

Rapid Mosquito Surveillance in Response to Floods — 2011



Background

Flooding occurred along the Missouri River in Northeast Kansas in Atchison, Doniphan, Leavenworth, and Wyandotte Counties in June 2011. Typically, citizens become concerned about an increase in mosquito population, and potential mosquito-borne disease transmission, after floods due to large areas of standing water. There are approximately 55 mosquito species found in Kansas and 15 of those have the potential to transmit diseases, such as West Nile virus. In addition, large numbers of nuisance mosquitoes, those that bite people but do not transmit disease, may hamper recovery efforts. Mosquito surveillance is critical in order to determine the number and type of mosquitoes present as this will allow public officials to effectively target vector control efforts. In addition, the Federal Emergency Management Agency requires mosquito surveillance be in place for states to receive reimbursement of funds for vector control measures associated with a disaster. During 2010, the Kansas Department of Health and Environment discontinued its West Nile virus mosquito surveillance program; therefore, no active mosquito surveillance system was in place in 2011.

In response to the floods in Northeast Kansas, the Kansas Department of Health and Environment established a mosquito surveillance system for Atchison and Doniphan Counties. Data from the mosquito surveillance system established on Fort Leavenworth by the Army Preventive Medicine staff was used as a representative sample for Leavenworth County. The Wyandotte County Health Department declined to conduct mosquito surveillance for their county.

This surveillance system was composed of four components: mosquito collection, mosquito identification, testing of mosquitoes for West Nile virus, and reporting the results to public health partners.

The Kansas Department of Health and Environment Bureau of Epidemiology and Public Health Informatics (KDHE-BEPHI) coordinated mosquito surveillance and testing of mosquitoes for West Nile virus for Atchison and Doniphan Counties.

Methods

Mosquito Collection

Mosquito surveillance was conducted weekly from July 25 to September 13, 2011. CDC light traps (so named because the instruments were developed by staff at the Centers for Disease Control and Prevention) were borrowed from Kansas State University (KSU). In the past, KDHE contracted with KSU for mosquito surveillance and the supplies remained with KSU at the end of the contract period. We requested light traps, batteries, and battery chargers. The supplies were inventoried, and three traps and associated supplies were sent to both Atchison and Doniphan Counties. A detailed instruction list, along with photographs, was created and sent to each health department.

Each county was instructed to establish three surveillance locations, at least 1.5 miles apart, to set each trap. The traps were to be placed between the flooded areas and a population center (e.g. a residential neighborhood). The traps were set out on Tuesday afternoons (after 4 p.m.) and retrieved by 9 a.m. Wednesday morning. Dry ice was recommended to be used as part of the trap as it attracts mosquitoes that prefer to obtain a blood meal from humans. No dry ice was available in Doniphan County; therefore their traps relied only on the light source as the primary attractant for mosquitoes. The Atchison County Health Department was able to obtain dry ice for trapping each week.

The contents of the traps were secured in a container and labeled with the address and/or GPS coordinates of the location of the trap. Shipping boxes and pre-filled FedEx labels were provided to the local health departments. The mosquitoes were sent overnight to the Kansas Biological Survey at the University of Kansas for identification.

Mosquito Identification

The KDHE-BEPHI contracted with the Kansas Biological Survey (KBS), to enumerate and identify mosquitoes to species level. Mosquito counts of greater than 1,000 were divided into a smaller subset for identification due to budget constraints. Those mosquitoes identified as potential West Nile virus vectors were submitted to the Kansas Health and Environmental Laboratories via the Douglas County Health Department courier for testing. Results from the enumeration and identification were submitted to KDHE-BEPHI weekly by KBS. Shipping boxes were returned to the local health departments via FedEx.

West Nile Virus Testing

The mosquitoes identified as potential West Nile virus vectors were shipped to the Kansas Health and Environmental Laboratories for testing by polymerase chain reaction (PCR). The mosquitoes from each trap location were tested for WNV. The results were entered in an Excel spreadsheet and sent to KDHE-BEPHI weekly. All results were reported to the Centers for Disease Control and Prevention's ArboNET surveillance system.

Human Case Surveillance

West Nile virus is a reportable disease in Kansas. It is a passive surveillance system; healthcare providers or laboratories are required to report cases to KDHE-BEPHI. Cases are entered into the Kansas Electronic Disease Surveillance System (KS EDSS) and the corresponding local health department completes the investigation. Information on West Nile virus case rates can be found in the Annual Infectious Disease Summary at http://www.kdheks.gov/epi/annual_summary.htm.

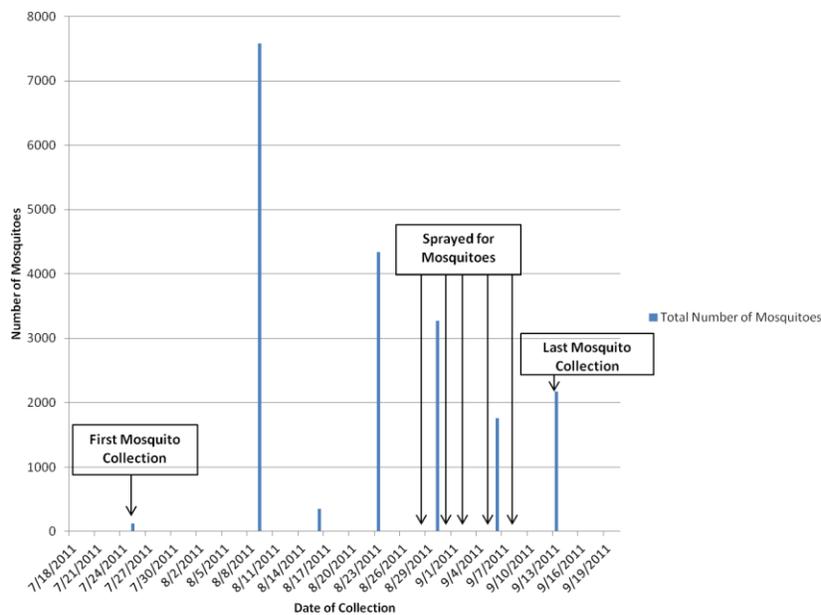
Results

Mosquito Surveillance

A report of all surveillance results was sent to the local health departments, KHEL, KBS, and the KDHE Bureau of Community Health Systems Preparedness section weekly. The report, created as a PowerPoint presentation for ease of visual aids (e.g. graphs, charts), included the number and species of mosquitoes collected as well as the WNV test results and mitigation recommendations. The local health departments were encouraged to share this report with city managers, county emergency managers and other partners as appropriate.

The first mosquito collection began on July 25 and continued weekly through September 13 for a total of 8 weeks of surveillance. All mosquitoes were identified to species level from all traps. In Atchison County, there was a significant increase in the total number of mosquitoes from July 25 to August 9 and from August 16 to August 23 (Table 1).

Table 1. Total Number of Mosquitoes, Atchison County



Nearly 100% of the mosquitoes identified were potential vectors for WNV. These included seven species of mosquitoes from the genera *Culex*, *Anopheles*, and *Psorophora* (Table 2).

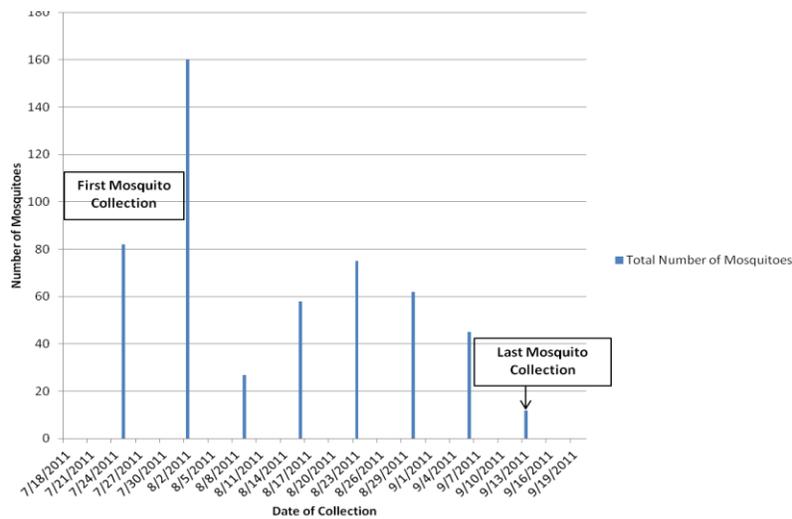
Table 2. Atchison County Mosquito Identification Results (genus level only).

Date of Collection	Total # of Mosquitoes	# Culex spp. (%)	# Anopheles spp. (%)	# Ochlerotatus spp. (%)	# Psorophora spp. (%)
07/25/2011	119	50 (42)	69 (58)	0	0
08/02/2011	4*	N/A	N/A	N/A	N/A
08/09/2011	7,581†	1,606 (21)	5,263 (69)	0	712 (9)
08/16/2011	348	243 (70)	102 (29)	0	3 (1)
08/23/2011	4,342†	1,630 (38)	2,701 (62)	0	11 (<1)
08/30/2011	3,277	37	3,237	0	3
09/06/2011	1,765	791	974	0	0
09/13/2011	2,173	753	1,420	0	0

*Mosquito samples were too degraded for identification
 †A sample of 500 mosquitoes was used for identification

The mosquito surveillance results in Doniphan County yielded lower mosquito counts, most likely due to the lack of dry ice as an attractant. However, these numbers represent a far higher number of mosquitoes than we would expect using a light source alone (Table 3).

Table 3. Total Number of Mosquitoes, Doniphan County



Nearly 100% of the mosquitoes identified were potential vectors for WNV. These included seven species of mosquitoes from the genera *Culex*, *Anopheles*, and *Psorophora* (Table 4).

Table 4. Doniphan County Mosquito Identification Results (genus level only).

Date of Collection	Total # of Mosquitoes	# Culex spp. (%)	# Anopheles spp. (%)	# Ochlerotatus spp. (%)	# Psorophora spp. (%)
07/25/2011	82	72 (88)	9 (11)	1 (1)	0
08/02/2011	158	152 (96)	6 (4)	0	0
08/09/2011	27	14 (52)	10 (37)	0	3 (11)
08/16/2011	58	53 (91)	5 (9)	0	0
08/23/2011	75	65 (87)	8 (11)	0	2 (3)
08/30/2011	62	31	14	0	17
09/06/2011	45	21	22	0	2
09/13/2011	12	5	4	1	2

West Nile Virus Testing

Mosquitoes were pooled for testing by location; a total of 25 mosquito pools were tested. All were negative for West Nile virus.

Human Case Surveillance

There were a total of four cases of West Nile virus encephalitis/meningitis during 2011: three probable and one confirmed. The confirmed case of WNV was in a resident of Doniphan County. The case-patient was reported to KDHE-BEPHI on September 28. The case-patient was an elderly adult male with symptom onset September 7, 2011 and was hospitalized on September 9. He was hospitalized for eight days and made a complete recovery. He reported receiving mosquito bites prior to symptom onset; he did not use any repellent containing DEET.

Discussion

A significant increase in mosquitoes from August 2 to August 9 in Atchison prompted the KDHE-BEPHI to recommend a press release be issued to the citizens of Atchison County to alert them to the high number of mosquitoes and to take appropriate precautions. A draft press release was created by KDHE-BEPHI and sent to the Atchison County Health Department (ACHD); however it was not published. In addition, mosquito control efforts (e.g. spraying for adult mosquitoes) were recommended to the Atchison County Health Department (ACHD). The KDHE-BEPHI continued to recommend mosquito abatement measures on each subsequent week of surveillance (except the week of August 16). The ACHD relayed this information to the City of Atchison manager and the Emergency Manager for Atchison County, but it was unknown if any mosquito abatement measures took place until the conclusion of the mosquito surveillance. During the After Action Report Hot Wash session, the Atchison County Health Department stated that the City of Atchison conducted spraying on August 29, August 31, and September 2, 6, and 8 (Table 1).

Conclusion

A rapid mosquito surveillance system was established for Atchison and Doniphan Counties in response to flooding. The Kansas Department of Health and Environment coordinated surveillance efforts with the local health departments, the Kansas Biological Survey, and the Kansas Health and Environmental Laboratories. There was a dramatic increase in the number of mosquitoes in Atchison and Doniphan counties after the flood event, including mosquitoes that had the potential to transmit West Nile virus. Mosquito surveillance during a disaster provides critical information to public officials and citizens. This information should be part of the decision making process regarding potential mitigation (e.g. use of pesticides) and messaging to the public.

Report author:

Ingrid C. Garrison, DVM, MPH, DACVPM
State Public Health Veterinarian
Kansas Department of Health and Environment

Acknowledgments:

Connie Zeit, RN (Atchison County Health Department)
Sheryl Pierce, RN (Doniphan County Health Department)
Capt. Ehren Linderman (Fort Leavenworth)
Dr. Christopher Rogers (Kansas Biological Survey)
Virginia Barnes (Kansas Department of Health and Environment)
Brian Hart (Kansas Health and Environmental Laboratories)

Contact Information:

Kansas Department of Health & Environment
Bureau of Epidemiology and Public Health Informatics
1000 SW Jackson St., Suite 210
Topeka, KS 66612
Epidemiology Hotline: (877) 427-7317
epihotline@kdheks.gov
<http://www.kdheks.gov/epi>

Our Mission

To protect and improve the health and environment of all Kansans