

MOSQUITO CONTROL EMERGENCY PREPAREDNESS AND RESPONSE TO NATURAL DISASTERS

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On February 9, 2019, the Bipartisan Budget Act of 2018 was signed into law and appropriated \$200M in hurricane funding to the Centers for Disease Control and Prevention (CDC) for preparation, response, recovery, mitigation, and other expenses related to the consequences of Hurricanes Harvey, Irma, and Maria. The CDC then awarded, through *CDC-RFA-TP18-1802 Cooperative Agreement for Emergency Response: Public Health Crisis Response notice of funding opportunity*, \$51,136,347 in extramural funding. Funding specific to vector-borne diseases, including intramural and extramural (partners and jurisdictions), was \$37,628,235 to Florida, Georgia, Louisiana, Mississippi, Texas, Puerto Rico, and US Virgin Islands. State and territorial funding supported the implementation of conventional and novel mosquito control techniques, training for public health pest control applicators, replacement of mosquito surveillance and control supplies utilized in the aftermath of the 2017 hurricanes, insecticide resistance testing and training, and source reduction. Additionally, the CDC hurricane funding supported this special issue of the Journal of the American Mosquito Control Association (JAMCA) focused on mosquito control response in the wake of natural disasters. We invited hurricane relief funding grantees, mosquito control programs, academics, manufacturers, product distributors, and applicators to submit response plans or descriptive articles related to their experience with mosquito control after natural disasters. The objective of this special issue of JAMCA is to provide a comprehensive volume that includes resources to help guide mosquito control in areas affected by natural disasters. The shared experiences should serve to assist others involved in mosquito control in planning for and responding to natural disasters.

CONTENTS

ADAPCO, AMVAC, and VDCI discuss the complexities of predicting and maintaining mosquito control product inventories for the hurricane season, moving mosquito control products around the country in the aftermath of a natural disaster when trucks may not be available and roads may not be cleared, and the steps that are taken after being called in to provide mosquito control services during emergencies.

Collier Mosquito Control District (Florida) describes an experience of what happens when hurricane plans are out of date, the scrambling they had to do during Hurricane Irma, and the revised planning that took place during and after the emergency. Florida Keys Mosquito Control District discuss preparedness local plans that include providing time for employees to prepare their personal homes and property, protection of mosquito control property and equipment, communications before, during and after the event, managing staff and work in the absence of power, performing mosquito control activities safely in the aftermath, and more.

Indian River Mosquito Control District, located on the east coast of Florida, provides a history since 1997 of experience with hurricanes and the many lessons learned over the decades, including navigating the Federal Emergency Management Agency (FEMA) reimbursement process. Experiences with specific hurricanes including mosquito population numbers, results of mosquito control treatments, and lessons learned are provided by Anastasia Mosquito Control District (Florida) (Hurricane Matthew 2016, Hurricane Irma 2017); Georgia Department of Public Health (Hurricane Irma, 2017, Hurricane Michael 2018); Harris County Public Health Mosquito and Vector Control Division (Texas) (Hurricane Harvey 2017); Mississippi State Department of Health (Hurricane Katrina 2005); and Texas Department of State Health Services (Hurricane Harvey 2017).

The Florida Department of Agriculture and Consumer Services regulates mosquito control in Florida and provides a description of their Mosquito Control Incident Response Team which has been activated 9 times since 2001. As an example that others may utilize, Texas Department of State Health Services (TDSHS) include their guidance document on mosquito surveillance and control and identifies tasks, roles and responsibilities for agencies involved in a mosquito control response to natural disasters. The TDSHS also discusses the importance of managing severe floodwater (nuisance) mosquito outbreaks after natural disasters.

From the Federal level, information is provided by authors from CDC, FEMA, and the US Department of Defense on the roles the agencies play during a response and how to work with these agencies post-disaster. Research results are provided here from authors in St. Tammany Parish, Louisiana who discuss the local risk of infection with West Nile virus post hurricane.

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Table 1. Best management practices and commonalities experienced in mosquito control post natural disasters.

Pre-disaster	Post-disaster
National Incident Command System (NICS) Training	Activate Emergency Operations Center (EOC)/NICS
Review and update response plans annually or create a response plan	Discuss lessons learned from current disaster for updating response plans
Review plans with all employees annually	Request ideas from employees to improve response plans based on current experience
Secure vehicles and drivers, evacuate /secure assets such as chemicals, airplanes, trucks, helicopters and equipment	Determine when it is safe to retrieve and utilize assets and do so
Mosquito surveillance data for non-hurricane years (support documentation for FEMA reimbursement)	Mosquito surveillance data for current hurricane years (support documentation for FEMA reimbursement)
Conduct insecticide resistance assays and maintain resistance profiles for local mosquito species	Incorporate insecticide resistance information into decision-making for mosquito control activities in the aftermath of a disaster
Understand FEMA process for reimbursement; maintain required records	Work with FEMA to provide documentation for reimbursement
Develop and maintain inventory of EOC, federal and neighboring state contacts	Reach out to EOC and other emergency contacts for damage and needs assessments
Plan for employee time to prepare personal property or secure/evacuate families	Plan for time to care for family, property and personal needs before returning to work
Contingency contracts in place - remember that contractors may have more than one customer needing service	Contact contractors to provide them with surveillance data and a needs assessment

COMMON THEMES

Within the papers of this special issue, there are recurring themes related to proper planning prior to natural disasters and communications plans for before, during, and after the event. Preparations must be made and followed when a location is within the “forecast cone”, the probable track of the center of a hurricane, (National Hurricane Center 2020) or when flooding is expected. Agencies cannot wait until the last minute because in addition to securing mosquito control facilities and equipment, employees need time to take care of their own homes and property. Planning for worst-case scenarios is prudent especially considering that loss of electricity and loss of cell phone service could take weeks before they are restored. Investments in items such as satellite phones and paper maps ahead of time are prudent. It is critical that response plans are reviewed and updated annually and that annual training of employees on local response plans is conducted. Although not inclusive of all components of planning for mosquito control after a natural disaster, some best management practices and some of the commonalities amongst the experiences described in this special issue are listed in Table 1.

ADDITIONAL RESOURCES

While major increases in mosquito populations are most often associated with rainfall, flooding, and storms, other types of disasters (natural or human influenced) can result in conditions that require mosquito control resources and creative solutions. For example, wildland fires in California in 2015

created new underground habitats for mosquitoes in septic tanks (Courcier 2017). Prior to the fires, the septic tanks were unavailable to ovipositing female mosquitoes, but plastic risers on some tanks were melted during the fires, and concrete tanks were damaged in the aftermath of the fire when heavy equipment was driven over the top of the tanks during clean-up efforts. Courcier (2017) describes how mosquito control operations incorporated treatment kits into their daily activities and explains that these sites will need to be monitored and treated for years until the process of rebuilding is completed.

There are several publications that describe disease risk after natural disasters (CDC 1993, Nasci and Moore 1998, Lehman et al. 2007, Watson et al. 2007, Harrison et al. 2009, Barrera et al. 2019); mosquito control experiences with specific hurricanes and results from control activities in a post-disaster environment (Brown 1997, Breidenbaugh et al. 2006, Simpson 2006, Foppa et al. 2007, Breidenbaugh et al. 2008, Harris et al. 2014); and mosquito habitats created in the wake of storms (Caillouët et al. 2008a, 2008b; Hribar 2018).

Connelly et al. (2020) recommends the continuation of mosquito surveillance and control to the extent possible after natural disasters. This recommendation is supported by 1) the requirement by FEMA to review historical and current data on mosquito populations for reimbursement for mosquito control expenses incurred in post-disaster situations; 2) the need to protect the health and safety of relief workers after a disaster; and 3) to prevent mosquitoes from becoming infected and causing human disease.

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