Identifications of the *Culex ppienis* Complex in Thailand, 
Based on the Study of Male Terminalia D/V Ratios

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ABSTRACT: Mosquitoes belonging to the *Culex ppienis* complex were collected from several localities in Thailand and identified by using D/V ratios of male terminalia. Most of the mosquitoes were *Cx. quinquefasciatus*, having D/V ratios between 0.1 - 0.6, mean 0.35 ± 0.07. Among the mosquitoes from Klong Taey, Phuket and Chiang Mai, 9/262 had D/V ratios of 0.7 - 0.9, which may be extreme variations of *Cx. quinquefasciatus* or may be the variety *pallens* of *Culex ppienis*.

INTRODUCTION

The *Culex ppienis* complex is subdivided into *Cx. ppienis ppienis*, *Cx. ppienis quinquefasciatus* (fatigans), *Cx. ppienis australicus*, *Cx. ppienis var. molestus*, *Cx. ppienis var. pallens* and *Cx. globocoxitus* (1). Sirivanakarn changed the status of some of the above names, e.g., *quinquefasciatus* was elevated to species status and *pallens* was elevated from variety status to subspecies (2).

All over Thailand, *Cx. quinquefasciatus* is a pest and local vector of Japanese B. encephalitis and carrier of Chikungunya infection (3). It could be an experimental vector of periodic Bancroftian filariasis but to a lesser degree for the subperiodic form (4). *Cx. quinquefasciatus* control or eradication is difficult because the breeding places are rapidly increasing with urbanization and because of the occurrence of insecticide resistance (5, 6). To cope with the *Culex ppienis* complex problems, it is first necessary to identify the different members of the species complex. *Cx. p. pallens* and *Cx. p. var. molestus* have not been previously reported in Thailand (3). This study was aimed at revealing variations of male terminalia, as described by Sasa (5) in order to distinguish forms of the *Cx. ppienis* complex collected from various localities of Thailand.

MATERIALS AND METHODS

Mosquito collection

* Culex ppienis* complex larvae were collected from different provinces in Thailand, reared and maintained in the laboratory in the Bangkok School of Tropical Medicine. Adult males aged 4 to 5 days were used for measuring D/V ratios of male terminalia.
Preparation of male terminalia

Male terminalia were prepared by cutting off the last abdominal segment of adult males, aged 4-5 days, slide-mounting each in Gater's medium, and leaving it for two or three days until the exoskeleton was clear. The specimens having dorsal and ventral arms spread properly were chosen for identification and measurement. The specimens were assessed by measuring the distances between tips of the dorsal and ventral pairs of arms. The ratios of spans between dorsal arms and ventral arms were calculated and recorded. About one hundred terminalia were used from each locality.

RESULTS

The D/V ratios of male terminalia of these Culex are given in Tables 1 and 2, showing a range of 0.1 - 0.9, with mean 0.35 ± 0.07. In most cases the ratios were 0.2 - 0.5, which would be typical of Cx. quinquefasciatus. Most variations were observed in the samples from Klong Taux, Phuket and Chiang Mai, where some ratios were 0.7 or more. These forms comprised 9.52%, 1% and 2% of the populations of Klong Taux, Phuket and Chiang Mai, respectively (Table 2).

DISCUSSION

The D/V ratios of male terminalia of the Culex pipiens complex in Thailand mostly coincide with Cx. quinquefasciatus as shown in Table 1 and 2. Sasa and Shirasaka showed that in Southeast Asia and Japan the Culex pipiens complex could roughly be classified into three forms: fatigans (now being referred to quinquefasciatus), distributed in Southern Asia, and the South Amami Islands (tropical and subtropical) was anautogenous, nonstenogamous and had the smallest value of D/V ratio (0.3); pallens, from the Japanese mainland (temperate), also anautogenous and with varying D/V ratios (0.4 - 0.9) greater than for quinquefasciatus; and molestus, mainly from underground waters in large cities of the Japanese mainland (temperate), autogenous and stenogamous, with the largest D/V ratio (1.2) (7, 8).

D/V ratios of 0.7 - 0.9 shown in Table 2 for the mosquitoes from Klong Taux, Phuket and Chiang Mai coincided with Cx. p. pallens or Cx. p. pipiens. Alternatively these specimens might represent extreme variations within the strains of Cx. quinquefasciatus or be the results of crosses between tropical and temperate species of Culex pipiens complex, e.g., quinquefasciatus and pallens. Sirivanakarn, who included pallens as subspecies of pipiens, noted that he has never found Cx. p. pallens extend into Southeast Asia and other parts of the Oriental region (2). It is most probably restricted to the cold temperate climate similar to that of the typical pipiens of Northern Europe in the Western palearctic (2). Klong Taux, is the Bangkok seaport area where there are frequent communications between Thailand and other countries. Six mosquitoes had D/V ratios higher than for Cx. quinquefasciatus and they could possibly be Cx. pallens. Selective breeding biological and biochemical analysis of diagnostic
allozymes studies of mosquitoes from these populations could eventually confirm
whether or not they represent a separate subspecies.

Harinasuta et al., reported that Cx. p. pallen, Cx. quinquefasciatus and
Cx. p. var. molestus experimentally harboured 27.7%, 6.4% and 0.9%, respectively,
of infective stage of subperiodic W. bancrofti from Kanchanaburi, Thailand (9).
Thirty percent of Japanese Cx. p. pallen could also be experimentally infected
with B. malayi (10).

The introduction of Cx. p. pallen into Thailand from elsewhere, e.g.,
Japan and China, is possible as Phuket and Klong Tauy are ports visited by ships
from such places. Chiang Mai is located in the Northern part of Thailand where
mosquitoes could be introduced from South China. Further adaptations of temperate
strains to tropical climate, or their seeking suitable microclimatic conditions,
could give chances of Cx. p. pallen survival in Thailand.

The possibility of Bancroftian filariasis occurring in Bangkok was indicated
by Sucharit and Harinasuta (4). In areas such as Southern Thailand, where Cx.
quinquefasciatus and Cx. p. pallen breed, the immigration of infected people
from other endemic areas might contribute a risk of introducing this disease.

The present evidence of D/V ratios suggesting the presence of Cx. p. pallen
as well as Cx. quinquefasciatus in Thailand will complicate studies on the vector
status of this group of mosquitoes in Southeast Asia.

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LITERATURE CITED


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58:501-503.


7. Sasa, M. and A. Shirasaka. 1967. Comparative studies on various forms and their hybrids of the *Culex pipiens* complex in Japan and Southern Asia, the principal vector of Bancroftian filariasis. The 1st Southeast Asian regional seminar on tropical medicine, the 3rd conference on parasitic diseases and the seminar on malaria, Bangkok, 7-11 August 1967. SEAMES, pp. 30-31.


TABLE I. D/V ratios of *Culex pipiens* complex males from various provinces of Thailand.

<table>
<thead>
<tr>
<th>Provinces</th>
<th>Mean of D/V ratios</th>
<th>Range of D/V ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klongton, Bangkok</td>
<td>0.30 ± 0.06</td>
<td>0.20 - 0.50</td>
</tr>
<tr>
<td>Klong Tauy, Bangkok</td>
<td>0.46 ± 0.226</td>
<td>0.29 - 0.94</td>
</tr>
<tr>
<td>Kanchanaburi</td>
<td>0.37 ± 0.034</td>
<td>0.28 - 0.48</td>
</tr>
<tr>
<td>Aranyaprathet, Prachin Buri</td>
<td>0.38 ± 0.057</td>
<td>0.24 - 0.63</td>
</tr>
<tr>
<td>Udon Thani</td>
<td>0.35 ± 0.052</td>
<td>0.25 - 0.48</td>
</tr>
<tr>
<td>Ranong</td>
<td>0.32 ± 0.04</td>
<td>0.21 - 0.44</td>
</tr>
<tr>
<td>Chumphorn</td>
<td>0.33 ± 0.036</td>
<td>0.24 - 0.45</td>
</tr>
<tr>
<td>Phuket</td>
<td>0.37 ± 0.095</td>
<td>0.25 - 0.84</td>
</tr>
<tr>
<td>Chiang Mai</td>
<td>0.35 ± 0.103</td>
<td>0.19 - 0.91</td>
</tr>
<tr>
<td>Mean</td>
<td>0.35 ± 0.07</td>
<td>0.19 - 0.94</td>
</tr>
</tbody>
</table>
TABLE 2. Distribution of D/V and DV/D ratios of *Culex pipiens* complex males from various provinces of Thailand.

<table>
<thead>
<tr>
<th>Provinces</th>
<th>No. of mosquitoes having D/V and DV/D ratios of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9</td>
</tr>
<tr>
<td>Klongton, Bangkok</td>
<td>49 42 8 1</td>
</tr>
<tr>
<td>Klong Tuay, Bangkok</td>
<td>9 30 15 3 2 3 1</td>
</tr>
<tr>
<td>Kanchanaburi</td>
<td>10 59 31</td>
</tr>
<tr>
<td>Aranyaprapheth, Prachin Buri</td>
<td>4 61 30 4 1</td>
</tr>
<tr>
<td>Udon Thani</td>
<td>16 59 25</td>
</tr>
<tr>
<td>Ranong</td>
<td>33 60 7</td>
</tr>
<tr>
<td>Chumphorn</td>
<td>16 77 7</td>
</tr>
<tr>
<td>Phuket</td>
<td>18 43 28 7 2 1</td>
</tr>
<tr>
<td>Chiang Mai</td>
<td>2 19 56 17 3 1 1</td>
</tr>
<tr>
<td>Total</td>
<td>2 165 466 183 30 7 2 5 2</td>
</tr>
</tbody>
</table>
