OPERATIONAL NOTE

**AEDES AEGYPTI IDENTIFIED IN YORK, NEBRASKA, THROUGH ROUTINE ARBOVIRAL SURVEILLANCE—AUGUST–OCTOBER 2019**

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**ABSTRACT.** On August 27, 2019, *Aedes aegypti* mosquitoes were identified in a neighborhood located in York, NE, through routine arboviral surveillance. Expanded surveillance using traps and morphologic identification revealed 118 adult *Ae. aegypti* throughout the adjacent neighborhood, including identification from larval sampling. Our findings describe the first recorded *Ae. aegypti* introduction in Nebraska and provide evidence of a breeding mosquito population, which suggests suitable habitat and the risk of potential establishment, raising concerns about prevention of arboviral diseases in Nebraska.

**KEY WORDS** *Aedes aegypti*, arboviral surveillance, mosquitoes, Nebraska

Approximately 3,557 species of mosquitoes exist worldwide, of which approximately 176 are recognized in the USA, with at least 50 species found in Nebraska (WRBU 2019); some of these mosquito species transmit arboviruses, including West Nile virus (WNV). Since becoming endemic in the USA in 2002, WNV has been the most prevalent mosquito-borne disease in Nebraska (NDHHS 2019a). To track and monitor mosquitoes and arboviruses, the Nebraska Department of Health and Human Services (NDHHS) has created a robust, multifaceted surveillance system, the Arbovirus Surveillance and Mosquito Monitoring Program. The program employs several tools to understand mosquito ecology and improve early warning to aid in preventing arboviral diseases for Nebraska residents. These tools include monitoring environmental conditions that might influence vector reproduction, determining rates of virus carriage among vector and reservoir species, and routine mosquito trapping surveillance, in addition to tracking human cases of arboviral diseases (NDHHS 2019b). Routine mosquito trapping surveillance is used to determine mosquito distribution and concentration and detect the presence of new mosquito species (Janousek et al. 2001).

During 2019, of 93 Nebraska counties, 29 counties (where 82% of 1,929,268 Nebraskans reside) conducted routine mosquito trapping as part of arboviral surveillance activities (Fig. 1). Local health department staff from participating counties set traps at regular biweekly intervals throughout the surveillance season (Morbidity and Mortality Weekly Report weeks 22–39), and traps were deployed within or just outside populated areas. Each participating county used one or more Centers for Disease Control and Prevention (CDC) miniature light trap Model 512 (CDC light traps; John W. Hock Company, Gainesville, FL). In total, 150 traps were set biweekly; 20 (69%) counties deployed 6 traps biweekly. These traps were baited with dry ice, set in the late afternoon or early evening, left in place overnight, and retrieved the next morning. Additionally, 3 eastern Nebraska counties, excluding York County, incorporated Biogents-Sentinel 2 mosquito traps (BG traps; Biogents AG, Regensberg, Germany) for enhanced surveillance, a practice employed since 2017 for surveillance of invasive *Aedes* mosquitoes. These BG traps were baited with nontoxic human scent lures (BG lures; Biogents AG, Regensberg, Germany) and dry ice, set in the morning, and retrieved after 24 h of operation. From both types of traps, mosquito collection nets containing live mosquitoes were then placed either in a cooler with dry ice or taken to the local health department and placed in a freezer, to immobilize and kill the live mosquitoes, and allow transfer from traps to sample bottles. Sample bottles were immediately packaged and shipped overnight on dry ice to NDHHS’s Mosquito Identification Laboratory for morphologic identification.

On August 27, 2019, 5 mosquitoes collected during routine surveillance from a CDC light trap in York, NE, were morphologically identified as female *Aedes aegypti* (L.). The genus and species were later confirmed by a duplex real-time polymerase chain reaction assay at CDC (Kothera et al. 2017). *Aedes aegypti* is more typically found in...
tropical regions and is the primary vector for chikungunya, dengue, Zika, and yellow fever viruses; *Ae. aegypti* has been increasingly detected in new subtropical and temperate regions since the 1950s (Weaver et al. 2014). This was the first recorded detection of this invasive tropical mosquito in Nebraska, which is outside the CDC’s predicted range of *Ae. aegypti* (CDC 2018). To define the *Ae. aegypti* population and distribution, surveillance efforts were extended to include 4 expanded mosquito trapping surveys conducted over increasing distances from initial detection site within a residential neighborhood of approximately 1.3 km². On September 6, a total of 10 mosquito traps (5 CDC light traps and 5 BG traps) and 8 ovitraps (cups lined with seed germination paper and filled with tap water, retrieved after 7 days) were deployed on 4 properties adjacent to the household where *Ae. aegypti* was first detected. Larval surveys were also conducted, and larvae were taken to NDHHS Mosquito Laboratory where they were reared in mosquito emergence jars (Mosquito Breeder; BioQuip Products, Rancho Dominguez, CA). The 2nd expanded trapping survey began on September 17 with 14 mosquito traps (9 CDC light traps and 5 BG traps) distributed throughout the residential neighborhood. Additionally, 60 ovitraps were deployed September 22 and retrieved after 7 days. The 3rd expanded trapping survey began on September 25 with 25 BG traps; the 4th and final expanded trapping survey began on October 9 with 25 BG traps.

The 1st expanded trapping survey collected 195 mosquitoes from CDC light and BG traps; 48 (25%) were identified as *Ae. aegypti*. No eggs were collected from ovitraps. From larvae collected, 1 *Ae. aegypti* adult emerged, indicating the presence of an established breeding population. The 2nd expanded trapping survey collected 138 mosquitoes; 22 (16%) were identified as *Ae. aegypti*. A single previously hatched egg was identified from 1 ovitraps. The 3rd expanded trapping survey collected 925 mosquitoes (34, 4% *Ae. aegypti*); 1,227 mosquitoes (9, 0.7%, *Ae. aegypti*) were collected during the 4th survey. In total, 2,485 mosquitoes were collected through expanded surveillance within the target neighborhood, and 113 *Ae. aegypti* (82 females and 31 males) were identified (Table 1), with overall declining counts as the season progressed.

During the 1st half of the 2019 mosquito season (May–July), approximately three-quarters of Nebraska experienced higher than expected average precipitation, including many areas that experienced nearly double the normal amounts (HPRCC 2019). However, during this same period, temperatures for approximately two-thirds of the state were 1–4°F below the expected average. The 2nd half of the 2019
mosquito season (July–September) presented a similarly elevated precipitation pattern with approximately half of Nebraska experiencing 150–200% of expected average precipitation, and approximately two-thirds of Nebraska experiencing temperatures 1–3°F above normal. Environmental conditions in York County reflected these statewide patterns. Environmental conditions like cool temperatures and limited precipitation are crucial factors in constraining the distribution of *Ae. aegypti* and *Ae. albopictus* (Skuse) distribution (Kraemer et al. 2015). Warm and wet environmental conditions in Nebraska likely contributed to *Ae. aegypti* introduction and survival.

The first detection of *Ae. aegypti* occurred through routine surveillance using CDC light traps and morphologic identification. Additional larval sampling and rearing larvae in mosquito emergence jars confirmed the presence of a breeding population, which suggests suitable habitat and the risk of potential establishment. The lack of eggs identified from ovitraps might be attributed to competing oviposition sites in the area. Expanded trapping surveys using CDC light traps and BG traps permitted characterization of the introduction and offers preliminary evidence suggesting a population decline over the course of expanded trapping. Genotyping and investigation into potential routes of *Ae. aegypti* introduction are ongoing, and expanded surveillance will continue to determine the persistence of the *Ae. aegypti* population.

We thank Roxanne Connelly (Centers for Disease Control and Prevention, Division of Vector-Borne Diseases Arboviral Diseases Branch, Entomology and Ecology Team) and Linda Kothera (Centers for Disease Control and Prevention) for their guidance and reinforcement. We thank Stacey Bosch (Centers for Disease Control and Prevention, Epidemiology Workforce Branch) for critical review of the manuscript. We thank Han Liu for the figure. Finally, we thank the affected community in York, who opened their properties to additional trapping and made expanded surveillance possible.

### REFERENCES CITED

CDC [Centers for Disease Control and Prevention]. 2018. *Estimated potential range of Aedes aegypti and Aedes albopictus in the United States, 2017* [Internet]. Atlanta, GA: Centers for Disease Control and Prevention [accessed May 27, 2020]. Available from: https://www.cdc.gov/zika/vector/range.html.

HPRCC [High Plains Regional Climate Center]. 2019. *ACIS Climate Maps* [Internet]. Lincoln, NE: High Plains Regional Climate Center [accessed December 7, 2019]. Available from: https://hprcc.unl.edu/.

Janousek TE, Plagge J, Kramer WL. 2001. Record of *Aedes albopictus* in Nebraska with notes on its biology. *J Am Mosq Control Assoc* 17:256–267.

Kothera L, Byrd B, Savage HM. 2017. Duplex Real-Time PCR Assay distinguishes *Aedes aegypti* from *Ae. albopictus* (Diptera: Culicidae) using DNA from Sonicated first-instar larvae. *J Med Entomol* 54:1567–1572. https://doi.org/10.1093/jme/tjx125

Kraemer MU, Sinka ME, Duda KA, Mylne AQ, Shearer FM, Barker CM, Moore CG, Carvalho RG, Coelho GE, Bortel WV, Hendricks G, Schaffner F, Elyzar IR, Teng HH, Brady OJ, Messina JP, Pigott DM, Scott TW, Smith DL, Wint GW, Golding N, Hay SI. 2015. The global distribution of the arbovirus vectors *Aedes aegypti* and *Ae. albopictus*. *eLife* 4:e08347. https://doi.org/10.7554/eLife.08347

NDHHS [Nebraska Department of Health and Human Services]. 2019a. *West Nile virus* [Internet]. Lincoln, NE: Nebraska Department of Health and Human Services [accessed December 7, 2019]. Available from: http://dhhs.ne.gov/Pages/West-Nile-Virus.aspx.

NDHHS [Nebraska Department of Health and Human Services]. 2019b. *West Nile virus data* [Internet]. Lincoln, NE: Nebraska Department of Health and Human Services [accessed December 7, 2019]. Available from: http://dhhs.ne.gov/Pages/West-Nile-Virus-Data.aspx.

Weaver SC. 2014. Arrival of chikungunya virus in the New World: prospects for spread and impact on public health. *PLoS Negl Trop Dis* 8:e2921.

WRBU [Walter Reed Biosystematics Unit]. 2019. *WRBU: providing entomological intelligence and taxonomic expertise* [Internet]. Suitland, MD: Walter Reed Biosystematics Unit [accessed May 27, 2020]. Available from: http://www.wrbu.org/docs/factsheet_ento_intel_final.pdf.

### Table 1. Data on expanded mosquito surveillance—City of York, NE, 2019.

| Mosquito species          | No.  | Relative abundance (%) |
|---------------------------|------|------------------------|
| *Culex pipiens*           | 1,083| 43.58                  |
| *Aedes vexans*            | 661  | 26.60                  |
| *Anopheles quadrivittatus*| 381  | 15.33                  |
| *Ae. aegypti*             | 113  | 4.55                   |
| *Cx. tarsalis*            | 112  | 4.51                   |
| *Ae. triseriatus*         | 99   | 3.98                   |
| *Ae. trivittatus*         | 14   | 0.56                   |
| *Culiceta inornata*       | 10   | 0.40                   |
| *Cx. salinarius*          | 9    | 0.36                   |
| *An. punctipennis*        | 2    | 0.08                   |
| *Cx. erraticus*           | 1    | 0.04                   |
| Total                     | 2,485| 99.99                  |

1 Rounding error, value represents 100% relative abundance.