transmission of malaria. Consequently, our department decided to begin testing *Anopheles* mosquitoes captured in our traps. We tested 50 individuals collected starting in June of this year and all were found negative for malaria. We will continue to test pools of *Anopheles* in 2024.

Area-Wide Mosquito Abatement

NOMTRCB continues to use area-wide mosquito abatement as one of our tools for mosquito population control. This year continue to rely on truck-mounted larvicide and adulticide for area-wide abatement while we prepare our newly acquired helicopter to with proper spray equipment. The area-wide abatement team includes Astacia Carter, Eric Dauzat, Rachel Denny, Trevor Dupree, Glen Higgins, Princeton King, Timmy Madere,

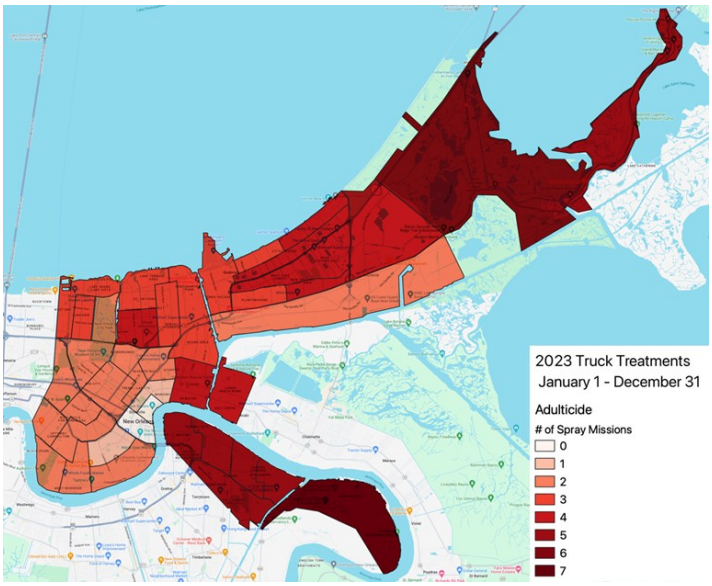


Figure 19. Fog zones treated with adulticide by fog trucks in 2023.

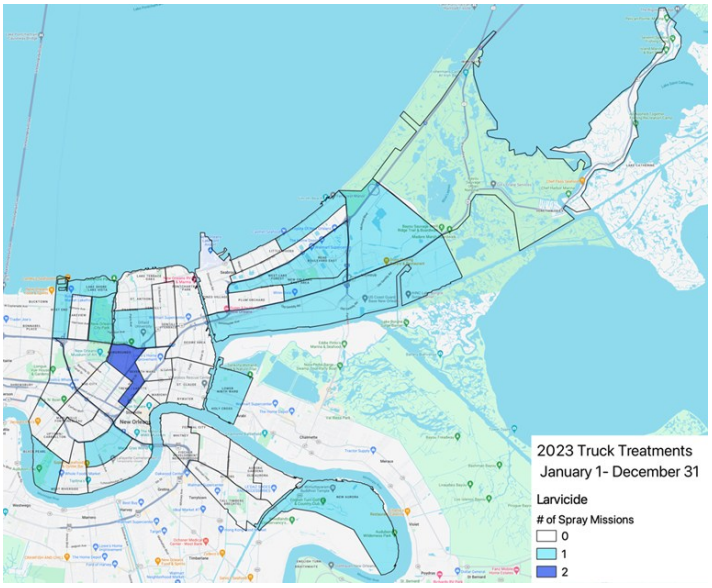


Figure 20. Fog zones treated with larvicide trucks in 2023.

Victor Maurice, Andra McClue, Jarret McKnight, Alex Pavlakis, and Phillip Smith, among other auxiliary staff. 38 of our 40 fog zones were treated by our fog trucks with at least one adulticide or larvicide treatment (Figs. 19, 20). We conducted a total of 121 area-wide adulticide treatments and 14 area-wide larvicide treatments.

Six new Clarke Grizzley Sprayers were secured in 2023 as well as a new software system that will track chemical usage and improve the in-truck experience for our abatement team. The tracking system is provided by FieldSeeker (Frontier Precision, Bismarck, ND), which is also used for our breeding site surveillance program. The plan is to rotate these new sprayers fully into our fleet once we begin area-wide adulticide abatement in 2024.

Breeding Site Surveillance

Weekly breeding site surveillance throughout Orleans Parish was conducted to look for the presence of waste tires, swales, infrastructure problems, and unmaintained pools and fountains. Water that accumulates in these issues can be ideal breeding sites for both nuisance and vector mosquitoes. All these potential breeding site types are known to be ideal breeding habitats for our local primary West Nile virus vector, *Cx. quinquefasciatus*. Our breeding site surveillance team included Eric Dauzat, Evan Davies, Maddie Fryer, Princeton King, Victor Maurice, Andra McClue, Alex Pavlakis, Nichelle Rowel, and Jill VanWhy-Spoonmore.

Over the last couple of years, we have continued to optimize our program by changing the surveillance protocol and utilizing software to better collect data to track these breeding sites. Towards the end of 2022, a new surveillance software program called FieldSeeker was implemented. This program allows our inspectors to access and update breeding site maps in real time, completely eliminating manual data. This software reduced the time in the field for our inspectors and allowed them to easily find and inspect previously recorded breeding sites. Inspectors were able to access all previous inspections and treatments at each of these previously recorded sites while out in the field (Fig. 21).

This year, we continued to make progress by building upon the software system we have in place. Calls for service were added to our map, allowing inspectors to respond to citizen's mosquito requests more effectively. Additionally, the software provided a better visual understanding of sites that needed inspections, reducing the time between inspections of these sites. Further advancements in tracking long-term breeding habitats that were previously not mapped as successfully were made. Unmaintained swimming pools, non-running fountains, large swales, and other containers conducive to mosquito breeding were included, which allowed us to better track larval habitats throughout the parish. We are in the process of converting some of those larger breeding sites, mainly floodwater areas, into polygons onto our map, which will allow our inspectors a better understanding of large potential mosquito breeding areas when they are in the field. Paired with targeted area-wide inspections based off adult surveillance data, our breeding site surveillance program has made major advancements to better address mosquito breeding around the parish and help break the mosquito life cycle. We hope to add larval sampling to our software system in 2024 to collect temporal and geospatial data of species-specific breeding sites.

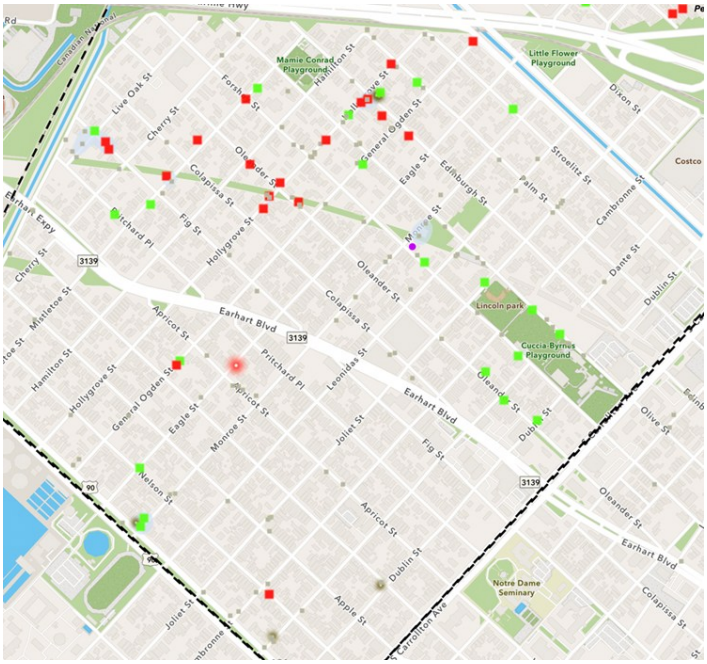


Figure 21. Snapshot of our breeding site map. Inspectors have access to this map on their tablets while out in the field. Each square represents an individual breeding site location. Green squares signify breeding sites that have been inspected or treated in the previous 30 days, red square signify sites that need an inspection, and gray squares signify sites that have been fixed or removed. Haloed dots on the map signify open calls for service that citizens have requested.

Collaborations with other agencies continued, including CNO Department of Sanitation and the Sewerage and Water Board to permanently resolve breeding site issues. NOMTRCB provides data and helps to prioritize resolution of issues based on several criteria: 1) if mosquito larvae have been observed; 2) size and depth of the problem; 3) proximity to residents; 4) adult mosquito counts particularly vector species; and 5) arbovirus screening results from mosquito traps in the vicinity. We are continuing to work with SWBNO to inspect construction sites as they break ground. Data to non-governmental groups and neighborhood associations is provided, like illegal tire dumping locations, to assist their cleanup.

Waste Tire Removal
NOMTRCB renewed our Waste Tire Transporter and Generator permits from the Louisiana Department of Environmental Quality (LADEQ). While conducting surveillance or responding to service requests, inspectors selectively removed tire piles. Typically, these were smaller tire piles in vulnerable areas throughout the city, such as near schools or in residential areas. In previous years, large tire sweeps were conducted in collaboration with the Department of Sanitation to address larger areas in the parish over a period of a couple of days. We are planning on running another one of these events in 2024 and hope to partner with other stakeholders to increase the impact of this event. Breeding site data is used to determine the best areas to conduct a multi-day event.

Mosquito Ecology Project
Operational Capacity Trials
This summer a research project was conducted to test the development rate and female fecundity of *Aedes albopictus* and *Cx. quinquefasciatus* mosquito larvae in different breeding habitats we typically found in Orleans Parish. These sites included waste tires, construction sites, swales and rain gardens, and fountains. Water and detritus from each of the breeding site types was collected (Fig. 24). Water from each site type was homogenized, and detritus from those sites was dried in an oven for 48 hours and added to each of the replicates. *Aedes albopictus* and *Cx. quinquefasciatus* larvae were placed in rearing containers and raised to adults. The survival rate and development time from 1st instar larva to adult was recorded. We are currently in the process of measuring the wing length for each female that emerged to determine female fecundity and analyzing the dataset. The results from this study may be able to assist in our operational decision making by establishing a better inspection interval for each of these specific breeding site types and help prioritize treatment of breeding site habitats based on female fecundity results.

***Toxorhynchites rutilus* Colony**
This summer, Dr. Anita Schiller from Harris County, TX approached NOMTRCB with the opportunity to inherit a large colony of *Toxorhynchites rutilus*. *Toxorhynchites* mosquitoes, also known as mosquito assassins, are a potential biological control agent because in their larval stage they are predators of other mosquito larvae. As adults, they do not blood feed, so they are neither potential vectors for diseases nor nuisance biters.

In September, the live colony and rearing supplies were collected from Harris County (Fig. 22). Dr. Schiller also visited the Biolab and conducted a week of training for our staff on mass rearing of *Tox. rutilus*. We have previously reared colonies of *Tox. rutilus* and *Tox. Amboinensis* for educational purposes. By receiving this colony, rearing supplies, and training in mass rearing of these mosquitoes, hundreds of *Tox. rutilus* mosquitoes can be produced weekly. In 2024, the effectiveness of this biological control agent in Orleans Parish will be studied by conducting mass releases. The goal is to use this biological control agent alongside other abatement measures to reduce container breeder abundances in select areas of Orleans parish.

Figure 22. Live colony of *Toxorhynchites rutilus* transported from Harris County, TX. to the Biolab.

RODENT AND PEST CONTROL

ANGELO ANDERSON, RACHEL DENNY, TIMMY MADERE, AND PHILIP SMITH

Service Requests

NOMTRCB inspectors continue to service residential requests for rodent control. Service requests, direct calls to the department, and emails were recorded and issued to inspectors where they were promptly addressed. Service requests are typically addressed within 2 to 3 business days. Between January and October 2023, there were 255 rodent service requests. Service request volume was similar between 2022 and 2023 (the average number of service calls per month was 25.9 in 2022 and 25.5 in 2023), though there was far more variation between months in 2022 (Fig. 23).

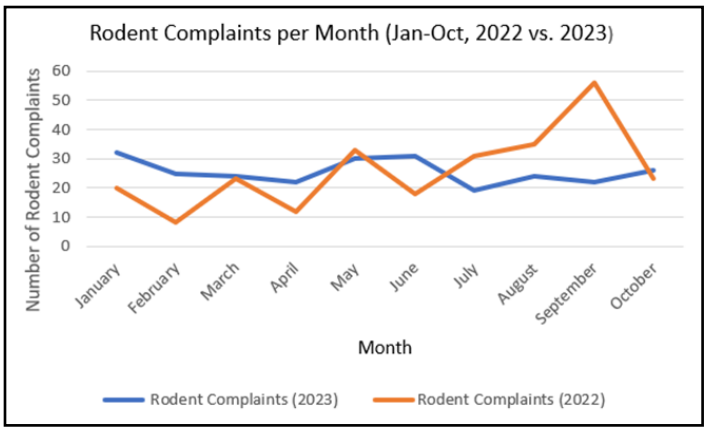


Figure 23. A comparison of 311 reported rodent service requests by-month, 2022 and 2023.

Areas that had a high volume of reported rodent activity included Central City, the Seventh Ward/Treme, the French Quarter/CBD, and the Upper Ninth Ward (Fig. 24). This is similar to last year's distribution of complaints.

Many times, pest problems are a direct reflection of poor sanitation practices and abundant food availability. The NOMTRCB staff continuously inform city employees, the public, and partnering agencies about the importance of good sanitation practices. Poor sanitation, open garbage cans, and lush or overgrown vegetation are the main factors contributing to rodent infestations. Typically, NOMTRCB inspectors speak directly with maintenance staff to offer suggestions. Our employees inspect properties and educate residents about the conditions that are conducive to rodents and how to pest-proof their homes.

A number of the calls we received were about urban wildlife. Currently, no state or city agency provides urban wildlife control to residents. We received calls regarding opossums, coyotes, raccoons, and other unwanted pests in yards and/or entering homes.

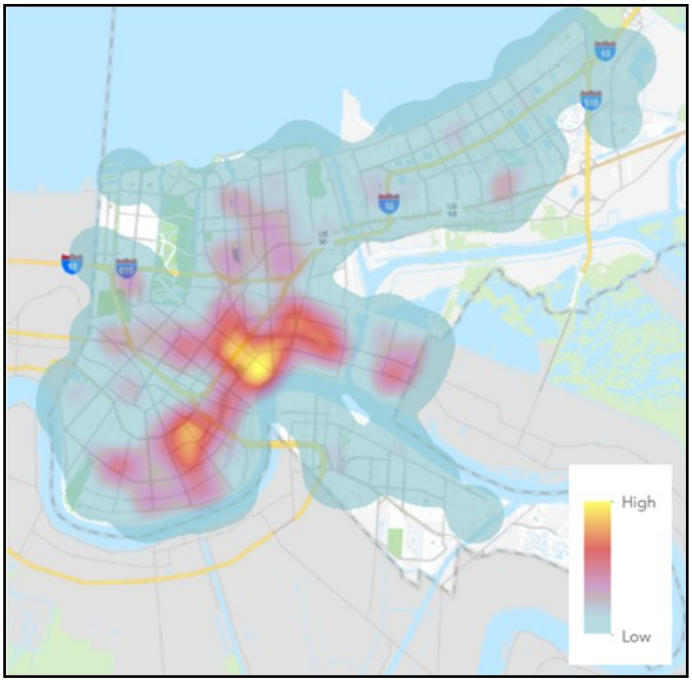


Figure 24. City-wide heat map of rodent service requests (January—October 2023).

City Facility Inspections and Treatments

NOMTRCB services city properties for all urban pests, not just disease vectors such as mosquitoes and rodents. Inspectors work with city employees and management to correct the conditions that are conducive to pest problems. It is often a challenge to change human behavior; however, once cultural practices are changed, rodent and pest problems are usually remediated. Cooperation is required to solve pest problems.

Integrated pest management (IPM) practices are used with an emphasis on changing cultural practices among city employees throughout New Orleans. A specific challenge we have faced this year is education of city employees regarding storage of food in workspaces. Poor sanitation and improper storage of food attracts pests. We are working on creating educational materials to distribute to city employees on proper pest-proofing and removal of sources of food, water, and haborage.

Our continuing efforts at City Hall, Duncan Plaza, the Main Library, Lafayette Square, the French Market, and multiple hot spots in the CBD have kept the rodent populations under control, though numbers have returned to roughly pre-COVID levels. Of note, Parks and Parkways removed much of the vegetation from Duncan

Figure 25. Interns, McKenna Devlin and Malcolm MacLean, prepared traps for snap trapping in the French Market.

Plaza and the Main Library, making our treatment efforts much more effective. The French Market is still experiencing rodent issues around Washington Artillery Park, Latrobe Park, and in the open-air market. Open trash cans, food debris, and unkempt vegetation are supportive conditions for rodent infestation. We utilize rodenticide and trapping to control rodent numbers. Over a two-night span (four hours total) of snap trapping, we removed over 40 animals from Latrobe Park and Washington Artillery Park (Fig. 25).

Rodent Control for Public Health in Homeless Encampments

NOMTRCB continued to utilize and test the effectiveness of dry ice (CO2) (Rat Ice, Bell Labs, Inc.) for rodent abatement on municipal properties. In addition to sites that we have been working at for the last few years, efforts were focused this year on rodent control in the growing encampments of unhoused people around the city, specifically at the Claiborne corridor and the intersection of Calliope and Tchoupitoulas. Due to the lack of sanitation and subsequent access to food and harborage, rodent populations exploded in these areas. Employees worked diligently to establish relationships, not only with the individuals residing in these encampments, but also to form partnerships with other City agencies to determine and comprehensive plan to reduce rodent numbers and mitigate potential adverse health outcomes in this vulnerable population. Under the direction of Nate Fields, Director of the Office of Homeless Services and Strategy, the NO Health Department (with major organization efforts from environmental health compliance officer, Rachel

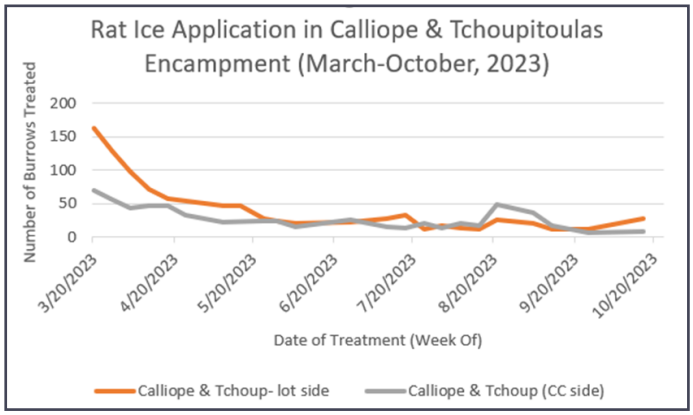


Figure 26. Rat Ice application in burrows at the Tchoupitoulas and Calliope encampment from March to October 2023.

Kimble), CNO Sanitation, NOPD, and the SPCA began weekly cleanups and public health harm reduction in the camps. Working alongside these other departments, we reduced the number of rodent burrows in the encampment at Calliope and Tchoupitoulas from 232 (March) to numbers consistently around 25-30 burrows (October) (Fig. 26).

In August, based on complaints from residents of the encampment about a growing flea issue, we performed a broadcast flea treatment in the area as well as provided treatment of residences when permitted. The LASPCA provided flea medication and vaccinations for companion animals owned by camp residents. While there are still issues in these encampments, we hope that the continued partnership between NOMTRCB and other city departments and the application of a One Health approach will not only to reduce rodent and other pest numbers in the area but also improve the health and well-being of all residents in the city.

Summer Projects

The Rodent Division welcomed two interns this summer, McKenna Devlin and Malcolm MacLean, both Masters students at the Tulane School of Public Health and Tropical Medicine. As a required part of their practicum experiences, each conducted a project of great value to the department,

Malcolm MacLean's project comparatively assessed conducive conditions for rodent activity in community gardens and residential gardens. After inspection and data collection about conducive environmental conditions at each site, the team utilized live cage-trapping to assess the demography of the rodents populations in these areas. Rodents were collected and necropsied for further analysis of pathogen loads and their potential public health impact (Fig. 27).

While working on this project, one of our study sites, the Bayou St. John Community Garden, was found to have a large rodent infestation. This project directly lead to the establishment of a partnership with the BSJ Community

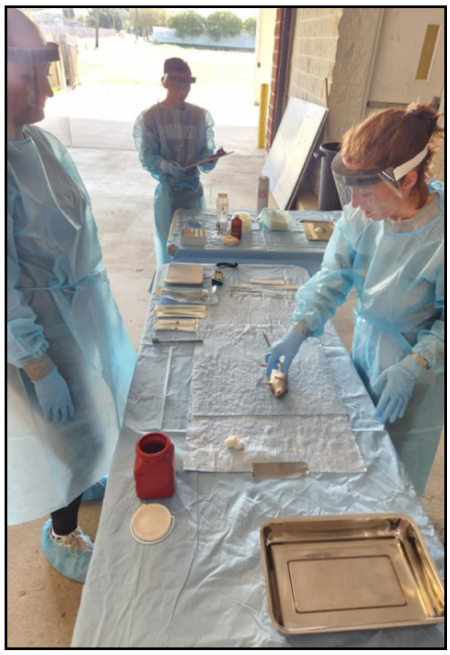
Garden worked  and we with

Figure 27. Rachel Denny (Pest Specialist I) instructs Malcolm MaC-lean and McKenna Devlin on the proper technique for rodent necropsy.

Figure 28. Bayou St. John Community Garden's compost pile before (A) and after (B) educational intervention by NOMTRCB.

volunteers to improve their garden management to remove the conditions supporting the infestation (Fig. 28). This information will be used to tailor educational interventions and training for community garden leaders and homeowners about best practices for garden management to prevent rodent activity.

McKenna Devlin's project utilized trail cameras to assess rodent interactions with tamper-proof bait stations at various city facilities. Bait stations can be effective tool s in an integrated rodent management plan, but it is important to evaluate the effectiveness of our rodent control tools at each site. Through collection and analysis of over 1000 individual observations across multiple sites, McKenna was able to categorize and quantify interactions with bait stations and parse out meaningful data that will improve our use of rodent abatement technology at city sites. McKenna will present this research at the 31st Annual Vertebrate Pest Conference in Monterey, California, March 11-14, 2024.

McKenna and Malcolm stayed on with NOMTRCB after their summer Practicums ended as part-time employees while they take classes in the fall. They are bright, hard-working, and fit well within our working team.

Team Accomplishments

Rachel Denny, Pest Specialist, began was accepted into a PhD program in Epidemiology at Louisiana State University School of Health Sciences– New Orleans. She will work under the supervision of Dr. Susanne Straif-Bourgeois and NOMTRCB director Dr. Claudia Riegel to study the eco-social epidemiology of rodent-borne disease in New Orleans. This information will help to improve our operational and mission-oriented rodent control work focusing on reducing the risk of adverse public health outcomes associated with rodent exposure for citizens of New Orleans.

Angelo Anderson, Pest Inspector, returned to our team full-time this year after light duty. His expertise, experience, and ability to effectively communicate with citizens is highly appreciated and a huge asset to our team.

Timmy Madere, Pest Specialist, is a well-known and respected speaker and attended a multitude of engagements to teach diverse audiences about rodent-control best practices. Timmy was a featured speaker/ instructor for Rose Pest Control, Virginia Tech, the West Coast Rodent Academy, the Texas Rodent Academy, Pest Control Technology, our Urban Rodent Control webinar series, and many other local, state-wide, and national engagements. We are fortunate to have Timmy and his expertise.

Philip Smith, Pest Specialist, wrapped up a 4-year study working with Corteva Agriscience to test new rodent control technology. Philip's ability to assist with study design, study design, location, and impeccable data collection continues to allow us to form working partnerships for studies with industry partners. He is an expert in the implementation of Integrated Pest Management in schools and commercial buildings. He also supports outreach events and school IPM recertification events.

TERMITE CONTROL DIVISION

CARRIE COTTONE, Ph.D. AND MARK JANOWIECKI, Ph.D.

The following are the ongoing goals of our Termite Control Division:

1. Gain knowledge of termite biology through research projects
2. Protect properties and trees from termite damage
3. Provide high-quality services
4. Continue extension services

The following pages detail how we are achieving these goals.

Termite Research Projects

Industry-Supported Research

The Termite Control Division continues to conduct field research and laboratory bioassays as part of agreements made with collaborators in the private industry and from universities. These agreements allow us to not only make nationally recognized contributions to the scientific community, but it also helps to supplement our budget. This year, we are continuing studies with Dr. Joe DeMark (Dow AgroSciences), Drs. James Austin and Bob Davis (BASF), Mr. Erik Keranen (Michigan Technological University), as well as Troy Chemical and the Professional Pest Management Alliance (PPMA).

Several field trials being conducted test the efficacy of new bait and liquid termiticide formulations against subterranean termites. We are able to verify the efficacy of the tested products by monitoring termite activity and comparing the DNA of termites present before treatment to that of termites that reinfest the treated area. This allows us to determine whether termites present after treatment belong to a colony that survived treatment or originated from a neighboring colony that was not exposed to treatment. Additional field trials test the effectiveness of wood treatments or physical barriers against termite attack on wood.

Barry Yokum continues to do an excellent job of managing multiple field research sites for cooperators from Dow AgroSciences and BASF. Timmy Madere has done a fantastic job coordinating all the field research for Michigan Technological University. Eric Guidry has coordinated all the laboratory testing for Michigan Technological University.

Several field trials conducted tested the efficacy of new bait and liquid termiticide formulations against subterranean termites. We are able to verify the efficacy of the tested products by monitoring termite activity and comparing the DNA of termites present before treatment to that of termites that reinfest the treated area. This allowed us to determine whether termites present after treatment belong to a colony that survived treatment or originated from a neighboring colony that was not exposed to treatment. Additional field trials test the effectiveness of wood treatments or physical barriers against termite attack on wood.

We regularly receive termite samples from collaborators to delineate colonies using molecular methods for a fee. We examine two microsatellite DNA loci in 10 individuals per sample. These samples are then compared to determine which samples are from the same colony. This is useful for accessing the success of termite control tactics to determine if termites present after control are from new colonies or survivors from the original colonies.

Blood meal analysis was completed to determine what animal a mosquito fed on last. Using established methods (Hopken et al. 2017), we are able to take recently fed mosquitos and sequence a barcoding gene. This provides a sequence that can be compared to a robust genetic database (GenBank) to determine the identity of the unknown blood sample. We are currently running mosquito samples from St. Tammany Mosquito Abatement District for a fee.

We are working towards building the capacity to conduct mosquito and rodent pathogen diagnostics in the laboratory. The genetics laboratory was upgraded into a Biosafety Level 2 Laboratory (BSL2) with the help of our biosafety consultant, Dr. Tammy Bavaret (Cypress Biosafety). This will enable us to screen for pathogens in rodents and mosquitos in house and is a critical step in our long-term goal to establish a robust rodent surveillance protocol. We began screening mosquitos for malaria in light of the recent cases of locally acquired malaria in parts of the US. We will soon begin screening rodents for *Leptospira* spp. and *Rickettsia typhi* pathogen loads. The goal is to screen rodents for pathogens in 2024.

Termite Swarming

This year, Formosan subterranean termites (*Coptotermes formosanus*) swarming alates were quantified in the Jackson Barracks and the French Quarter. Sticky traps were placed out under street lights and collected every 3-5 days to determine the number of swarmers. The French Quarter has had area-wide control for the last approximately 20 years whereas area wide control began in the Jackson Barracks only 8 years ago in 2015. Area-wide control is a method which reduces termite populations in a large area to prevent damage to structures rather than having individual control protecting specific structures. When area-wide control is successful, there should be few if any termite colonies in an area and

will correspond to little to no damage to structures. After area-wide control methods are put in place, success can be determined by a decrease in the number of swarming termites, since there should be no colonies in the area for termites to fly from. We have been comparing the swarming levels in the French Quarter and Jackson Barracks to gauge our success of reducing populations in the Jackson Barracks. We found generally a low number of swarming alates per collection time (Fig. 29A), but still had more swarming activity in the Jackson Barracks (solid line) compared to the French Quarter (dashed line) (Fig. 29B). Generally, there has been a downward trend in both sites from 2015 to present but there are consistently more termites per trap in Jackson Barracks than in the French Quarter (Fig. 30). A subset of these samples are preserved in the freezer for future genetic analysis to determine the number of colonies contributing to each sticky card monitor. This work is ongoing.

To determine what caused this discrepancy between our area-wide control results in the Jackson Barracks and French Quarter, in 2021 we removed alates from our sticky traps, and subjected them to genetic analysis using microsatellite DNA to determine the number of colonies contributing to each swarm (Fig. 31). We found that in the French Quarter, a small number of colonies are contributing compared to swarms in Jackson Barracks (Fig. 32). This difference between sites is likely caused by colonies in surrounding areas still swarming into the Jackson Barracks despite successful control of termites in structures. Previous studies have found termites are able to fly up to around a half-mile, making them able to fly into the Jackson Barracks from surrounding areas.

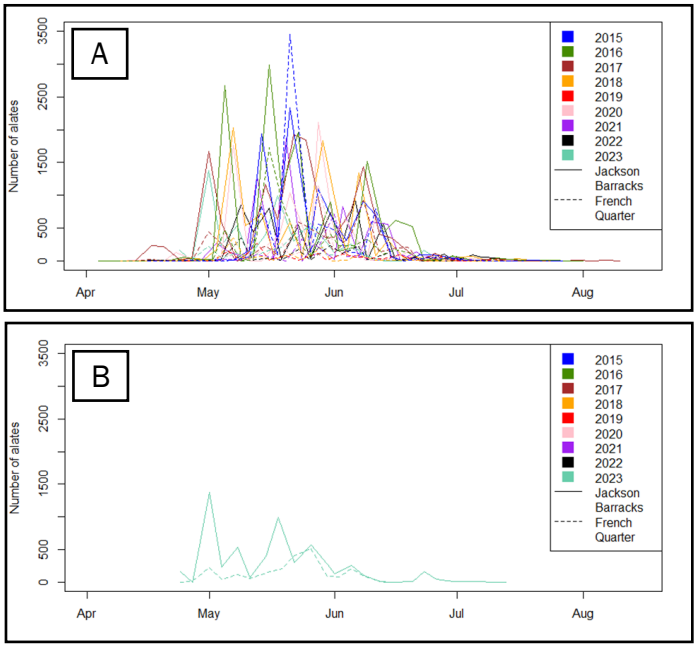


Figure 29. Termite swarming activity across the swarm season (April through July) comparing the Jackson Barracks (solid lines) and French Quarter (dashed lines) from 2015-2023. The top graph (A) has all years included to see how the number of alates fluctuates by year And (B) shows 2023 numbers alone.

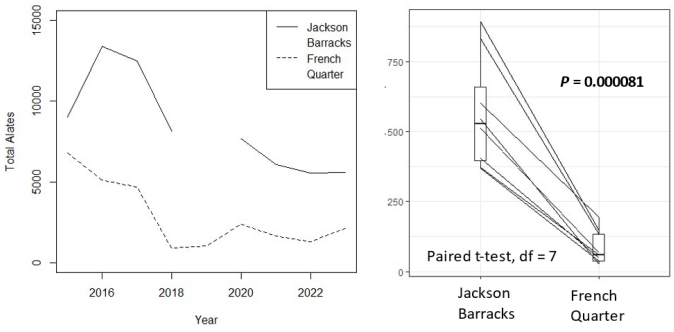


Figure 30. Comparison of total alates captured over season in Jackson Barracks and French Quarter over time (left) and pairings for each year (right). There were significantly less termites per trap in the French Quarter than the Jackson Barracks.

Protecting Properties and Trees

We are still continuing to protect historically significant and city-owned properties by installing and servicing Sentricon® Recruit HD Always Active bait around structures and trees. Barry Lyons, Shaun Broadley, and Eric Guidry have been doing an excellent job at managing these sites. Servicing each site involves checking every in -ground bait station, evaluating it for current termite activity and looking for evidence of feeding and replacing the baits when necessary. We are working with NOFD to install in-ground termite bait stations around all fire stations to protect theme against termite attack. Installation of Sentricon around all NOFD fire stations and fumigation of those infested with drywood termites is planned for 2024.

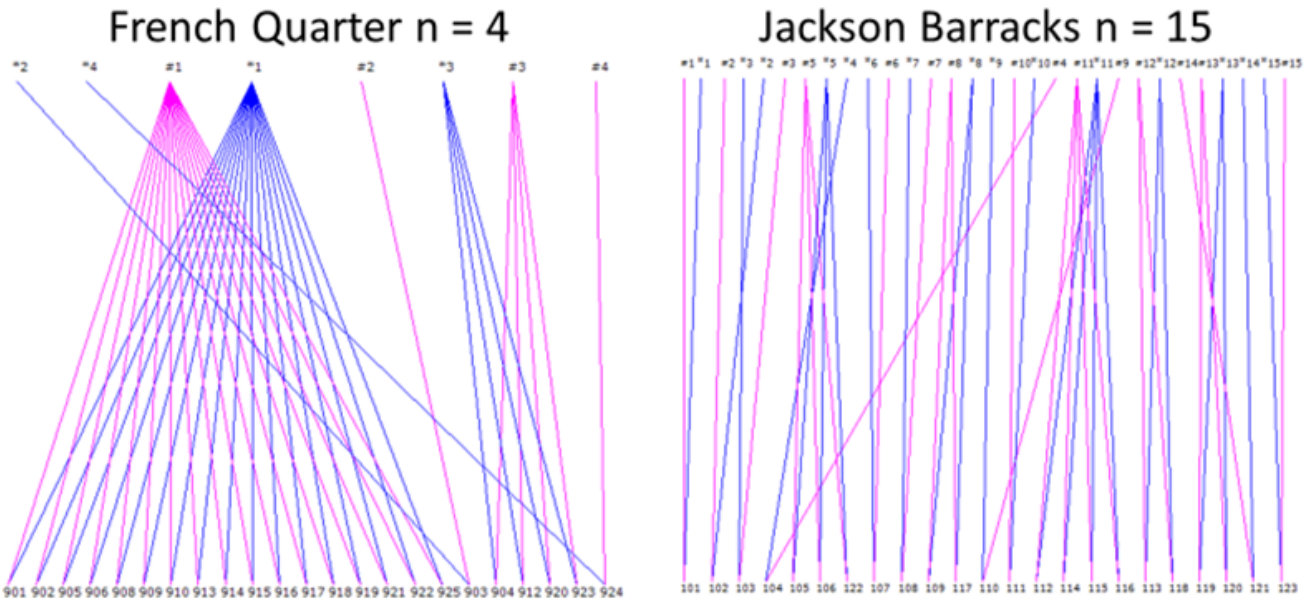


Figure 31. Pedigree analysis comparing the microsatellite DNA results for the two sites. Across the bottom are the individual alates removed from glue boards while across the top are the inferred parent colonies. When samples in the bottom connect to the same pair of parents on the top, these individuals are determined to be from the same colony. In this figure, the French Quarter has four contributing colonies while the Jackson Barracks has 15.

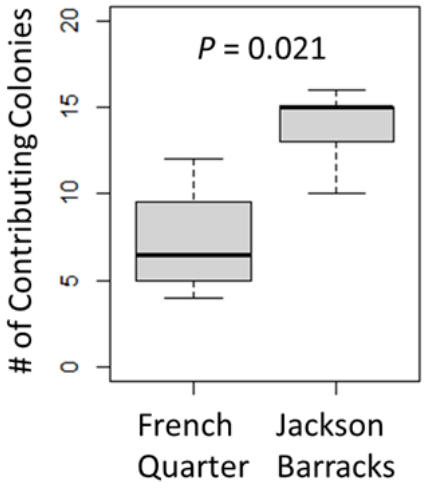


Figure 32. Comparison of number of contributing colonies per glue board in the French Quarter and Jackson Barracks. There were significantly more colonies per glue board in the Jackson Barracks than in the French Quarter.

PHOTOGRAPHY

ED FREYTAG

NPMA—PPMA Projects

For the calendar year of 2023, Vault Communications, Inc., contracted by the Professional Pest Management Alliance (PPMA) and the National Pest Management Association (NPMA), asked us to repeat the termite episode "Will They Eat It". This project, in which items are placed in a container and filmed to see if Formosan subterranean termites would eat them, gathered a great following in their educational and outreach series of PestWorld.org. in 2019. New items were exposed to termites, including a chair in a large container with one million Formosan subterranean termites.

Just like in the past years working on special projects with Vault Communications, we had weekly online meetings to discuss the details of the project. Discussions included how to set up the equipment for filming and the construction of the sets. A side project with a large chair was called the "Mega tank", because a large platform had to be constructed to house both the large chair and the termites. We wanted to use a plain unfinished child-sized wooden chair to facilitate filming time-lapse video, instead they opted for a large padded chair.

This year they only selected four items to be placed in10 gallon aquariums, each with at least 100,000 Formosan subterranean termites, to see it the termites would eat and damage them. Items selected were 1) a white baseball cap made from cotton components, 2) a stuffed cloth dog bone toy, 3) a photo album (with pictures we printed) also made with some paper components, and 4) a cotton school backpack holding two books inside. The feeding activity was recorded with GoPro cameras in time-lapse mode. Pictures and videos from 2019 were reviewed to determine how we set up the photography equipment and what settings were used. This allowed us to start the project much quicker, because there was less time spent figuring out the best way to setup the items and how to film them.

The first step in the project was to inspect our current collection buckets or milk crates buried in the soil to determine if they were still active (Fig. 33). Since we used the same collection sites for research projects, depending on the size of the colony and how many termites were collected, the populations were reduced by over-harvesting the termites. We started collecting termites in early November of 2022, but discovered that some of the termites sites were not active and very few termites were collected. We searched for new infested trees to initiate collecting locations in December through May. At least a dozen new trees were selected to install the collecting buckets in the soil. Unfortunately not all the installations had termites, even though the trees were infested.

Figure 33. Francesco collecting Formosan subterranean termites from a cardboard roll buried in a bucket site named "Bulldog".

Once we started to collect termites from the field, we had to replenish the wood and moistened cardboard in each site at least once a week. The cardboard rolls were labeled and placed in separate containers to make sure they did no get contaminated with another colony. Doing so would result in fighting and very few termites would survive. In the laboratory, the cardboard rolls were unrolled and the termites were shaken off the cardboard into a large tall plastic tub (Fig. 34). Then they were placed in a separate labeled plastic tub with moistened carboard, and covered with a lid to prevent desiccation.

When we collected enough termites we started on a timelapse of the termites feeding on the NPMA logo. They sent us the logo on two different types of paper– one thick and one thin. Plastic trays were filled 1/3 capacity with sifted sand, moistened, and approximately 20,000 Formosan subterranean termites were added. We waited at least one week for the termites to settle in the sand before putting the logo on top of the sand. The GoPro camera connected to a power supply was attached to a tripod and placed about one foot over the middle of the tray directly over the logo (Fig. 35). Two LED lights provided the lighting. Initially we had to make tests to find out the correct timelapse settings. The GoPro was set to take one photo every two minutes continuously until the logo was completely consumed. The logo photos were then edited to make a 10 second video playing backwards, so that it appeared as if the termites were constructing the logo. The personnel from Vault Communications were thrilled

Figure 34. Removing termites from a cardboard roll.

Figure 35. GoPro camera setup for filming time-lapse video of termites consuming a logo printed on paper.

with the resulting video was edited and shortened to about 10 seconds. It was also edited to run backwards to appears as if the termites were "constructing" the logo (Fig. 36). The time-lapse video was used to introduce the "Will They Eat It" episodes on the PestWorld website. We also concurrently made time-lapses of termites feeding of three different designs of the BugFest logos using the same setup and settings as the NPMA logo. They were also edited to last only 10 seconds and played backwards to appear as if the termites were creating the logo on sand.

The time-lapse videos of the four items were conducted in one of the small conference rooms in the NOMTRCB Administration office. It was too hot in the BSL trailer (bio-safety lab) because the portable air conditioning stopped working. We put potting soil in the bottom of the 10 gallon aquariums (about 1/4 full) for the termites. In

Figure 36. The NPMA logo with termites feeding on the surface after a few days.

the past we used sand but it dries up too fast and the trails are not as easy to see. We introduced approximately 100,000 Formosan subterranean termites in each aquarium and left them to settle-in for about a week before introducing the items. The GoPro cameras were placed on tripods in front of each aquarium, all powered by a power supply and without the battery in the camera. Having the battery in the camera caused the unit to heat up and shut down automatically. The whole setup was covered with black cloth to prevent reflections, the ceiling lights turned off, and two LED lights on tripods turned on only during the filming. Each day the cameras were set to record three hours of time-lapse photos at a rate of one frame every five minutes (Fig. 37). The photos were downloaded from the GoPro to a computer and then sent to Vault Communications for editing. The filming lasted over three weeks.

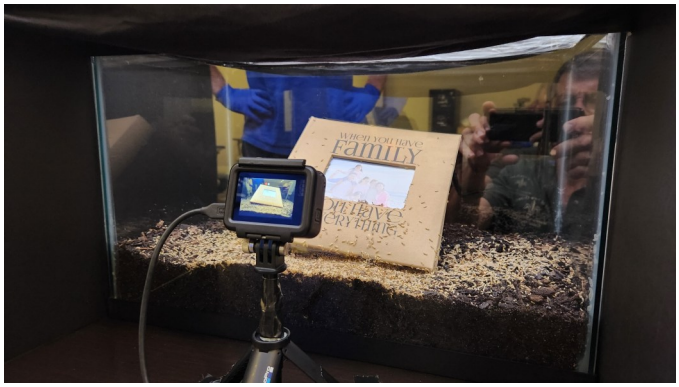


Figure 37. Setup for taking time-lase photos of Formosan termites eating the item in the aquarium..

The "Megatank" was a more complicated setup than the 10 gallon aquariums. The original concept was to construct an actual large "aquarium" with plexiglass sides, but that was not going to work for taking pictures and time-lapses because of reflections. Instead, Shaun Broadley designed and constructed a wooden base with wheels (to be able to move it). It had to be big enough to house the large chair and have enough potting soil and space to house one million termites (Fig. 38). The plywood bottom and sides of the housing were covered with a termite

Figure 38. The "Megatank" setup with chair, soil, termites, and GoPro cameras.

repellent membrane to prevent the Formosan termites from escaping. We housed the Megatank" in the equipment room of the Administration building kitchen. The reason for that was that Vault Communications hired a professional video company to film the chair after the termites had damaged it and needed to used the training room to set up a large stage.

Collecting close to a million termites was a daunting task because they all had to be from a single colony. Our biggest collections came from a site in New Orleans East, close to our mosquito rearing facility called the Biolab. Six collecting buckets were installed in the woods where there was a lot of mud trails and damage in the dead trees. Termites were collected every week and stored in several plastic tubes util we had enough to add them to the "Megatank" and start the GoPro cameras.

Within a few days after the termites were released into the "Megatank", mud trails started to show up on all the legs of the chair. Then they started to move over the chair fabric and behind the cushions. It was exciting to see the action and captured a lot of time-lapse videos and still pictures (Fig. 39).

Unfortunately, after a few weeks, we noticed that the termites stopped making new trails on the legs and they did not continue adding soil to the trails on the fabric. We assumed that the termites had moved to the interior of the chair and were feeding on the wood, thus stopped making trails on the exterior. To make sure, we used a flexible borescope to look inside the chair, and found hundreds of dead termites. We notified Vault Communications but

Figure 39. The chair showing termite mud trails on the legs and fabric of the chair.

they said to allow the termites to continue without us interfering in any way.

The Vault Communication video flew in town to New Orleans on May 16th to film the results of the damage to the items in the aquariums and to the chair in the "Megatank". They came in to the Administration building early morning and started to set up the stage, cameras, lights and everything else they needed to make the "reveal" (Fig. 40).

Figure 40. Setup for filming the reveal of the "Will They Eat It" episodes occurred in the NOMTRCB training room.

A separate set of aquariums had been prepared with the items and soil, but without termites. We collected and stored enough termites so that they could film pouring the termites over each item to pretend they were setting the termites to feed on them. After that filming was finished, then they filmed the actual items that had been in the dark conference room. Each item was lifted out of the aquarium, and Mike Bentley, entomologist with the National Pest Management Association, would hilariously show how the termites destroyed each item.

The "Megatank" chair that was in the tank and exposed to termites was filmed first, and because it had little to no damage, they opted to used the flexible boroscope to show live termites inside the chair. We had to add Formosan termites so that we could show the termites actively foraging inside. They also decided to cut the chair in half to show termite damage, but disappointedly, there was very little feeding on the wood components (Fig. 41). We all concluded that pr that chair had probably been treated with preservatives such as formaldehyde, so it made it toxic or repellent and the termites stayed away from it.

The clone chair that had not been exposed to termites, was the last thing they filmed. Mike Bentley dumped several hundred thousand Formosan termites on the chair to show how termites would attack the chair (Fig. 42). It was mostly for show since we actually added the termites to the soil, and not on the chair itself.

All in all, the "Will They Eat It" Season Two was a success and Vault Communication and the NPMA crew were very happy with the results.

Figure 41. Entomologists from NPMA and the video team discussing how to proceed with the chair after it was cut in half.

Figure 42. Mike Bentley getting ready to pour over 300,000 Formosan termites on the chair.

EXTENSION, TECHNOLOGY TRANSFER, AND EDUCATION

Presentations

Riegel, C. and A. Frishman. January 10, 2023. Legends of Pest and Vector Control—Dr. Austin "Doc" Frishman. Virtual.

Janowiecki, M. January 19, 2023. Termite Biology and Control. Mississippi Pest Control Association Annual Meeting. Pearl, MS.

Riegel, C. and N. Quinn. January 19, 2023. Rodent Biology. Urban Rodent Control Seminar Series—Part 1. Virtual.

Denny, R. January 31, 2023. Rodent Control and Rodent-borne Diseases. Tulane SPHTM Entomology class tour. New Orleans, LA.

Denny, R. and T. Madere. February 2, 2023. Municipal Rodent Control & Integrated Rodent Management. Urban Rodent Control Seminar Series—Part 2. Virtual.

Madere, T. and C. Riegel. February 16, 2023. Rodent Proofing Techniques. Urban Rodent Control Seminar Series—Part 3. Virtual.

Denny, R. and C. Riegel. March 2, 2023. Rodent Control and Rodent-borne Disease (Modern and Historical). Urban Rodent Control Seminar Series—Part 4. Virtual.

Janowiecki, M. March 2, 2023. Termite Swarming. Greater New Orleans Pest Control Association Member Lunch Meeting. Metairie, LA.

Breaux, J. March 14, 2023. Mosquito Control and Biology. Pest Control Seminar Series, Mosquitoes—Part 1. Virtual.

Janowiecki, M. March 15, 2023. Termite Biology and Control. Louisiana Department of Agriculture and Forestry Structural Pest Control Technician Recertification. New Orleans, LA.

Janowiecki, M. March 16, 2023. Termite Biology and Control. Louisiana Department of Agriculture and Forestry Structural Pest Control Technician Recertification. New Orleans, LA.

Janowiecki, M. March 27, 2023. Termite Swarming. Bugman Pest Control Internal Training. Virtual.

Breaux, J. March 28, 2023. Mosquitoes and Diseases. Pest Control Seminar Series, Mosquitoes—Part 2. Virtual.

Riegel, C. April 4, 2023. Vector Control Preparedness. Public Health Education Series: Vector Preparedness. Virtual.

Freytag, E. April 16, 2023. Termite Biology. Greater New Orleans Pest Control Association Member Lunch Meeting. New Orleans, LA.

Breaux, J. April 18, 2023. Integrated Pest Management. Pest Control Seminar Series, Mosquitoes—Part 3. Virtual.

Freytag, E. May 5, 2023. Termite Protection for your Historic Home. Preservation Resources Center Historic House Specialist. New Orleans, LA.

Beck, J. May 25, 2023. Mosquito Control and Biology. Louisiana Department of Agriculture and Forestry Recertification. Bossier City, LA.

Denny, R. May 25, 2023. Municipal Rodent Control and Rodent-borne Disease. Louisiana Department of Agriculture and Forestry Recertification. Bossier City, LA.

Janowiecki, M. May 25, 2023. Termite Biology. Louisiana Department of Agriculture and Forestry Recertification. Bossier City, LA.

Janowiecki, M. May 25, 2023. Nematode Basics. Louisiana Department of Agriculture and Forestry Recertification. Bossier City, LA.

Denny, R. and T. Madere. June 22, 2023. Rodent Myths. NORD Summer Camp visit. New Orleans, LA.

Cottone, C. and M. Janowiecki. June 22, 2023. Termite Control. NORD Summer Camp visit. New Orleans, LA.

Denny, R. Municipal Rodent Control. NET Charter School visit. New Orleans, LA.

Cottone, C. and M. Janowiecki. June 30, 2023. Termite Control. NET Charter School visit. New Orleans, LA.

Freytag, E. July 12, 2023. Termite Inspections and Treatments in Trees. Greater New Orleans Pest Control Association Member Lunch Meeting. New Orleans, LA.

Denny, R. July 12, 2023. Pesticide Safety. Louisiana Department of Agriculture and Forestry Recertification. New Orleans, LA.

Beck, J. July 12, 2023. Vertebrate Pollinators. Louisiana Department of Agriculture and Forestry Recertification. New Orleans, LA.

Janowiecki, M. July 12, 2023. Conserving Pollinators in Landscapes and Turf. Louisiana Department of Agriculture and Forestry Recertification. New Orleans, LA.

Denny, R. July 20, 2023. Rodent and Mosquito Control in Urban Gardening. Bayou St. John Community Garden meeting. New Orleans, LA.

Riegel, C., C. Cottone, M. Janowiecki, and R. Denny. August 1, 2023. Vector Control Preparedness in New Orleans. National Environmental Health Association Annual Educational Conference. New Orleans, LA.

Riegel, C. August 31, 2023. The Label and Pesticide Mode of Action. Pesticide Safety and Spill Containment Workshop. New Orleans, LA.

Riegel, C. August 31, 2023. Spill Prevention and Mitigation. Pesticide Safety and Spill Containment Workshop. New Orleans, LA.

Riegel, C. August 31, 2023. The Importance of PPE. Pesticide Safety and Spill Containment Workshop. New Orleans, LA.

Pavlakis, A., G. Eric, J. Beck, and M. Janowiecki. September 11, 2023. City of New Orleans Mosquito, Termite and Rodent Control & BEACONS Advanced Mosquito Identification Course. New Orleans, LA.

Cottone, C. September 15, 2023. The Impact of Operation Full Stop. 3rd International Symposium on the Formosan Subterranean Termite. Honolulu, HI.

Riegel, C. September 19, 2023. The Role of Humans and Infectious Diseases in History. Greater New Orleans Pest Control Association and City of New Orleans Rodent Academy. New Orleans, LA.

Riegel, C. September 19, 2023. Human Pathogen Bingo. Greater New Orleans Pest Control Association and City of New Orleans Rodent Academy. New Orleans, LA.

Janowiecki, M. October 3, 2023. Introduction to Entomology. Greater New Orleans Pest Control Association and City of New Orleans Termite Academy. New Orleans, LA.

Janowiecki, M. October 3, 2023. Drywood Termites. Greater New Orleans Pest Control Association and City of New Orleans Termite Academy. New Orleans, LA.

Cottone, C. October 5, 2023. Pesticide Safety Game Show. Greater New Orleans Pest Control Association and City of New Orleans Termite Academy. New Orleans, LA.

Denny, R. October 5, 2023. Rodent Control. Greater New Orleans Pest Control Association and City of New Orleans Termite Academy. New Orleans, LA.

Riegel, C. October 25, 2023. Roof Rats. National Pest Management Association PestWorld. Honolulu, HI.

Denny, R., November 1, 2023. Urban Rodent Control for Public Health. 47th FAMU Entomology Field Day and Workshop. Tallahassee Community College. Tallahassee, FL.

Riegel, C. November 1, 2023. Vector Control and Preparedness. Louisiana SPCA Humane Law Officers Training. New Orleans, LA.

Denny, R. November 10, 2023. Development and Validation of a Predictive Risk Score for Leptospirosis. Epidemiology PhD Journal Club. New Orleans, LA.

Denny, R. December 12, 2023. Rodent Control, Rodentborne Disease, and Public Health. Texas Rodent Academy. Dallas, TX.

Smith, P. December 14, 2023. Integrated Pest Management. Louisiana Department of Agriculture and Forestry Recertification. New Orleans, LA.

Special Topic Webinars Hosted by NOMTRCB

Carlson, J. March 9, 2023. Immune Reactions to Insect Bites and Stings. Virtual.

Arnold, C. March 21, 2023. All Hazards Preparedness and the Role of Emergency Management. Public Health Education Series: Vector Preparedness. Virtual.

McInturff, M. May 4, 2023. The Role of Public Health Preparedness Before and After an All-hazards Event. Public Health Education Series: Vector Preparedness. Virtual.

Outreach & Extension
Denny, R., P. King, A. Carter, and C. Quijano. 2023 Neighborhood Cares Day in the Upper Ninth Ward.

King, P., A. Carter, E. Dauzat, J. VanWhy-Spoonmore. April 2, 2023. City Park Spring Garden Show.

Riegel, C., R. Denny, T. Madere, C. Cottone, M. Janowiecki. April 19, 2023. French Quarter Pest and Vector Tour.

Janowiecki, M. April 20, 2023. Use of Molecular Diagnostics in Mosquito Control Workshop. New Orleans, LA.

Carter, A. and J. VanWhy-Spoonmore. April 22, 2023. Neighborhood Cares Initiative: Hoffman Triange. New Orleans, LA.

Carter, A. and F. Scattorin. May 20, 2023. Neighborhood Cares Initiative: Lower Ninth Ward. New Orleans, LA.

Riegel, R. May 27, 2023. NOLA Ready Storm Aware and Preparedness Event. New Orleans, LA.

Carter, A. and C. Riegel. July 8, 2023. Gentilly Terrace and Gardens Improvement Association.

Janowiecki, M. and A. Carter. July 11, 2023. Faubourg St. John Neighborhood Association Board and Membership Meeting. New Orleans, LA.

Carter, A., P. King, and J. VanWhy-Spoonmore. July 25, 2023. Mayor's 2024 Budget Meeting. New Orleans, LA.

Carter, A. and P. King. August 1, 2023. Mayor's 2024 Budget Meeting. New Orleans, LA.

Riegel, C., R. Denny, T. Madere, E. Freytag, M. Janowiecki. French Quarter Pest and Vector Tour. New Orleans, LA.

Carter, A. and P. King. August 3, 2023. Mayor's 2024 Budget Meeting. New Orleans, LA.

Carter, A. and J. VanWhy-Spoonmore. August 7, 2023. Mayor's 2024 Budget Meeting. New Orleans, LA.

Annual Rodent and Wildlife Academy
This year marked the 4th annual Rodent and Wildlife Academy hosted by NOMTRCB. The purpose of the academy is to educate pest management professionals, academics, and government employees about proper rodent and wildlife management techniques. Individuals from Texas, New Mexico, and Alberta, Canada attended the academy in addition to professionals from Orleans and neighboring parishes. Based on pre- and post-testing scores for the group, average improvement in knowledge was about 29%. We will use this information to further tailor our teaching to improve information delivery for future academies.

Programming for the academy changed this year, including the introduction of a hands-on trapping exercise conducted at the NOPD stables in City Park (Fig. 43) and a necropsy demonstration. This hands-on training and application of knowledge learned in the classroom was well received and helped to reinforce the use of proper skills and techniques. Notable speakers this year from outside the department included Dr. Matt Frye (Cornell), Sylvia Kenmuir (BASF), Pon Dixon (USF&W), Charles Parker (Parker Wildlife), Brett Johnson (Dallas Parks & Recreation), and Dr. Amy Bunch (LDH).

Figure 43. Annual Rodent & Wildlife Academy attendees learn proper trapping techniques at the NOPD stables in City Park.

Annual Termite Academy
The 2023 Annual City of New Orleans and Greater New Orleans Pest Control Association Termite Academy was held from October 3-5. We had wonderful speakers join us including Dr. Paul Bardunias (Florida Atlantic University), Dr. Joe DeMark (Corteva AgriSciences), Dr. James Austin (BASF), Dr. Bob Davis (BASF), Dr. Qian "Karen" Sun (Louisiana State University), Alec Sabo (Louisiana Department of Agriculture and Forestry), and Ernie Esteve (Billiot Pest Control) along with internal speakers including Eric Guidry, Dr. Claudia Riegel, Ed Freytag, Dr. Carrie Cottone, Dr. Mark Janowiecki, and Rachel Denny. Students had three full days of lecture and hands on termite biology and control and the manageable number of students made interactions between students and instructors much more engaging. This class also prepared students to take the licensee exam and qualified as part of this licensing process. Highlights included seeing soil treatments with food dye in Plexiglas setups and Dr. Carrie Cottone's inventive quiz show game to review safety.

BugFest 2023

Our 3rd Annual BugFest took place on October 14, 2023 at our Administration building front lawn. Over 1,000 individuals from the public attended. We hosted this free event with the help of our generous sponsors: Terminix NOLA, Corteva AgriScience, Greater New Orleans Pest Control Association, Clarke, DA Exterminating, Orkin Pest Control, Billiot Pest Control, The Bug Man, Fastenal, Insight Events LLC, J&J Exterminating, Louisiana Pest Management Association, Rockwell Labs Ltd., Syngenta, Target Specialty Products, and Veseris. Without these sponsors, BugFest would not be possible.

BugFest offered numerous booths where the public could get a close encounter with insects (Fig. 44), learn about their diversity, and chat with scientists and pest control experts. There were stations with crafts and activities that were not only educational, but got everyone of all ages excited about insects (Fig 45). Many of our staff were in costume (Fig. 46) and center stage got everyone involved with cockroach races and story time (Fig. 47). There was even a partial solar eclipse that day, and special glasses were given out to allow attendees to safely enjoy viewing the sky.

Figure 44. Eric Guidry runs the "Ask the Entomologist" booth at BugFest, showing kids insects under a microscope and answering questions about insects and pest control.

Figure 45. The University of Florida's booth at BugFest. This was one of many educational booths during the event.

Figure 46. Claudia Riegel greets BugFest attendees of all ages while in her flower costume.

Figure 47. The center stage hosted numerous events, including cockroach races, bug raps, and story time.

APPENDIX A: INSECTICIDE RESISTANCE SCREENING

ERIN CLOHERTY, Ph.D.

Resistance screening is a critical part of integrated mosquito management and helps to prevent and manage the development of insecticide resistance. *Culex quinquefasciatus* is a West Nile virus vector and a primary species of medical and veterinary concern here in Orleans Parish and the greater New Orleans area.

In 2021, Erin Cloherty (Entomologist) screened *Culex quinquefasciatus* throughout the city for resistance to four commercial insecticides (Fig. A-1). Our screening process included CDC bottle bioassays to determine the proportion of populations exhibiting resistance and topical assays to measure relative frequency of susceptibility of mosquitoes. Erin investigated mechanisms of resistance using Real-Time PCR to detect altered target-sites, and we measured detoxification enzyme activity. In 2023, Erin continued her training with toxicologist, Dr. James Ottea, of Louisiana State University in Baton Rouge, interpreting the data collected from 2021 (Tables A1-A3).

This year we used data collected in 2021 to decide what chemicals we should or should not use to control populations of the West Nile virus vector, *Culex quinquefasciatus*. In fact, we chose to control the immature stage of the *Culex quinquefasciatus* with Bti larvicides and be conservative with the amount of insecticide we used to control adult mosquitoes. The analysis and interpretation of the insecticide resistance and mechanisms of resistance data was instrumental in making these decisions.

The results from the susceptibility testing show evidence that our *Culex quinquefasciatus* mosquito populations are resistant to pyrethroids and organophosphates. Mechanisms involved with insecticide resistance in these populations, include metabolic and possibly target-site.

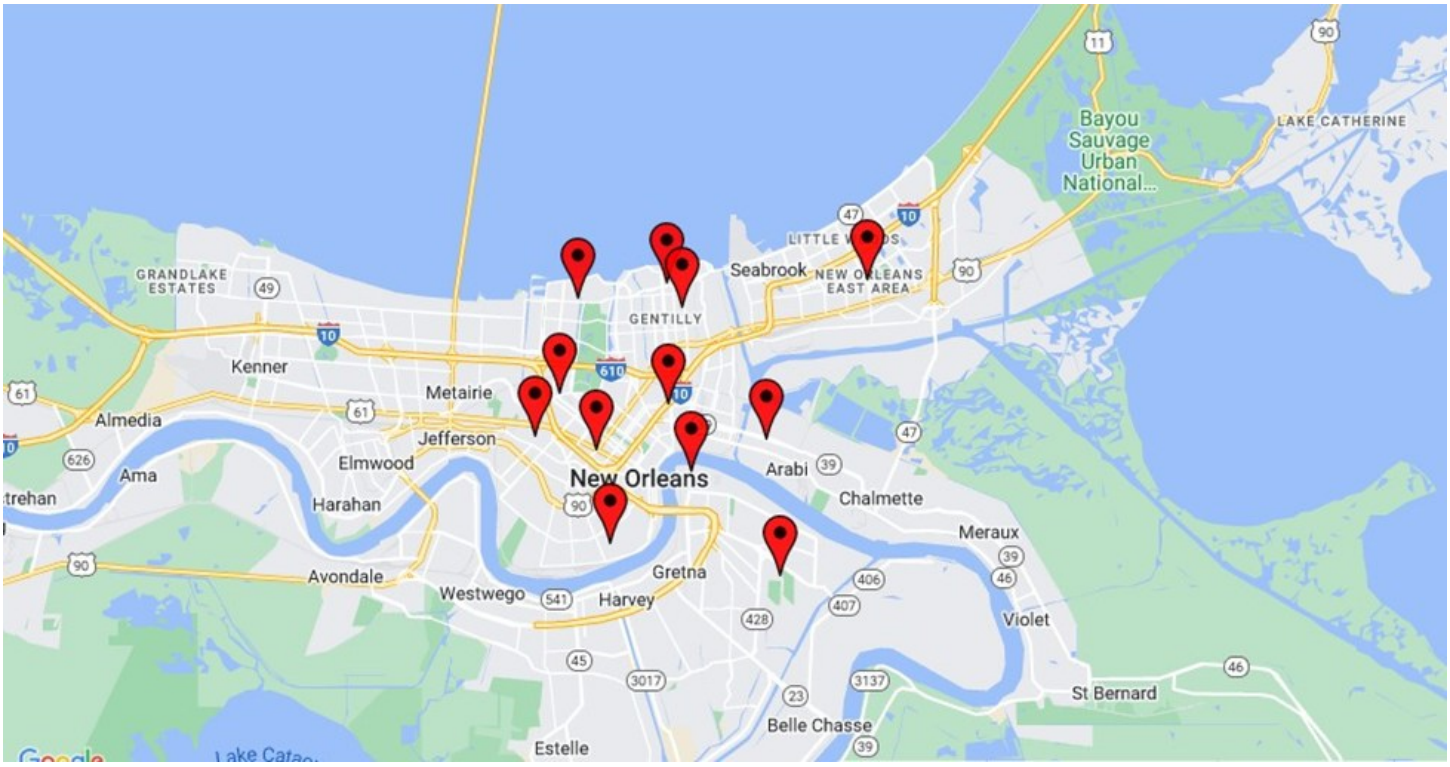


Figure A-1. Map of test sites for insecticide resistance testing in 2021. Each test site is marked in red.

Site	Bifenthrin		Deltamethrin		Malathion		Naled	
	Bottle	Topical	Bottle	Topical	Bottle	Topical	Bottle	Topical
Site 1	96	70	100	93	32	67	0	0
Site 2	93	80	71	62	24	94	12	12
Site 3	91	90	93	100	33	30	0	0
Site 4	79	92	84	84	38	20	0	0
Site 5	100	67	100	80	19	100	0	77
Site 6	98	64	100	71	37	100	0	0
Site 7	100	73	100	58	74	55	0	77
Site 8	89	70	100	60	30	50	0	0
Site 9	38	60	58	30	36	33	0	0
Site 10	88	82	96	94	4	88	0	0
Site 11	88	69	97	62	21	71	0	0
Site 12	35	38	100	71	80	58	0	0
Mean (S.D.)	83 (22.50)	71 (14.42)	92 (13.77)	72 (19.59)	36 (21.59)	64 (27.78)	1 (3.46)	14 (29.70)

Table A-1. Comparison of frequencies of resistance to four insecticides in field-collected *Culex quinquefasciatus* mosquitoes using CDC bottle bioassays and topical application assays at 12 locations in New Orleans, LA in 2021.

Site (n)	α-esterase	β-esterase	GST
Susceptible mean (30)	0.013_A	0.024_A	0.027_A
Mean for all sites	0.880_B	0.583_B	0.080_B
Site 1 (8)	1.067	0.977	0.0587
Site 2 (8)	0.269	0.238	0.1017
Site 3 (8)	1.42	0.923	0.135
Site 4 (8)	1.531	0.617	0.0728
Site 5 (9)	0.606	0.448	0.0563
Site 6 (9)	0.3875	0.291	0.06

Table A-2. Enzyme activity from six of the twelve collections sites of Cx. quinquefasciatus populations tested in 2021. Values followed by different letters are significantly different within each column.

Site (n)	R/R	R/S	S/S	Total Resistant Allele
Susceptible mean (30)	0.000	0.033	0.967	0.017
Mean for all sites	0.522	0.360	0.133	0.704
Site 1 (8)	0.250	0.500	0.250	0.500
Site 2 (8)	0.766	0.219	0.125	0.875
Site 3 (8)	0.316	0.492	0.191	0.563
Site 4 (8)	0.316	0.492	0.191	0.563
Site 5 (9)	0.790	0.198	0.012	0.889
Site 6 (9)	0.694	0.278	0.028	0.833

Table A-3. The L1014F mutation frequencies from six of the twelve collections sites of Cx. quinquefasciatus populations tested in 2021. Genotype Key : R/R = homozygous resistant; R/S = heterozygous resistant; S/S = homozygous susceptible.

APPENDIX B: WORK PLAN AND STRATEGIES FOR THE CDC VECTOR GRANT

CLAUDIA RIEGEL, Ph.D.

WORK PLAN

Process measurements will describe actual steps to be completed by this GSC and will work with CDC to include specific details if funded.

Our first step upon funding will hold a workgroup call to bring all our Partners together along with our CDC Coordinator to discuss this project and everyone's role. Month 1-3

Each quarter there after until the end of the project this group will meet monthly to ensure that all outcomes are met, and that information is being shared with CDC in a timely manner. **(Year 1-5)**

STRATEGY 1: TRAIN - Increase opportunities for students and professionals to receive training in VBD prevention and control.

Activity 1: Improve and standardized VBD prevention and control training and education.

Measurement:

The GSC will provide a core curriculum that can be replicated at training facilities in all the Gulf South states by reviewing what is currently available and begin training by **month 6** after funding. With the aid of Strategy 2, Activity 4, we will review all the materials that are currently available, place them into a digital database, then work with our Partners to improve content. This will allow us to create a variety of standardized training modules for online and in person, media outreach kits to be used by local health authorities and collect training performance date (KAP) in one location [Year 1 meet in person to review all the information collected and begin to determine a hierarchy of usefulness and need.]

Members responsible for objective and outcomes met Riegel, Hurley,

To increase the number of VBD students and professionals trained in best practices our second subgroup will consist of those partners that can offer education to students and those that can offer internships and practicums. Within the **first year** we will work with Dillard University and Florida A&M to coordinate new pilot efforts for their students who fall into those disparities' areas within the south. The goal will be to enhance this program from year to year to allow for a measurement of more students, and to track potential cohorts to be followed overtime. **Year 1 – 5**

Members responsible for objective and outcomes met Riegel,

Activity 2: Train and educate VBD prevention and control professionals.

Create, pilot test, and evaluate educational content Year 1. Based on information found and collected this information will be used to refine training information to be used by the GSC and all others training about VBDs. (Year 1 -5 we anticipate this material will change over time, but will also be retained Strategy 3, Activity 8 this will be ongoing throughout the project)

Members responsible for objective and outcomes met Riegel,

Activity 3: Increase awareness of VBD prevention and control among professionals and students at universities, colleges, and community colleges.

Provide interprofessional and cross-sector training and mentorship opportunities for professionals and students to encourage collaboration, provide visibility for information sharing and adoption of best practices to respond to VBD. Include vector control and VBD subject matter in existing framework of trainings and meetings in the Gulf South Universities and Colleges that have agreed to partner with us (see LOS). Year 1 – 5

Members responsible for objective and outcomes met Riegel,

Provide internships and practicums for students across interprofessional vector control disciplines to obtain VBD competencies while understanding the importance of collaboration, and roles of the interprofessional team members that are required for effective VBD prevention and control measures. A pilot program will be launched during the first 6 months that will allow for a pathway to explore a career in vector control.

Members responsible for objective and outcomes met Riegel,

STRATEGY 2: EVALUATE - Evaluate the impact and effectiveness of VBD prevention and control programs, tools, and strategies.

Activity 4: Conduct preliminary needs assessment to determine extent of vector control programs available and services throughout the Gulf States and identify knowledge gaps and areas needed to maximize program core competencies (Year 1-2)

- Form working groups to develop needs assessment tools with internal (e.g., CDC , vector control districts) and external (e.g. pest control industry and community organizations) partners and stakeholders; compile a collection of relevant information that defines current VBD preparedness, monitoring, and response capacity tools and resources available. This step is linked directly to the first measurement to hold monthly workgroup calls. Month 1-3
- Create subgroups to facilitate evaluation strategies and key measurement activities for the remainder of the project. Month 6 – 12 (Retain and recruit members year 2 -5)
- Evaluate the capacity, infrastructure, workforce, and resources available across academic, professional, and public sectors to respond to VBD. Year 1 [Year 2 – 5 we will continue to evaluate and refine materials, needs assessments and other information as meetings progress]

Activity 5: Develop a needs assessment that can be used nationwide to evaluate the operational use of approved VBD prevention and control tools, strategies, and programs.

- Evaluate operational procedures and commercially available tools to establish cost efficient and effective best practices for vector control. Learn from project participants what future tools are needed to help with future planning.
- Evaluate operational procedures and commercially available tools to establish cost efficient and effective best practices for vector control. Learn from project participants what future tools are needed to help with future planning.

Activity 6: Develop and implement an evaluation and performance monitoring/improvement plan to evaluate impact of training programs and ensure training goals are accomplished.

- Conduct surveys to document where vector control services are absent and formulate a plan to expand education and training through partners.
- Create a standardized database of existing education and training infrastructure across the Gulf States.

STRATEGY 3: PARTNER - Build partnerships among relevant stakeholders to accomplish the activities proposed in Strategies 1 and 2

Activity 7: Work with our partners to engage undergraduates, graduate students, and post-docs to be trained in VBD and work with our partners to conduct needs assessments.

- Create linkages between public, private, Non-governmental Organizations (NGOs) and academic organizations using the major professional and trade associations. Establish workgroup meetings with association leaders to align priorities around VBD education, training, and management. (**Begins within 3 months** of funding notification and will continue throughout the project)
- Establish a regional sub-state governmental organization that will serve as the "Operational Centers of Excellence (OCE)" to provide sustainable, comprehensive vector surveillance and control programs **(Year 2)** with increased awareness of these hubs through **year 3 -5 and beyond**.

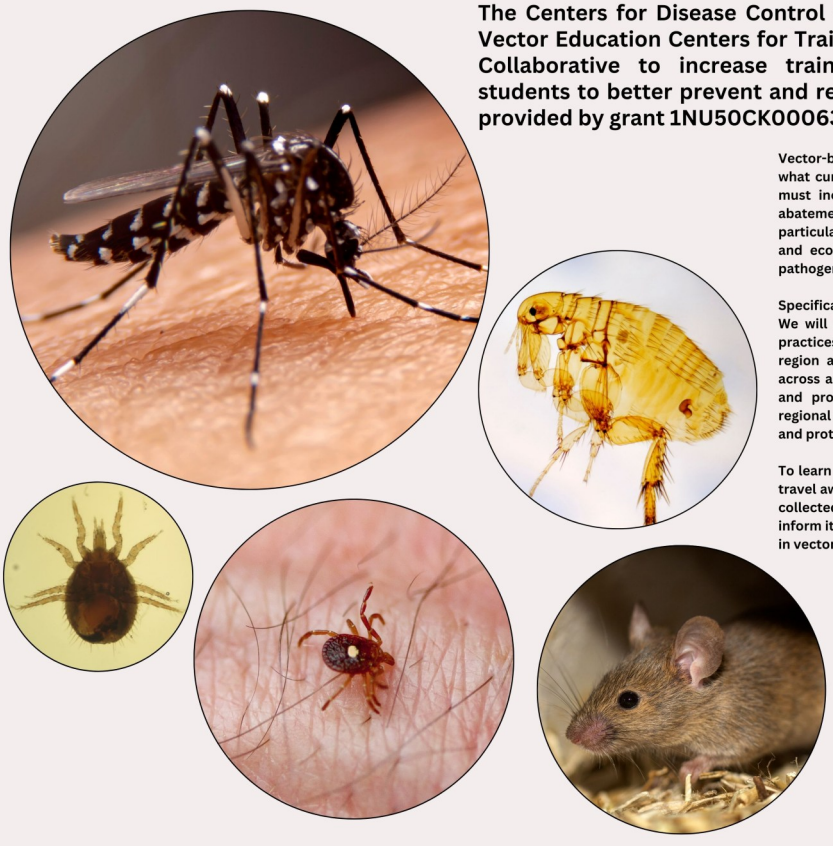
Activity 8: Create a mechanism for sustainability of partnerships and infrastructure to ensure continued interagency and cross-sector cooperation, data, and information sharing.

- Create a centralized online platform to describe project priorities, house educational materials, resources, and opportunity announcements, and provide linkages to other training and educational resources for future sustainability. The platform will also have an intranet that will serve as a data portal. We will also create linkages between public, private, NGO, and academic organizations using the major professional and trade associations and workgroup meetings with association leaders to align priorities around VBD education, training, and management **(Year 1-5)**
- Develop a five-year mentoring program to allow for beginners in VBD to achieve Master level awareness and preparedness through a Pathway to Excellence program. Beginning in **year 1** a selected municipality in the Gulf south region being selected to be mentored by several leaders in the industry to establish the best way to replicate this nationwide. Tracked, expanded and reported to CDC (**Year 2-5**).

Coordinated training and evaluation of pest management, vector control district, public health, sanitary, and animal health professionals to achieve an integrated workforce to mitigate community vector-borne disease risk in the Gulf Coast region.

Strategies/Activities	Short-Term Outcomes	Intermediate Outcomes	Long Term Outcomes(Yrs 2- 5)
Strategy 1: TRAIN: Increase opportunities for students and professionals to receive training in VBD prevention and control Activity 1 Conduct training and educational needs assessments for VBD prevention and control Activity 2 Train and educate VBD prevention and control professionals **Strategy 2: EVALUATE: Evaluate the impact and effectiveness of the VBD prevention and control programs, tools and strategies.** Activity 3 Develop a needs assessment that can be used nationwide to evaluate the operational use of approved VBD prevention and control tools, strategies, and programs. Activity 4 Develop and implement an evaluation and performance monitoring/improvement plan to evaluate impact of training programs and ensure training goals are accomplished **Strategy 3: PARTNER - Build partnerships among relevant stakeholders to accomplish the activities proposed in Strategies 1 and 2** Activity 5 Work with our partners to engage undergraduates, graduate students, post-doctoral fellows to be trained in VBD and work with our partners to conduct needs assessments. Activity 6: Create a mechanism for sustainability of partnerships and infrastructure to ensure continued interagency and cross-sector cooperation, data and information sharing among stakeholders and partners.	Determine gaps in information and what is readily available as open-source data VS needs assessments. Develop a procedural plan for obtaining data and data linkage to obtain baseline data and information needs Increase cross-sector collaboration with partners to address VBD across the Gulf Coast region of the US. Work with WGCE to offer replicated educational programming for students and professionals that will be evaluated using the same measurement tools. (Beginner, Intermediate and Master Class) Hold Core workgroup meetings and engage our EHC partners to be on Task Force team	Work with partners to conduct needs assessments of VBD programs throughout the region which includes working with all communities to ensure VBD mgmt. is uniform in all areas of a state. Improve data availability and quality by working with partners to establish public health resource in multiple online locations for easy dissemination for future preparedness. Increase awareness these resources to all levels of partnerships. Increased adoption and use of new and existing vector control tools, strategies, and programs through partnership training to students and professionals. Based on information learned work with CDC to improve and standardized VBD prevention and control training modules to better serve the nation.	Apply information learned about this project to others through national, state, and local meetings to help spread awareness around VBD & public health issues. Strengthen the public & environmental health workforce with knowledge and capacity for VBD control and prevention. Master Class participants learn to disseminate additional information and increase education about VBD and those pathogens that results of secondary diseases. Improve performance VBD programs and services regarding all communities – expanding the lessons learned based on needs assessment documents, that will help guide small, medium and large communities respond to future outbreaks of VBD or public health diseases.

Gulf South V.E.C.T.O.R.



The Centers for Disease Control and Prevention has funded the Gulf South Vector Education Centers for Training, Outreach and Resources (V.E.C.T.O.R.) Collaborative to increase training opportunities for professionals and students to better prevent and respond to vector-borne diseases. Funding is provided by grant 1NU50CK000638-01-00.

Vector-borne diseases have increased in the past two decades at rates beyond what current infrastructure can manage. In order to protect public health, we must increase and strengthen our front-line defenses, which are mosquito abatement districts, public health workers and private industry. This is particularly important in the Gulf South because of its intersection of health and economic disparities with a climate that is susceptible to vectors and pathogens.

Specifically, this project will TRAIN and EVALUATE students and professionals. We will create and test educational content that highlights procedural best practices. The core curriculum will be standardized and replicated across the region and will be offered to students, working professionals, and trainees across audiences with diverse backgrounds. This project will break down silos and promote interdisciplinary training and create PARTNERSHIPS through regional and national cooperation that is desperately needed to build resiliency and protect people and animals from vector-borne disease.

To learn more about the project and receive information about training events, travel awards and internships, please complete the form provided. Information collected will be strictly used by the Gulf South V.E.C.T.O.R. Collaborative to inform its members of upcoming educational opportunities and of advancement in vector control. The information will not be sold or shared.

https://forms.office.com/g/iD2UJZrt0r

APPENDIX C: INSECTICIDE RESISTANCE TESTING

MARK JANOWIECKI, Ph.D.

To date, we analyzed all samples we had available, 25,543 out of 26,101 *Aedes aegypti* mosquito samples (~98%) to determine if they carry either kdr 3 or kdr 5 genes for pyrethroid resistance. Our results showed a small number of individuals have the kdr 3 mutation (653 homozygotes, 227 heterozygotes) or kdr 5 mutation (735 homozygotes, 459 heterozygotes) (Table C-1). Only 0.8% of the samples screened to date had the homozygous genotype for both kdr mutations (Table C-2). These resistant individuals were primarily clustered in spray groups I1 and L1, although small numbers of resistant individuals were also detected in spray zones B2, E2, G1, G2, H2, J2, K2, L2, and R2 (Table C-3). These individual mosquitoes were also subjected to bottle bioassay analysis and had similarly low levels of resistance to pyrethroids (Fig. C-1). When comparing these two methods of quantifying resistance, the percent survival in pyrethroid bottle bioassays is correlated to the number of alleles present (Fig. C-2). This is expected because KDR alleles are a mechanism of resistance only to pyrethroid insecticides.

Table C-1. Numbers of individuals carrying kdr 3 and 5 alleles

Totals	1534 (kdr 5)			
1016 (kdr 3)	F F	F C	C C	
V V	24136	432	95	24663
V I	203	284	166	653
I I	10	19	198	227
	24349	735	459	25543

Table C-2. Percentage of individuals carrying kdr 3 and 5 alleles

Percent	1534 (kdr 5)			
1016 (kdr 3)	F F	F C	C C	
V V	94.5	1.7	0.4	96.6
V I	0.8	1.1	0.6	2.6
I I	0.0	0.1	0.8	0.9
	95.3	2.9	1.8	

Table C-3. KDR genotypes by spray zone

Spray Zone	kdr 3 Susceptible	kdr 3 Resistant	kdr 3 Heterozygous	Total	kdr 5 Susceptible	kdr 5 Resistant	kdr 5 Heteroygous	Total
A3	473	0	0	473	458	0	15	473
A4	697	0	0	697	681	0	16	697
B1	608	0	0	608	603	0	5	608
B2	645	3	5	653	647	3	3	653
C1	512	0	0	512	508	0	4	512
C2	518	0	0	518	518	0	0	518
D1	630	0	4	634	605	7	22	634
D2	836	0	3	839	834	0	5	839
E1	653	2	5	660	652	0	8	660
E2	487	10	62	559	497	22	40	559
F1	726	0	6	732	723	1	8	732
F2	654	0	1	655	645	0	10	655
G1	635	5	4	644	615	6	23	644
G2 (2017)	919	0	11	930	924	0	6	930
G2 (2018)	730	1	4	735	722	4	9	735
H1	712	0	21	733	716	0	17	733
H2	677	7	11	695	661	13	21	695
I1	481	98	125	704	488	173	43	704
I2	594	27	6	627	586	35	6	627
J1	809	4	10	823	760	28	35	823
J2	660	6	13	679	653	10	16	679
K1	806	0	4	810	801	0	9	810
K2	738	5	190	933	722	50	161	933
L1	591	57	36	684	556	93	35	684
L2	787	0	37	824	777	2	45	824
M1	557	0	0	557	553	0	4	557
M2	607	1	10	618	600	2	16	618
N1	684	0	3	687	681	0	6	687
N2	714	0	11	725	720	0	5	725
O1	698	0	2	700	695	0	5	700
O2	643	0	0	643	642	0	1	643
P2	528	0	12	540	537	0	3	540
Q1	733	0	17	750	742	0	8	750
Q2	759	0	1	760	749	4	7	760
R1	786	0	2	788	775	0	13	788
R2	768	1	36	805	698	6	101	805
S1	608	0	1	609	605	0	4	609
Total	24663	227	653	25543	24349	459	735	25543

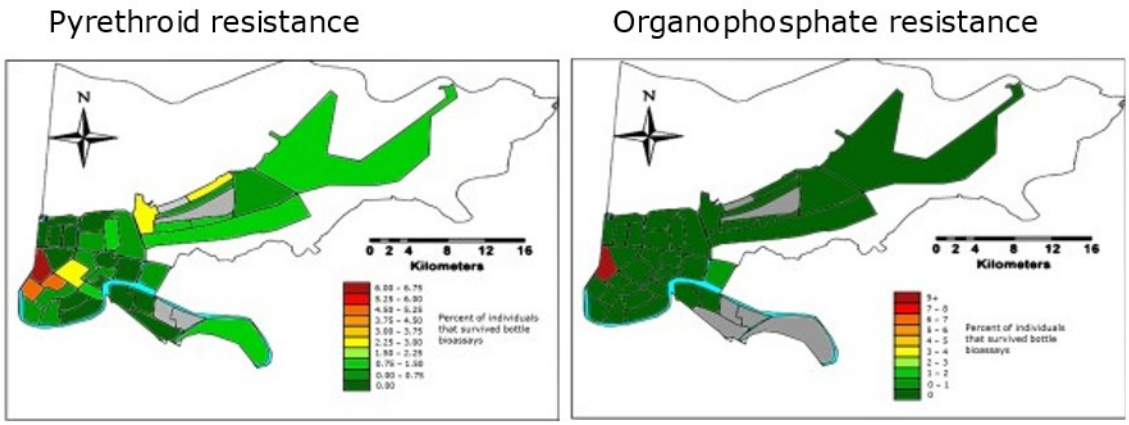


Figure C-1. Resistance level by zone determined by bottle bioassays for pyrethroid and organophosphate insecticides

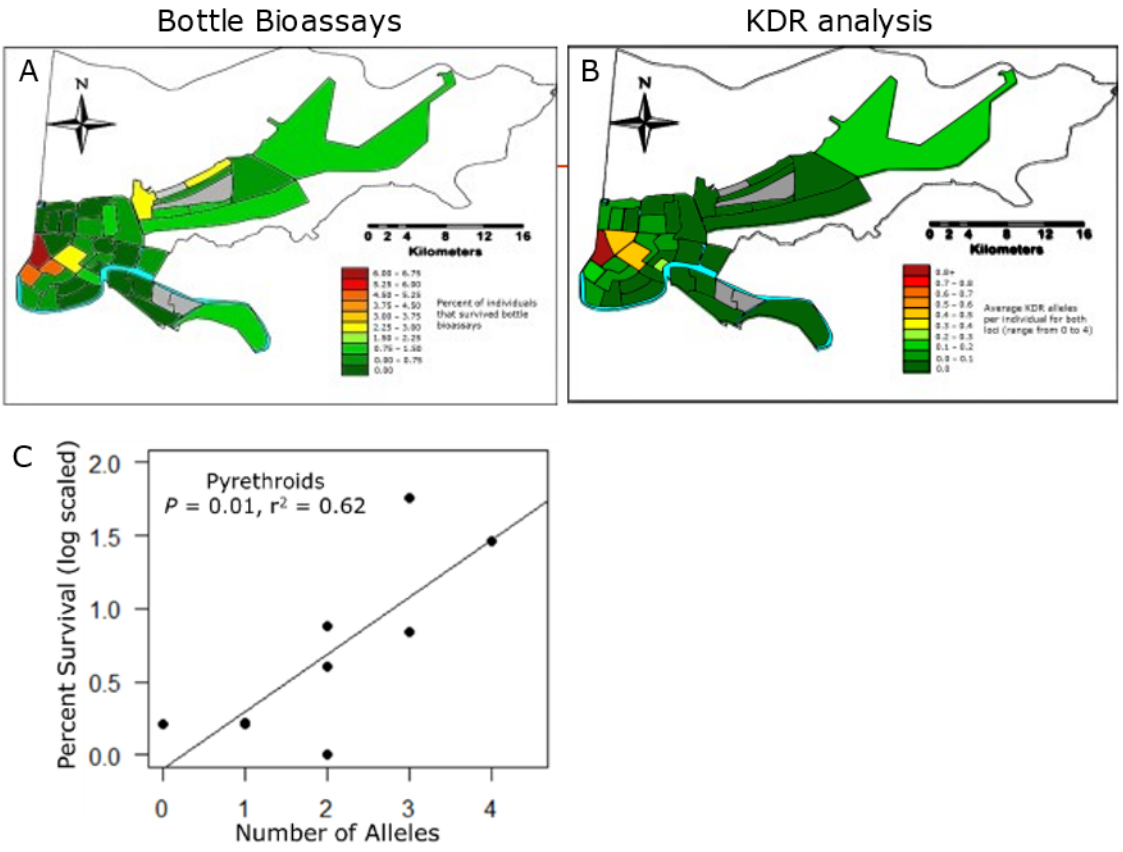


Figure C-2. Resistance level by zone determined by bottle bioassays (A) and genetic KDR analysis (B). Pyrethroid survival rate in bottle bioassays is correlated to number of KDR alleles present ©.