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DISCOVERY OF AN EXOTIC ASIAN MOSQUITO, *OCHLEROTATUS JAPONICUS*, (DIPTERA: CULICIDAE) IN SOUTHERN INDIANA

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ABSTRACT. *Ochlerotatus (Oc.) japonicus*, an exotic Asian mosquito, appeared in New York, New Jersey and Connecticut in 1998. The species now inhabits 20 eastern states, Washington state and Quebec, Canada. *Oc. japonicus* was found at three sites near an existing railway system in Clark County, southern Indiana, in July 2004. During the 2004 sampling season, the species was found in small numbers at 20 of 100 sampling locations in Clark, Floyd and Harrison counties. Most early samples were taken near existing railway and interstate transportation systems. Later, in September and October, the mosquito expanded its range into other habitats. This invading non-indigenous species should be monitored closely since it is a known vector for several viral pathogens including those responsible for West Nile fever, Saint Louis encephalitis, Japanese encephalitis and eastern equine encephalitis.

Keywords: *Ochlerotatus japonicus*, Indiana, Diptera, Culicidae

Ochlerotatus (Oc.) japonicus, the Asian rock pool mosquito, is an exotic species that was introduced into the United States in 1998, possibly in shipments of used tires entering New York, New Jersey and Connecticut (Peyton et al. 1999). Since the initial discoveries, the mosquito has been quickly expanding its range (Fonseca et al. 2001). By the end of 2003, it was found in Quebec, Canada and 19 states: Connecticut, Delaware, Georgia, Maine, Massachusetts, Maryland, North Carolina, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, Vermont, Washington and West Virginia (Scott 2004). It is almost certain that the Ohio specimens found in 1999 came from New York or New Jersey since they were trapped near a tire retreading business that regularly receives shipments from the east coast (Berry 1999).

Since *Ochlerotatus japonicus* has a short flight range of less than 1.6 km, its rapid movement into several states presumably was facilitated by interstate trade and transit (Fonseca et al. 2001). Studies have shown that another Asian mosquito, *Aedes (Ae.) albopictus*, may have arrived in Texas in a shipment of used tires and then spread across southeastern USA along the interstate highway system (Moore & Mitchell 1997). *Aedes albopictus* currently is very common in many southern states. *Ochlerotatus japonicus* could be moving westward in a similar fashion, hitching a ride in tires and other containers found on barges, trains and trucks. Alternatively, the species may have had a more direct transit via airline, train or truck traffic from the west coast.

RESULTS

We report the first Indiana appearance of *Ochlerototus (Oc.) japonicus* in Clark County, southern Indiana. In July 2004, the first specimens of *Oc. japonicus* appeared in mosquito nets set by Indiana University Southeast researchers. We suspected the mosquito was a new species for Indiana and forwarded the unidentified specimens to the Indiana State Department of Health where Brad Foster and Adam Estes verified the identification. In August 2004, Dina Fonseca of the Smithsonian Institution further substantiated the identifi-

cation using mitochondrial DNA-sequencing techniques.

The first Indiana specimens were trapped in early July 2004 in both urban and rural areas of Clark County, very near an existing active railway. In the immediate vicinity of the trap locations, we found water-filled artificial containers, small drainage systems with pooled water and older trees with tree holes. These locations correspond well with published habitat data from New Jersey, Connecticut and New York (Andreadis et al. 2001). Nets in which *Oc. japonicus* were found typically contained specimens of *Culex pipiens* and *Aedes albopictus*.

After the initial finding, we established base-line information at our sampling locations so that we can follow the distribution and numbers in subsequent years. Briefly, during sampling from May–October 2004, we found 48 *Oc. japonicus* in about 20,000 mosquito specimens at 20 of 100 sampling locations. We also found the species at one location in Salem, Indiana (Washington County). Of these 21 locations, 15 were less than 0.4 km from the railway system. As the sampling season progressed, specimens were found in more traditional settings near failing septic systems (2 stations), the interstate highway system (2 stations), arboreal settings (1 station) and a tire dump (1 station).

DISCUSSION

The failure to detect *Ochlerotatus japonicus* in Indiana in previous sampling seasons may be related to the low capture frequency of this species using traditional light and gravid trap methods. Andreadis et al. (2001) found *Oc. japonicus* in 0.5% of 182,590 adult female mosquitoes taken in 1999 and 2000. In these samples, the light and gravid traps produced less than 2.5 mosquitoes per trap.

Our results compare favorably with those published by Andreadis et al. (2001). We found the new mosquito in 0.25% of 20,000 mosquitoes with a capture rate of 1–3 mosquitoes per trap. Once our finding was publicized and other researchers developed search images for this species, other counties began to report its occurrence. Therefore, it is tempting to conclude that the mosquito may have been present for some time and is now being detected because researchers are searching for the organism. In fact, the mosquito could have arrived with *Aedes albopictus* via movement of goods along interstate and water transportation routes. To adequately assess the numbers of *Oc. japonicus* in Indiana, sampling efforts should include collections of larvae from natural habitats where the species is known to lay its eggs (rock pools, tree holes, and spring-fed depressions).

Travel and the rapid transcontinental movement of products are known to be potent forces in the emergence of disease (Wilson 1995). Invading non-indigenous species can cause public health problems, and the number of introductions is expected to rise (Fonseca 2001). In addition to being found in used tires, *Ae. albopictus* and *Oc. japonicus* have also been found in a variety of other materials: Lucky Bamboo (an ornamental lily in the genus *Dracaena*), imported machinery, and in airplanes (Linthicum et al. 2003).

Ochlerotatus japonicus is important from a public health perspective because it can spread the pathogens responsible for West Nile virus, St. Louis encephalitis, eastern equine encephalitis, and Japanese encephalitis (Sardelis & Turrell 2001; Sardelis et al. 2002; Sardelis et al. 2003; Takashima & Rosen 1989; Turrell et al. 2001). In Japan, the mosquito sometimes bites humans who venture into forested habitats (Peyton et al. 1999). In Connecticut in wooded habitats, Andreadis et al. (2001) found that human bait enhanced by CO_2 attracted *Oc. japonicus*. This suggests that the species will feed on humans.

Unlike many other mosquitoes (e.g., *Ae. albopictus* and *Ae. aegyptii*), *Oc. japonicus* readily inhabits areas such as Hokkaido, Japan where winter temperatures drop below −18 °C. (Fonseca et al. 2001). With its ability to survive very cold winters, we expect *Oc. japonicus* to spread throughout most of the northern United States and Canada.

The discovery of *Oc. japonicus* in southern Indiana verifies the importance of existing mosquito control and monitoring programs. The selection of natural predators and competitors, elimination of mosquito habitat, and regulation of insects on trade vessels are a few of the many actions being taken to slow the introduction of foreign species. On a local level, public awareness and education are key factors; however, research into the spread of these vectors is of equal importance. Today's unprecedented swift transit of goods has set

the stage for the spread and emergence of additional infectious diseases. It is essential, therefore, to research how these mosquitoes disperse and take action to protect our local environments.

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