

HURRICANE PREPAREDNESS AND RESPONSE ALONG FLORIDA'S CENTRAL-EAST COAST: INDIAN RIVER MOSQUITO CONTROL DISTRICT'S EXPERIENCES OVER THE YEARS

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ABSTRACT. The hurricane is no stranger to longtime residents of Florida's east coast. In 1979, after about 15 years of local inactivity, Hurricane David made landfall in West Palm Beach. Thirteen years later and 100 miles south, category 5 Hurricane Andrew caused catastrophic damage when it hit the city of Homestead in the Miami-Dade area. In 2004, the counties along the east coast of central Florida were hit by 2 devastating hurricanes, Frances and Jeanne, that made landfall at Sewall's Point just 20 days apart. The very next year, Hurricane Wilma made landfall near Everglades City as a Category 3 storm. After a decade of relief, a glancing blow from Hurricane Matthew struck in 2016, only to be followed by the extremely devastating Hurricane Irma just 1 year later. Each of these hurricanes caused significant property damage and mosquito problems for the Florida residents affected by these storms. In 1997, the Indian River Mosquito Control District (IRMCD) developed a hurricane preparedness plan outlining the appropriate action to be taken depending on the severity of the approaching storm. The IRMCD has also learned to negotiate the intricacies of the Federal Emergency Management Agency's reimbursement program, thus reducing the financial impact to the District. This paper provides an overview of how IRMCD has prepared, reacted, and followed-up with the seemingly constant parade of hurricanes that have threatened and affected the east coast over time.

KEY WORDS Hurricane preparation, disaster response, mosquito control, FEMA, central east coast Florida

INTRODUCTION

The central east coast of Florida has been known for its mosquitoes and storms for hundreds of years. In fact, shortly before Florida achieved statehood in 1845, this region was part of a large portion of Florida known as Mosquito County. When the need to control both pestiferous and vector mosquito species became a goal of many residents, the Florida Anti-Mosquito Association was formed in 1922. Indian River Mosquito Control District (IRMCD), the first mosquito control program in Florida, was created in 1925 by an act of the Florida Legislature. The post-WWII years accelerated mosquito control efforts in this region as residents and visitors became more commonplace. The creation of 40K acres of impoundments along the central east coast's lagoonal estuary, the Indian River Lagoon (IRL), further aided with the control of saltmarsh mosquitoes, making the area more habitable. During this period in the early- to mid-20th century, occasional hurricanes threatened, and some affected the area.

There was little hurricane activity in the 1960s and 1970s along the Florida's Treasure Coast, which includes Martin, St. Lucie, and Indian River counties (Fig. 1). After this period of relative calm, Hurricane David significantly affected the area when it hit Indian River County (IRC) on Labor Day Weekend of 1979. This storm produced over 15 inches of rain, which generated huge populations of *Aedes taeniorhynchus* (Wiedemann), *Psorophora columbiae* (Dyar and Knab), and *Ae. vexans*

(Meigen). It was the *Ps. columbiae* brood from this storm that made Alan Curtis, IRMCD's Research Entomologist, famous when a photo featuring his legs illustrated a landing rate of approximately 200/min (A. Curtis, pers. comm., Fig. 2). Another lull of about a decade was broken by the arrival of Hurricane Andrew in Miami-Dade County in 1992. While this storm had little impact on the Treasure Coast, it amply demonstrated to Floridians and beyond the destructive nature that these storms can take. Hurricane Andrew ushered in a period of heightened hurricane activity along Florida's east coast, which increased awareness of the potential destructive nature of these storms. This very significant hurricane demonstrated the importance of being prepared for future storms.

INDIAN RIVER MOSQUITO CONTROL DISTRICT

Indian River Mosquito Control District is an independent taxing district with 29 full-time employees and an annual budget of approximately \$7M. It encompasses approximately 2/3rds of IRC's 532 square miles and virtually all its population of approximately 140K. The District employs an Integrated Pest Management approach to control both nuisance and pathogen-transmitting mosquitoes. The IRL runs north to south through the entire county and encompasses habitats that produce the saltmarsh mosquito, *Ae. taeniorhynchus*, which was the main target when IRMCD was created and remains the

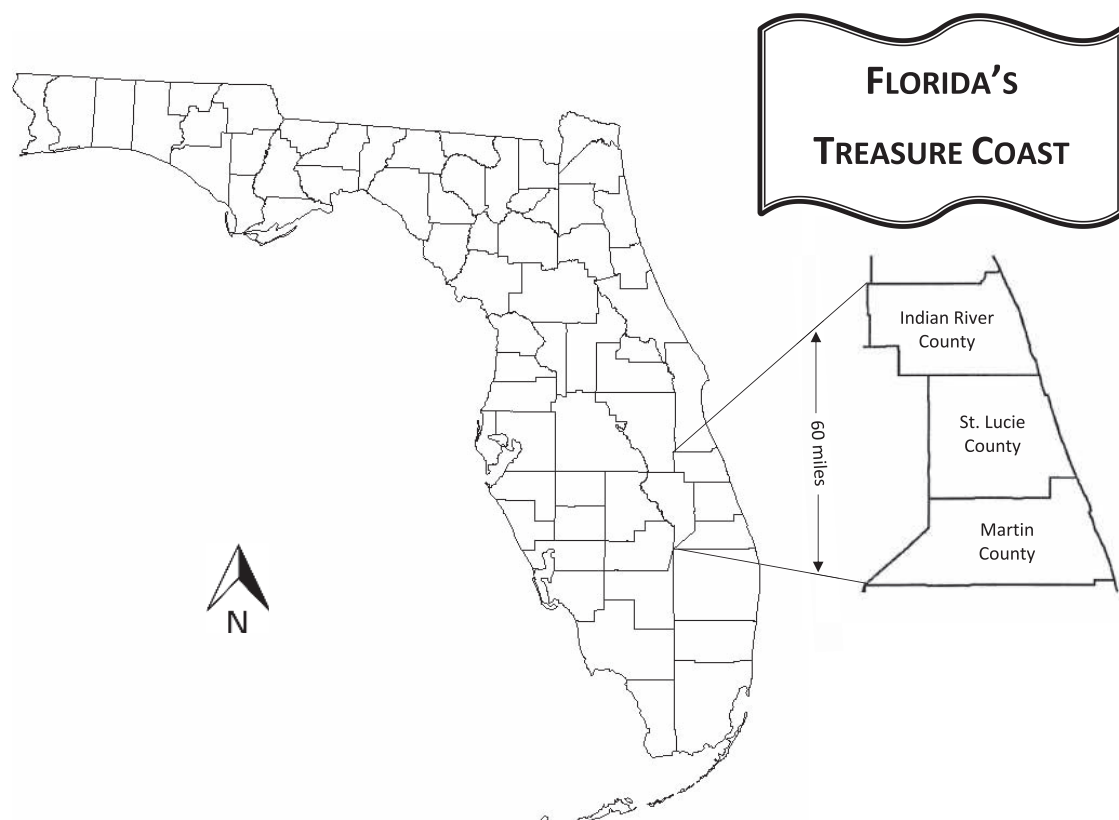


Fig. 1. Florida's Treasure Coast.

centerpiece of much of the District's efforts today. Saltmarsh mosquitoes are typically kept well under control with a series of 30 saltmarsh impoundments, totaling approximately 2800 acres, most of which are under Rotational Impoundment Management (Rey et al. 1999). Ground and aerial larviciding and ground adulticiding are also used to control these mosquitoes. Inland from the IRL, freshwater mosquito control is largely accomplished through ground adulticiding.

Indian River Mosquito Control District contracts for aerial larviciding with a local agricultural flight service and, when conditions warrant, aerial adulticiding is also done through a contract service. Over each of the past 5 years, IRMCD's aerial larviciding totaled 25K–30K acres, and ground adulticiding totaled approximately 6K miles. Primary larvicides have included *Bacillus thuringiensis israelensis* (Bti) de Barjac, spinosid, temephos, and methoprene. Permethrin is the primary ground adulticide used. Since 1978, the IRMCD has participated in the State of Florida sentinel chicken program for the detection of encephalitis viruses. The IRMCD coordinates with the IRC Health Department in regard to the local presence of mosquito-transmitted pathogens.

Hurricane preparation planning

The District first developed a Hurricane Preparedness Plan in 1997 to ensure appropriate measures would be taken to safeguard the District's equipment and facilities. Each year near the start of the hurricane season, a Staff meeting is held to review the Preparedness Plan and make any necessary updates (the PowerPoint plan is available by contacting the author). Plan preparations are assigned by department, and each has a primary and secondary coordinator. It is the responsibility of each supervisor to know the whereabouts of departmental employees at all hours, day and night, during a storm event. Employees are required to contact their supervisors if they will be out of contact for any significant period. Preparedness levels are as follows:

- Level 1: A tropical disturbance is in the Caribbean Sea or Atlantic Ocean.
- Level 2: A hurricane watch may be issued in IRC in the next 12–24 h.
- Level 3: A hurricane watch has been issued for IRC. Preparations for the storm should be well underway.



Fig. 2. *Ps. columbiae* outbreak in September 1979 after Hurricane David.

Level 4: A hurricane warning has been issued for IRC.

Preparation progresses from Level 1, where no action is necessary, to Level 4, where all preparations must be completed and all District assets must be secured. Some of the actions required as the District advances from Level 1 to Level 4 include the following: 1) Making certain that all vehicles have fuel; 2) ensuring that all equipment is in working condition, including the shop/office generator; 3) securing loose items at the office and at field locations, including sentinel chicken flocks; 4) making current backups of all important data; 5) disconnecting computers; and 6) moving portable impoundment pumps to a safe location. Steps taken in Level 4 include the following: 1) Shutting off electrical panels, 2) covering chemical containers, 3) opening several culvert pipes in each impoundment to prevent overflowing of dikes, and 4) installing window protection on the office building. Assigned individuals remain in contact with the IRC Dept. of Emergency Services at all times. The director makes arrangements to have sufficient petty cash available for emergency expenditures.

Shortly after a storm has passed, all employees are responsible for contacting their immediate supervisor to report their status and learn about the District's

immediate needs. Offering employees the opportunity to take care of their personal needs is an important consideration during this entire process. An employee worried about home and family cannot be expected to commit their full attention to meeting the District's needs.

LOCAL HURRICANES DURING THE EARLY-21ST CENTURY

The first experiences in putting the Hurricane Preparedness Plan into action was in 1999 with Hurricane Floyd, which passed several hundred miles to the east of Florida before coming ashore in the Carolinas. While relatively little damage occurred in Florida, it was a close call, which required that adequate preparations be made. The year 2004 radically changed how residents along the Treasure Coast view hurricanes. In September, within a period of 20 days, 2 hurricanes (Francis, at Category 2, and Jeanne, at Category 3) came ashore, both in the Sewall's Point area of Martin County. Tremendous damage occurred from this quick one-two punch. A year later, Hurricane Wilma caused extensive damage as it crossed Florida from west to east as a Category 2 storm. By the end of 2005, Treasure Coast residents were weary from this barrage of highly destructive storms.

LESSONS LEARNED

First poststorm actions

In a 13-month period, IRMCD learned a great deal about how to prepare for an approaching storm and respond to its aftermath. We learned that employees need to take care of their personal needs first and then report to the District as soon as is practicable. Upon returning to the office, our top priority is safety. Storm damage is assessed, but steps are taken to ensure our actions are done safely. It is important to follow the instructions of local emergency managers and not drive on roads until they have been cleared of debris and are deemed safe for vehicles. Once the go-ahead is received, surveying the damage done to our inspection trails and mosquito impoundments along the IRL take priority. Our sentinel chickens, left in their secured field cages during a storm, are also checked.

Larviciding: During normal day-to-day operations, our District attempts to control all saltmarsh mosquito broods by ground and/or aerial larviciding. However, a storm's extreme high tides and rainfall in excess of 10 inches can make this a futile endeavor. Under those extreme circumstances, it is difficult to know where to start and where to stop larviciding because there is water present in locations that are not typically flooded. Our focus then turns to adulticiding.

Adulticiding: The initial poststorm ground ultra-low volume (ULV) spraying should be conducted as



Fig. 3. Hurricane damage to an impoundment dike where approximately 1 foot of dike was scoured by storm surge and wave action.

soon as possible to target mosquitoes that had emerged prior to the storm event. Bad road conditions immediately after the storm must be addressed because debris often blocks roads. Prior to any spray mission, the ULV Department inspects the routes in the daytime to observe their condition and make any necessary route adjustments. The adult mosquito surge that will occur about 7–10 days after the storm event passes is addressed by aerial adulticiding.

The District has a company under annual contract to do aerial adulticiding when ground ULV spraying is not adequate, which is often the case when a tropical storm or hurricane affects the District. We usually have a 1-wk lead time from the flooding event to our target for spraying. This time gives the company under contract adequate time to plan for the 76,500-acre mission. The IRMCD has done such spraying for hurricane situations in 2004 (3 times), 2008, and 2017. Presurveillance and postsurveillance with landing rates and trapping are done in conjunction with these spraying events. Each year, IRMCD typically budgets for 3 aerial adulticiding missions, so that funds are available to make a quick response in situations such as these.

Permanent control: Assessing the damage to the 40 miles of impoundment dikes and pump stations immediately after a storm is the Permanent Control Department's top priority. Following the immediate assessment, the Permanent Control Department typically works with the Larviciding Department to open inspection trails by using the District's rubber-tracked loaders with grinding equipment attached.

The Special Projects Coordinator also has a role in the repair of damaged impoundment dikes. The creation of geographical information maps of the damaged areas is necessary so that the amount of fill required to make the repairs can be determined. Damage can be extensive, and reconstruction efforts can take the entire winter season (Fig. 3 demonstrates common damage to dikes). Every effort is made to finish repairs before the impoundment management period begins in April.

FEDERAL EMERGENCY MANAGEMENT AGENCY

President Jimmy Carter's 1979 executive order consolidated the disaster-related responsibilities of several separate entities into the Federal Emergency Management Agency (FEMA). FEMA's mission remains: to lead America to prepare for, prevent, respond to, and recover from disasters (US Department of Homeland Security 2019a).

Public assistance program

Federal Emergency Management Agency programs are activated once the president signs a major disaster declaration (US Department of Homeland Security 2018). There are 2 main assistance programs: individual assistance (IA), available to individuals and households, and public assistance (PA), available to state and local governments, which constitutes the bulk of its assistance grants. FEMA breaks the PA funding process into 2 types of work: emergency work and permanent work, which are then further broken down into categories. FEMA and the state, also known as the grantee, work as a partnership in the PA process. For a PA project to be approved for reimbursement, both the applicant and damaged facility must meet eligibility requirements. FEMA 2018 defines cost eligibility as:

- Directly tied to the performance of eligible work;
- Adequately documented;
- Reduced by all applicable credits, such as insurance proceeds and salvage values;
- Authorized and not prohibited under federal, state, territorial, tribal, or local government laws or regulations;
- Consistent with the applicant's internal policies, regulations, and procedures that apply uniformly to both federal awards and other activities of the applicant; and
- Necessary and reasonable to accomplish the work properly and efficiently.

FEMA does not send funds directly to the applicant, also known as the subgrantee, but its awards are administered by the state and disbursed to the applicant. FEMA will reimburse at least 75 percent of the eligible costs of recovery; the

remaining costs are split between the state and the applicant.

Summary of the Process: FEMA's applicants' briefing, for those entities that may be eligible for PA funding, is the first step in the grant process (US Department of Homeland Security 2019b). Attending applicants receive a request for public assistance (RPA) form and are instructed to submit the RPA via the State of Florida Public Assistance web portal within 30 days of a Presidential Disaster Declaration. Once the RPA is received, a public assistance coordinator (PAC) is assigned to the applicant. The PAC's function is to work with the applicant throughout the process to provide information and technical assistance and facilitate the repair and restoration process.

The PAC will arrange a "kick-off" meeting with the applicant, and the applicant liaison, the state's customer service representative, will also attend to explain any state-specific reporting requirements. Prior to the kick-off meeting, the applicant should compile a list of all damages, including estimates for repairs. The PAC will explain FEMA's work classification system and assist the applicant in preparing the project worksheet (PW), the form used to document the scope of work and cost estimate for the necessary repairs. Once approved, the PW will be the basis for funding under the PA Program.

IRMCD'S EXPERIENCES WITH FEMA

Indian River Mosquito Control District has considerable experience with the FEMA funding process and its changes through the years. The IRMCD has requested funding under Emergency Work Category A (debris removal) to reimburse the District for the cost of clearing trails for immediate access, and Category B (emergency protective measures) to reimburse the District the costs involved in aerial adulticiding necessitated by storm-related rains. The permanent work category assigned to the District by FEMA for reimbursement of permanent repairs made to its mosquito impoundments has varied. For Hurricanes Francis and Jeanne, IRMCD was assigned Category D (water control facilities), while for Matthew and Irma we were assigned Category G (parks, recreation, and other). We have learned through our experience to have as much information as possible available for the kick-off meeting. After a storm, IRMCD sends a crew armed with a geographical positioning system (GPS) unit and a smart phone to get accurate start and stop points for all damaged sections of dikes as well as photos at each start and stop point. The data are then uploaded to a mapping program. Maps are generated that mark the GPS points reflecting the damaged sections of the dikes. Measurements are made, and the linear feet of damage calculated. All this information is loaded onto a thumb drive then given to the FEMA representatives at the kick-off meeting.

FEMA reimburses for hard and soft costs. It reimburses for personnel costs at a base rate plus benefits and rental equipment are reimbursed based on the rental agreement contract and invoicing. Reimbursement for IRMCD-owned equipment is quite another story. Historically, IRMCD was reimbursed for the time the equipment was on the job (the theory being that it was unavailable for our use elsewhere), but that method of equipment tracking changed during our reimbursement application for Hurricane Matthew. Well into the process, IRMCD was informed that FEMA would reimburse for *usage* only, not for any idle time, and equipment reports had to list each operator as well. Basically, we had to track engine hours and operators for each piece of equipment. It did not suffice to report that a dump truck had been used a total of 6 h in a day: We had to divide those 6 h by driver, and then FEMA would check the hours an employee used the equipment against that individual's hours worked each day. Because our personnel routinely switched off from dump truck to loader several times during the course of a day, this became a very involved process. To compound the problem, FEMA initially had no mechanism to deal with multiple pieces of equipment being used at the same time. For instance, we had a dump truck towing a trailer that was carrying an excavator that was equipped with brush grinder. An employee would spend 1 h a day driving to and from a job site but, by FEMA's original method, it was 4 h, 1 h for each piece of equipment. At times, there literally were not enough hours in a day if an employee's hours were counted by FEMA's method! Perhaps the most frustrating aspect of the FEMA process during Hurricane Matthew was the fact that our PAC was changed on more than one occasion. This required multiple meetings covering the same ground only with different attendants. For Hurricane Irma, we were introduced to FEMA's grants portal, which greatly streamlined the process. We started off with our thumb drive of data ready for the kick-off meeting. After that, any information we collected was uploaded to the portal and was shared with the state. This eliminated the need to duplicate our reports for the state. Once an area was completely repaired and the information was circulated through all FEMA departments, it went to the state level. After their review, we received a contract showing exactly how much was to be reimbursed, breaking down what FEMA paid versus the state and local cost share. The FEMA grants portal simplified the entire process, thus saving taxpayer dollars. It was a much-welcomed change to the reimbursement process.

CONCLUSION

Indian River Mosquito Control District remains vigilant in its preparation for major storm events. Weather trends indicate that Florida will face

catastrophic hurricanes in the future, making damage to our impoundments a near certainty, and, so long as the program exists, we will have the option to apply to FEMA for reimbursement of our costs. No doubt, the FEMA grant funding process will continue to evolve. The only way to prepare for this inevitability is to keep meticulous records—document, document, document! Navigating the FEMA PA process can be frustrating and extremely time-consuming. One might ask: Is it worth it? Since the turn of the century, IRMCD has received more than \$1.6M in PA dollars—an amount we believe our taxpayers would consider worthwhile.

REFERENCES CITED

- Rey JR, Carlson DB, Carroll JD. 1999. Regional Marsh Management Strategies for the Indian River Lagoon, *Tech Bull Florida Mosq Control Assoc* 2:D11–D13.
- US Department of Homeland Security. 2018. *FEMA. Public Assistance Program and Policy Guide*. FP 104-009-2.
- US Department of Homeland Security. 2019a. *FEMA—About the Agency* [Internet]. Washington, DC: FEMA [accessed August 19, 2019]. Available from: <https://www.fema.gov/about-agency>.
- US Department of Homeland Security. 2019b. *FEMA—Frequently Asked Questions* [Internet]. Washington, DC: FEMA [accessed August 19, 2019]. Available from: <https://www.fema.gov/public-assistance-frequently-asked-questions##grant>.