OPERATIONAL AND SCIENTIFIC NOTES

THE DISCOVERY AND DISTRIBUTION OF *AEDES ALBOPICTUS* IN HARRIS COUNTY, TEXAS

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On August 2, 1985, numerous adults and larvae of an unknown species of *Aedes* were collected from several widely separated tire dumps, in and around the city of Houston, Texas. Specimens sent to Dr. Y.-M. Huang at the U. S. National Museum, were identified as *Aedes albopictus* (Skuse), a container-breeding species, indigenous to the Oriental and Australian regions. *Aedes albopictus* has been collected three times previously in the United States (Pratt et al. 1946, Eads 1972, Reiter and Darsie 1984), but this is the first record of breeding populations established in the continental United States.

A survey of Harris County was begun on August 22 to determine the frequency, abundance and distribution of *Ae. albopictus* in water-filled containers, especially tires. Organization of the survey was based upon the coded system of sectors used by the Harris County Mosquito Control District to identify specific regions within the county. Under this system, Harris County is divided into 268 sectors, averaging 6.6 square miles. Once *Ae. albopictus* was found breeding on a site, we considered the entire sector in which the sample was taken to contain Ae. *albopictus*. We then proceeded to survey the next successive sector. In this way, the 1,765 square miles of the county could be surveyed in a minimal amount of time.

The survey was completed on October 11, with 178 (66.4%) of the sectors from all parts of the county being investigated. Twenty-three water-filled containers and 166 used tires were found with mosquito larvae of 8 different species (Table 1). Surprisingly, *Ae. albopictus* was both the most abundant and frequently collected species. *Aedes albopictus* was found in 125 (75.3%) of the used tires and in 17 (73.9%) of the water-filled containers harboring mosquito larvae. Of the 2,950 larvae identified during the survey, 1,564 (53%) were *Ae. albopictus*.

The distribution of *Ae. albopictus* extended to the northern, eastern and southern borders of the county (Fig. 1), suggesting the presence of this species in Montgomery, Liberty, Chambers and Galveston counties as well as Harris County. Extreme differences in distribution and frequency of collection of *Ae. albopictus* larvae in water-filled tires were observed between eastern and western portions of the county. In the east, *Ae. albopictus* was found in 100% of the tires which contained mosquito larvae, while none of the tires in the southwestern portion of the county held that species.

Table 1. Species, numbers and percentages of larvae collected from water-filled containers during the period from August 22 to October 11, 1985.

Species	Number collected	Percentage of total collected
Aedes albopictus	1,564	53.0
Culex quinquefasciatus	670	22.7
Aedes aegypti	525	17.8
Aedes triseriatus	75	2.6
Toxorhynchites rutilis septentrionalis	54	1.8
Orthopodomyia signifera	36	1.2
Culex territans	17	0.6
Culex salinarius	9	0.3

The exact date and means by which this spe-

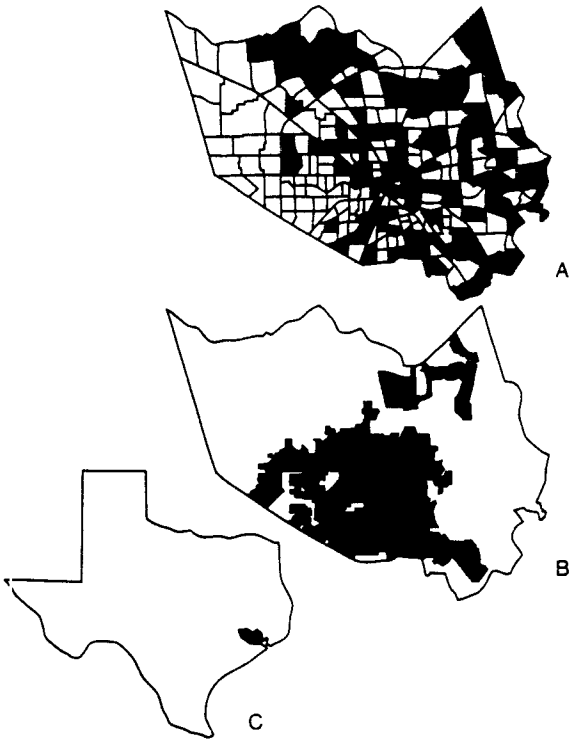

Fig. 1. A. The distribution of *Aedes albopictus* in Harris County. B. Houston city limits within Harris County. C. Location of Harris County in Texas.

cies entered the county is unknown. The abundance and widespread distribution of *Ae. albopictus* suggest that it has been present for many months and possibly years. Since *Ae. albopictus* was not observed during a county survey of used tires conducted in 1980, we believe the introduction occurred after that date.

The introduction of *Ae. albopictus* increases the risk of reintroduction of dengue viruses into the United States by its capacity for both vertical and horizontal modes of transmission. Dengue viral serotypes 1, 2 and 4 have been isolated from wild caught *Ae. albopictus* in Asia (Gould et al. 1968, Russell et al. 1969, Chan et al. 1971). Rosen et al. (1983) have demonstrated that *Ae. albopictus* is capable of transmitting all 4 viral serotypes of dengue transovarially. *Aedes albopictus* has been considered to be less important than *Ae. aegypti* (Linn.) as an epidemic vector of dengue viruses in areas of the world where the distributions of the two species are sympatric (Chan et al. 1971). However, it has been incriminated as the primary epidemic vector in cases where *Ae. aegypti* was rare or absent (Sabin et al. 1952, Metsellaar et al. 1980, Qui et al. 1981).

Aedes albopictus may be easily transported as larvae in the shipment of used tires (Eads 1972), a method of dispersal recognized for *Ae. aegypti* (Pratt et al. 1946, Haverfield and Hoffman 1966, Keirans 1969). Adults are comparatively short fliers, 475 yards was the maximum distance flown in tests conducted in Hawaii (Bonnet and Worcester 1946); therefore flight may be relatively unimportant in the dispersal of this species. Nevertheless, we have observed autogeny in females, reared from larvae brought into our laboratory, which suggests that transportation of adult females could also be important in dispersal.

The gravity of the introduction of *Ae. albopictus* presents a unique challenge because of its possible implications to public health in the Western hemisphere and potential impact upon international politics. Knowledge of the complete distribution of the infestation will be essential to future decisions as to the appropriate course of action. Therefore it is necessary to determine whether other as yet undetected populations of *Ae. albopictus* currently exist in other parts of the continental United States.

Surveillance techniques presently used for *Ae. aegypti* may be employed for *Ae. albopictus*. Adults are diurnal (Usinger 1944) and from our surveillance records, since recognizing the introduction, few are attracted to New Jersey light traps. Although females are attracted to oviposition traps there are no keys available to separate the eggs of *Ae. albopictus* from those of *Ae. aegypti*. The eggs of these species may be distinguished by scanning electron microscopy (Matsuo et al. 1972); however, this is not feasible for survey purposes. For this reason, we have found that larval surveillance with a soup ladle, rather than a standard dipper, to be the quickest and easiest means of surveying tires and water-filled containers. Larvae and adults may be identified using the keys and descriptions of Huang (1968, 1972, 1979).

We wish to express our sincere appreciation to Dr. Y.-M. Huang, Department of Entomology, Smithsonian Institution Washington, D.C., for the identification of our specimens.

References Cited

Bonnet, D. D. and D. J. Worcester. 1946. The dispersal of *Aedes albopictus* in the territory of Hawaii. Am. J. Trop. Med. Hyg. 26:465–476.

Chan, Y. C., B. C. Ho and K. L. Chan. 1971. *Aedes aegypti* (L.) and *Aedes albopictus* (Skuse) in Singapore City. 5. Observations in relation to dengue haemorrhagic fever. Bull. W.H.O. 44:651–657.

Eads, R. B. 1972. Recovery of *Aedes albopictus* from used tires shipped to United States ports. Mosq. News 32:113–114.

Gould, D. J., T. M. Yuill, M. A. Moussa, P. Simasathien and L. C. Rutledge. 1968. An insular outbreak of dengue haemorrhagic fever. III. Identification of vectors and observations on the vector ecology. Am. J. Trop. Med. Hyg. 17:609–618.

Haverfield, L. E. and B. L. Hoffman. 1966. Used tires as a means of dispersal of *Aedes aegypti* in Texas. Mosq. News 26:433–435.

Huang, Y.-M. 1968. Neotype designation for *Aedes (Stegomyia) albopictus* (Skuse) (Diptera: Culicidae). Proc. Entomol. Soc. Wash. 70:267–302.

Huang, Y.-M. 1972. Contributions to the mosquito fauna of Southeast Asia. XV. The subgenus *Stegomyia* of *Aedes* in Southeast Asia. I. - The *scutellaris* group of species. Contrib. Am. Entomol. Inst. (Ann Arbor). 9(1):1–109.

Huang, Y.-M. 1979. Medical entomology studies - XI. The subgenus *Stegomyia* of *Aedes* in the Oriental region with keys to the species (Diptera: Culicidae). Contrib. Am. Entomol. Soc. Inst. (Ann Arbor). 15(6):1–79.

Keirans, J. E. 1969. Larval development of *Aedes aegypti* (L.) in used tires. Mosq. News 29:43–46.

Matsuo, K., Y. Yoshida and I. Kunou. 1972. The scanning electron microscopy of mosquitoes (Diptera: Culicidae). I. The egg surface of five species of *Aedes* and *Armigeres subalbatus*. J. Kyoto Prefect. Univ. Med. 81:358–363.

Metselaar, D., C. R. Grainger, K. G. Oei, D. G. Reynolds, M. Pudney, C. J. Leake, P. M. Tukei, R. M. D'Offay and D. I. H. Simpson. 1980. An outbreak of type 2 dengue fever in the Seychelles, probably transmitted by *Aedes albopictus* (Skuse). Bull. W.H.O. 58:937–943.

Pratt, J. J., R. H. Heterick, J. B. Harrison and L.

Haber. 1946. Tires as a factor in the transportation of mosquitoes by ships. Mil. Surgeon 99:785–788.
Qui, F., H. Zhang, L. Shao, X. Luo and Y. Yu. 1981. Studies on the rapid detection of dengue virus antigen by immunofluorence and radioimmunoassay. Chinese Med. J. 94:653–658.
Reiter, P. and R. F. Darsie. 1984. *Aedes albopictus* in Memphis, Tennessee (USA): An achievement of modern transportation? Mosq. News 44:396–399.
Rosen, L., D. A. Shroyer, R. B. Tesh, J. E. Freier and J. C. Lien. 1983. Transovarial transmission of dengue viruses by mosquitoes: *Aedes albopictus* and *Aedes aegypti*. Am. J. Trop. Med. Hyg. 32:1108–1119.
Russell, P. K., D. J. Gould, T. M. Yuill, A. Nisalak and P. E. Winter. 1969. Recovery of dengue 4 viruses from mosquito vectors and patients during an epidemic of dengue hemorrhagic fever. Am. J. Trop. Med. Hyg. 18:580–583.
Sabin, A. B. 1952. Research on dengue during World War II. Am. J. Trop. Med. Hyg. 1:30–50.
Usinger, R. 1944. Entomological phases of the recent dengue epidemic in Honolulu. Public Health Rep. 59:423–43.

A STANDARDIZED PROCEDURE FOR THE QUANTITATIVE SURVEILLANCE OF CERTAIN *CULEX* MOSQUITOES BY EGG RAFT COLLECTION

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Mosquitoes of five genera, *Coquillettidia*, *Culex*, *Culiseta*, *Sabethes* and *Uranotaenia*, lay their eggs in the form of compact floating rafts. The size, shape, and appearance of these eggs rafts is so distinctive that they are readily visible and easy to collect. Although their morphologic characteristics are often insufficient for species identification, hatching normally occurs within hours or days of oviposition, and the resulting larvae can be readily identified in the first instar (Dodge 1966, Haeger and O'Meara 1983). Egg raft collections, coupled with larval taxonomy, can therefore be useful for monitoring population levels and oviposition activity (Service 1976, Madder et al. 1980, Leiser and Beier 1982).

Among the *Culex* species that are important vectors, many share a preference for oviposition sites with a high level of microbial activity. This feature can be exploited by placing hay infusions or other live cultures in artificial oviposition sites to collect their egg rafts (Service 1976). A difficulty with this approach is that the microbial flora of such attractants is constantly changing, so that rapid changes in the attractance of the oviposition medium are inevitable (Ikeshoji et al. 1975; Kramer and Mulla 1979). An ideal method might be to identify the attractant substances and then use them in measured dosages in the field, but this has yet to be achieved. An alternative is to develop a strict routine for producing and using the attractant. The procedure described in this note was developed in Memphis, Tennessee for monitoring the activity of *Culex restuans* Theobald and *Culex pipiens* s.l. and has been in routine use for 4 years.

The basis of the method was suggested by Mr. J. Haeger of the Florida Medical Entomology Laboratory, Vero Beach. An oviposition attractant, produced by steeping 0.5 kg of grass-hay and 5 gm each of lactalbumen powder and dried brewer's yeast in 114 liters of water for 6 days, is left overnight in a large black pan at the required site and egg rafts collected on the following day. The rafts are hatched in the laboratory and identified to species in the first instar.

Figure 1 shows a convenient arrangement for producing the attractant. It consists of two 120-liter garbage cans, one placed inside the other. The outer can is mounted on a 4-wheel dolly and has a spigot installed near its base. The base of the inner can is perforated with a

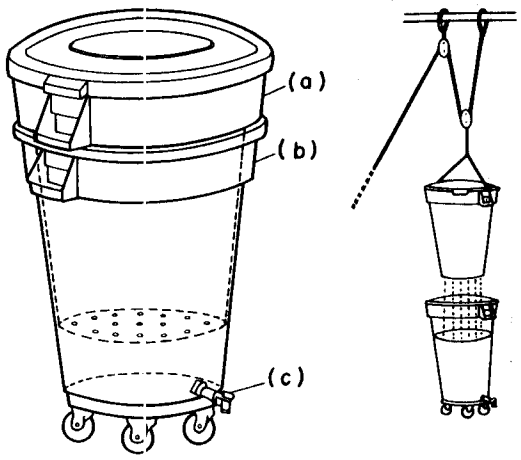

Fig. 1. Arrangement for production of attractant. (a) Inner can, (b) Outer can, (c) Spigot.

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[2] The use of trade names or commercial sources is for identification only and does not constitute endorsement by the Public Health Service or by the U.S. Department of Health and Human Services.