

PRESENT STUDYCollections at Bang Phra

Description of the area. Bang Phra (figure 1) is a coastal town on the Gulf of Thailand. It is approximately 110 kilometers southeast of Bangkok, in Choburi Province. The soil in the area is quite sandy for the most part, and away from the immediate beach area it appears to be chiefly sandy loam. The chief agricultural activities are the raising of tapioca, and rice and there are a number of tapioca processing mills in the area. The area was covered by forest in the past, and there are remnants of the forest on the low hills which come close to the coast. Three isolated hills come close to the area where the collections were made. These are: Khao Rawadi, 124 m., to the East, Khao Yai Li, 192 meters, to the South, and Khao Chalak, 313 meters, located to the Southeast. The altitude of the catching station itself is approximately 20 meters.

The collections were made on the grounds of the Queen Saovabha Institute, the Red Cross Society of Thailand. The Institute maintains a large horse farm at Bang Phra for the production of antisera for the treatment of snakebite. The horses are generally imported from Australia and held at the farm for some time. Members of the SEATO Medical Research Laboratory have cooperated in a study of mosquito-borne virus diseases at Bang Phra since late 1962. The study was undertaken because there had been a number of horse deaths on the farm in 1960 which were believed due to Japanese encephalitis. A light trap and horse-baited mosquito trap were operated at the farm several

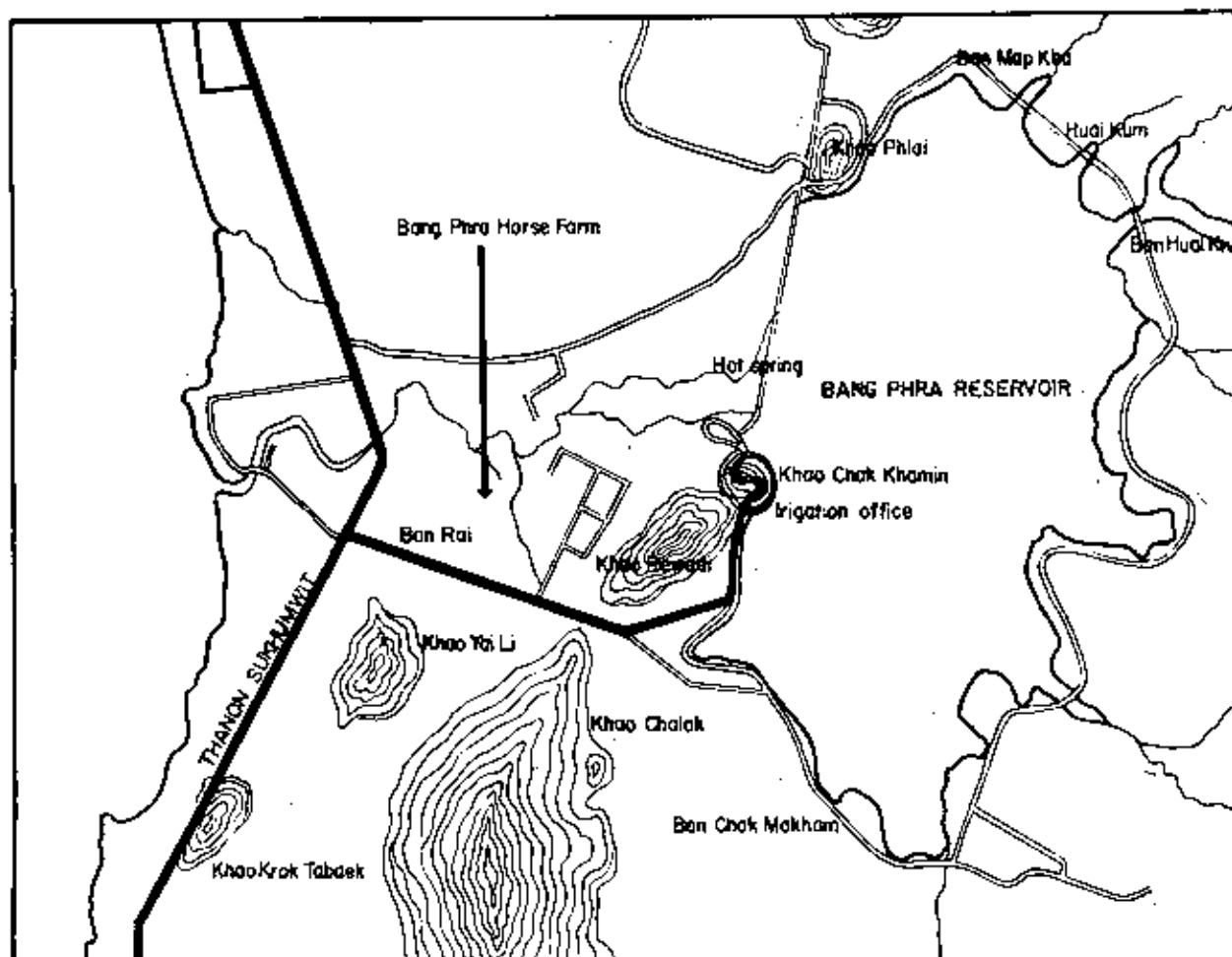


Figure 1. Map of Bang Phra Area.

times a week, and the mosquitoes taken from the traps were inoculated into mice for the recovery of virus. By the end of 1963 six strains of virus, chiefly Japanese encephalitis, had been isolated from the mosquitoes. While the contents of the light trap were being examined it was noted that there were Culicoides present all through the year, and that sometimes they were present in large numbers. The area around the farm shows a great diversity of possible breeding sites for Culicoides. To the west of the farm and the coastal highway there is a stretch of sandy beach with mud flats extending into the Gulf of Thailand. The farm is bounded on the North by a slow moving stream which enters the Gulf in the town of Bang Phra. This stream carries off the waste products from a large tapioca mill located to the East of the farm, and during the dry season the water may become extremely foul due to the accumulation of vegetable wastes. No search was made for immature Culicoides during this study, but SRATO collectors have found large numbers of the mosquitoes Culex gelidus and C. tritaeniorhynchus breeding in the stream during the dry season, so it appears to be capable of supporting aquatic insect life. The stream takes its origin in Bang Phra reservoir, approximately two kilometers East of the farm. This is a large reservoir operated by the Royal Irrigation Department. The Eastern end is sealed by an earthen dam and there is little marginal vegetation. The eastern end of the reservoir, however, is swampy, and many small streams enter it from the East. There is another smaller swampy area below the face of the dam. The farm itself is well drained, and there appear to be few possible breeding sites for Culicoides within the farm limits.

Most of the large trees have been cut from the area, and there is relatively little possibility for treehole breeding species at the farm. There are small remnants of forest on the surrounding hills, but the extent of the treeholes available was not determined.

Bang Phra has a monsoon climate, with marked dry and wet seasons. The wet season extends from May to October or November. This is followed by a cooler dry season from November to February. The months from March to May are usually hot and dry, and at this season almost all the fresh surface water disappears.

In addition to the large human and horse populations in and near the farm, there are cattle and water buffalo nearby. The extent of the wild animal population was not determined.

Species identified and seasonal abundance :

The time available for the Bang Phra study did not permit examination of specimens from a complete year. However, it was possible to detect seasonal trends in the nine months of collections which were available. The light traps captured very large numbers of midges during most months, but the catches in January were quite low. The fact that twenty five species, listed in table 1, were taken in the light traps indicates that a fairly diverse fauna was present in the area. Not all of the species were equally abundant, nor did they show the same pattern of seasonal abundance.

Culicoides peregrinus was the most common species taken at Bang Phra. It was the dominant species in every month, except for June, when C. annamensis was slightly more abundant. It ranged from a minimum of 35.2% of the midges examined in February, to a maximum

Table 1 - LIST OF BANG PHEA CULICOIDES SPECIES

(June 1963 - February 1964)

<u>Culicoides actoni</u>	Smith, 1929
" <u>albipennis</u>	Wirth & Hubert, 1959
" <u>anamiensis</u>	Tokunaga, 1937
" <u>anophelis</u>	Edwards, 1922
" <u>arakawai</u>	(Arakawa), 1943
" <u>distinctus</u>	Sen. & DasGupta, 1959
" <u>flavescens</u>	Macfie, 1937
" <u>flaviscutatus</u>	Wirth & Hubert, 1959
" <u>geminus</u>	Macfie, 1937
" <u>guttifer</u>	(Meijere),
" <u>huffi</u>	Causey, 1938
" <u>humeralis</u>	Okada, 1941
" <u>medowelli</u>	Delf., 1961
" <u>orientalis</u>	Macfie,
" <u>palpifer</u>	Das Gupta & Ghosh, 1956
" <u>paraflavescens</u>	Wirth & Hubert, 1959
" <u>pelilibouensis</u>	Tokunaga, 1937
" <u>peregrinus</u>	Kieffer, 1910
" <u>recurvus</u>	Delfinals, 1961
" <u>schultzei</u>	Enderlein, 1908
" <u>shortti</u>	Smith & Swaminath, 1932
" <u>similis</u>	Macfie, 1932
" <u>Sp. 1</u>	
" <u>Sp. 2</u>	
" <u>Sp. 3</u>	

of 85.7 in October. The form of the population curve for peregrinus was quite different from that of C. amaniensis (fig. 2). The breeding places of these species was not determined at Bang Phra, but it is probable that this is the primary determining factor in seasonal abundance. C.peregrinus is the species which Causey (1938) reported finding infected with microfilariae in Thailand. It is possible that the microfilariae were non-human in origin, but this is a question which deserves additional attention. Since all of the Bang Phra collections were dead and dried on receipt, it was not possible to make dissections for filariae. The available literature does not indicate the feeding habits of peregrinus, nor its preferred breeding sites.

The second most abundant species collected was Culicoides amaniensis Tokunaga. The seasonal distribution of this species (table 2) is quite different from that of C. peregrinus. It was most abundant in the periods June-July, and January-February, and least abundant in the months of October and November. C.amaniensis has been reported to feed on water buffalo in Taiwan (Wirth and Hubert, 1961), and it also is reported to feed on man. Its abundance and feeding habits, thus make it a possible suspect for disease transmission, but no information is available on this subject at present. Culicoides schultzei showed yet another type of seasonal pattern, with a peak population in July and August. This species has been reported from many parts of Asia, and at the time of Tokunaga's report from Taiwan (1937)

Figure 2. Two types of seasonal pattern, *Culicoides* species
Bang Phra, Choburi. June 1963 to February 1964.

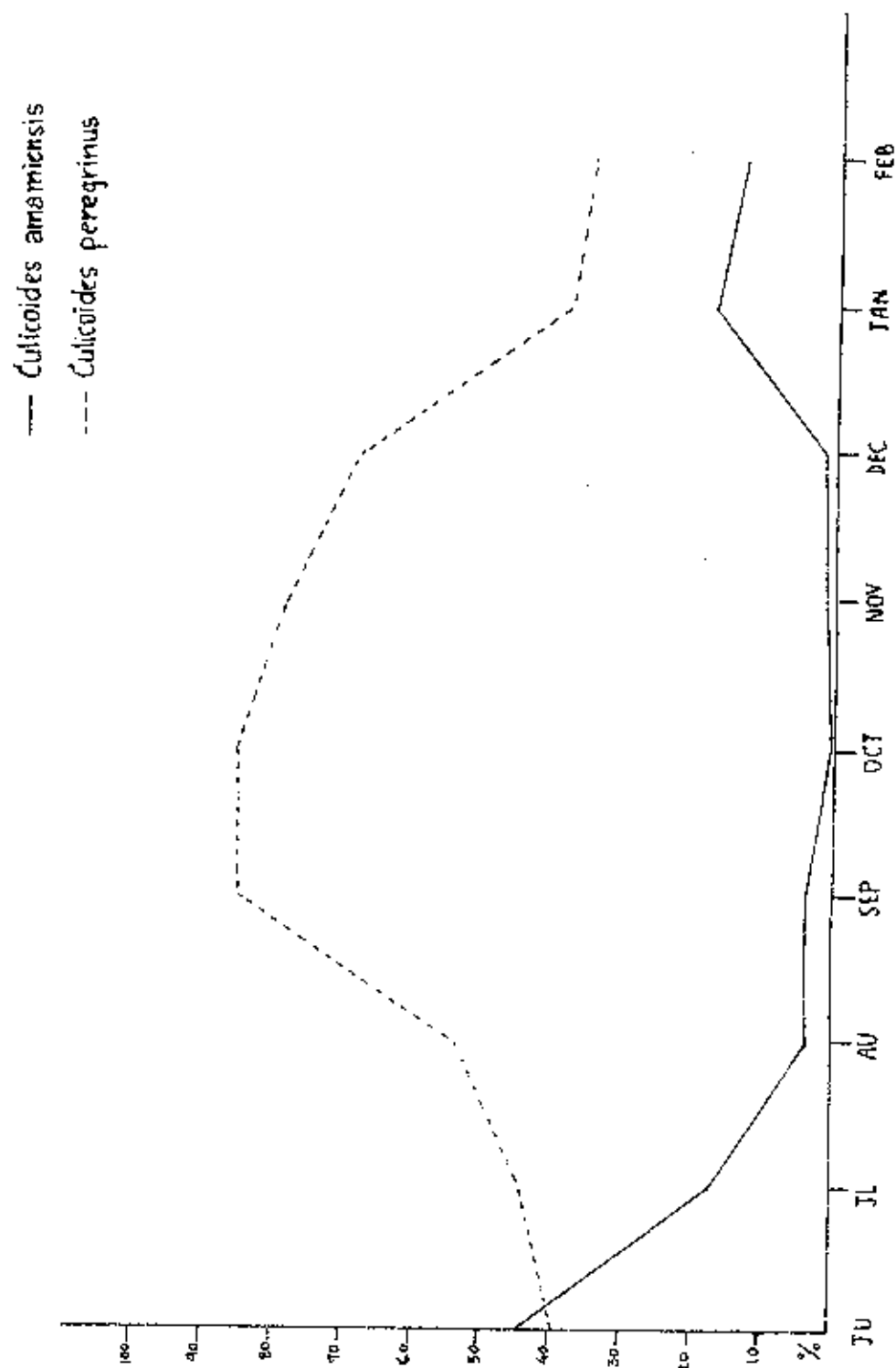


Table 2 Relative abundance of Culicoides species, Bang Phra,
Cholburi June 1963 to February 1964

<u>Culicoides</u>	<u>Jun.</u>	<u>Jul.</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Jan.</u>	<u>Feb.</u>
annamensis	44.3	17.1	3.5	3.6	0.2	1.0	1.4	17.6	13.3
peregrinus	39.4	44.4	54.1	85.4	85.7	78.3	68.5	38.5	35.2
schantzei	7.0	23.4	34.7	6.9	6.4	3.3	4.8	3.1	6.0
orientalis	5.5	10.1	6.0	2.8	2.5	7.5	5.6	12.7	13.5
geminus	0.2	0.8	0.1	0.1	-	3.4	6.2	2.4	3.2
recurvus	-	-	0.1	0.1	1.3	1.6	2.7	0.3	-
Trithoeoides									
sp.	1.7	0.6	0.3	0.3	1.2	2.1	2.8	10.7	12.0
Other sp.	1.9	3.6	1.2	0.8	2.7	2.8	8.0	14.7	16.8
Sample Size	1142	846	1382	1223	1553	930	711	291	1041

its feeding habits were still unknown. All of the records seen during this study were from light traps in various parts of Asia. The species is very widely distributed, from Africa to New Guinea.

Culicoides orientalis has previously been recorded by Causey (1938) from Bangkok and Traang. It was spread more evenly through the year than the species discussed above, but showed a slightly higher percentage in July and January to February. Relatively little has been published on the habits and biology of this species. Culicoides genivus was present in small numbers from June to September, and absent in October. The highest population occurred in December. Culicoides recurvus was absent from the collections in June, July and February. It reached a peak in December, but even then was present in only small numbers. This record of recurvus from Bang Phra is the first record of this species from Thailand.

Most of the remaining species were present in quite small numbers during most of the year, with only occasional peaks in different months. The three members of the subgenus Trithecooides with three subequal spermathecae- C. anophelis, C. flavescens, and C. paraflavescens, were most common in the cooler months of November through February. Culicoides anophelis reached peak numbers in February. This species feeds on the abdomens of blooded Anopheles mosquitoes, but it is also reported to feed on cattle (Wirth and Hubert, 1959). This is another species which should be studied further as a possible host of human or animal disease organisms. Culicoides flavescens also has been reported to feed on man and cattle, but only a single female was found at Bang Phra in February. Thus it appears to be too rare in

the area to be of importance as a disease carrier.

Four members of the Erithecoides group with one large and two small spermathecae were found at Bang Phra- Culicoides palpifer, C. humeralis, C. albibasis and C. flaviscutatus. Culicoides palpifer is reported to feed in the rotted stems of banana plants (Wirth and Hubert, 1959). It has been reported from cattle sheds, but the actual feeding habits are unknown. It occurred at Bang Phra from December to February. Culicoides flaviscutatus is of interest, since it is known to feed on man and deer (Wirth and Hubert, 1959). It was found only in the month of February at Bang Phra. C. humeralis was found in December; only a single female being collected. Four specimens of C. albibasis were also taken in February, but not at any other time of the year. This species is reported to feed on cattle, and C. humeralis on man (Wirth and Hubert, 1959), but they are too rare at Bang Phra to pose a problem as pests or in disease transmission.

Culicoides actoni occurred in very small numbers in July and September. It is reported to feed on man (Smith, 1929). C. arakawai was much more abundant, reaching a peak (95 specimens) in February. Nothing is known of its feeding habits in Thailand, but elsewhere it is known to feed on domestic fowl. Culicoides distinctus was found only in July. Another species, C. guttifer, was most common in the months of October to February, while essentially absent from the earlier collections.

An important human-biting species, C. belilouensis, was collected in moderate numbers from June to December. It was relatively more common in July, at that time making up 1.1% of the total midges

examined. The habits of the species in Thailand are not known, but it is a fierce biter of man in other areas (Tokunaga, 1937) and may be important in disease transmission. Culicoides huffi, C. mcDowelli and C. shortti were found in small numbers at various times of the year. The latter species was fairly common in December and February. It is reported to feed on man. The record of C. mcDowelli is the first for Thailand, and a moderate number (37 specimens) were identified at Bang Phra in February.

Three new species were found among the midges collected at Bang Phra. One of these (n. sp. 2) was represented in September. It is a member of the orientalis group. New species no. 3 is also represented only by a single male, collected in January. The other species (n. sp. 1) was present in much larger numbers, reaching a peak in October. This species is a member of the gymnopterus group. The males and females of this species are assigned together provisionally, since they differ in the structure of the radial cells.

It should be noted that the material collected from Bang Phra was obtained entirely from a single light trap, hung under the eaves of a horse barn. The richness of the fauna thus obtained, and the diversity of possible breeding sites in the Bang Phra lead one to suspect that there are many more species which will be found in the area when other methods of collection are used, and when other sites in the Bang Phra area are examined.

Other collections

Additional collections were examined from Chiangmai and Bangkok and from a number of the sites visited by teams engaged in the collection of mosquitoes for virus isolation. These collections were generally not extensive enough to give a complete picture of the Culicoides population, but they permit an extension of the known distribution of several of the species in Thailand. Of particular interest were the collections of specimens biting man on Kao Yai, a newly opened National Park northeast of Bangkok. Other collections, largely by light trap, were made at: Petchburi- on the southeastern coastal plain; Karnchanaburi- in the foothills of the mountains bordering Burma; Udorn- on the Northeastern plateau; Prachuabkirikarn on peninsular Thailand; Rajburi- southwest of Bangkok at the head of the Gulf of Thailand. Each of these areas represents a somewhat different environment, but there was considerable overlap in the species encountered in the various areas.

The greater part of the collections from Bangkok and Chiangmai (light trap collections from 1962 to 1963) were forwarded to the United States National Museum for study. These will form part of the material for a complete review of the Culicoides fauna of SE Asia which is being undertaken by Dr. Wirth and cooperating specialists. A small number of the alcohol preserved Culicoides from Bangkok and Chiangmai were examined by the investigator, as a basis for future work.

The following species were identified from the area listed above:-

Bangkok (Light traps in the city, 5 ft. above sea level)

Culicoides arakawai, C. newertzi^{*}, C. guttifer,

C. orientalis, C. peregrinus, C. recurvus, C. schultzei

Chiengmai (Light traps on the outskirts of the city, 1000 ft. altitude)

Culicoides amamiensis, C. arakawai, C. guttifer,

C. huffi, C. humeralis, C. mcdowelli, C. orientalis,

C. palpifer, C. peregrinus, C. schultzei, C. shortti.

Petchburi (on the coastal plain, west coast of the Gulf of Thailand)

Culicoides actoni, C. amamiensis, C. arakawai,

C. orientalis, C. peregrinus, C. shortti,

Rajburi (on the coastal plain, north of Petchburi and closer to the Bangkok metropolitan area)

C. amamiensis, C. arakawai, C. circumscriptus^{*},

C. guttifer, C. huffi, C. orientalis, C. peregrinus,

C. schultzei, C. shortti

Kanchanaburi (Northwest of Bangkok, in the foothills of the Blaucong Range, altitude 400 feet)

Culicoides amamiensis, C. clavipalpis^{*}, C. insignipennis^{*},

C. orientalis, C. palpifer, C. schultzei, C. shortti,

C. tenuipalpis^{*}

Kao Yai National Park (Northeast of Bangkok in a region of tropical hill forest, altitude 2500 feet)

Culicoides actoni, C. amamiensis, C. humeralis

* Collected only at this locality.

Udon (on the Korat plateau, in the dry northeastern part of the country altitude 700 feet)

Culicoides arakawai, C. peregrinus

A consolidated list of all of the species of Culicoides from Bang Phra and the other areas listed above is presented in table 3. An examination of the literature revealed a number of species of Culicoides reported by other workers which were not found in the present study. For the sake of completeness these are listed in table 4.

Table 3

List of species of Thailand Culicoides in the collection of the SEATO Medical Research Laboratory.

<u>Culicoides actoni</u>	Smith, 1929
"	<u>albibasis</u> Wirth & Hubert, 1959
"	<u>anomienis</u> Takunaga, 1937
"	<u>anophelis</u> Edwards, 1922
"	<u>arakawi</u> (Arakawa), 1943
"	<u>circumscriptus</u> Kieffer, 1918*
"	<u>clavipalpis</u> Mukerji, 1931*
"	<u>distinctus</u> Sen, & DasGupta, 1959
"	<u>flavescens</u> Macfie, 1937
"	<u>flaviscutatus</u> Wirth & Hubert, 1959
"	<u>geminus</u> Macfie, 1937
"	<u>gewertzi</u> Causey, 1938*
"	<u>guttifer</u> (Meijere)

<u>Culicoides huffi</u>	Causey, 1938
" <u>humeralis</u>	Okada, 1941
" <u>insignipennis</u>	Macfie, 1937*
" <u>mcDowelli</u>	Delfinado, 1961
" <u>orientalis</u>	Macfie
" <u>palpifer</u>	DreGusta & Ghosh, 1956
" <u>proflavescens</u>	Wirth & Hubert, 1959
" <u>pellilioneensis</u>	Tokunaga, 1937
" <u>peregrinus</u>	Kieffer, 1910
" <u>recurvus</u>	Delfinado, 1961
" <u>schultzei</u>	Enderlein, 1908
" <u>shortti</u>	Smith & Swaminath, 1932
" <u>similis</u>	Macfie, 1932
" <u>tenuipalpis</u>	Wirth & Hubert, 1959*
" <u>sp. 1</u>	(Gymnoterus Group)
" <u>sp. 2</u>	(Orientalis Group)
" <u>sp. 3</u>	(Ornatus Group)

* Insufficient material of these species was available to permit a detailed description.

Table 4Culicoides species reported from Thailand - not present in the collections

	<u>Culicoides andrewsi</u>	Causey, 1938
"	<u>corti</u>	Causey, 1938
"	<u>denmeadi</u>	Causey, 1938
"	<u>elbeli</u>	Wirth & Hubert, 1959
"	<u>hegneri</u>	Causey, 1938
"	<u>hewitti</u>	Causey, 1938
"	<u>jacobsoni</u>	Macfie, 1934
"	<u>liui</u>	Wirth & Hubert, 1961
"	<u>macfieii</u>	Causey, 1938
"	<u>shermani</u>	Causey, 1938
" "	<u>sumatrae</u>	Macfie, 1934