# THE 1958 *AEDES AEGYPTI* DISTRIBUTION IN THE UNITED STATES

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Yellow fever is one of the most severe diseases affecting mankind. In the past, great epidemics of this disease have exacted large tolls. For example, in 1878 New Orleans had 13,817 cases with 3,984 deaths out of a population of 216,000 (Boyce, 1906). While the occurrence of yellow fever has been greatly reduced or eliminated from large areas of the world, the virus is still active in the tropical forests of South America and Africa, and the urban vector, the *Aedes aegypti* mosquito, is widely distributed. Because of the continual danger, the World Health Organization classified yellow fever as one of the six quarantinable diseases. By international agreement, when the occurrence of one of these diseases is suspected, it must be reported. Upon confirmation, quarantine measures are applied (World Health Organization, 1957). These measures were imposed in the case of yellow fever which was found in Biche, Trinidad, in January 1959.

Recently there has been a renewed awareness of the threat of yellow fever to the United States (Hayes and Tinker, 1958). In the past few years, an epizootic of jungle fever has moved from an enzootic focus in Panama through Central America to the Mexico-Guatemala border, posing a threat of overland introduction of yellow fever into the United States. The greater threat, however, is that of introducing the virus by means of infected mosquitoes, persons, or animals brought in by surface shipping or air travel. Thus, in those continental and overseas areas of the United States where *Ae. aegypti* continues to exist, there is a continuous possibility of a recurrence of epidemic urban yellow fever.

Three steps have been taken in the United States to prepare defenses against this threat. First, international quarantine measures have been intensified to reduce the chances of entrance of the virus (Hughes and Porter, 1958). Second, surveys have been conducted to determine the extent of the susceptible area (Bradley and Atchley, 1953; Hayes and Tinker, 1958). Third, a pilot eradication project was initiated in November 1957, in Pensacola, Florida, to determine the methodology and cost of conducting *Ae. aegypti* eradication.

Surveys to determine the distribution and density of *Ae. aegypti* have been conducted periodically since 1943 by the Communicable Disease Center and its predecessor, the Malaria Control in War Areas program. During World War II, surveys were made in connection with *Ae. aegypti* control projects in Gulf and South Atlantic port communities. In order to maintain current information on the species, Communicable Disease Center personnel conducted surveys of 31 communities in 1952 and of 25 in 1956. In July 1957, funds for conducting yellow fever investigations were made available to CDC by the Division of Foreign Quarantine. With these funds the surveillance program was continued with surveys in 38 communities in 1957, and the *Ae. aegypti* eradication pilot project was initiated. By the 1958 season, the areas of the United States in which *Ae. aegypti* could be found had been generally established (Hayes and Tinker, 1958). However, data were lacking for a number of areas, for example, the northern boundary in South Carolina and the western boundary in Texas. These data were supplied by the more comprehensive surveys in 1958.

Surveys for *Ae. aegypti* were of two types prior to 1958. The first involved only the recording of premises found breeding the mosquito during control pro-

TABLE 1.—Locations, types, and results of *Aedes aegypti* surveys conducted in 1958 by the communicable disease center

| States (by east-west tiers) | Type of Survey | | | Number of premises surveyed | Results * |
|---|---|---|---|---|---|
| | Qualitative urban | Quantitative urban | Exploratory rural | | |
| Florida | Ft. Lauderdale | | | 23 | + |
| | Ft. Myers | | | 45 | — |
| | Gainesville | | | 118 | — |
| | Ocala | | | 13 | + |
| | St. Augustine | | | 12 | + |
| | Tallahassee | | | 42 | + |
| | | Panama City | | 216 | 0.0% |
| | | Sarasota | | 225 | 0.0% |
| | | Vero Beach | | 294 | 0.0% |
| | | | Escambia Co. | 29 | + |
| | | | Polk Co. | 68 | — |
| South Carolina | Beaufort | | | 75 | — |
| | Florence | | | 18 | + |
| | Greenville | | | 2 | + |
| | Spartanburg | | | 29 | + |
| | Sumter | | | 101 | — |
| | | Columbia | | 272 | 22.8% |
| | | | Georgetown Co. | 90 | + |
| Georgia | Brunswick | | | 21 | + |
| | Columbus | | | 38 | + |
| | Macon | | | 38 | + |
| | Savannah | | | 56 | — |
| | Thomasville | | | 11 | + |
| | Tifton | | | 112 | — |
| | Waycross | | | 15 | + |
| | | Atlanta | | 518 | 11.6% |
| | | Gainesville | | 225 | 0.0% |
| | | | Thomas Co. | 53 | — |
| | | | Dodge Co. | 155 | — |
| Alabama | Dothan | | | 2 | + |
| | Huntsville | | | 25 | — |
| | Montgomery | | | 4 | + |
| | Selma | | | 2 | + |
| | Tuscaloosa | | | 4 | + |
| | | Birmingham | | 429 | 14.4% |
| | | | Covington Co. | 60 | + |
| Mississippi | Clarksdale | | | 17 | — |
| | Columbus | | | 50 | — |
| | Greenville | | | 43 | — |
| | Meridian | | | 9 | + |
| | Natchez | | | 62 | — |
| | Pascagoula | | | 45 | — |
| | Tupelo | | | 24 | — |
| | | Vicksburg | | 313 | 0.6% |
| | | | Montgomery Co. | 155 | — |
| Louisiana | Alexandria | | | 9 | + |
| | Lafayette | | | 10 | — |
| | Lake Charles | | | 25 | — |
| | | Shreveport | | 340 | 0.0% |
| | | | St. James Parish | 97 | — |

* Percent of premises found breeding given only for quantitative urban surveys.

TABLE 1—*Continued*

| States (by east-west tiers) | Type of Survey: Qualitative urban | Quantitative urban | Exploratory rural | Number of premises surveyed | Results * |
|---|---|---|---|---|---|
| Texas | Abilene | | | 63 | — |
| | Ft. Worth | | | 23 | — |
| | Huntsville | | | 11 | — |
| | Kerrville | | | 11 | + |
| | Lubbock | | | 21 | — |
| | Midland | | | 19 | — |
| | Paris | | | 6 | + |
| | San Angelo | | | 36 | — |
| | Uvalde | | | 22 | — |
| | Victoria | | | 23 | — |
| | Waco | | | 1 | + |
| | Wichita Falls | | | 33 | — |
| | | Austin | | 231 | 1.3% |
| | | Tyler | | 210 | 18.1% |
| | | | Trinity Co. | 117 | — |
| New Mexico | | Carlsbad | | 249 | 0.0% |
| Arizona | | Tucson | | 269 | 0.0% |
| North Carolina | Charlotte | | | 98 | — |
| | Fayetteville | | | 83 | — |
| | Greensboro | | | 92 | — |
| | New Bern | | | 60 | — |
| | Rocky Mount | | | 69 | — |
| | Salisbury | | | 80 | — |
| | Wilmington | | | 86 | — |
| | | Asheville | | 319 | 0.0% |
| | | Raleigh | | 388 | 0.0% |
| Tennessee | Dyersburg | | | 73 | — |
| | Memphis | | | 46 | — |
| | Murfreesboro | | | 43 | — |
| | Pulaski | | | 23 | — |
| | Waverly | | | 19 | — |
| | | Chattanooga | | 336 | 0.3% |
| | | Jackson | | 190 | 0.0% |
| Arkansas | Arkadelphia | | | 11 | — |
| | El Dorado | | | 3 | + |
| | Ft. Smith | | | 12 | — |
| | Hot Springs | | | 7 | + |
| | Jonesboro | | | 25 | — |
| | Texarkana | | | 23 | — |
| | | Little Rock | | 297 | 0.0% |
| Virginia | Danville | | | 95 | — |
| | Franklin | | | 107 | — |
| | | Portsmouth | | 423 | 0.0% |
| Missouri | Cape Girardeau | | | 21 | — |

* Percent of premises found breeding given only for quantitative urban surveys.

cedures. The sample size was usually large because all premises were inspected as part of the control program. The second type of survey had no connection with control work. Instead, premises on which *Ae. aegypti* breeding was considered possible were inspected in surveys lasting one week or less in a community. The sample size was relatively small, and the ability of the surveyor to select likely premises was important in determining results.

In 1958, three types of surveys were used to develop three sets of facts: quantitative urban surveys of 19 cities in which blocks inspected were selected by random sampling techniques to obtain a statistically valid determination of the magnitude of the species population; qualitative urban surveys of 65 cities where the presence of the species was determined in as short a time as possible; and exploratory rural surveys of 9 counties in which likely premises were inspected to discover breeding of the species in such areas.

The population statistics for *Ae. aegypti* from surveys made prior to 1958 are not strictly comparable since no standard method was employed for determining which blocks within the communities were to be sampled. Considerable bias in determining the population size was possible since each inspector selected his own blocks to be sampled. This bias was reduced in the 1958 quantitative urban surveys by selecting stratified random samples previous to the survey in each community. The samples were divided as follows: business premises, 10 percent; substandard residential premises, 60 percent; and standard residential premises, 30 percent. The rate of infestation by *Ae. aegypti* was expressed as the percentage of the inspected premises found breeding the mosquito.

Only the presence or absence of the species in the locality was determined with certainty in surveys made prior to 1958. In examining data from previous surveys, it was found that an extensive survey was not necessary to obtain only these qualitative data. A one- to two-day check of the most favorable habitats in the community was usually sufficient. In 1957, *Ae. aegypti* was found on the first day of the survey in 17 of 18 cities where the species was found, and on the second day in the eighteenth city. In fact, if the species was common, it was usually found in the first few favorable habitats inspected; this was the case in 11 of the 18 positive 1957 surveys, 4 of the 6 positive 1958 quantitative urban surveys, and 14 of the 23 positive 1958 qualitative urban surveys. By spending only enough time in a community to determine the presence of *Ae. aegypti*, a surveyor could visit many more cities.

There was little information on the rural occurrence of the species prior to the 1958 season, since only one of the previous *Ae. aegypti* surveys had been in a rural area. This information will be required in planning control and eradication programs. If *Ae. aegypti* were as common in rural as in urban areas, a much more extensive eradication program would be required. For this reason, exploratory rural surveys were made in counties where occurrence of the species was considered possible.

The 1958 surveys disclosed a large number of negative findings, especially in areas previously believed to be infested (Hayes and Tinker, 1958) (Table 1 and Figure 1). Lake Charles, Louisiana, and Memphis, Tennessee, were negative in 1958, although *Ae. aegypti* had been found in both cities in 1956. The absence of *Ae. aegypti* from Memphis was verified later in 1958 by the Tennessee Department of Public Health. Of the 42 cities where seaport and airport facilities were inspected by the Division of Foreign Quarantine, *Ae. aegypti* was found in only one, Savannah, Georgia, where they were not found during CDC surveys. Since 3 subsequent surveys of the Savannah port facilities by the Division of Foreign Quarantine and a survey of the whole city by CDC have failed to disclose further infestations, this positive finding was probably a temporary import. In the 9 rural surveys, only Escambia County, Florida, and Covington County, Alabama, had large *Ae. aegypti* populations. Only one of the premises was found breeding the

species in the other positive rural surveys; those of Georgetown County, South Carolina, and Thomas County, Georgia. No *Ae. aegypti* was found in St. James Parish, Louisiana, where in 1945 the last epidemic of dengue fever in the United States occurred.

The distribution of *Ae. aegypti* as determined from the 1956–58 surveys is shown in Figure 2. The shaded portion represents areas from which *Ae. aegypti* has been reported at least once since 1900, and was determined from a compilation of all published and unpublished reports obtainable. The limits were obtained by connecting the locations of the geographically extreme records. It is noteworthy that most of the extreme records were made in the period 1944–46. The distribution outlined in the present report differs somewhat from previous ones (Bradley and Atchley, 1953; Hayes and Tinker, 1958) by indicating the absence of records for the Appalachian area and west Texas. Records were found for only eight locations west of a line drawn from Wichita, Kansas, to Del Rio, Texas. Records of collections made east of the line are quite numerous. In Texas, the species has been found in 48 counties to the east and in only 2 counties to the west of the line.

The heavy shading (Figure 2) indicates that area where *Ae. aegypti* was found during the 1956–58 surveys and can be described as that in which the species is usually common. The lightly shaded area is that in which *Ae. aegypti* has been found occasionally. The map shows strikingly that the area where *Ae. aegypti* is common at present is much smaller than that where it had been found in the past. The extent of the area from which it has been reported is approximately 662,000 square miles, while the present distribution includes approximately 202,000 square miles, only one-third as much area. Because the limits of the area recognized as "yellow fever receptive" follow state lines, this area is larger than that from which the species has been reported (Hughes and Porter).

FIGURE 1

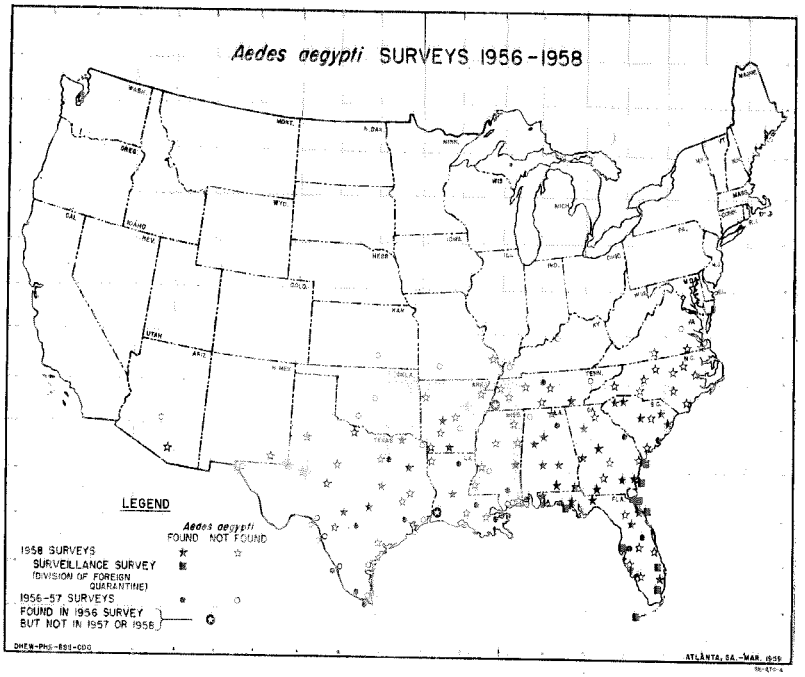
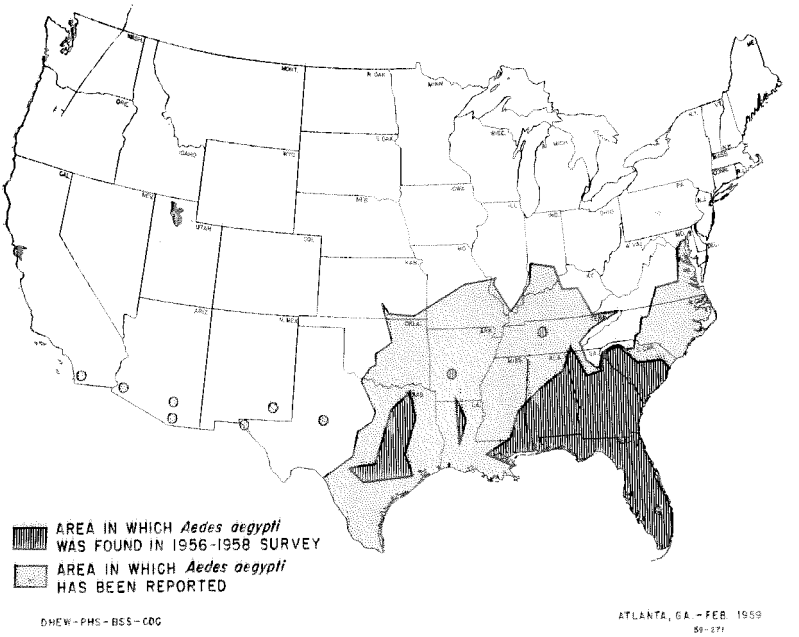


FIGURE 2

DISTRIBUTION OF *Aedes aegypti* IN THE UNITED STATES




Even though the trend toward reduction in the area infested by *Ae. aegypti* is apparently continuing, the infestation is still extensive, and there are communities where *Ae. aegypti* populations are large. If the yellow fever virus should be introduced in cities like Tyler, Texas; Birmingham, Alabama; Atlanta, Georgia; or Columbia, South Carolina, an urban outbreak of yellow fever would be a distinct danger.

On the other hand, the data from this study indicate that consideration can be given to revising the area of the United States presently recognized as yellow fever receptive. This area was delineated by the Public Health Service and reported to the World Health Organization in 1953 in accord with article 70 of the International Sanitary Regulations (World Health Organization, 1957). Hughes and Porter (1958) point out that the delineated area will be modified as necessary to reflect changes in the distribution pattern of *Ae. aegypti*. The area presently recognized as receptive for yellow fever is five times that in which infestations of the species were found during the recent surveys. Should this condition continue for another year or two, the Division of Foreign Quarantine will undoubtedly act to revise its delineation of the yellow fever receptive area.

*References Cited*

BOYCE, RUBERT. 1905. Yellow fever prophylaxis in New Orleans. Liverpool Sch. Trop. Med. Memoir, 19:62 pp.

BRADLEY, G. H. AND ATCHLEY, F. O. 1953. The *Aedes aegypti* situation in the United States. Proc. N. J. Mosq. Exterm. Assn., 40th Ann. Meet., pp. 104–108.

HAYES, GEORGE R., JR. AND TINKER, MILTON E. 1958. The 1956–1957 status of *Aedes aegypti* in the United States. Mosquito News 18(3):253–257.

HUGHES, JOHN H. AND PORTER, JOHN E. 1958. Measures against yellow fever entry into the United States. Pub. Health Rep. 73(12):1101–1106.

WORLD HEALTH ORGANIZATION. 1957. International sanitary regulations. Geneva. 129 pp.