

SEATO MEDICAL RESEARCH STUDY ON MOSQUITOES

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STUDY REPORTS

1. Title Mosquito Fauna of Thailand

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Objective--To collect, identify, catalog and redescribe all of the mosquito species of Thailand. Information is also assembled on the distribution, larval habitats and other aspects of the bionomics of the various species. The eventual goal is the production of a monograph on the mosquitoes of the area, together with keys, handbooks and other identification aids for use of workers in public health and associated fields and the later inclusion of this material into a larger monographic work on the mosquitoes of Southeast Asia. Since the final monographs will not be completed for several years, periodic papers with keys, descriptions and distribution of important groups will be made available as soon as practical. The immediate objective is to make available as much information as possible on the Anopheles and species of other genera which are known or suspected to be vectors of disease. The training of competent Thai personnel and, more recently, U.S. military personnel in Southeast Asia in the identification and bionomics of the mosquito fauna of Thailand is also a major concern. Another objective is the building of a reference collection at SMRL of all the mosquitoes known to occur in Thailand to provide readily accessible study material to newly assigned and other personnel who may have the need for rapid familiarization with the mosquitoes in this area.

Description: Mosquitoes are collected from many areas of Thailand in connection with various studies on arthropod-borne viruses and malaria. Additional collections of a specialized nature are made to obtain correlated series of larvae, pupae and adults for illustration and other detailed studies. These consist mainly of collections of the immature stages from forested or undeveloped areas; these immature stages are reared individually, as far as is possible, in order to recover a correlated series cast skins and adults. All of the reared material is later identified and processed at SMRL in Bangkok. After processing, the material is transferred to the Southeast Asia Mosquito Project, U.S. National Museum for confirmation, description and eventual inclusion in the final monograph.

Progress: During the year 937 larval collections from 10 different provinces of Thailand were made. From these collections 7,115 adults were pinned and added to the collections. Each of these were reared individually and are represented by matched larval and pupal skins. Slide mounts were prepared from 10,993 larvae and larval and pupal skins. The transfer of material to the U.S. National Museum during the year included 95 boxes of pinned adults and 127 slide boxes of immature stages representing several hundred species and several thousand specimens.

Many Thai species not previously represented were added to the department collection this year. Several of these are new records for Thailand, while others require confirmation by examination of type material at the U.S. National Museum before a specific determination can be made. Much additional information on distribution and bionomics of approximately 160 species was also added. A breakdown of

this information for the Anopheles collected during the year is presented in Table 1. A project is underway to compile similar information on all species of mosquitoes collected by SMRL over the last few years and will be published as a separate report at a later date. Although the number of collections in Table 1. are not sufficient to draw conclusions for all species there are a few points worthy of discussion. Of the 106 collections of mosquitoes made from elephant foot-prints, 41 contained larvae of Anopheles (Cellia) balabacensis, representing 66% of the 62 collections of balabacensis made during the year. Of the 5 species found in this type of habitat it was by far the most common. All of these foot-prints are found in forested areas in the hill or mountain regions, usually where elephants are used in logging operations but many, especially at the higher elevations are made by wild elephants. In Thailand the elephant foot-print is definitely a true habitat entry and is the specific habitat of several of the Culex (Culiciomyia) species. It can also be noted from the table that balabacensis strongly favors partially to heavily shaded habitats. It is usually not found in foot-prints that are completely exposed to sunlight or those that are not maintained in a very fresh state by rainfall or seepage. It could therefore be logically assumed that during rainy season those areas where the foot-prints are numerous and under forest cover become one of the primary sources of this species. It is also the only species collected at all levels of altitude from below 15 to above 1500 meters. An. (C.) minimus and An. (C) maculatus occurred at all levels from below 150 to above 900 meters, both of these species are fresh water breeders, but show less preference for shade than balabacensis. Ground pools and flood pools in the broad sense are the same habitat. However flood pools are classified here as those small, usually shallow, temporary pools that are maintained in a very fresh state, primarily by frequent rainfall, and they frequently have one or more species of the genus Aedes present which are almost exclusively temporary flood pool breeders occurring only after heavy rains or flooding. Ground pools include both small to large, temporary or semipermanent pools with polluted, turbid or clear, but not necessarily fresh water. It can be seen that significant numbers of collections of maculatus and balabacensis were made only from flood pools; as the rains become less frequent neither of these species are found in this type of habitat. With the exception of An. (Anopheles) barbirostris and An. (C.) vagus, An. balabacensis and An. maculatus were found in a wider range of habitat than all other species. The greatest number of species were collected between the 15 to 150 meter level. All but five of these are commonly found in open agricultural or forest fringe areas and are commonly found breeding in rice fields or irrigation ditches. An. (An.) campestris occurs almost exclusively in the open agricultural plains, predominately in irrigation ditches. Two species are shown as habitat specific. An. (An.) asiaticus and An. (A.) tigertti are known only from these type habitats. The localities listed for both species are new distribution records for Thailand. Previous to this report An. (A.) sintonoides was known to occur only in tree and stump holes. Many of the localities listed for the various Anopheles species are new distribution records for Thailand.

No one area of Thailand was surveyed for an extended period of time during the year and the number of collections from each area are insufficient to make a valid comparison on a regional basis. The areas selected for study, as shown in Figure 1, represent to some extent a cross-section of the entire country. Species collected during the year that have not been listed in previous reports under this study are presented in Table 2. Some of these and others of special interest are briefly mentioned below.

Anophelines—Anopheles (A.) asiaticus, discussed in above paragraph, was reported earlier in Thailand for the first time by SMRL from Tak province. Until this report period it was known only from that province. An. (C.) pampanai, was also earlier reported for the first time in Thailand by SMRL from Chanthaburi and Prachinburi province. The additional collection from the northern province of Nan is of special taxonomic interest. Determination of this species is important since it is so very closely related to An. (C.) minimus and some of the earlier records from these areas probably include pampanai. An. (A.) sintonoides: the two collections of this species from Pandanus (screw pine) axils are of interest and somewhat of a surprise. As far as we can tell this is the first time an Anopheles has been collected from Pandanus axils. An. (A.)

tigertti, discussed briefly above, was first discovered by SMRL and previous to this report was known only from Prachinburi province. An. (C.) varuna: a very small number of adult specimens which appear to be this species still continue to be collected occasionally by SMRL. The species has been reported from Thailand but its correct identification and status has been questionable. The species is very close to several others of the minimus group, and the morphological characters used to separate members of this group exhibit a marked degree of variation within each species. We believe that the few adults being encountered and tentatively identified as varuna are in fact not varuna and are nothing more than variants of minimus. Two sibling series of minimus from Saraburi have been obtained and the adults from this series exhibit the full range of variables in wing characters used in identification. A small number of varuna (?) also occur in Saraburi and further attempts are to be made to recover eggs from some of these specimens. Recovery of a sibling series from one or more of these specimens should clear up the question. Because of the proven status of An. minimus as the primary vector of malaria in many areas of Thailand, solution of taxonomic problems in this group takes on added significance.

Ayurakitia: Only one species previously described for this genus and known to occur only in Northern Thailand. Specimens collected recently from pandanus axils in Southern Thailand belong to this genus but represent a new and undescribed species.

Culex: Culex (Culiciomyia) termi, this very unusual mosquito, the larvae of which have siphons longer than the combined length of head, thorax and abdomen, was described from Thailand by Thurman, 1955. Specimens were collected in Lampang Province during 1952-53. Since that time repeated efforts to collect this species by several subsequent investigators have been unsuccessful. Collectors of SMRL encountered this species several times in elephant foot-prints, the type habitat, along with three other new and undescribed species of Culex (Culiciomyia) in Mae Hongson Province during September.

Aedes: Aedes (Diceromyia), only one species of this subgenus had previously been reported from Thailand and prior to this report no collections of the immature stages had been made. The larvae of a new and undescribed species were collected several times from bamboo in the northern and southern provinces of Nan and Phangnga.

Summary: A large number of specimens were added to the collection during the year, including several not previously known from Thailand and others which are new but undescribed. Much additional information on the distribution and bionomics has been accumulated on many species. The Thai mosquito fauna is extremely complex and much remains to be learned, but after several years of collecting we are now at the point of understanding many of these complexities. An effort is underway to consolidate all available information on the Thai mosquito species. Detailed studies of several specific groups are continuing and several manuscripts are pending publication. Many of the early problems encountered in the study have been satisfactorily solved and prospects for even more accomplishments during the coming year look more promising.

Figure 1.

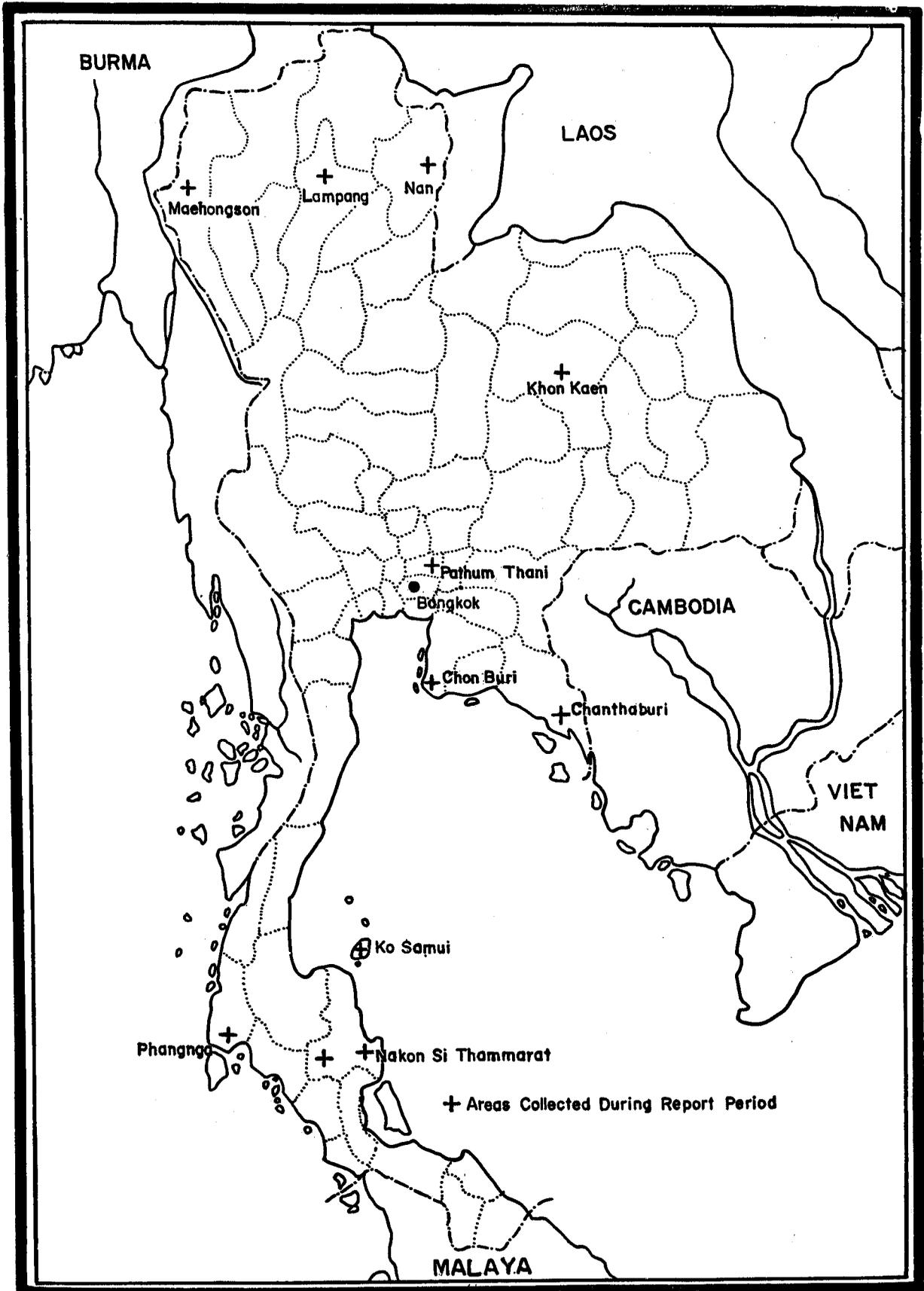


Table 1A Tabulation of Anopheles larval collections made during the year.

SPECIES	HABITAT																TOTAL	SHADE FREQUENCY										
	Stream Pool	Rock Pool	Stream Margin	Rice Field	Ditch-Canal	Ground Pool	Flood Pool	Wheel-Rut	Well	Seepages-Springs	Bog-Marsh	Swamp	Elephant Foot-print	Animal Hoof-print	Stump Hole	Tree Hole		Fallen Tree Trunk	Pandanus Axil	Bamboo Stump	Split Bamboo	Crab Hole	Banana Stump	Total collections of each species.	None	Partial	Heavy	
Number of each type habitat examined	47	65	14	19	44	15	44	17	7	8	21	8	106	4	16	105	25	12	105	64	15	2						
<i>Anopheles</i> (<i>Anopheles</i>)																												
<i>An. annandalei interruptus</i>															1									1				
<i>An. asiaticus</i>																					13			13				
<i>An. barbirostris</i>	2	2	1	3	4	3	4	1	2	1														23	8	11	4	
<i>An. barbumbrosus</i>	10	2	3	1		3	1						1											21	1	11	9	
<i>An. bengalensis</i>	26	3	9	1	1				5	2	3											2		49	3	18	28	
<i>An. campestris</i>				1	25	1	1	5																34	2	27	5	
<i>An. crawfordi</i>	1																							1				

Table 1A (Cont.)

SPECIES	HABITAT	TOTAL	SHADE FREQUENCY		
			None	Partial	Heavy
<i>Anopheles (Cellia) Cont.</i>					
<i>An. pampanai</i>	Stream Pool	1	1		
<i>An. philippinensis</i>	Stream Margin Rock Pool Stream Pool Rice Field Ditch-Canal Ground Pool Flood Pool Wheel-Rut Well Seepages-Springs Bog-Marsh Swamp Elephant Foot-print Animal Hoof-print Stump Hole Tree Hole Fallen Tree Trunk Pandanus Axil Banana Stump	3	6	2	1
<i>An. riparis macarthuri</i>	Stream Pool	4	1	1	2
<i>An. splendidus</i>	Stream Pool	2	2		
<i>An. subpictus</i>	Stream Margin Rock Pool Stream Pool Rice Field Ditch-Canal Ground Pool Flood Pool Wheel-Rut Well Seepages-Springs Bog-Marsh Swamp Elephant Foot-print Animal Hoof-print Stump Hole Tree Hole Fallen Tree Trunk Pandanus Axil Banana Stump	9	5	2	2
<i>An. tessellatus</i>	Stream Margin Rock Pool Stream Pool Rice Field Ditch-Canal Ground Pool Flood Pool Wheel-Rut Well Seepages-Springs Bog-Marsh Swamp Elephant Foot-print Animal Hoof-print Stump Hole Tree Hole Fallen Tree Trunk Pandanus Axil Banana Stump	10		10	
<i>An. vagus</i>	Stream Margin Rock Pool Stream Pool Rice Field Ditch-Canal Ground Pool Flood Pool Wheel-Rut Well Seepages-Springs Bog-Marsh Swamp Elephant Foot-print Animal Hoof-print Stump Hole Tree Hole Fallen Tree Trunk Pandanus Axil Banana Stump	35	19	15	1
Total species from each type habitat.		12	8	13	17
Total collections from all type habitats for the year 937		8	7	10	2
Total collections made from all habitats listed 762		10	2	7	6
Total collections with <u>Anopheles</u> 286		8	10	8	5
		1	2	1	2
		1	1	2	3

Table 1B. Tabulation of Anopheles larval collections made during the year.

SPECIES	MONTH												ALTITUDE IN METERS							PROVINCE		
	January	February	March	April	May	June	July	August	September	October	November	December	0-15	15-150	150-300	300-500	500-900	900-1400	1400-1650			
<i>Anopheles (Anopheles)</i>																					Chanthaburi, Cholburi, Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Pathum Thani, Surat Thani.	
<i>An. annandalei interruptus</i>						x									x						Nakorn Si Thammarat,	
<i>An. asiaticus</i>						x			x					x							Nakorn Si Thammarat, Phangnga, Mae Hongson	
<i>An. barbirostris</i>				x		x	x	x	x			x	x	x	x	x					Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Pathum Thani, Phangnga	
<i>An. barbumbrosus</i>			x				x	x	x					x							Chanthaburi, Khon Kaen, Nan	
<i>An. bengalensis</i>		x						x	x	x			x						x	x	x	Chanthaburi, Mae Hongson, Nan, Phangnga
<i>An. campestris</i>			x											x								Khon Kaen, Pathum Thani

Table 1B. (Cont.)

SPECIES	MONTH	ALTITUDE IN METERS	PROVINCE
<i>Anopheles (Anopheles) Cont.</i>	January February March April May June July August September October November December	0-15 15-150 150-300 300-500 500-900 900-1400 1400-1650	Chanthaburi, Cholburi, Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Pathum Thani, Surat Thani.
<i>An. crawfordi</i>	x	x	Phangnga
<i>An. fragilis</i>	x	x	Phangnga
<i>An. hodgkini</i>	x	x	Phangnga
<i>An. hyrcanus group</i>	x x x x	x x x x	Khon Kaen, Nakorn Si Thammarat, Nan
<i>An. indiensis</i>	x	x	Nakorn Si Thammarat, Phangnga
<i>An. insulaeflorum</i>	x	x x	Chanthaburi, Nan
<i>An. nigerrimus</i>	x x	x x	Nakorn Si Thammarat, Nan
<i>An. palmatus</i>	x	x	Chanthaburi
<i>An. peditaeniatatus</i>	x	x x x x	Phathum Thani, Nan
<i>An. roperi</i>	x	x	Phangnga
<i>An. sinensis</i>	x x x x	x x x x	Khon Kaen, Mae Hongson, Nan, Phangnga

Table 1B. (Cont.)

SPECIES	MONTH												ALTITUDE IN METERS						PROVINCE	
	January	February	March	April	May	June	July	August	September	October	November	December	0-15	15-150	150-300	300-500	500-900	900-1400		1400-1650
<i>An. sintonoides</i>		x				x				x			x	x	x					Chanthaburi, Chonburi, Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Pathum Thani, Surat Thani.
<i>An. tigerti</i>			x																	Chanthaburi, Nakorn Si Thammarat, Phangnga
<i>An. umbrosus</i> group																				Chanthaburi
<i>Anopheles (Cellia)</i>																				Phangnga
<i>An. aconitus</i>				x		x		x	x				x	x	x					Khon Kaen, Nakorn Si Thammarat, Pathum Thani, Phangnga
<i>An. annularis</i>																				Khon Kaen
<i>An. balabacensis</i>			x			x		x	x				x	x	x					Chanthaburi, Mae Hongson, Nakorn Si Thammarat, Nan, Phangnga
<i>An. jamesii</i>																				Khon Kaen
<i>An. kochi</i>						x		x												Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Phangnga

Table 1. (Cont.)

SPECIES	MONTH												ALTITUDE IN METERS						PROVINCE		
	January	February	March	April	May	June	July	August	September	October	November	December	0-15	15-150	150-300	300-500	500-900	900-1400		1400-1650	
<i>Anopheles (Cellia) Cont.</i>																					
<i>An. maculatus</i>	x					x	x	x	x				x	x	x	x	x				Chanthaburi, Cholburi, Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Pathum Thani, Surat Thani.
<i>An. minimus</i>							x	x					x	x	x	x					Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Surat Thani
<i>An. pampanai</i>							x														Mae Hongson, Nan
<i>An. philippinensis</i>															x						Nan
<i>An. riparis macarthuri</i>							x	x	x						x	x					Khon Kaen, Nakorn Si Thammarat, Nan
<i>An. splendidus</i>																					Nakorn Si Thammarat
<i>An. subpictus</i>										x								x			Mae Hongson
<i>An. tessellatus</i>																					Chanthaburi, Khon Kaen, Mae Hongson, Nakorn Si Thammarat
<i>An. vagus</i>																					Pathum Thani
<i>Total Species</i>	1	7	6	6	0	15	12	16	9	15			8	23	1	18	15	6	2		Cholburi, Khon Kaen, Mae Hongson, Nakorn Si Thammarat, Nan, Pathum Thani

Table 2

Mosquito species collected during 1966-1967
not previously represented in SMRL collections.

SPECIES	PROVINCE
<u>Aedes</u> (<u>Aedimorphus</u>) <u>culicinus</u> , Edwards, 1922	Khon Kaen
<u>Aedes</u> (<u>Diceromyia</u>) u. sp.	Nan, Phangnga
<u>Aedes</u> (Subgenus Unknown) u. sp.	Nan
<u>Anopheles</u> (<u>Anopheles</u>) <u>figertii</u> , Scanlon and Peyton, 1967	Prachinburi, Chanthaburi
<u>Armigeres</u> (<u>Leicesteria</u>) <u>pendulus</u> , (Edwards), 1914	
" " <u>traubi</u> , Macdonald, 1960	Phangnga
" " <u>inchoatus</u> , Barraud, 1927	"
" " u. sp.	"
<u>Ayurakitia</u> u. sp.	Nakorn Si Thammarat, Phangnga
<u>Culex</u> (<u>Culiciomyia</u>) <u>termi</u> , Thurman, 1955.	Mae Hongson
" " u. sp. 1	"
" " u. sp. 2	"
" " u. sp. 3	"
<u>Culex</u> (<u>Culex</u>) <u>litoralis</u> , Bohart, 1946	Chanthaburi, Cholburi
<u>Toxorhynchites</u> (<u>Toxorhynchites</u>) <u>amboinenensis</u> , (Dolleschall), 1857.	Nan

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