## SCIENTIFIC NOTE

## AEDES JAPONICUS JAPONICUS IN NEBRASKA AND TEXAS

WILLIAM J. SAMES,<sup>1</sup> JEFF HAMIK,<sup>2</sup> JAMES G. MANN,<sup>3</sup> JOSHUA D. BAST<sup>4</sup> AND R. JASON PITTS<sup>3</sup>

ABSTRACT. Aedes japonicus japonicus continues to spread westward and in this study, its presence is documented in 8 counties in Nebraska and in Bowie County, TX. In 1998, Ae. japonicus was collected in Connecticut, New Jersey, and New York for the 1st records of this species in North America. Except for Louisiana, it has been reported from all states that border or are east of the Mississippi River. In Canada, it has been reported in Ontario and all eastern provinces. In the Pacific Northwest, it has been reported in Washington, Oregon, and British Columbia, and in the midwestern states that do not border the Mississippi River, Kansas, Oklahoma, and South Dakota are the only states to have reported its presence in peer-reviewed journals.

KEY WORDS Culicidae, habitat, mosquito, new records, surveillance

In 1998, Aedes japonicus japonicus (Theobald) was first reported in the USA from collections in Connecticut, New Jersey, and New York (Munstermann and Andreadis 1999, Peyton et al. 1999). Except for Louisiana, it spread to all states that border or are east of the Mississippi River (Kaufman and Fonseca 2014, Riles et al. 2017). In Canada, Fielden et al. (2015) reported *Ae. japonicus* from Ontario and all eastern provinces, and in the Pacific Northwest, *Ae. japonicus* was discovered and reported in Washington, Oregon, and British Columbia (Roppo et al. 2004, Irish and Pierce 2008, Jackson et al. 2016).

Spatial modeling based on climatic variables predicted changes for current and future distributions of *Ae. japonicus* in North America (Peach et al. 2019). Results indicated suitable habitat in all of Louisiana, portions of eastern Texas, in the eastern half of Oklahoma, Kansas, and Nebraska, in all states east of these, and in the Pacific Northwest. The model did not predict suitable habitat for North and South Dakota. In Canada, suitable habitat was predicted only in provinces already known to have established populations of *Ae. japonicus*.

Aedes japonicus was reported in 39 Mississippi counties (Goddard et al. 2017), from Shawnee County, KS (Rogers et al. 2021), and in Ottawa County, OK (Bradt et al. 2018). It has also been reported from Arkansas (Gaspar et al. 2012), Missouri (Claborn et al. 2018, 2019), and Iowa (Dunphy et al. 2009). A 2009 newspaper article reported *Ae. japonicus* in Sioux Falls, SD, and it

mentioned this species as being in Nebraska and Minnesota (Associated Press 2009). Substantiating the newspaper's mention of *Ae. japonicus* in South Dakota and Minnesota, Vincent et al. (2020) reported the South Dakota *Ae. japonicus* records in Lincoln and Minnehaha counties, which are along the Iowa and Minnesota borders, and Neitzel et al. (2009) reported the 1st *Ae. japonicus* records in Minnesota. Peer-reviewed publishing of the Nebraska data and presenting the 1st report of *Ae. japonicus* in Texas were the objectives of this study.

The Nebraska Department of Health and Human Services first collected Ae. japonicus on August 24, 2010, in Falls City, Richardson County (Table 1 and Fig. 1). It was collected in a Centers for Disease Control and Prevention (CDC) light trap (John W. Hock Company, Gainesville, FL) as part of the county surveillance program. Over the next 30 days, Ae. japonicus was collected in CDC light traps in Douglas and Lancaster counties as part of their routine surveillance. In the fall of 2017, it was collected in Cuming and Dixon counties. In 2019, it was collected in Cass and Sarpy counties, and in 2020, it was collected in Jefferson County. During the 2021 surveillance season, Ae. japonicus was again collected in Douglas and Jefferson counties. A total of 35 females from 25 collections in Nebraska were made using 21 CDC light traps, 3 Biogents Sentinel-2 traps (Biogents AG, Regensberg, Germany), and 1 larval collection. Thus far, all counties with Ae. japonicus are in the eastern quarter of the state (Fig. 1). We did not find a data source to support the Associated Press (2009)-reported collection of Ae. japonicus in this state, so earlier data may exist.

In eastern Texas, larval mosquito surveillance was conducted in 2018, 2019, and 2020, with the primary objective of collecting *Culex coronator* Dyar and Knab (Sames et al. 2019, 2021) and a secondary objective of searching for *Ae. japonicus*. These surveys included Texas counties, from Fannin to Sabine County, that bordered Oklahoma, Arkansas,

<sup>&</sup>lt;sup>1</sup> PO Box 547, Leakey, TX 78873.

<sup>&</sup>lt;sup>2</sup> Nebraksa Department of Health and Human Services, Office of Epidemiology, 301 Centennial Mall S, Lincoln, NE 68905.

<sup>&</sup>lt;sup>3</sup> Baylor University, Department of Biology BSB A 159R, 101 Bagby Avenue, Waco, TX 76706.

<sup>&</sup>lt;sup>4</sup> Public Health Command-Central, 2899 Schofield Road, Building 2630, Joint Base San Antonio, San Antonio, TX 78234-6230.

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Table 1. County-level records for Aedes Japonicus in Neoraska and Texas.				
State	County	City or location	Date	Collector
NE NE NE NE NE NE TX	Cass Cuming Dixon Douglas Jefferson Lancaster Richardson Sarpy Bowie	Plattsmouth West Point Ponca Omaha Fairbury Lincoln Falls City Bellevue Texarkana	Jul 23, 2019 Aug 30, 2017 Sep 24, 2017 Sep 22, 2010 Aug 25, 2020 Aug 30, 2010 Aug 24, 2010 Jul 23, 2019 May 25, 2021	Sarpy/Cass Health Department Elkhorn Logan Valley Public Health Department Northeast Nebraska Public Health Department Douglas County Health Department Hamik J, Nebraska Department of Health and Human Services Lincoln-Lancaster County Health Department Southeast District Health Department Sarpy/Cass Health Department Sames WJ, Mann JG, Boyi J

Table 1. County-level records for Aedes japonicus in Nebraska and Texas

and Louisiana, and included counties interior to these border counties (Sames, unpublished data). *Aedes japonicus* was not found during these surveys.

In May 2021, a larval survey specifically searching for *Ae. japonicus* was conducted along the Texas– Louisiana and Texas–Arkansas border and included Bowie, Cass, Harrison, Marion, Panola, Shelby, Smith, Upshur, and Wood counties. Larval surveil-



Fig. 1. Reported records of *Aedes japonicus* in selected midwestern states with new records in Nebraska and Texas highlighted in red. (In Claborn et al. [2018], Newton and Jasper counties, MO, were not listed in the text but were annotated on their map. David Claborn [personal communication, 2021] confirmed that *Ae. japonicus* was collected in Newton and Jasper counties, which are depicted as previous records in this figure.)

lance using dippers and basters was the primary collection method, and attacking adults were collected with vials. While rock hole formations are the primary larval habitat for *Ae. japonicus*, these habitats are lacking in this region of Texas. Tires were targeted as the primary habitat along with water troughs, plastic tubs, ground pools, tree holes, and other containers.

On May 25, 2021, a sample from an unauthorized tire pile (approximately 25 tires) in western Texarkana, TX, resulted in the emergence of a female *Ae. japonicus* (Table 1 and Fig. 1). The specimen was identified using morphological characters by Darsie and Ward (2005) and was confirmed by sequencing a region of the mitochondrial cytochrome c oxidase I gene (Valentini et al. 2009) that showed a >99% match to *Ae. japonicus* by BLASTn search (Zhang et al. 2000).

The site was along a tree line and surrounded by grassy fields and woodlands. A house (300 m) and a commercial building complex (500 m) were the closest human structures. Prior larval surveillance at this site was conducted in March 2019, and March and September 2020. No tires appeared to have been added to the site during this time, which suggested that a gravid female migrated to the site and laid eggs in the tires rather than someone bringing an egg-filled tire to the site. Combining data from all surveillance dates at this site, 6 other species were collected: *Ae. albopictus* (Skuse), *Cx. coronator*, *Cx. quinquefasciatus* Say, *Cx. restuans* Theobald, *Cx. salinarius* Coquillett, and *Culiseta inornata* (Williston).

With *Ae. japonicus* in Arkansas (Gaspar et al. 2012) and Texarkana, TX, bounded by Arkansas to the north and east, it is possible that *Ae. japonicus* simply spread from Arkansas into Texas. However, with Texarkana being along a major east—west corridor represented by Interstate Highway 30 and the collection site being 22 km east of the Red River Army Depot (RRAD), which receives and auctions large quantities of surplus tires, it was necessary to investigate the possibility that *Ae. japonicus* was established at the depot.

Routine surveillance conducted by the RRAD Natural Resources Department in 2019 (14 total CDC light traps over 3 nights in July and August) and 2021 (18 total CDC light traps over 6 nights in July– September) resulted in the collection of 21 species: Ae. aegypti L., Ae. albopictus, Ae. canadensis (Theobald), Ae. epactius (Dyar and Knab), Ae. triseriatus (Say), Ae. trivittatus (Coquillett), Ae. vexans (Meigen), Anopheles crucians Wiedemann, An. punctipennis (Say), An. quadrimaculatus Say, Cx. coronator, Cx. erraticus (Dyar and Knab), Cx. nigripalpus Theobald, Cx. quinquefasciatus, Cx. salinarius, Psorophora ciliata (Fabricius), Ps. columbiae (Dyar and Knab), Ps. cyanescens Coquillett, Ps. discolor (Coquillett), Ps. howardii Coquillett, and Ps. longipalpus Randolph and O'Neill. No surveillance was conducted during 2020 due to coronavirus disease restrictions.

On September 2, 2021, larval surveillance was conducted at RRAD, which resulted in the collection of 5 species (185 larvae and 2 adults). The species were *Ae. albopictus*, *Ae. epactius*, *Ae. triseriatus*, *Orthopodomyia signifera* (Coquillett), and *Toxorhynchites rutilus septentrionalis* Dyar and Knab. *Aedes japonicus* was not collected at RRAD during these surveys, which further suggested the specimen collected in western Texarkana spread from Arkansas or through other interstate transportation.

This study reported data to support the establishment of *Ae. japonicus* in Nebraska since 2010 and in Texas where it appears to be a recent arrival. Peach et al. (2019) predicted *Ae. japonicus* to establish in the eastern half of Nebraska and thus far it has been collected in the eastern quarter of the state. In eastern Texas and based on the map in Peach et al. (2019), we estimate the modeled establishment in Texas to be roughly along Interstate Highway 45 from Galveston to the Dallas/Fort Worth Metroplex, then north into Oklahoma. Additional surveillance in both states will help to further document its spread and determine its limits.

Although Ae. japonicus is not recognized as a major vector of arboviruses to humans in its native range, West Nile, La Crosse, and Usutu viruses have been detected in field-collected specimens (Westby et al. 2015, Camp et al. 2019, DeCarlo et al. 2020). Aedes japonicus adapts well to many different breeding sites, including natural rock holes, discarded tires, and other small containers near human dwellings (Kaufman and Fonseca 2014). Despite being considered a temperate species, one study demonstrated yearlong persistence of Ae. japonicus in a subtropical location in Florida, further demonstrating its adaptability to new environments (Riles et al. 2020). Although Ae. japonicus prefers to feed on mammals, including humans (Apperson et al. 2004, Molaei et al. 2009, Anderson et al. 2018, Goodman et al. 2018), this species may also feed opportunistically on birds in some geographical settings (Schönenberger et al. 2016). When considered collectively, the above studies suggest that Ae. japonicus has the potential to serve as a maintenance or bridge vector for endemic or emerging viral threats and should therefore be the subject of ongoing surveillance and study (Martinet et al. 2019).

We sincerely thank Bethany Bolling and Tony Bosworth for their discussions and comments on this paper. We thank Marty Dial, City of Texarkana Vector Control, Dennis Kuykendall of RRAD, Farida Mahmood for the taxonomic identifications of the RRAD collections, John Boyi and Heidi Lindsley of Baylor University, Anthony Bosworth, David and Margaret Desha, and Pete Unkel for their assistance with mosquito collections along the Texas–Arkansas and Texas–Louisiana borders. We also thank mapchart.net for allowing access and use of their online mapping capabilities in the creation of the distribution map.

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