CONTROL OF AN OUTBREAK OF MOSQUITO-BORNE ENCEPHALITIS ALONG THE COLORADO RIVER IN 1983

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In the summer of 1983, a large scale mosquito surveillance and control program was initiated along the Colorado River to control a flood-induced outbreak of mosquito-borne encephalitis. The overall program was a cooperative effort among state and county agencies in Arizona and California, the Indian Health Service, and the Centers for Disease Control (CDC).

In July 1983, the flow of the Colorado River from Davis Dam at Bullhead City, Arizona, was increased from 20,000 cubic feet/second (cfs) to over 40,000 cfs to accommodate excessive snow melt run-off from the Rocky Mountain watershed. The levees along the river south of Davis Dam were able to contain much of the water releases. However, flooding did occur outside the levees where ground water levels rose and formed hundreds of acres of shallow seepage pools. Fig. 1 identifies major problem areas. Large seepage pools formed near Yuma (500 acres), Cibola (200 acres) and Ehrenberg (200 acres) on the Arizona side of the river, and California was similarly affected. Thousands of acres of land were flooded around Topock Marsh where dikes eroded and collapsed. An estimated 7,000 acres of flooded land were potential habitats for immature mosquitoes in the Mohave Valley area alone. Flooded areas provided ideal mosquito breeding habitat. Residents in Mohave Valley, Yuma and Cibola reported large numbers of mosquitoes. Adult and larval mosquitoes collected from these locations were identified as *Culex tarsalis* Coq., the vector species for St. Louis encephalitis (SLE) and western equine encephalitis (WEE). Landing counts were taken in the Mohave Valley area shortly after dusk since this corresponds with the peak activity of *Culex tarsalis* mosquitoes. It was estimated that individual residents were exposed to more than 1,800 mosquitoes per hour.

Four confirmed and three suspected human SLE cases with onsets in July, August and September were attributed to the mosquito/arbovirus outbreak (Fig. 1). Three cases occurred in Arizona; two suspected cases in Yuma and one confirmed case in Mohave Valley. Three confirmed SLE cases occurred in California; one each in Winterhaven, Bard and Blythe. One suspected SLE case was reported in Needles (Centers for Disease Control 1983).

Mosquito/arbovirus surveillance was initiated in late July. Dipping counts and identifications of larvae were made in flooded areas, and adult mosquito populations were monitored nightly with New Jersey light traps. Mosquitoes were also collected with CO_2 light traps in early August by representatives of the CDC in order to measure arbovirus activity in mosquito populations. *Culex tarsalis* was the predominant species present. Seven-hundred-and-one pools of *Culex tarsalis* mosquitoes (approximately 68,000 mosquitoes) were tested by the CDC using primary duck embryo cell culture. Ninety-nine pools were positive for SLE, 23 pools were positive for WEE, and 1 pool was positive for Turlock virus. (U.S. Department of Health and Human Services and World Health Organization 1983). Other species collected were *Culex quinquefasciatus* Say, *Cx. thriambus* Dyar, *Cx. erythrothorax* Dyar, *Aedes vexans* (Meigen), *Anopheles franciscanus* McCracken and *Psorophora columbiae* (Dyar and Knab).

The Arizona Department of Health Services initiated large scale aerial applications of pesticide at Mohave Valley on August 13. Seven-thousand acres were treated with larvicide Abate 2G® (2% granular temephos) at a rate of 2.5 lb./acre of formulation, using fixed wing aircraft. Larvicide applications were followed in 36 hours, weather permitting, by adulticide applications. Approximately 10,000 acres were sprayed with Cythion® (91% malathion) to control adult mosquitoes. Cythion was applied at a rate of 3 oz/acre in 100 ft. swaths by a helicopter equipped with Micron® ultra low volume nozzles. Adulticide was applied at night, starting 30 minutes after sundown, since this corresponds with peak activity of *Culex* mosquitoes. The larvicide and adulticide cycles were repeated approximately every 15 days. Fig. 2 shows reductions in mosquito populations that resulted from application of larvicides and adulticides at Mohave Valley as measured by a New Jersey light trap. A single light trap was set-up in a residential area of Mohave Valley, and the trap contents were collected and sorted daily.

Applications of larvicides and adulticides were also made in repeating cycles at Yuma, Cibola and Ehrenberg. Applications were initiated in Yuma on August 24 and in Ehrenberg and Cibola on September 2. The larvicide used at these locations was granular *Bacillus thuringiensis* var. *israelensis* (*Bti*) and was applied at a rate of 5 lb./acre of formulation. For most larvicide

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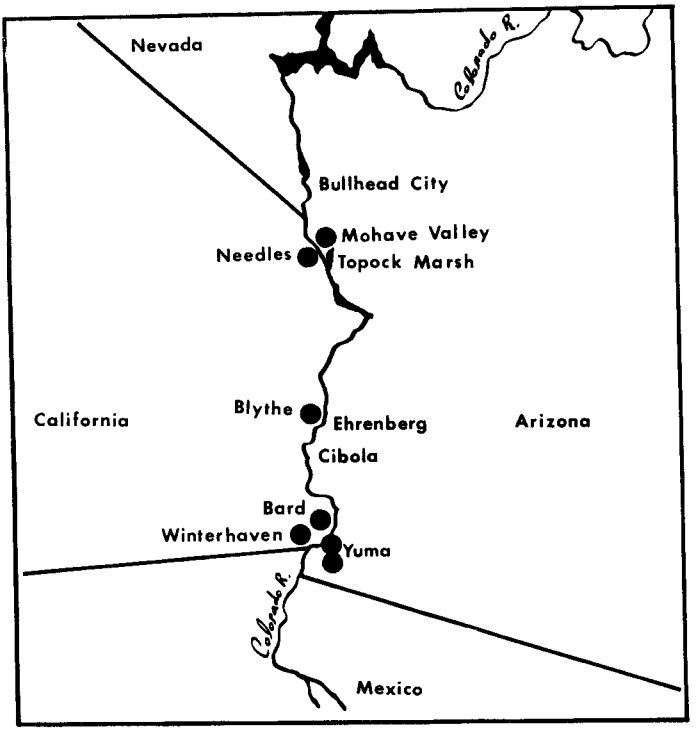

Fig. 1. Map of the Colorado River showing locations of human St. Louis encephalitis cases (black dots) in the summer of 1983.

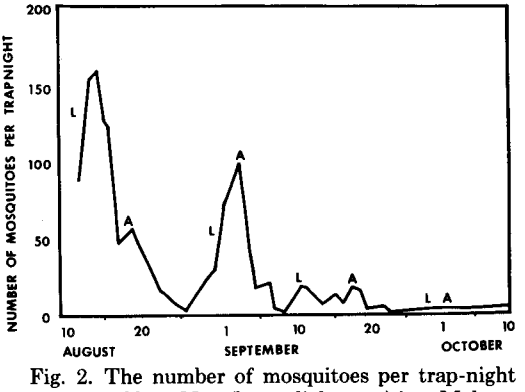

Fig. 2. The number of mosquitoes per trap-night (as measured by a New Jersey light trap) in a Mohave Valley community during the first two months of the control program. **L** indicates larvicide applications and **A** indicates adulticide applications.

applications (Abate and *Bti*), larval dipping counts were made at target areas before and after treatments. Efficacy of larvicides was excellent. Pretreatment larval dipping counts varied greatly, although samples of 25–150 mosquito larvae/dip were common in flooded areas. No live mosquito larvae were observed in dipping samples taken 48 hours after larvicide applications.

The control program continued into early November. During the 1983 mosquito control program, 96,592 acres received adulticides and 42,460 acres were treated with larvicides along the Colorado River in Arizona.

The mosquito control program was successful. Assuming an incubation period of up to 15 days from the bite of an infected mosquito to onset of symptoms, no human cases of SLE in Arizona occurred with probable exposure after mosquito control measures began.

We wish to acknowledge the efforts of the Centers for Disease Control in Fort Collins, Colorado, for their laboratory surveillance of arboviruses. We are also grateful to the San Bernadino County Health Department in Needles, California, and members of the Indian Health Service for monitoring the light trap in Mohave Valley during the mosquito control program. The California Department of Health provided information on human SLE cases in California.

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