

MOSQUITOES AND THEIR CONTROL IN THE TERRITORY OF HAWAII

PATRICK Y. NAKAGAWA¹ AND ROBERT T. MIKUNI²

Hawaii has been actively concerned with mosquito control for well over 50 years. As early as 1902 *Gambusia* were introduced from Texas for mosquito control. In 1906 the Honolulu Shippers' Wharf Committee and the Hilo Shippers' Wharf Committee voluntarily provided \$3,858 for a rat and mosquito campaign; mosquito control was, however, incidental to rat control, and what time could be "justly spared" from rats was devoted to mosquitoes.

Men for mosquito control work were employed by the Bureau of Sanitation in 1911, but in succeeding years mosquito control activities appear to have been carried out in a rather hit-or-miss fashion. In 1930, mosquito and rat control programs were assumed by the Public Health Committee of the Chamber of Commerce, which had been active for a number of years in promoting support for these programs. Funds were obtained for the programs by a "voluntary" tonnage tax levied upon imports.

The dengue outbreak of 1943-44 in Honolulu brought the need for mosquito control forcefully to the attention of both the Federal and the Territorial Governments. The U. S. Public Health Service, the military authorities, and others came to the assistance of the Territorial Board of Health, and an intensive mosquito control program was carried out on Oahu during 1943-44 and extending through 1945. This prompt action apparently stopped the outbreak and limited it to 1,498 human cases, whereas it might otherwise have involved many thousands of the Islands' half million population.

The last dengue case was reported in July 1945, and no military personnel were assigned to the program after November 1945. The U. S. Public Health Service assistance was also discontinued at the end of May 1946. Since that time the Territorial Board of Health has maintained a minimal mosquito control program with annual expenditures running a little over \$100,000. This program was established primarily for the control of dengue mosquitoes (*Aedes*), but, as was inevitable, it has been increasingly involved with "emergency control" of *Culex*. With the apparent eradication of *Aedes aegypti* from Oahu, the program has evolved into an "Aedes prevention" and "Culex control" program.

The present Bureau which is the outgrowth of the dengue campaign has been very fortunate in having had such able leadership during 1943-1946 when the program was under Public Health Service guidance and was administered by such eminently qualified men as Mr. Wesley E. Gilbertson, Dr. R. L. Usinger, and Mr. Arve H. Dahl. Since its conversion to Territorial status in about June 1946, under the continuing able leadership and guidance of its former chiefs, Dr. David D. Bonnet and Dr. Stephen M. K. Hu, the Bureau of Mosquito Control has attained maturity and status as an important Bureau in the Division of Sanitation, Department of Health. From September 1955 to December 1957, during Dr. Hu's leave of absence, Mr. Robert T. Mikuni carried on the program as its acting administrative officer. Upon Dr. Hu's subsequent resignation to accept a position with the U. S. Naval Medical Research Unit No. 2, in Formosa, its present Chief Mr. Patrick Y. Nakagawa was appointed to fill the vacancy in January 1958.

¹ Appointed as Chief, Bureau of Mosquito Control, January 1958.

² Former Acting Administrative Officer and present Assistant Chief.

Fortunately, there are only three species of biting mosquitoes in Hawaii: *Aedes aegypti*, *Aedes albopictus*, and *Culex quinquefasciatus*.

Aedes aegypti (Linn.), the classic vector of yellow fever, is also a vector of dengue fever and a potential vector of filariasis and several forms of encephalitis. This species is highly domesticated and is much more limited than that of the other species; it is usually restricted to the warmer, drier areas of the Islands. Apparently this species has been eradicated from the island of Oahu because repeated surveys to date have failed to uncover its presence.

Aedes albopictus (Skuse) is a proven vector of dengue fever and has also been demonstrated to be capable of transmitting yellow fever and encephalitis. This species is widely distributed in the Hawaiian Islands, being found at both low and high elevations. It is found in artificial containers along with *Aedes aegypti* but is commonly found in natural containers such as tree-holes, rock holes, and water-holding plants. The flight range of this species in Hawaii has been reported as usually less than 200 yards.

Culex quinquefasciatus Say is by far the most abundant and the most annoying of the mosquitoes in Hawaii. It commonly breeds in ground pools, swamps, and irrigation ditches, as well as in artificial containers. It is particularly abundant in waters of high organic content such as sewage effluents and run-off from pig and dairy farms. This species is a known vector of filariasis (*Wuchereria bancrofti*) in the West Indies, and has been experimentally infested in Hawaii; however, so far as is known, no case of locally acquired filariasis has been recorded. It is also said to be a potential vector of Japanese B, western equine, St. Louis, and Murray Valley encephalitis.

In addition to the three biting species, four species of non-biting *Toxorhynchites* (*-Megarhinus*) have been introduced into the Islands for biological control of *A. albopictus*: *T. inornatus* from New Britain in 1929 (probably no longer present); *T.*

brevipalpis from South Africa in 1950; *T. splendens* from the Philippines in 1953; and *T. hypoptes* from Panama in November-December, 1953 (probably no longer present).

The basic justifications for mosquito control in Hawaii have been aptly summarized by Dr. A. D. Hess, Scientist Director, PHS, CDC, Technology Branch, Logan, Utah, who at the request of Dr. Richard K. C. Lee, President of the Board of Health, conducted an appraisal of the mosquito control program during January 22 to February 22, 1957. These are: (1) prevention of human disease transmission; (2) prevention of other public health nuisance; (3) prevention of the introduction of new diseases and mosquitoes into the Islands; and (4) prevention of interference with tourist trade and other economic developments. Of these four justifications, we would like to single out for special emphasis the third point, "prevention of the introduction of new diseases and mosquitoes into the Islands," not necessarily because it outweighs the other three in importance, but because it well emphasizes the important role Hawaii assumes as "stepping stones" in the prevention and introduction of dangerous vectors or vector-borne diseases into the United States. It is, therefore, essential not only to carry out disinsectization of incoming vessels and aircraft, but to conduct thorough inspections and control measures around all ports of international travel and commerce. Records reveal that since 1939, a total of 32 species of mosquitoes have been intercepted on aircraft arriving at Honolulu, including at least six species of *Anopheles*.

Mosquito breeding is a year-round problem in Hawaii because of the equable climate. The moderately tropical climate which is so tempered by the trade winds never provides a condition too hot, or too cold, or too dry, or too wet to inhibit the multiplication of mosquitoes. Consequently, mosquito abatement in Hawaii is a year-round proposition.

The scope of operation of the Bureau

of Mosquito Control is dictated by its limited legislative appropriation and must necessarily be confined to surveys, inspections, education, and temporary control measures such as larviciding and adulticiding. It has, however, always recognized as foremost, the desirability of permanent control measures and has constantly advocated such measures as filling, ditching, and water management whenever feasible.

Unless requested or on special surveys which are coordinated and cleared through channels, the Bureau's operation does not normally extend into areas under military jurisdiction. On military reservations, the Territorial program is adequately complemented by the respective control programs of the Army, Navy and Air Force in Hawaii. The strategic location of the Hawaiian Islands provides centers for numerous military commands which have con-

ducted mosquito control programs for several years. With the new materials, insecticides and equipment which are available for mosquito control, the effectiveness of the military control program has improved considerably in recent years. These advancements in the techniques of mosquito control have established the fact that mosquito control on an island-wide basis is possible and practicable through coordinated efforts by all interested parties, civilian and military. To date, the cooperation existing among the Department of Health, the military, and interested community associations, which have voluntarily subscribed contributions to enter into the field of mosquito control, provides an optimistic view towards the realization of a concerted mosquito control program for Hawaii.

EDITORIAL

In place of a formal editorial, the editor takes this space to urge readers, especially those who are members of AMCA, to read the minutes of the last annual meeting as published on pages 150-176 of this issue of *Mosquito News*. Potential contributors especially should read Attachment No. 5, in which the rules which should be followed in preparing and submitting manuscripts are presented by Dr. Twinn, Chairman of the Publications Committee.

Doctor McDuffie's report as chairman of the Committee on Research and Development (Attachment No. 14) includes much material which if expanded could easily comprise several original papers. Most of the reports of other committees also have features of special interest and merit thoughtful attention.