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GEOGRAPHIC DISTRIBUTION OF *OCHLEROTATUS JAPONICUS* IN NEW YORK STATE

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ABSTRACT. Tires and other water-holding containers throughout New York State were sampled during 2000 for the presence of immature or adult *Ochlerotatus japonicus* to determine the geographic distribution of this species. Waste tire stockpiles were one of the primary sites surveyed. Immature or adult *Oc. japonicus* were confirmed in 18 counties in New York State, including the northernmost recorded occurrence of this species in the United States.

KEY WORDS *Ochlerotatus japonicus*, mosquito, tires, New York State

INTRODUCTION

In Asia, *Ochlerotatus japonicus japonicus* (Theobald) (Reinert 2001) is a container-breeding species found in a variety of natural and artificial collections of water. Larval surveys conducted in Japan by the U.S. Army found that 95% of larval *Oc. japonicus* were collected from either movable (e.g., barrels and buckets) or stationary (e.g., cisterns and latrines) artificial containers (LaCasse and Yamaguti 1948). Larval surveillance data from the eastern USA have largely confirmed these observations (Andreadis et al. 2001, Scott et al. 2001). Fonseca et al. (2001) assumed that the introduction and spread of *Oc. japonicus* in the USA was associated with trade in scrap tires. Tires were not listed as a larval source among the 18 categories listed in the Army surveys of 1946 and 1947 (LaCasse and Yamaguti 1948), probably because at that time tires were a controlled commodity in occupied Japan. In 1993, Laird et al. (1994) reported finding *Oc. japonicus* and 3 other species in scrap tires imported to New Zealand from Japan.

Waste tire stockpiles containing more than 1,000 tires are regulated as solid waste disposal sites by the New York State Department of Environmental Conservation (NYSDEC). Stockpile regulations involve both environmental and health issues including fire potential, proximity to bodies of water, road accessibility, and presence of potential vector insects and rodents. Currently, more than 100 regulated sites exist, which contain approximately 24 million tires. Six of these sites contain more than 1 million tires each and 1 site has an estimated 8–9 million discarded tires and is reported to be the 3rd largest waste tire stockpile in the USA. Here we report on our investigations of tires and other artificial containers for the presence of *Oc. japonicus* in New York State.

MATERIALS AND METHODS

A list of the regulated tire facilities, including county and town locations and specific addresses, was obtained from central and regional offices of the NYSDEC. Sampling during 2000 emphasized sites in relative proximity to the 4 major interstate transportation routes (Fig. 1).

We collected mosquitoes at each site by various collection methods, including larval dipping, mouth-aspirated adult landing collections, and carbon dioxide–baited New Standard Miniature Light Traps (John W. Hock Company, Gainesville, FL). We sampled readily accessible tires that were on the ground or in low piles. Stockpiles were sampled for approximately 60 min or upon obtaining a sample of more than 100 larvae. We recorded water temperatures of each tire sampled for *Oc. japonicus* with a Reotemp™ digital thermometer (Model TM99A, Reotemp Instrument Corporation, San Diego, CA).

Specimens were transported alive in coolers to the New York State Department of Health laboratories at Griffin Laboratory in Albany or the State University of New York, College of Environmental Science and Forestry, Syracuse. Aspirated adults were killed by placing them in a −60°C freezer for approximately 5 min. After preserving a representative sample of larvae from each collection site, the remaining immatures were transferred to mosquito emergence chambers (BioQuip Products, Inc., Gardena, CA) and held in a programmable incubator at 22°C until all specimens had emerged or died. Adult and immature specimens were identified to species by using keys of Stojanovich (1961) and Means (1979, 1987). We checked larval morphologic characteristics suggested by B. Harrison (personal communication) for the separation of larval *Oc. japonicus* from *Ochlerotatus atropalpus* (Coquillett). Adult specimens of suspected *Oc. japonicus* were compared to the description of *Oc. japonicus* published by Peyton et al. (1999). Collections of *Oc. japonicus* made by local health departments (LHDs) during West Nile virus (WN)

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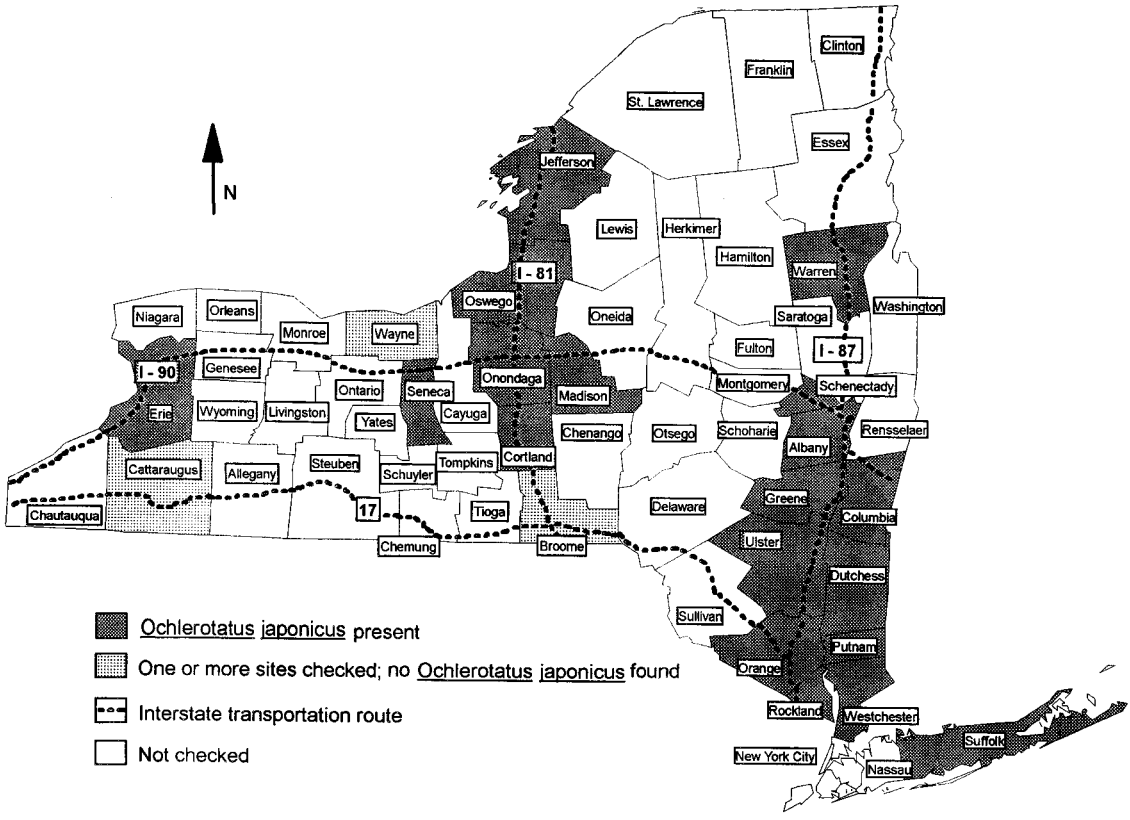

Fig. 1. Location of sites surveyed by county for the presence of *Ochlerotatus japonicus* in New York State, 2000.

surveillance programs also were included as county records for this species if the authors confirmed identification of 1 or more specimens of *Oc. japonicus.*

RESULTS

We surveyed 9 regulated waste tire stockpiles between May and September 2000 and collected immature or adult *Oc. japonicus* from 4 stockpiles in 4 counties. Three of the sites were along the Route 81 corridor in Cortland, Oswego, and Jefferson counties (Fig. 1) and the 4th was along the Route 90 corridor in Seneca County. The Jefferson County site was approximately 5 km west of Watertown. *Ochlerotatus japonicus* was not found in the remaining regulated waste tire stockpiles in Jefferson (1), Wayne (1), Cattaraugus (1), and Erie (2) counties.

No apparent ecological or entomological differences were found among stockpiles with or without *Oc. japonicus.* We collected immature *Oc. japonicus* from tires exposed to full sunlight, and partial to full shade. Negative sites had similar settings. Water temperatures in tires containing larvae ranged from 11.1 to 23.9°C during June through September. Water temperatures of 32 tires sampled at 8 negative stockpiles ranged from 18.3 to 27.2°C during June through September. At sites with *Oc. japonicus,* the most frequently observed immatures of other species were *Ochlerotatus triseriatus* Say followed by *Oc. atropalpus, Culex restuans* Theobald, and *Culex territans* Walker. The same species were found at stockpiles where no *Oc. japonicus* were present. The most abundant species collected in landing collections at all sites was *Oc. triseriatus,* with an occasional *Oc. atropalpus.* Collections of adult mosquitoes from New Standard Miniature Light Traps included small numbers of *Oc. japonicus.* Two male and 2 female *Oc. japonicus* were collected from light traps set June 7 on the perimeter of a large tire pile bordering a NYSDEC-regulated wetland in Oswego County. Other species found in this collection included *Aedes cinereus* (Meigen), *Anopheles punctipennis* (Say), *Anopheles quadrimaculatus* Say, *Coquillettidia perturbans* (Walker), *Culiseta melanura* (Coquillett), *Ochlerotatus canadensis* (Theobald), *Ochlerotatus stimulans* group (i.e., *Ochlerotatus stimulans* (Walker), *Ochlerotatus fitchii* (Felt and Young), and *Ochlerotatus excrucians* (Walker)), and *Ochlerotatus trichurus* (Dyar).

Mosquito surveillance activities by LHDs resulted in the documentation of *Oc. japonicus* in 11 oth-

er counties. Larvae were collected from a water trough in Rockland County and discarded tires in Orange, Dutchess, Ulster, Columbia, Albany, Schenectady, Greene, and Onondaga counties (Fig. 1). Adults were collected in carbon dioxide–baited light traps in Madison and Erie counties.

DISCUSSION

We confirmed the presence of *Oc. japonicus* in 18 New York State counties during 2000. Although now documented in only 19 of 62 counties, the species probably is present in other counties. Mosquito collection data from new or expanded county mosquito surveillance programs throughout New York State may reveal additional geographic locations for *Oc. japonicus* during 2001. Although no *Oc. japonicus* were observed at a single unregulated tire pile sampled in Broome County, the senior author collected this species from a single tire behind a rural residence in Harvey's Lake, PA (Lake Township, Luzerne County), approximately 115 km south of the Broome County site.

Establishing the presence of *Oc. japonicus* at even the largest waste tire stockpiles was remarkably easy. On 2 occasions, adults were found sitting on the surface of the water dipped from tires. Resting males and females were aspirated from the inside walls of tires at other sites and females could be observed as they alighted on the investigators during tire sampling. Stockpiles and tires were the primary sources used to establish the presence of this species in New York State but larvae also were found in other artificial containers, including tarps, buckets, and pool covers.

The earliest collection of *Oc. japonicus,* in late March, was of 4th-stage larvae collected from a rain barrel in Dutchess County (Luke, personal communication). Although this observation suggests that this species may overwinter in the larval stage, we were unable to collect larvae from iced-over tires in October at a stockpile where *Oc. japonicus* was abundant. The latest specimens collected in the season were adults in early October from the Oswego County stockpile.

The 1st report of *Oc. japonicus* in the USA was based on the identification of adults collected in 1998 from sites in Suffolk County, Long Island, NY, and Ocean County, NJ (Peyton et al. 1999). A recent search of archived specimens that had been collected in Hamden, New Haven County, CT, in 1998 revealed 2 *Oc. japonicus* and is the earliest reported finding of this species in the USA (Andreadis et al. 2001). In 1999, this species was confirmed from 2 additional counties in New York, Connecticut, and 7 counties in New Jersey. The geographic range of specimens collected in the USA during 1999 were Shelter Island, Suffolk County, NY; Frederick, MD; Oak Hill, OH; and Kent, CT (Fonseca et al. 2001). During 2000, the reported finding of this species from Salem, MA (Armstrong, personal communication) and near Watertown, Jefferson County, NY, as reported herein, expanded the range of *Oc. japonicus* to the east and north, respectively. This species now appears established in a 850,000-km^2 (635 × 1,330-km) area of the Northeast and upper Midwest. The range of *Oc. japonicus* has not expanded as rapidly in the USA as has the range of the Asian tiger mosquito, *Aedes albopictus* (Skuse). The 1st report of *Ae. albopictus* in the USA was from Houston, TX, in 1985 (Knudsen 1986). In 1987, it was found at the waste tire site in Oak Hill, OH, approximately 1,960 km to the northeast. It did take an additional 8 years for *Ae. albopictus* to expand into New Jersey (Crans, personal communication). Although the concerns over the involvement of *Ae. albopictus* as a presumed vector of arboviruses in the USA have largely not been realized (Knudsen 1986, Shroyer 1986), the role of *Oc. japonicus* as a vector of WN is open to speculation. Laboratory studies indicate that *Oc. japonicus* is a highly efficient vector of WN (Turell et al. 2001). In New York, isolations of WN were reported from pools of *Oc. japonicus* submitted from Columbia (1), Orange (2), Rockland (1), and Westchester (1) counties (White et al. 2001). However, inoculation of Vero cells with suspensions of these same pools failed to yield infectious virus particles and the high mosquito infection rate, 0.7 of 1,000, may be attributed to the fact that the number of specimens per pool ranged from 3 to 12 (Kramer, personal communication). The association between *Oc. japonicus* and WN would be strengthened if the 2 expand concurrently in the forthcoming years. A better understanding of the life history of this species is needed to explain its rapid range expansion in the USA. Studies of its adult behavior have been limited by the difficulty of collecting large numbers of specimens with existing mosquito trapping methodologies.

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