

# PROGRESS REPORT OF THE *Aedes Aegypti* ERADICATION PROGRAM IN THE UNITED STATES FOR 1965<sup>1</sup>

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The background leading up to, and a description of the initiation of, field operations for the eradication of *Aedes aegypti* in the United States (including Hawaii), Puerto Rico and the Virgin Islands have been published by Schliessmann (1964), Schliessmann and Magennis (1964) and Dukelow and Alden (1965). When these operations were initiated in June 1964 as an outgrowth of the collaborative effort by nations of the Americas to eradicate urban yellow fever from the Western Hemisphere, this vector of urban yellow fever and dengue had been eradicated from all mainland countries of the Western Hemisphere except the United States, Venezuela, Colombia and French Guiana (Anonymous 1964). In 1965, however, reinfestations were discovered in San Salvador, El Salvador and in Nuevo Laredo, Mexico. Eradication efforts are now in progress in all infested countries of the hemisphere, except some of the islands in the Caribbean.

Ecologically, *Aedes aegypti* is a semi-tropical mosquito characterized as a domestic mosquito with human preferential biting habits, and having a limited flight range. Prior to the initiation of the eradication program in the United States, it was believed that its breeding sites were confined almost entirely to artificial containers in the immediate proximity of hu-

man habitations. While there is an abundant supply of preferred breeding sites, such as discarded automobile tires, automobile bodies, refrigerators and other appliances, tin cans, bottles, jars, etc., in the immediate environs of many dwellings, these items are also scattered over large vacant and overgrown areas in U. S. cities and suburbs and to a considerable extent in wooded rural areas. Contrary to earlier beliefs, *Aedes aegypti* are being readily found breeding in these discarded containers in such areas at distances up to approximately one-half mile from the nearest human habitation. Tree-hole breeding has been found in most areas, and in south Florida the axils of leaves of travelers palms and air plants or bromeliads often serve as breeding sites.

The operational plan for the program in the United States evolved from the procedures utilized by other countries of the Americas that had successfully achieved eradication, and from methods developed during the conduct of a pilot eradication project in Pensacola, Florida (Morlan 1963). In Central and South America, where community water supplies are minimal or non-existent in much of the area, eradication has been accomplished largely through categorized programs conducted by the central governments to control interior household breeding occurring in containers used for the collection and storage of water. However, in the United States where the breeding habitats occur mainly outside dwellings and primarily in

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the litter accumulated by an affluent society that has failed to develop or apply procedures for the sanitary storage, collection and disposal of refuse, the eradication program is being conducted as a generalized vector control and sanitation program in cooperation with State and local health departments. The evolved plan of operations in the United States consists of (1) entomological inspections to determine the occurrence of infestations, (2) insecticidal spraying of *Aedes aegypti* larval breeding sites and of selected adult resting sites, (3) community environmental sanitation or source reduction activities to rid the human environment of water-holding containers, and (4) periodic reinspection and application of remedial measures until eradication is achieved.

To achieve maximum local cooperation and participation, the operations are being conducted under contractual arrangements with the departments of health of the States lying within the infested area. Under this arrangement, the Public Health Service develops and provides operational guidelines and evaluation criteria; furnishes most of the major items of supplies and equipment; assigns technical staff to State and local areas; trains personnel; develops public information materials; and conducts investigations for evaluating and improving eradication techniques. The States assign a senior staff member who arranges for office and warehouse facilities; develops and reviews operational plans to assure that the eradication effort is being conducted in conformity with State policies; establishes and maintains liaison with other State and local governmental agencies for attainment of their maximum cooperation and participation in the eradication program; and employs the labor force and ancillary personnel required in operations. Aside from these contributions by the cooperating agencies, the program is totally financed by the Federal government.

The initial plan provided for the initiation of concurrent State programs throughout the infested area, with field operations

in all major urban areas. Limited funds precluded such extensive activities, and in the spring of 1964 field operations were begun in the Virgin Islands, in 10 selected urban portions of Puerto Rico, in 7 southern counties in Florida, and in 4 counties in Texas. Considerations prompting selection of these areas were knowledge of their heavy infestation, continuous breeding throughout the year, or high potential for infesting neighboring countries. Operations were expanded in the late summer of 1965 to include coverage of virtually all heavily infested areas in Puerto Rico, Florida, and Texas, and a contract was negotiated with Hawaii. Preliminary negotiations are currently underway which will permit expansion of activities into heavily infested counties of Alabama, Georgia and South Carolina. Operations are currently being conducted by approximately 175 Federal and 1600 State contract employees.

The usual pattern of operations, following a public information campaign and recruitment and training of personnel, consists of premises inspections and insecticidal treatment of all existing and potential breeding containers and adjacent adult resting habitats within a 1-block radius of observed infestations.

DDT, because of its long residual action and economy, is the insecticide of choice on the mainland where the mosquito species is susceptible. Malathion is utilized in Puerto Rico and the Virgin Islands where the species is resistant to the chlorinated hydrocarbons. Both insecticides were initially applied as a 2.5 percent water emulsion. The concentration of DDT was reduced to 1.25 percent following field investigations that confirmed its effectiveness, and a water suspension is now being substituted for the emulsion. Reinspections and any required insecticidal treatments of areas are conducted on a 3-month cycle where DDT is used and on a 2-month cycle where malathion is used. Major used tire lots and other primary foci are inspected and treated monthly. Extensive efforts are made to involve the

community in source reduction or community premises sanitation following initial knock-down of heavy infestations.

Progress of work in the operational areas has been hampered by technical considerations and logistical problems associated with the procurement of equipment and recruitment of personnel. Pre-program survey data indicated that rural infestations were confined to a relatively limited geographical area, and that primary problems of infestations were associated with lower socioeconomic areas of communities—areas generally characterized by poor housing and having accumulations of refuse on premises and vacant lots.

Operational results in urban areas have disclosed in excess of 80 percent of the premises infested in parts of Puerto Rico and the Virgin Islands, and up to 70 percent block-infestation rates on the mainland. Rural infestations have also proved to be much heavier and more widespread than previously indicated. Used automobile tires represent the most frequent source of larval development and long-distance dissemination of eggs, and reinfestations have been associated with intra- and interstate commerce in used tires. To add to the complexity of the problem, larvae have also been recovered with considerable frequency in tree holes and bromeliads and, contrary to common belief, at distances in excess of  $\frac{3}{8}$  of a mile from human habitations.

Significant reductions in infestations have been achieved in all operational areas, and portions of many areas appear to be free of infestations. No positives have been found on successive inspections in Coamo, Puerto Rico and several counties along the U. S.-Mexico border. The cities of Key West, St. Petersburg, and Bradenton, Florida, and the Island of St. John in the Virgin Islands and Vieques off the coast of Puerto Rico are rapidly approaching negativity. These results are highly encouraging and tend to confirm the validity of the operational procedures. In addition, results have demonstrated the mutual benefits that can accrue by coordinating the eradication effort with

local vector control and community sanitation programs. Premises sanitation has been improved, concerted efforts have been made by several public works departments to collect and dispose of accumulations of community refuse and litter, and local ordinances permitting pick-up and disposal of abandoned automobiles have been passed. The net effect of such cooperative activity in premises sanitation lies not only in the elimination of many conditions contributing to persistent infestations, rodent-harborage, and presence of other vectors, but also in improvement of the environmental health and aesthetic appearance of communities.

During the past two summers, surveys were conducted in 5,257 communities in 639 counties in 10 southeastern States to provide more precise information on the scope of the problem. The surveys reaffirmed the extensiveness of rural and urban infestations as disclosed by the operational programs and revealed widespread infestations throughout Florida; southern Alabama and Georgia; and portions of Mississippi, South Carolina, and Texas. Louisiana, Arkansas, Tennessee, and western Mississippi were characterized by scattered areas of infestations. The six known positive cities in these latter states (Alexandria, La.; Vicksburg, Miss.; El Dorado and Texarkana, Ark.; and Chattanooga and Memphis, Tenn.) were subjected to reinspections and insecticidal treatments by mobile crews.

Surveillance data would suggest that, with the exception of the Tennessee communities having large used tire processing centers, which are subject to continuous reinfestations, the area of the Mississippi River Valley comprising Arkansas, Louisiana, Tennessee, and western Mississippi is free of *Aedes aegypti* or, if the species is present, that infestations are nominal. While similar conditions were observed in portions of Texas, Mississippi, Alabama, South Carolina, and Georgia, no conclusive hypothesis for the apparent lack of infestations in the Mississippi Valley has been advanced other than the activity of some biological agent(s). It should be

noted that limited infestations have been found in North Carolina but some of these may prove to be of a transitory nature.

As an essential supportive element of the operation, laboratory and field research represent a continuing aspect of the program. Field collections of *Aedes aegypti* are obtained at periodic intervals and tested to determine any change in susceptibility to insecticides. In a limited collaborative study undertaken to evaluate the hazard to wildlife resulting from the use of pesticides on this program, no significant damage has been indicated to bird population in the treated areas in south Florida. Studies in progress to develop more effective and economical procedures include evaluations of alternate insecticides, chemosterilants, potential biological agents, and various types of dispersal equipment. Plans are being finalized for the extensive operational use of Abate in larvicidal treatment of potable water stored in containers in areas not served by community water supplies, and in bird baths and animal watering pans in all areas. In addition, studies are continuing for the development or improvement of oviposition and adult traps for detection of the mosquito in areas of low infestations.

**CONCLUSION.** Field operations for the eradication of *Aedes aegypti* from the United States were begun in 26 locations in 1964 and were greatly expanded in 1965. Significant reductions have been achieved, with a few areas rapidly approaching negativity. In infested areas, the mosquito breeding has been found to be more abundant and more widely distributed throughout both urban and rural areas than was anticipated. An analysis

of field operations and surveys conducted throughout the yellow fever receptive area has permitted a more precise definition of the scope of the problem and has more clearly defined the technical and logistical complexities of the operations. The surveys throughout the Mississippi River Basin, supplemented by limited field operations, indicate that a large geographical segment of the yellow fever receptive area is either free of infestations or that the mosquito is present in exceedingly small numbers. Research for the development of new or improved methodology is being continued and field programs will be underway in parts of all heavily infested states by the end of FY 1966. Despite technical and logistical problems which have tended to defer the anticipated timetable for achieving eradication, the results clearly indicate the feasibility of eradication. With continued budgetary support, eradication will be accomplished, the threat of yellow fever and dengue eliminated, and concurrent environmental improvements affecting some 40,000,000 people will be achieved.

#### References

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