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Source: Journal of the American Mosquito Control Association, 21(2):144-146. 2005.
Published By: The American Mosquito Control Association
DOI: http://dx.doi.org/10.2987/8756-971X(2005)21[144:OJJTIG]2.0.CO;2
URL: http://www.bioone.org/doi/full/10.2987/8756-971X%282005%2921%5B144%3AOJJTIG%5D2.0.CO%3B2

Journal of the American Mosquito Control Association, 21(2):144–146, 2005

OCHLEROTATUS JAPONICUS JAPONICUS (THEOBALD) IN GEORGIA AND NORTH CAROLINA

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ABSTRACT. Although the 1st published record of *Ochlerotatus japonicus japonicus* in Georgia (Rabun County) occurred in 2004, we report here a 2002 collection and identification in Fulton County, Georgia (metro Atlanta). The finding of *Oc. j. japonicus* in Fulton County represents the most southern record of this species in the United States to date. Also, subsequent collections in North Carolina and 4 additional counties in northeast Georgia are reported.

KEY WORDS *Ochlerotatus j. japonicus,* new records, Georgia, North Carolina

INTRODUCTION

The discovery in 1998 of *Ochlerotatus* (*Finlaya*) *japonicus japonicus* in New York and New Jersey (Peyton et al. 1999) and Connecticut (Andreadis et al. 2001) alerted mosquito control professionals in the eastern United States and Canada that another exotic mosquito species had arrived and was possibly established in the Western Hemisphere. In 2000 and 2001, the earlier findings were accentuated by the discovery of at least 9 positive pools of West Nile virus (WNV) in feral specimens of *Oc. j. japonicus* (Turell et al. 2001b). Subsequent to the initial reports of *Oc. j. japonicus* in Connecticut, New York, and New Jersey, this species was found in Maryland, Ohio, Pennsylvania (Fonseca et al. 2001), Washington (West Nile Virus Surveillance in Washington State, January 2002, http://www.doh.wa.gov/Publicat/2002_news/WestNileVirusSurv.pdf; Roppo et al. 2004), Virginia (Harrison et al. 2002), and South Carolina and Georgia (Reeves and Korecki 2004). Our findings support the Georgia record of Reeves and Korecki (2004) with additional Georgia records and document a specimen identified as *Oc. j. japonicus* in 2002 that is widely recognized by mosquito control professionals in Georgia as the 1st discovery of *Oc. j. japonicus* in Georgia (Fulton County). Also, the 1st records of this species in North Carolina are reported.

MATERIALS AND METHODS

Atlanta in particular was affected significantly by the introduction of WNV in 2001. Consequently, all of the metropolitan counties and numerous other Georgia counties have improved or initiated mosquito control and disease surveillance activities. Fulton County, which includes downtown Atlanta and part of the greater Atlanta suburban area, was one of the 1st counties to respond to the 2001 outbreak, and a significant number of WNV-positive birds and mosquito pools were found in the county. The Fulton County program includes adult monitoring and disease surveillance operations with ABC® light traps (East Greenwich, RI) baited with dry ice, along with other mosquito control operations. In addition to the metro Atlanta area, increased larval surveillance was conducted throughout the state. Larvae that were reared to adults were placed in mosquito breeders (BioQuip®, Gardena, CA), and adult specimens were removed on emergence. North Carolina collections were made during larval surveillance with modified Centers for Disease Control and Prevention (CDC) light traps baited with dry ice. Larvae and adult specimens were identified with keys by Darsie (2002) and Darsie and Ward (1981) and compared with descriptions published in Peyton et al. (1999). Specimens were submitted for preservation to the Georgia Museum of Natural History (University of Georgia, Athens, GA). Specimens from North Carolina were preserved in the Public Health Pest Management collection (Winston-Salem, NC).

RESULTS

The 1st *Oc. j. japonicus* specimen collected in Georgia was on June 30, 2002, in Fulton County (33°76′N, 84°36′W) in a light trap. This specimen was identified by one of the authors (BAH) from an abdomen found in a trap collection submitted for pooling and virus assay. Two additional specimens were collected in Fulton County during June and July of 2003. One specimen came from the same trap site that the 1st specimen was found in 2002, and the 2nd specimen came from a new site (33°68′N, 84°37′W). Additional larval surveys in the northeastern part of the state found larvae of *Oc. j. japonicus* with *Anopheles punctipennis* (Say) and *Culex territans* Walker in White County in rock

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holes along the Chattahoochee River (34°42′N, 83°44′W) near the town of Helen in 2003; with *Ae. albopictus* (Skuse) in Lumpkin County in rock holes along Boggs Creek (34°40′N, 83°54′W) ~8 mi west of the White County site in 2003; with *Ae. albopictus* in Towns County in used tires in Hiawassee (34°54′N, 83°49′W) in 2003 and as early as March 19, 2004, when late-stage *Oc. j. japonicus* instars were found at this site; and in Union County in a bucket in Blairsville (34°51′N, 83°57′W) in March 2004. These records, plus the specimens reported from Rabun County by Reeves and Korecki (2004) indicate that 6 counties in Georgia had confirmed *Oc. j. japonicus* populations.

During 2003, larvae of *Oc. j. japonicus* were confirmed by one of the authors (BAH) in North Carolina from rock pools in Buncombe, Macon, and McDowell counties; a used tire in Cabarrus County; and bird baths and a small plastic dish in Charlotte, Mecklenburg County. In addition, a male was found in a modified CDC light trap in Iredell County. The larvae from Buncombe County came from rock pools on the UNC-Asheville campus, and those from McDowell County were collected in rock pools in Linville Gorge. Macon County specimens were found by one of the authors (MLW) in rock pools along the Callasaja River at 991 m elevation. The Cabarrus County collection site is ~45 km north of Charlotte off Interstate 85. The male captured in Iredell County came from a trap set on a horse farm just east of Statesville, off Interstate 77 and ~65 km north of Charlotte.

DISCUSSION

During the summer of 2002, the initial specimen of *Oc. j japonicus* collected in Fulton County, Georgia, was identified from a single adult male abdomen. The large, silver, basolateral scale patches on abdominal terga II–VII of *Oc. j. japonicus,* although distinct from most other species in the eastern United States, could be confused with those on *Ae. albopictus, Oc. triseriatus* (Say), and *Oc. hendersoni* (Cockerell). However, abdominal tergum VIII on male *Oc. j. japonicus* have silver basolateral spots but lack a basal white band, whereas those of *Ae albopictus, Oc. triseriatus,* and *Oc. hendersoni* have tergum VIII with a wide white basal band and silver basolateral spots.

Finding *Oc. j. japonicus* in Fulton County in 2002 represents the 1st discovery of this species in Georgia and the most southern extension of its range in the United States to date. During the summer of 2003, two additional intact specimens were collected in Fulton County, thereby confirming the 2002 record. Subsequent collections of *Oc. j. japonicus* larvae in 2003 and 2004 in 4 additional counties and in Rabun County (Reeves and Korecki 2004) indicate this species is much more widely distributed in Georgia than in the metro Atlanta area. The initial Fulton County collection site is located in an urban area and not in proximity to a riverine rock hole environment, suggesting that *Oc. j. japonicus* is utilizing artificial containers for immature habitats near this site. The Lumpkin and White county sites are classic rock hole habitats along flowing waterways. These rock holes were similar in description to those described by Scott et al. (2001) in that the water was clear and contained many decaying leaves and algae coated the sides and substrates within the holes. These sites are also similar to those described by Reeves and Korecki (2004) for Rabun County. All of these locations are in the northern portion of the state, in areas considered foothills or piedmont-type topography, with limited interstate travel. This portion of Georgia is the primary region where classic rock holes would be likely to occur along natural waterways. These habitats are much less likely to occur in the sand hill and coastal plain environments, where rocky ledges and outcroppings are infrequent along waterways. However, because this species is known to use a wide range of natural and artificial container habitats other that rock holes and pools (La Casse and Yamaguti 1950, Tanaka et al. 1979, Andreadis et al. 2001), it is expected to spread throughout Georgia, with artificial containers being more important in the southern and coastal portions of the state.

The initial confirmed collection of *Oc. j. japonicus* in North Carolina occurred in Charlotte, Mecklenburg County, on June 20, followed closely by a collection in Cabarrus County on July 11 and another Charlotte collection in August 2003. The adult male was collected on September 9 in Iredell County, which, like the above collections, is also in the middle piedmont region at elevations of $\leq$300 m. The more western mountain collections occurred at elevations of $>$750 m in Macon County (August 17), Buncombe County (September 9), and McDowell County (September 9). The 1st records in the piedmont are a result of well-established and active mosquito surveillance programs in Cabarrus and Mecklenburg counties. The mountain collections occurred in areas without mosquito control programs or where larval surveillance is not a routine occurrence.

The simultaneous 1st collections of this species in 2 distinct regions of Georgia and North Carolina suggest 2 possible mechanisms of introduction for *Oc. j. japonicus* into these states. Although both mechanisms would be based primarily on artificial containers, the method of dispersal of the containers is very different. The 1st would be along major interstate highway systems (I-75, I-77, and I-85) in the piedmont regions via artificial containers transported by humans, as was found during the spread of *Ae. albopictus* (Moore and Mitchell 1997). We hypothesize that the 2nd method is via rock holes and containers scattered along the river systems of the Appalachian and Blue Ridge mountain chains. These rivers and streams often flood after heavy

rains, and eggs of *Oc. j. japonicus* oviposited in rock holes, in artificial containers in or beside the rivers and streams, and possibly on wooden debris in rock holes would almost certainly be washed long distances downstream during storms. This would greatly enhance the spread of this species in mountainous regions of the country. It would also possibly explain the initial appearances of this species in the mountainous regions of the more southern states where it has been found.

At present, there are no published reports of *Oc. j. japonicus* as a pest in North America, although personal communications suggest that it is an avid human biter for approximately the 1st hour after dark (M. Sardelis, personal communication, Maryland; N. Caldwell, personal communication, Tennessee). *Ochlerotatus j. japonicus* could be involved in the WNV cycle because it has been found naturally infected with this virus (Turell et al. 2001b) and has been found a highly efficient vector of WNV in the laboratory (Sardelis and Turell 2001, Turell et al. 2001a). However, the importance of this species as a pest or a vector in Georgia and North Carolina has yet to be determined.

ACKNOWLEDGMENTS

CDC Cooperative Agreement U50/CCU420516 supported the sampling conducted in Union and Towns counties, Georgia. The Tennessee Valley Authority provided surveillance funds (contract 99RE3-250585) for work in Lumpkin County, Georgia. Clarke Mosquito Control, Inc., provided technical support that detected the 1st specimen of *Oc. j. japonicus* in Georgia. Jim Ericson, Chrystal Swinger, Jessica Maddox, and Parker Whitt collected and identified specimens in North Carolina. Nolan Newton, Public Health Pest Management, NCDENR, Raleigh, NC, performed mosquito surveillance.

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