FIRST RECORD OF BREEDING POPULATIONS OF *AEDES ALBOPICTUS* IN CONTINENTAL AFRICA: IMPLICATIONS FOR ARBOVIRAL TRANSMISSION

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ABSTRACT. Eggs of *Aedes albopictus* were collected in oviposition cups from 3 forested areas of Delta State in south-central Nigeria during September 1991 as part of a post-yellow fever outbreak investigation. These eggs were shipped to the Centers for Disease Control in Colorado, where they were reared to the adult stage and identified. This is the first record of breeding populations of *Ae. albopictus* in continental Africa. Other taxa reared from the same oviposition cups included *Ae. aegypti*, *Ae. apicoargenteus*, *Ae. africanus*, *Ae. lilii* and *Ae. simpsoni* subgroup. The introduction and establishment of *Ae. albopictus* in Africa may have important implications for transmission of indigenous arboviruses.

Delta State, Nigeria, experienced a yellow fever (YF) epidemic from April 15 to July 20, 1991. A rapid assessment team estimated that 600–1,200 cases of YF occurred in Ika Local Government Area, Delta State, with human fatalities of 300–600 (P. Moore and D. J. Gubler, personal communication).

As part of a follow-up investigation of this epidemic, mosquito oviposition cups were placed in 4 rural communities of Ika and Aniocha Local Government Areas, Delta State that had experienced YF activity. These communities are located within a 24 km radius of the principal town of Agbor (Fig. 1). The vegetation of the study area is deciduous forest referred to as derived savanna, which represents a transition zone between the lowland rain forest zone and the drier guinea savanna zone typical of central Nigeria. In the 4 surveyed communities, areas immediately surrounding human dwellings, typically at a radius of 5–10 m, are cleared and farmed as large gardens. Secondary forests still exist near most villages as strips stretching from the edge of each village to extensive farmlands located 2–3 km from the village. These forests are traversed by footpaths and jeep roads and include economically important trees such as kola nut, banana, breadfruit, oil-palm, lime and papaya trees.

In September 1991, 700 cc plastic mosquito oviposition cups with cloth liners were placed on the ground in the forest edge at an average distance of 200 m from human dwellings. Liners were collected after 48 h and those with eggs of *Aedes* mosquitoes were sent to the Division of Vector-Borne Infectious Diseases (DVBID), Centers for Disease Control (CDC), Ft. Collins, CO. Eggs were hatched and larvae mass-reared, by locality, to the adult stage for specific identification. *Aedes albopictus* (Skuse) was present in collections from 3 communities: Igbodo, IX-12-1991; Owa-Alero, IX-27-1991; and Egbudu-Aka, IX-27-1991. Specimens from the 2 largest collections, Igbodo and Owa-Alero, were combined by taxonomic group in an effort to start colonies before their numbers were recorded by locality. The composition of the 271 specimens in combined collections from Igbodo and Owa-Alero follows: *Ae. aegypti* (Linn.), 73.8%; *Ae. albopictus*, 18.1%; *Ae. apicoargenteus* (Theobald), 4.0%; *Ae. lilii* (Theobald), 2.6%; and *Ae. simpsoni* subgroup (sensu Huang 1988), 1.5%. The 14 specimens from Egbudu-Aka represented only 2 taxa: *Ae. albopictus*, 64%; and *Ae.*

Fig. 1. Study area in Delta State, Nigeria. Local Government Areas within Delta State are in large type, and communities are in small type.

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africanus (Theobald), 36%. An additional 8 adults were reared from Mbiri on IX-17-1991, and all were identified as *Ae. africanus*. A representative series of *Ae. albopictus* has been deposited in collections of the U.S. National Museum, Washington, DC.

Egg collections of *Ae. albopictus* from 3 separate localities, none of which are associated with harbors or with tire dumps, indicate that this species is well established in this area of Delta State. These collections represent the first record of breeding populations of *Ae. albopictus* in continental Africa.

Recently, live larvae of *Ae. albopictus* were found on 3 separate occasions entering South Africa in used tires imported from Japan (Cornel and Hunt 1991). These recent collections in South Africa, along with previous introductions of *Ae. albopictus* into the United States and Brazil via used tires from Asia (Reiter and Sprenger 1987), suggest that importation of used tires was the most likely method of introduction into Nigeria. As inspection of imported cargo for mosquitoes is rare in Africa, other undetected established populations of *Ae. albopictus* may be present.

Field and laboratory data indicate that *Ae. albopictus* is susceptible to or an efficient vector of a number of viruses that currently cause human disease in Africa including dengue (DEN), YF, chikungunya, Rift Valley fever and West Nile viruses (Tesh et al. 1976, Shroyer 1986, Mitchell 1991). *Aedes albopictus* is highly anthropophilic, able to utilize both artificial and natural containers for oviposition, and is an aggressive colonizer as demonstrated by its rapid spread and establishment in North America, Brazil and various islands of the South Pacific (Hawley 1988, Moore et al. 1988). The further spread and establishment of *Ae. albopictus* in Africa from established populations in Nigeria and other undetected populations seems likely based on the colonization history of this species. Indeed, *Ae. albopictus* may displace *Ae. aegypti* in some areas as has occurred in some areas of the southern U.S. (Hobbs et al. 1991) and alter established arbovirus transmission cycles.

Of particular concern to public health officials is the potential role of *Ae. albopictus* in DEN and YF transmission, two viruses indigenous to Africa that continue to cause epidemic disease. Strains of *Ae. albopictus* from Asia and strains introduced into North America are efficient vectors of DEN (Gubler and Rosen 1976, Rosen et al. 1985, Mitchell et al. 1987). In addition to its role in epidemic transmission, *Ae. albopictus* may act as a reservoir host and facilitate endemic transmission due to its ability to transmit dengue viruses vertically (Rosen et al. 1983). Vector competence studies on different strains of *Ae. albopictus* introduced into North and South America indicate that *Ae. albopictus* is a competent vector of YF virus (Mitchell et al. 1987, Miller and Ballinger 1988). Virus transmission studies with African strains of YF virus and *Ae. albopictus* from Nigeria are in progress.

Due to its utilization of a wide variety of oviposition sites, its biting habits, and its competence as a YF virus vector in the laboratory, *Ae. albopictus* may link the sylvan and urban YF transmission cycles. Our data indicate that *Ae. albopictus* already has colonized both villages and rural forested areas in Delta State. This, in conjunction with the recent YF epidemic in Delta State, suggests that the components of the above scenario are already in place in some areas of Nigeria.

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Note added in proof: After this manuscript was accepted for publication, 3 egg collections from Oju Local Government Area, Benue State, Nigeria, were sent to CDC, Ft. Collins, by V. I. Ezike and A. C. N. Nwankwo. One collection (Ega-Okileme, X-29-1991) contained 14 *Ae. aegypti* specimens. Two collections contained *Ae. albopictus* and other taxa as follows: Adum East, XI-6-1991, 16 *Ae. albopictus*, 13 *Ae. aegypti* and 13 *Ae. simpsoni* complex; and Anyuwogbu, XI-4-1991, 19 *Ae. albopictus* and 15 *Ae. aegypti*. The 2 *Ae. albopictus* collection sites in Benue State are located approximately 255 km ENE of the localities in Delta State.

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