

## SPECIES COMPOSITION AND HUMAN DISEASE RELATIONSHIPS OF MOSQUITOES ON U. S. AIR FORCE BASES IN THE REPUBLIC OF VIETNAM<sup>1</sup>

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**INTRODUCTION.** The data presented in this paper on the species composition of mosquitoes in the Republic of Vietnam (South Vietnam) are based on light trap and larval collections made on ten U. S. Air Force bases located throughout the country (Fig. 1) over a two-year period between 1966 and 1968. These surveys were accomplished on a monthly basis in connection with the conduct of disease-vector surveillance and control programs in compliance with the objectives of the U. S. Air Force Aerospace Medicine program to prevent and control vector-borne diseases.

Data presented on the known human-disease relationships of Vietnamese mosquito species represented in this two-year study are based on information compiled by Foote and Cook (1959) and Stojanovich and Scott (1966).

**MATERIALS AND METHODS.** Adult collections were made on a monthly basis utilizing the standard New Jersey mosquito light trap (Mulhern 1942). These traps, equipped with 25-watt incandescent bulbs, were operated over a 12-hour period, from 6 p.m. to 6 a.m. once every month in a minimum of two representative locations at each of the ten Air Force base locations. Polyethylene jars of 1 pint (473 ml.) size were used as killing jars and were prepared in the usual manner using 4.5 g of granular sodium cyanide covered with 1.27 cm of sawdust and a thin layer of

plaster of paris. Collections were removed from the killing jars after each collection night, properly packaged and transported by military aircraft to the USAF 5th Epidemiological Flight laboratory, Manila, Philippines, where species determinations were made by entomological personnel trained in mosquito taxonomy.

Larval collections were also made on a monthly basis from two representative aquatic environments within or adjacent to the confines of each of the ten bases, utilizing the standard white-enameled dipper. Collected larvae were preserved in 70 percent alcohol in dental procaine hydrochloride cartridges (Carpenter 1945) and shipped to Manila for identification.

**RESULTS AND DISCUSSION.** During the two-year survey a total of 94,287 adult and larval specimens were collected from the ten bases included in the study. In these collections 93 different species were identified (Table 1). Of this number, 27 species or 29 percent are confirmed vectors of human diseases endemic in Vietnam (Table 1) and thereby pose a potential threat to the health and welfare of U. S. Air Force personnel engaged in military operations in the Republic of Vietnam.

A review of hospital admission records for Air Force personnel in Vietnam showed that mosquito-borne diseases have not been as serious as expected. The amount of illness diagnosed as "fever of undetermined origin" (FUO) exceeds that of all mosquito-borne diseases, including malaria. Musgrave (1968) reported that the incidence of FUO in Air Force personnel in Southeast Asia averaged approximately 8 percent during 1966-1967.

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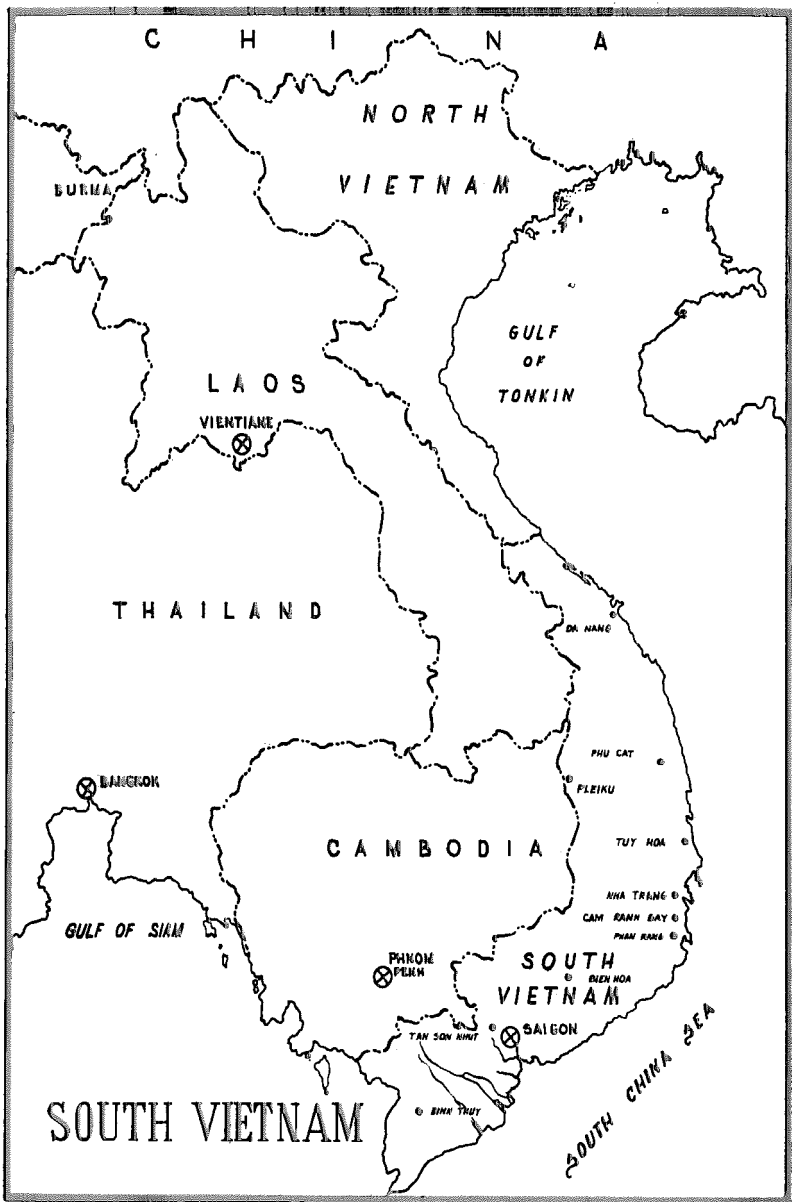


FIG. 1.—Locations of U. S. Air Force bases where adult and larval mosquito surveys were made during 1966-1968.

TABLE I.—Species and disease-vector composition of mosquitoes collected during 1966–1968 on ten U. S. Air Force bases in the Republic of Vietnam.

Species <sup>a</sup>	Bases									
	Bien Hoa	Binh Thuy	Cam Ranh Bay	Da-Nang	Nha Trang	Phan Rang	Pheic-lu	Phu Cat	Tan Son Nhut	Tuy Hoa
<i>Aedes aegypti</i> <sup>a</sup>								x	x	
<i>albolineatus</i>			x							
<i>albopictus</i> <sup>a</sup>			x			x	x			
<i>alboscutellatus</i>					x					
<i>amesi</i>								x		
<i>chrysolineatus</i>					x					
<i>dux</i>		x			x	x			x	x
<i>gubernatoris</i>					x		x			
<i>imprimens</i>			x							
<i>laniger</i>							x			
<i>lineatopennis</i> <sup>a</sup>		x		x	x	x	x	x		x
<i>longirostris</i>								x	x	x
<i>mediolineatus</i>	x						x	x	x	
<i>niveoscutellum</i>		x					x			
<i>ostentatio</i>							x			
<i>poicilius</i>	x	x						x		
<i>pseudoalbopictus</i>			x		x	x	x			
<i>tacniorhynchoides</i>					x					
<i>vexans</i> <sup>a</sup>	x		x		x	x	x	x	x	x
<i>vigilax</i> <sup>a</sup>					x	x	x			
<i>vittatus</i>							x	x		
<i>Aedeomyia catasticta</i>			x	x	x	x	x		x	x
<i>Anopheles aconitus</i> <sup>a</sup>		x			x	x	x	x	x	
<i>annandalei</i>							x			
<i>annularis</i>	x				x	x	x	x	x	x
<i>argyropus</i>					x	x	x	x		
<i>barbistrostris</i> <sup>a</sup>		x					x	x		
<i>campestris</i> <sup>a</sup>		x					x	x		
<i>crawfordi</i>				x	x	x	x	x	x	x
<i>indiensis</i>		x					x	x		
<i>jeyporiensis</i> <sup>a</sup>								x		
<i>karwari</i>				x			x	x		
<i>lesteri</i>	x	x								
<i>maculatus</i> <sup>a</sup>						x				
<i>minimus</i> <sup>a</sup>		x			x	x	x	x		
<i>nigerrimus</i> <sup>a</sup>		x				x	x	x		
<i>pallidus</i>						x	x	x		
<i>peditaeniatus</i>	x	x		x	x	x	x	x		x
<i>philippinensis</i>					x	x	x	x	x	
<i>sinensis</i> <sup>a</sup>	x	x	x	x	x	x	x	x	x	x
<i>splendidus</i>	x						x			
<i>subpictus</i>	x	x		x	x	x	x	x	x	x
<i>tessellatus</i> <sup>a</sup>		x			x	x			x	
<i>umbrosus</i> <sup>a</sup>		x								
<i>vagus</i> <sup>a</sup>	x	x	x		x				x	x
<i>varuna</i>								x		
<i>Armigeres flavus</i>							x			
<i>subalbatus</i> <sup>a</sup>							x	x		
<i>Culex annulus</i> <sup>a</sup>	x		x	x	x	x	x	x	x	x
<i>bitacniorhynchus</i> <sup>a</sup>	x	x	x	x	x	x	x	x		x
<i>brevipalpis</i>	x	x			x		x	x	x	
<i>fuscans</i>	x	x	x	x		x	x	x	x	
<i>fuscocephalus</i> <sup>a</sup>	x	x	x	x	x	x	x	x	x	
<i>gelidus</i> <sup>a</sup>	x	x	x	x	x	x	x	x	x	x
<i>khavani</i>					x	x		x		
<i>incomptus</i>								x		

<sup>a</sup> An x indicates the presence of a species; the letter d denotes disease vector.

TABLE I.—Continued

Species <sup>a</sup>	Bases									
	Bien Hoa	Binh Thuy	Cam Rahn Bay	Da-Nang	Nha Trang	Phan Rang	Pheiku	Phu Cat	Tan Son Nhut	Tuy Hoa
<i>mimeticus</i>			x							
<i>minor</i>						x				
<i>nigropunctatus</i>		x			x	x	x			
<i>peytoni</i>										
<i>pipiens-quinquefasciatus</i> <sup>a</sup>	x	x	x	x	x	x	x	x	x	x
<i>pholeter</i>		x			x	x	x	x		
<i>pseudosincensis</i>			x		x	x	x	x		
<i>pseudovishnui</i>		x	x	x	x	x	x	x		
<i>quadrilpalpis</i>			x							
<i>raptor</i>		x							x	
<i>reidi</i>						x				
<i>rubithoracis</i>	x			x		x				
<i>sinensis</i> <sup>a</sup>	x	x			x		x	x	x	
<i>sitiens</i> <sup>a</sup>					x	x	x			
<i>tritaeniorhynchus</i> <sup>a</sup>	x	x	x	x	x	x	x	x	x	x
<i>whitei</i>			x		x		x			
<i>whitmorei</i>	x				x	x	x	x	x	x
<i>Ficalbia chamberlaini</i>		x	x		x		x	x		x
<i>hybrida</i>	x	x						x		
<i>luzonensis</i>	x	x	x		x			x		
<i>minima</i>		x						x		
<i>Hodgesia malayi</i>		x					x			
<i>Malaya jacobsoni</i>					x					x
<i>Mansonia annulifera</i> <sup>a</sup>		x								
<i>crassipes</i>	x	x	x		x	x		x		x
<i>nigrosignata</i>		x								
<i>ochracea</i>	x	x	x			x				x
<i>uniformis</i> <sup>a</sup>	x	x	x		x	x	x	x		x
<i>Toxorhynchites kempi</i>			x		x			x		
<i>splendens</i>	x		x			x		x		
<i>Tripteroides aranoioides</i>	x		x				x			x
<i>Uranotaenia annandalei</i>		x			x					
<i>campestris</i>		x			x			x		
<i>macfarlanei</i>					x					
<i>maxima</i>		x					x	x		
<i>obscura</i>		x					x	x		
<i>recondita</i>							x			

Medical authorities have estimated that one-third or more of these fevers may be dengue.

Military public health authorities in Vietnam report that the distribution of malaria in the Republic of Vietnam is highly discontinuous. Incidence is very low in most of the coastal plains including the cities and delta, but in parts of the foothills and highlands the rate is extremely high. Based on observations by U. S. Navy entomologists in Vietnam (Holway *et al.* 1967) it is believed that

most of the malaria in military personnel is contracted outdoors rather than indoors and there is considerable evidence that the endophilic *Anopheles minimus* has not been a significant vector. The exophilic species, *Anopheles aconitus*, *A. maculatus*, *A. jeyporiensis*, and in limited areas, *A. balabacensis*, are believed to be the most important vectors affecting military personnel (Holway *et al.* 1967). These authors also reported that the extraordinary amount of personnel movements is causing a redistribution of malaria from

the hyperendemic foci of the interior to all parts of the Republic of Vietnam and beyond and that wherever suitable vectors occur, malaria has increased as new reservoirs are established.

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## THE RELATIONSHIP OF MOSQUITOES TO OXIDATION LAGOONS IN COLUMBIA, MISSOURI

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### INTRODUCTION

Species of mosquitoes reported from sewage lagoons include *Aedes campestris* (Dyar and Knab) from North Dakota, *Aedes dorsalis* (Meigen) from North and South Dakota, *Aedes vexans* (Meigen) from Arizona and Nebraska, *Anopheles quadrimaculatus* Say from Missouri and Tennessee, *Culex erraticus* (Dyar and Knab) from Mississippi and Tennessee, *Culex restuans* (Theobald) from Nebraska and North Dakota, *Culex salinarius* (Coquillett) from Georgia and Texas, *Culex thriambus* (Dyar) from Texas, *Culiseta inornata* (Williston), from Nebraska, Missouri, and Oklahoma, *Psorophora confinnis* (Lynch-Arribálzaga) from Arizona, *Culex tarsalis* Coquillett from the mid-west, and the *Culex pipiens* complex from

the south-west (Eads and Mengies 1956, Beadle and Harmston 1958, Rapp 1960, Beadle and Rowe 1960, Rapp 1961, Myklebust and Harmston 1962, Rapp and Emil 1965, Smith and Enns 1967, 1968, Smith 1969a, and Smith 1969b).

Sewage lagoons constructed near cities which are well within the flight range of most mosquitoes may create a potential danger for the residents of trailer courts, outdoor camps, resort motels, and other suburban dwellings that use lagoons for sewage disposal.

This investigation was undertaken to study the relationship of mosquitoes to sewage lagoons and to acquire basic biological data concerning the principal species of mosquitoes in the lagoon environment. During the summers of 1965-1966, a survey was made of the mosquitoes of Columbia, Missouri. The objectives were to determine which species of mosquitoes were present and to relate this information to mosquito production in the lagoon environment.

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