PICTORIAL KEYS TO THE MOSQUITOES OF MEDICAL IMPORTANCE

V. FRENCH INDOCHINA

RICHARD H. FOOTE
Entomology Research Branch, Agricultural Research Service, United States Department of Agriculture

This is the fifth in a series of keys prepared primarily to help public-health workers separate and identify rapidly the mosquitoes of medical importance in various parts of the world. This series is being reduced under a transfer of funds from the Department of the Army to the Bureau of Entomology and Plant Quarantine. The keys are so constructed that they separate the important species not only from each other but also from all others known to occur, or suspected of occurring, in the region. Suggestions and comments will be welcomed, especially from those with first-hand information about the faunas or diseases of the region.

Anopheles minimus is the chief vector of malaria in Indochina. It breeds typically at the edges of clear, slow-running, slightly shaded streams, but has been found in clear water at the edges of swamps, rice paddies and borrow pits. It is the most anthropophilic of the malaria vectors in Indochina, and its wide distribution in the extensive foothill regions makes it responsible for the most serious malaria problems in this country.

Anopheles jeyporiensis candidiensis is a nothofligh species, found typically in anding or running, grassy, clear water. It is less important as a vector of malaria than A. minimus because of its greater reference for non-human blood. Anopheles maculatus is a third species associated with hilly or mountainous country, breeding in many types of water collections, and occurring in large numbers in newly cleared jungle areas. Anopheles sinensis is responsible for the transmission of a low-grade malaria, with occasional explo- sive outbreaks, in the flat rice-growing areas of the northern and southern delta lands. It often occurs in tremendous numbers, and breeding tends to increase with the clearing or cultivation of jungle areas. Anopheles sundaiicus breeds almost entirely in brackish water along the southern coast of Indochina, where it is found in lagoons, swamps and salt-water fish ponds. It is less important than the foregoing species owing to its restricted distribution and its less definite anthropophilism. Anopheles acrocryptus has variable breeding habits, but is found most often in rice fields and fresh-water ponds in mountainous as well as in plains areas. It has been strongly suspected as a vector in South Annam. Throughout most of Indo- china, however, its importance appears to be unpredictable, and it is regarded as a secondary vector.

Other Anopheles species and varieties known or assumed to be present in Indochina are atikeni atikeni, atikeni bengalensis, elongensis, annandalei, annandalei, annandalei interruptus, baecai, barbirostris, barbirostris, barbicornis, annularis, culicifacies, flavifacies, jamesi, jeyporiensis jeyporiensis, karwari, kochi, lewisiophyti, hilaris, maculipilis, pallidus, philippinensis, splendidus, stephensi, subpictus, tessellatus and vagus vagus.

Approximately 90 non-anopheline species of mosquitoes have been recorded from this country. Of these, two are important in disease transmission. Aedes albopictus breeds principally in plant containers throughout Indochina and is the
chief vector of dengue fever. *Aedes aegypti* breeds principally in artificial containers near human habitations. It is included in the key because of its role in the transmission of dengue and its ability to transmit yellow fever, the introduction of which is a serious and constant threat to the entire Orient.

TESTS WITH GRANULATED BHC AND DIELDRIN FOR CONTROLLING SAND FLY LARVAE


The salt-marsh sand fly, *Culicoides furens* (Puey), breeds abundantly in the densely foliated tidal marshes bordering the Florida Intracoastal Waterway, and often causes severe annoyance to the inhabitants of the adjacent areas. Since preliminary tests with bentonite granules impregnated with an insecticide showed great promise against *furens* larvae, tests were conducted on a practical scale to evaluate the method further.

Recent studies have shown that applications of certain insecticides to marsh breeding areas provide effective control of sand fly larvae for several months (Goulding *et al.* 1951). Treatments may be made with ground equipment, but this is time-consuming and extremely costly where it is necessary to cut extensive access trails through dense mangrove. Treatments may also be applied as aerial sprays, but so much material is lost by impingement on the vegetation, principally red and white mangrove, that excessive amounts must be applied to insure the proper amount reaching the ground. Since similar problems of penetrating vegetation for the control of mosquito larvae in rice fields and salt marshes had been overcome by applying granulated insecticides (Whitehead 1951, Keller *et al.* 1953), it was thought that this method might also be suitable in sand fly control.

On January 16, 1952, 325 acres of marshland infested with sand fly larvae north of Fort Lauderdale, Fla., were treated by airplane with bentonite granules (16/30 mesh) impregnated with BHC (30 percent gamma isomer). The average rate of application was 2 pounds of the gamma isomer per acre. Comparative treatments were made a month later with an oil spray containing sufficient BHC to give 0.5 pound of the gamma isomer per gallon, which was applied to a 24-acre plot at the rate of 4 gallons per acre. An 8-acre plot was treated with 6 percent of dieldrin on bentonite granules at the rate of 1.25 pounds of dieldrin per acre. An isolated, untreated 8-acre plot was utilized as a check.

The granulated BHC was prepared in a cement mixer by spraying melted BHC on the bentonite while the mixer was in operation, adding 2.8 pounds (containing 1 pound of gamma isomer) to 9.7 pounds of bentonite. The granulated dieldrin was a commercial product.