ADAPTATIONS FOR WNV SURVEILLANCE AND CONTROL IN CHATHAM COUNTY

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I. INTRODUCTION

Chatham County is the most northern coastal county in Georgia occupying approximately 438 square miles. The area includes a variety of aquatic and terrestrial habitats, such as coastal barrier islands, urban landscape, and xeric sandhill regions. Thirty-nine species of mosquitoes are known to occur in the county.

West Nile virus activity was first detected in Chatham County in 2001; however, surveillance and control program changes to deal with the developing disease threat began in 1999. As information about West Nile virus epidemiology was acquired, surveillance and control methods were adapted so that the following programs were in place at the start of the 2003 mosquito season. Our sentinel chicken surveillance program, originally intended to detect Eastern Equine Encephalitis virus in limited rural areas of the county, was expanded to monitor West Nile virus activity county-wide especially the urban area of Savannah. Mosquito surveillance was accomplished primarily with gravid traps that were placed at twelve fixed locations around the county. Additional gravid traps were temporarily deployed that year in neighborhoods where infected birds and mosquitoes were collected. In urban Savannah, catch basins were treated with 150 day Altosid® Briquets because these habitats are known or are potential larval developmental areas for *Culex* mosquitoes in other locations of the United States (Covell and Resh 1971, Halzelrigg and Pelsue 1980, Pfunter 1978). Ground and aerial spray operations specifically targeted *Culex quinquefasciatus* Say, but the finding of West Nile virus infected birds and mosquitoes was the primary indicator used to initiate treatment. In spite of a massive effort by Mosquito Control and District Health Department staff, the outcome in Chatham County seemed disappointing: 27 birds, 67 mosquito pools, 6 sentinel chickens and 1 horse tested positive for West Nile virus. Nine human cases (one fatal) of West Nile fever/encephalitis were reported. For the effort expended, staff members were not satisfied with the West Nile virus control results. A comprehensive review of the West Nile virus surveillance and control program began in September 2003.

II. COMPREHENSIVE PROGRAM REVIEW—2003

Every aspect of our West Nile virus surveillance and control program was evaluated. In order to test for pesticide resistance, our review began by contacting Dr. William Brogdon at the Centers for Disease Control and Prevention. *Culex quinquefasciatus* egg rafts were shipped and pesticide resistance tests were conducted on two local populations of this species. Analysis of the two populations showed 64% and 74% less susceptibility to malathion, and 20% and 40% less susceptibility to permethrin when compared with a known insecticide-susceptible population of *Cx. quinquefasciatus*.

Mapping known indicators of West Nile virus activity, including infected birds, mosquitoes, and sentinel chickens that tested positive for the virus proved to be very useful for our program. It showed a concentration of transmission activity in the main urban area of Savannah including the Downtown, Victorian, and historic districts,

an area occupying approximately 24 square miles. Seven of the nine individuals infected with West Nile virus in 2003 resided within this high risk area. During the 2003 mosquito season, the gravid trap placed at the downtown Savannah location generally collected over 100 adult *Cx. quinquefasciatus* per trap night and peaked at over 600 during a single night in November 2003.

Placing critical events that occurred within the high risk area on a timeline gave additional information. Laboratory confirmation by the Southeastern Cooperative Wildlife Disease Study (SCWDS) of the first West Nile virus positive mosquito pool collected on July 22 was received on July 29, 2003. Confirmation of the first human West Nile virus infection was received on September 4 from a presumed onset date of August 1, only 3 days after notification of the first positive mosquito pool. Confirmation (also by SCDWS) of the first West Nile virus positive birds collected on September 11 and 12 within the high risk area was not received until September 23. Finally, confirmation of the first West Nile virus infected sentinel chicken by the University of Georgia, Veterinary Diagnostic and Investigational Laboratory in Tifton, GA, having an exposure date of August 27, was not received until October 1. This delay is the result of the lag time involved between chicken exposure, incubation time before the initial blood sample and analysis, and the re-bleeding and subsequent lab confirmation of the sample. From this timeline, we noted that waiting for these specific viral activity indicators to occur before initiating adult mosquito control operations might not be useful in preventing human cases of West Nile fever/encephalitis. Only three days separated the finding of infected mosquitoes and the first human case, allowing only a minimal amount of time to mount an aggressive control response. Confirmations of West Nile virus infected birds and the single infected sentinel chicken were not received until after notification of the first human case. In fact, during an approximately seven week period (July 30-September 10), 15 positive mosquito pools were collected at a residence before a sentinel chicken, placed at the same residence one night each week, tested positive for West Nile virus. The relatively low reliability of sentinel chickens to detect WNV in advance of human illness has been previously reported from NY and NJ, where the majority of positive seroconversions occurred well after the onset of human cases (Cherry et al. 2001, Komar 2001). We concluded that: sentinel chickens were not adequate indicators of human risk for West Nile fever/encephalitis; dead birds were not good neighborhood-specific indicators of human risk; and infected mosquitoes may indicate an increased risk of human infection, but cannot be relied on to predict the timing of human cases.

III. 2004 RESPONSE AND RESULTS

In light of these conclusions, significant surveillance and control program changes were instituted which yielded more positive results in 2004. Staff minimized the amount of time collecting and shipping dead birds for analysis. Rather than test all bird species, only crows, blue jays, and predatory birds were submitted for testing. Only 27 birds were shipped in 2004 compared with 371 submitted in 2003. Using sentinel chickens for West Nile virus detection was discontinued in 2004 because of the failure of this program to produce adequate results. Much greater emphasis was placed on mosquito analysis and the use of gravid traps. In 2004, a total of 28 gravid traps were regularly placed at fixed locations throughout Chatham County. Locations were selected based on local historic information. Additional traps were not placed at locations where positive birds and mosquitoes were collected as was done previously. Thirty day Altosid® pellets were used to treat catch basins rather than the 150 day briquets. The intent was to treat catch basins in the high risk area on a 30 day schedule. It was our opinion that the 150 day Altosid® Briquets were washed out of the catch basins, as reported previously by Hazelrigg and Pelsue (1980), long before the end of their expected efficacy period. Using the 30 day

Table 1. Comparison of *Culex quinquefasciatus* average catch per trap night from gravid trap sites in Chatham County, Georgia during 2003 and 2004.

	2003		2004	
Trap site	Average	Range	Average	Range
Carver Heights	270.62	0-2688	50.59	0-244
Downtown Savannah	109.09	0-607	38.11	0-174
Truman Parkway	55.39	0-304	17.48	0-172
64th Street*	131.25	2-800	54.33	1-460

*Trap moved 0.3 mi. between years.

pellets forced staff to retreat catch basins in the high risk area on schedule. We considered all the storm water catch basins as an interconnected system. Complete control might not be necessary in every individual catch basin if an unknown threshold level of control could be maintained throughout the entire system. In this way, we believed that adult *Cx. quinquefasciatus* populations might be prevented from reaching a level required to produce a West Nile fever/encephalitis epidemic in the county.

Because of pesticide resistance, alternate chemicals were chosen. Resmethrin replaced permethrin for ground ULV applications, and naled (Trumpet® EC) replaced malathion for aerial control operations. CDC tests confirmed susceptibility to these substitute products. A new helicopter high pressure spray system was also constructed and installed to deal with the corrosiveness of naled.

Rather than wait for positive indicators of West Nile virus transmission activity in birds and mosquitoes, raw numbers of adult *Cx. quinquefasciatus* collected in gravid traps were used to direct control operations. Therefore, in 2004, aggressive adult mosquito control operations began before notification of any positive test results. Finally, the timing of aerial pesticide applications was shifted from early morning when weather conditions are generally more favorable for aerial control work, to the predusk period just preceding the peak activity hours of *Cx. quinquefasciatus* (Lyimo and Irving-Bell 1988). In 2003, routine adult mosquito control operations began on August 3, in response to evidence of West Nile virus transmission as indicated by infected birds and mosquitoes. In 2004, routine adult mosquito control operations began on July 2, in response to the seasonal rise in *Cx. quinquefasciatus* populations.

Collection averages of *Cx. quinquefasciatus* trapped at four locations within the high risk area in the City of Savannah showed a reduction in numbers in 2004 compared with collections in 2003 (Table 1). While this is not conclusive evidence, it is suggestive that program changes implemented in 2004 resulted in a more positive outcome. Table 2 compares West Nile virus positive indicators in 2003 and 2004 which are also suggestive of better control results.

IV. SUMMARY

In summary, Chatham County staff reviewed the success of our West Nile virus surveillance and control program near the end of the 2003 mosquito season and implemented improvements in 2004. The most important change was to determine the susceptibility of our target West Nile virus carrier, *Cx. quinquefasciatus*, and change the adulticides used to known susceptible products. Secondly, we changed the timing of aerial applications from dawn to dusk to apply our products at the beginning of the

Table 2. Comparison of West Nile Virus positive indicators 2003/2004.

Infected organism	2003	2004
Birds	27	0
Mosquito Pools	67	38
Sentinel Chickens	6	*
Horses	1	0
Human Cases (Fatalities)	9 (1)	1

* None submitted from high risk area.

peak activity time of the vector species. Thirdly, we initiated adult mosquito control measures based on increasing numbers of adult *Cx. quinquefasciatus* collected, rather than waiting for infected birds or mosquitoes. Additionally, we concluded that West Nile virus positive birds, mosquitoes, and sentinel chickens may not be reliable predictors of human risk that provide sufficient time to initiate adequate measures that will prevent human cases of disease.

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