cally all of Pearl Harbor within its range.

It is hoped that this study will stimulate further research in order to evaluate more thoroughly the range and direction of flight of *Culex quinquefasciatus* from Waipio Peninsula. The author believes that the release of marked mosquitoes from a point approximately two miles northwest of the release site used in this study would be extremely beneficial. This would be in the general area where heavy mosquito production normally occurs.

ACKNOWLEDGMENTS. This study was made possible by the conscientious and tireless efforts of the following Hospital Corpsmen, who at the time were assigned to the Entomology Department of Preventive Medicine Unit Number Six: C. W. Roane, HMC, USN; A. S. Callaham, HMC, USN (Deceased); J. L. Jensen, HM1, USN; P. C. Boynton, HM1, USN.

The author is also indebted to: Mr. Kiichi Ohinata, of the U. S. Department of Agriculture, Entomology Research Division, Honolulu, Hawaii, for his invaluable assistance in procuring and handling the radioactive material; W. F. Lyons, CAPT, MC, USN, Ret., who at the time of this study, was Officer-in-Charge of Preventive Medicine Unit No. Six, for his interest and assistance; C. J. Jordan, LCDR, MSC, USN, for monitoring the mixing of the radioactive material; and to the members of the following agencies, located in Hawaii, who assisted in operating the light traps: State Bureau of Mosquito Control, U. S. Public Health Service Quarantine Station, U. S. Air Force and U. S. Army.

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LARVAL HABITAT OF *AEDES AEGYPTI* (L.) IN THE UNITED STATES

MILTON E. TINKER [1]

Probably more workers in mosquito control and related fields are familiar with the *Aedes aegypti* (L.) than with any other species of mosquito. This familiarity results from the widespread use of *Ae. aegypti* as a laboratory insect; its occurrence, always near human habitations, throughout a large area of the United States; and from the many publications concerning its role as the urban vector of yellow fever and dengue.

In spite of this voluminous literature, very little information is available on the exact habitats of the larvae. King *et al.* (1960) mention some of the types of receptacles in which the larvae have been found. Porter, Evans, and Hughes (1961) have discussed the importance of tree holes as a habitat. More information is available for Africa (Teesdale, 1955, Surtees, 1959 and 1960) and for Malaya (MacDonald 1956).

During the years 1956 through 1962, the Communicable Disease Center conducted surveys in 440 communities in 262 counties to determine the distribution

[1] *Aedes aegypti* Eradication Branch, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Atlanta, Georgia.

of *Ae. aegypti* in the United States. Data on the occurrence of the species and its urban nature have been reported previously by Hayes and Tinker, 1958; Tinker and Hayes, 1959; Simmons, Tinker and Morlan, 1961; and Tinker, 1963. In addition to the distribution already reported, much information on the larval habitats of the species was also collected in these surveys, including: the portion of the community most likely to be infested, the relation of number of receptacles per premises to infestation, and the type of receptacle favored as a larval habitat. The number and type of receptacles present, and the number and type of receptacles breeding mosquitoes were recorded for each premises inspected. The receptacles were classified as: small receptacles, those of 5 gallons or under; large receptacles, those over 5 gallons; tires; and miscellaneous receptacles. Thus, records were obtained on the potential and actual mosquito infestation occurring on each premises inspected. These data were processed by IBM methods. This procedure made possible a thorough handling of information on 15,269 premises in the 36 cities where detailed surveys were made. Advice on the statistical analysis of the data was obtained from the Statistical Section, Epidemiology Branch, CDC.

OBSERVATIONS

EFFECT OF RESIDENCE CLASS. Even though it is seldom stated in the literature, past experience in *Aedes aegypti* control in the United States has indicated that the infestation rate is highest in the substandard portion of a city, i.e., that portion with poor housing and poor sanitation. For this reason, control operations and surveys have been concentrated in such areas. In the detailed surveys conducted by CDC in 1958–1962, twice as many substandard areas as standard areas were inspected, even though only about 10–20 percent of a city is usually substandard. The differences between *Ae. aegypti* populations were determined by χ^2 tests.

The *Aedes aegypti* indices, i.e., percent of inspected premises with infestations, for the substandard areas were consistently higher than those for the standard areas in both heavily and lightly infested cities. In the heavily infested cities, the index in the substandard areas was 4.5 times as great as in the standard areas (Fig. 1). The differences between indices in substandard areas in these cities, which ranged from 15 to 22 percent, were insignificant. On the other hand, differences between indices in standard areas were significant, and differences between indices for substandard and standard areas in each city were significant. In the lightly infested cities (Fig. 2), the indices were consistently higher for the substandard areas than for the standard.

EFFECT OF NUMBER OF RECEPTACLES. The importance of the number of receptacles in the breeding of *Aedes aegypti* is shown by a frequency distribution of premises with different numbers of receptacles from cities with large *Ae. aegypti* populations (Figs. 3 and 4). In order to compare *Ae. aegypti* populations in the standard and substandard premises which have different sized samples, the figures have been converted to percent of premises inspected. Data for both *Ae. aegypti* and *Culex pipiens quinquefasciatus* Say have been considered, to determine if species differ in the relation of breeding to class of housing. The significance of differences was tested with χ^2 and coefficient of association.

There are more receptacles on premises in substandard areas (Fig. 3), i.e., there are more premises with receptacles, more premises with large numbers of receptacles, and more receptacles per premises in substandard areas. There are 28 percent fewer premises without receptacles in substandard areas than in standard areas. When the frequency distributions for substandard and standard premises are compared, it is found that the premises with 0 to 1 receptacles per premises are more common in the standard areas, and the premises with 2 or more receptacles per premises are more common in the

**COMPARISON OF AEDES AEGYPTI INDICES
IN SUBSTANDARD AND STANDARD RESIDENTIAL AREAS
1958–1962**

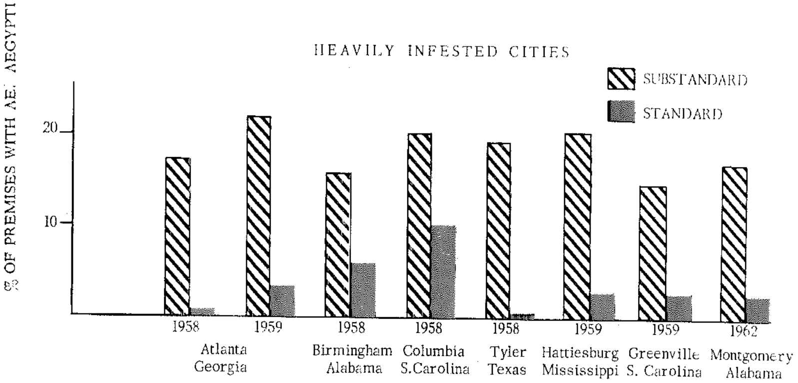

FIGURE 1.

**COMPARISON OF AEDES AEGYPTI INDICES
IN SUBSTANDARD AND STANDARD RESIDENTIAL AREAS
1958–1962**

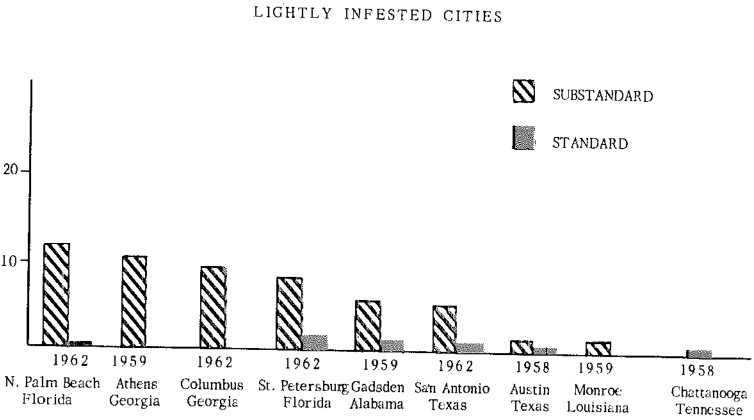

FIGURE 2.

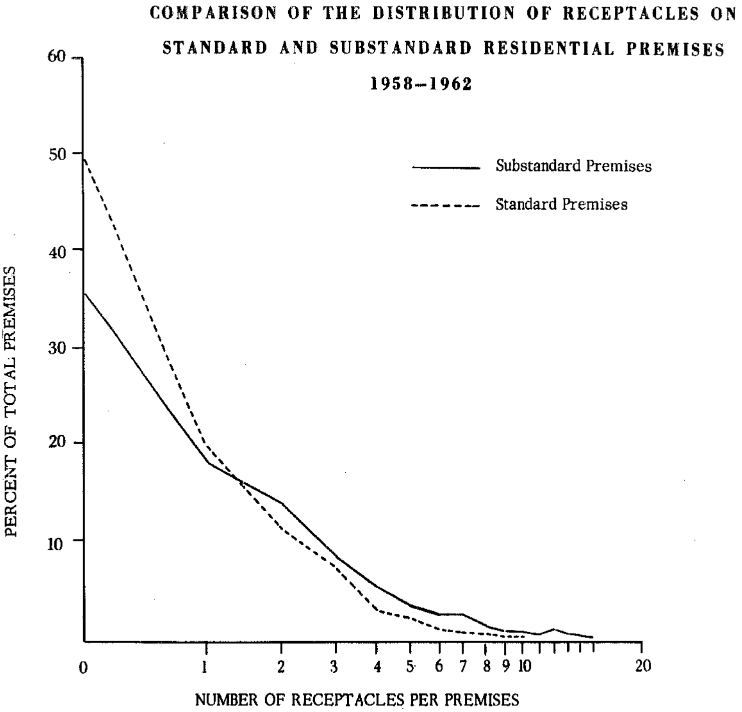

FIGURE 3.

substandard areas. The average number of receptacles in substandard areas is 2.7 per premises. This is 1.4 times those in standard areas—where they have 1.8 receptacles per premises.

Along with the larger number of receptacles per premises in the substandard areas, the greater amount of breeding by *Aedes aegypti* and *Culex pipiens quinquefasciatus* was highly significant (Fig. 4). The average number of breeding receptacles per premises for the two species is 0.37 for *Ae. aegypti* and 0.36 for *C. p. quinquefasciatus* in substandard areas, but 0.04 and 0.15, respectively, in standard areas. Within each premises type there are no significant differences between the two species. The amount of breeding is significantly related to the number of receptacles per premises. The more receptacles there are on the premises, the more likely they are to have breeding but in a smaller proportion of the receptacles.

EFFECT OF RECEPTACLE TYPE. The data collected on the type of receptacles where *Aedes aegypti* was found breeding illustrate a common misconception (Figs. 5 and 6). Small receptacles such as tin cans are not the favored breeding habitat; rather, it is abandoned automobile tires. But small receptacles are the most common type of receptacle found, e.g., 1.70 per substandard premises, or 63.7 percent of the total. Tires were next with 0.54 per substandard premises, or 19.5 percent of the receptacles found. Despite this difference in numbers for the two types, equal numbers of small receptables and tires were found to contain *Ae. aegypti* larvae: 0.15 small receptacles per substandard premises, and 0.16 tires per substandard premises. This is due to

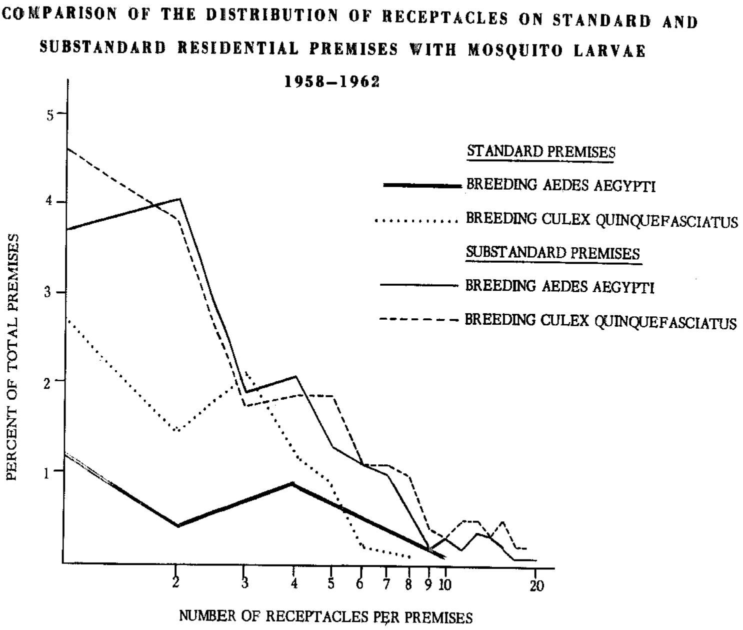

FIGURE 4.

the much greater proportion of the tires being infested with *Ae. aegypti* (Fig. 6).

The amount and rate of breeding in each type of receptacle was higher in the substandard areas. Not only was there considerably more of each type of receptacle in the substandard areas, e.g., 0.54 tire per substandard premises vs. 0.14 tire per standard premises, but there were considerably more of each type of receptacle with *Aedes aegypti* larvae in substandard areas, e.g., 0.16 tire with larvae in the substandard areas vs. 0.02 tire in the standard areas (Fig. 5). In addition, the proportion of each type of receptacles that contained *Ae. aegypti* larvae was greater in the substandard areas, e.g., 30.4 percent of the tires in the substandard areas, and 13.0 percent in the standard areas (Fig. 6). Thus, the difference in *Ae. aegypti* populations in substandard and standard areas is a function of both the greater number of receptacles and the greater rate of infestation of the receptacles.

On the other hand, the importance of the different types of receptacles in the breeding of *Aedes aegypti* is the same in both standard and substandard areas (Fig. 7). In both areas, tires and small receptacles both made up essentially the same percentage of the receptacles with *Ae. aegypti* larvae, 37 to 44 percent. Large and miscellaneous receptacles had a low percentage in both areas, 4.5 to 13.5 percent.

SUMMARY. Detailed surveys in 36 communities made by personnel of the Communicable Disease Center during the years 1956 through 1962 have provided detailed information on the larval habitats of *Aedes aegypti*. It was found that rates of infestation were consistently greater in substandard areas of cities than in standard. The larger *Ae. aegypti* population was due both to the greater number of receptacles present and to the greater rate of infestation of the receptacles. The type of receptacle most favored as a larval site is tires. Although there are fewer

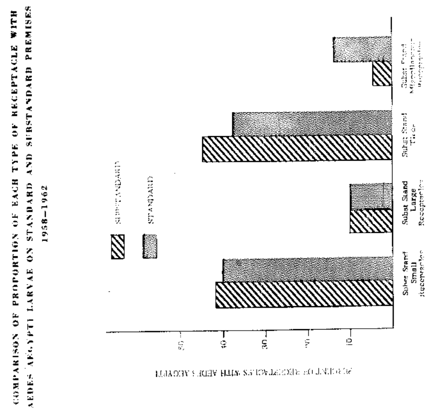

FIGURE 7.

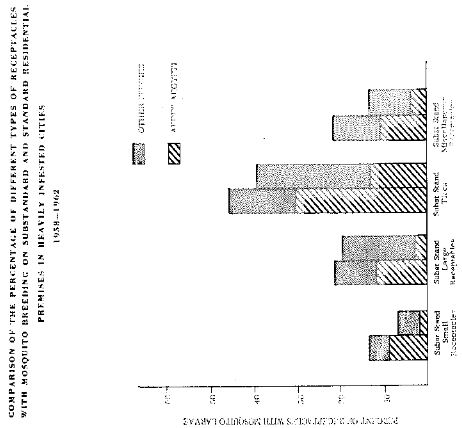

FIGURE 6.

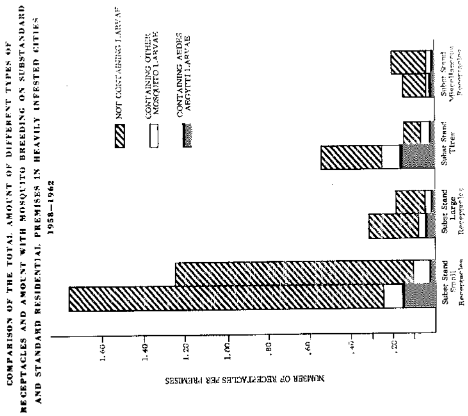

FIGURE 5.

tires than small receptacles, the numbers of the two that are infested are equal.

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OBSERVATIONS ON THE BIOLOGY AND ECOLOGY OF *ORTHOPODOMYIA CALIFORNICA* BOHART (DIPTERA:CULICIDAE)

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INTRODUCTION. Very little biological or ecological information has been published on *Orthopodomyia californica* since its description by Bohart in 1950. This species is recorded in California from Fresno, Kern, Kings, Riverside, San Bernardino, and Yolo Counties (Freeborn and Bohart, 1951) and additionally from Butte, Contra Costa, Lake, Los Angeles, San Joaquin, San Mateo, Sutter, Tehama, and Tulare Counties by Loomis *et al.* (1956). The *Field Guide to Common Mosquitoes* of California (Loomis, 1963) also lists this species from Plumas and Shasta Counties. Most of these records are based on adult collections.

[1] In cooperation with the California State Department of Public Health, Bureau of Vector Control, Fresno, California.

Rigby and Ayers (1961) reported *O. californica* from Arizona, but my examination of their larval material indicated their specimens were *O. kummi* Edwards. Hence, *O. californica* is still known only from California.

I observed *O. californica* both in the field and in the laboratory over a period of several years (1961–1964) and some of my observations are presented below.

The aquatic stages of *O. californica* have been reported only from cottonwood, willow, and oak (Reeves, 1941; Grant, 1953; Bohart, 1950). The last author mentions this species occurring wherever suitable holes are found in cottonwood and willow trees. Bohart (1953) also states: "Competition may also be the influence which makes *Orthopodomyia*