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Distribution of Medically Important Mosquitoes in Nava Nakorn Industrial Estate, Pathum Thani Province, Thailand

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Abstract

A survey of the distribution of medically important mosquitoes was conducted in Nava Nakorn Industrial Estate, Pathum Thani Province from May to July, 2003. Mosquitoes were sampled bi-monthly by dipping, CO_2 light trap and human landing catch. Five species of mosquito larvae were found in breeding sites with *Culex* species potentially breeding in this area. *Cx. quinquefasciatus* was found to be breeding at a higher rate than other species in both sites of study, followed by *Cx. gelidus*. An estimated 47 larvae/dip were found at breeding site A and 36 larvae at breeding site B. By light trap method, *Cx. tritaeniorhynchus* was the main species found (53.1%) at site A, and *Cx. vishnui* (54.8%) at site B. An average of 25 mosquitoes/trap/night was recorded at site A, which was double that of site B. The mosquitoes attracted to humans were mainly *Cx. gelidus* (site A: 35.9%; site B: 52.3%) followed by *Cx. quinquefasciatus* and *Cx. vishnui*. The highest mosquito landing activity was found at 19.00-21.00 hr and 23.00-24.00 hr, and the highest mosquito landing density was 21 mosquitoes/hour.

Keywords: mosquito distribution, industrial area

Introduction

The emergence of industrialized areas around suburban Bangkok may lead to changes in breeding sites of medically important mosquitoes. There have been no reports about the impact of medically important mosquitoes in a new industrial area of Pathum Thani Province since this area changed into a large community, with various kinds of people living and working in this industrial area. A study in an industrial complex at Hardwar (UP), India, found 15 species of mosquitoes, and 80% were *Culex quinquefasciatus* Say; the remaining were 14 species of anophelines, with a small population of *Aedes aegypti* (Linn.) and *Ae. albopictus* (Skuse). The mosquito nuisance on the site was mainly due to *Cx. quinquefasciatus*, followed by *Anopheles subpictus*, and the area was located in vicinities with moderate to high malaria risk [1]. Even though no filariasis case has been reported in Pathum Thani Province, 17 cases of malaria and 3 cases of Japanese encephalitis (JE) have been reported in this area [2], and the prevalence of JE has now increased to 1,000 cases per year in Thailand. Therefore, this study aimed to pilot a survey of the distribution of medically important mosquitoes in an industrial estate in Pathum Thani Province, to derive baseline data for mosquito surveillance.

Materials and methods

Study site

Nava Nakorn Industrial Estate is located at

46 km Phahonyothin Road in Pathum Thani Province, and has an area > 6,000 rais serving all kinds of industries. Nava Nakorn was registered as a public company, named Nava Nakorn Public Company Limited, on October 31, 2002. This area has 170 factories and many companies, including leather, electronics and computer, packing materials, food, snacks, desserst, ink, diamond polishing, wood, microscopes, watches, automative parts, plastic color compounds, plastic toys, accessories, medical equipment, molds and dyes, household products, cosmetics, furniture, garments, and engines. Mosquitoes were collected from wastewater at two breeding sites inside the industrial area. Breeding site A was located in front of factories and breeding site B was located in front of a wastewater treatment area (Fig 1).

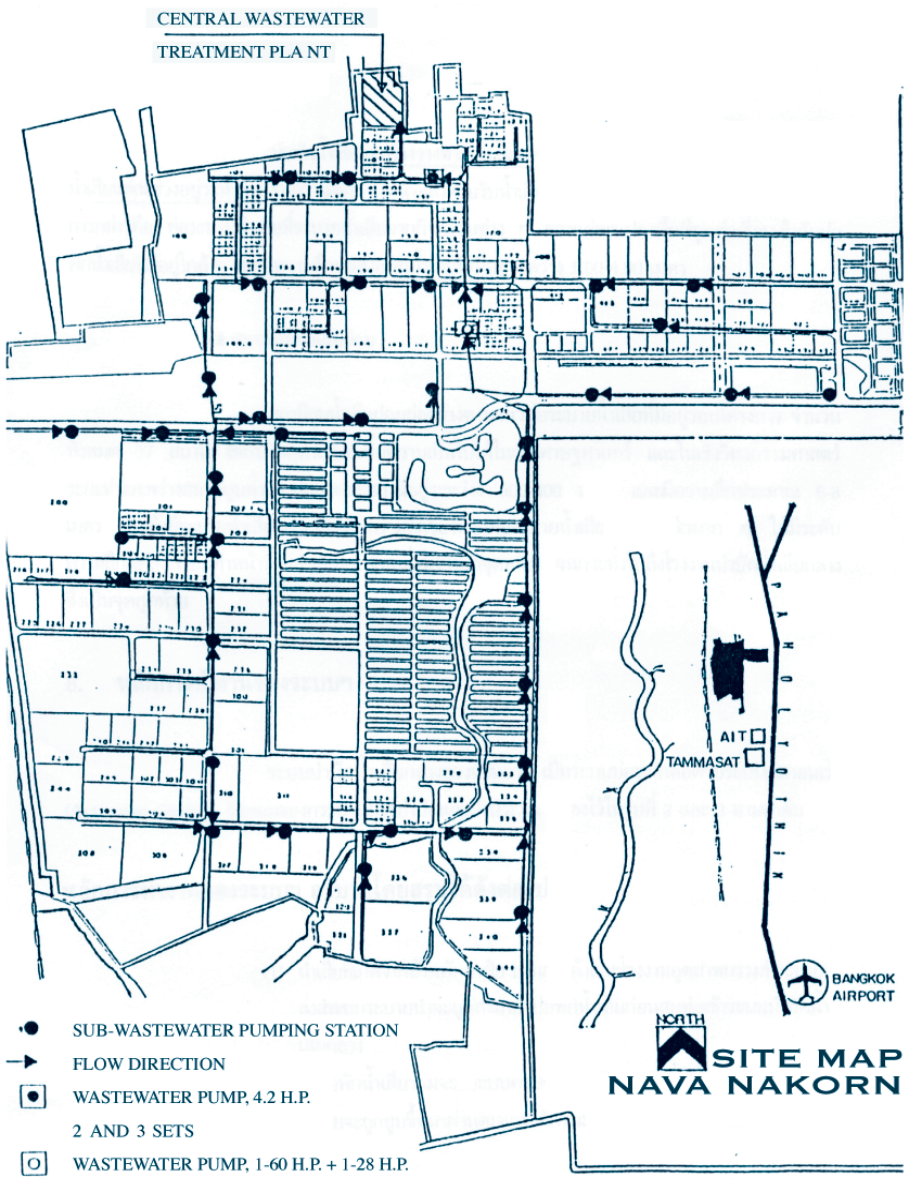

Fig 1 Map of study area and sites A and B in Nava Nakorn Indurtrial Estate, Pathum Thani Province [3].

A pilot mosquito survey was carried out in Nava Nakorn Industrial Estate, Pathum Thani Province. Mosquitoes were collected twice a month in the first and third weeks for a period of three months, May-July 2003 (6 collections).

Mosquito survey

Larva survey: larval populations were sampled at the sites where larvae were observed by dipping technique using a 1,000 ml dipper and taking 3-5 dip samples at each site to average the density of larvae per dip, and the most abundant species of mosquito able to breed in the industrial area. Samples were taken in a biased manner, sampling only those spots where mosquito larvae were noted in large numbers. Dips were taken at wastewater sites A and B (Fig 1), and the density was counted by transferring the contents of the dipper to white plastic trays in the laboratory, the count were reported as number of immature larvae found/dip/habitat. The larvae were randomly mounted and identified using a larva identification key and the remaining larvae or pupae were left in a cage to confirm the adults. The proportion of mosquito larvae and average of larvae/dip (with range) were reported for each area from 6 collections.

Adult mosquito survey: adult mosquitoes were sampled by CO_2 light trap and human landing catch.

CO_2 light traps were hung 1.3 m above the floor or ground. The traps were activated at 18.00 hr and turned off at 6.00 hr. The collected mosquitoes were brought to the laboratory and counted for density. The proportions of mosquito species trapped by CO_2 light trap were classified by area. The average number of mosquitoes/light trap/night at sites A and B were reported for 6 collections.

Landing rates were determined by indoor human landing catch from 18.00-24.00 hr (half night) by trained staff, twice a month. A half-night catch period was used for the pilot mosquito survey for security and convenience. One catcher sat inside a security office, exposing his arms and legs as bait, and caught all mosquitoes attempting to bite with a tube. Hourly catches were kept in separate cups and identified in the laboratory. The proportions of mosquito species trapped by human landing were calculated and classified by area. The average numbers of mosquito landing/hour/area from the 6 collections were recorded.

Species identification

The fourth instar larvae and adult mosquitoes were identified under microscope

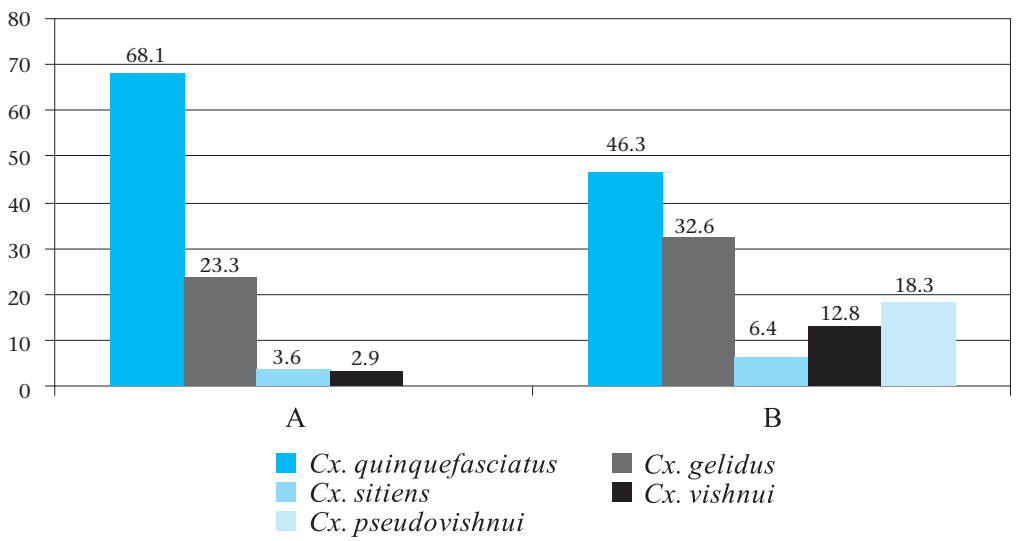

Fig 2 Proportion of mosquito larvae species at sites A and B in Nava Nakorn Industrial Area, Pathum Thani Province.

and stereomicroscope using the identification key of Rattanarithikul and Panthusiri [4].

Results

Larva survey

Five species of mosquito larvae were found in breeding sites A and B. Only *Culex* species found potentially breeding inside this area. *Cx. quinquefasciatus* was found to be breeding in higher number than other species at both sites, 68.1 % at site A (in front of factories) and 46.3% at site B (in front of the wastewater treatment area). *Cx. gelidus* had the second highest distribution, and a few of *Cx. sitiens, Cx. vishnui* and *Cx. pseudovishnui* were recorded. The percentages of mosquito larvae in Nava Nakorn Industrial Estate are shown in Fig 2.

An estimated 47 larvae/dip were found in breeding site A and 36 larvae in breeding site B. *Cx. quinquefasciatus* was the predominant species with an average of 30 larvae/dip at site A and 17 larvae at site B. *Cx. gelidus* had the second highest distribution, with an average of 12 larvae/dip at both sites. A few other species were also recorded. The results are shown in Table 1.

Adult mosquito survey

Adult mosquito collection using CO_2 light trap

Using a light trap, the main species found were *Cx. tritaeniorhynchus* (53.1%) at site A, and *Cx. vishnui* (54.8%) at site B. *Cx. quinquefasciatus* had the second highest distribution, followed by *Cx. gelidus* at both sites. A few other species were also recorded, as shown in Table 2.

An average of 25 mosquitoes/trap/night was recorded at site A, which was double site B (12/trap/night). *Cx. tritaeniorhynchus* was found in the highest density of 13/trap/night at site A, *Cx. vishnui* (7/trap/night) at site B (Fig 3).

Table 1 Average number of larvae per dip by species at sites A and B.

Species	Average larvae/dip (range)	
	site A	site B
Cx. quinquefasciatus	30 (11-54)	17 (8-34)
Cx. gelidus	12 (0-24)	12 (3-34)
Cx. sitiens	3 (0-12)	2 (0-11)
Cx. vishnui	2 (0- 8)	5 (0-12)
Cx. pseudovishunui	0	1 (0-3)

Table 2 Proportion of mosquito species trapped by CO_2 light trap.

Species	No of mosquitoes (%)	
	site A	site B
Cx. tritaeniorhynchus	78 (53.1)	1 (1.4)
Cx. vishnui	0	40 (54.8)
Cx. quinquefasciatus	35 (23.8)	18 (24.7)
Cx. gelidus	27 (18.4)	7 (9.6)
Cx. sitiens	3 (2.0)	2 (2.7)
Cx. pseudovishnui	2 (1.4)	2 (2.7)
Cx. bitaeniorhynchus	0	3 (4.1)
Ma. indiana	2 (1.4)	0
Total	147 (100)	73 (100)

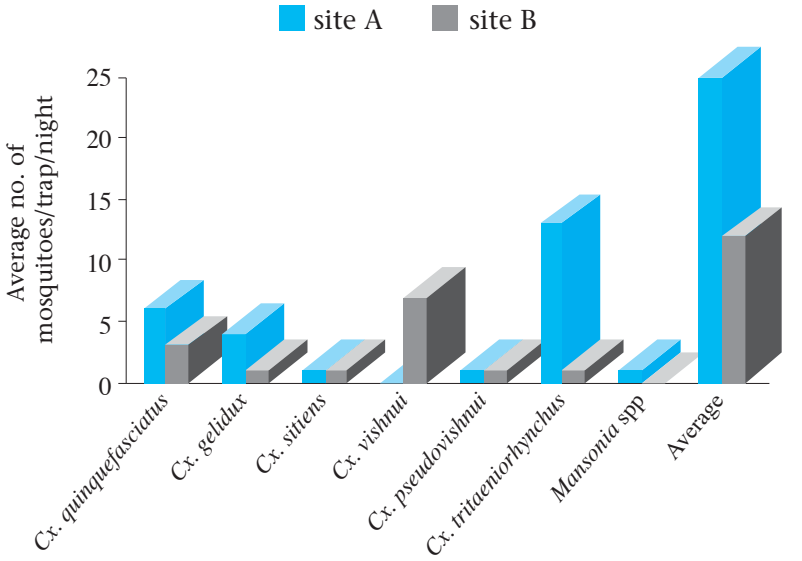

Fig 3 Average number of mosquitoes/light trap/night.

Table 3 Proportion of mosquito species by human landing catch.

Species	No of mosquitoes (%)	
	site A	site B
Cx. gelidus	126 (35.9)	320 (52.3)
Cx. quinquefasciatus	77 (21.9)	137 (22.4)
Cx. vishnui	41 (11.7)	97 (15.9)
Cx. tritaeniorhynchus	38 (10.8)	16 (2.6)
Cx. sitiens	14 (4.8)	18 (2.9)
Cx. pseudovishnui	8 (2.3)	17 (2.3)
Cx. whitmorei	1 (0.3)	1 (0.2)
Ma. indiana	30 (8.6)	3 (0.5)
Ma. uniformis	12 (3.4)	2 (0.3)
Ma. dives	1 (0.3)	0
An. peditaeniatus	0	1 (0.2)
Total	351 (100)	612 (100)

Human landing catch

The mosquito nuisance at the site was mainly due to *Cx. gelidus* (site A: 35.9%; site B: 52.3%), followed by *Cx. quinquefasciatus* and *Cx. vishnui* at both sites. *Cx. tritaeniorhynchus* was found at a rate of 10.8% at site A. Other species, including *Mansonia* spp and *Anopleles peditaeniatus*, were also attracted to humans, as shown in Table 3.

At site A, mosquito landing activity started after the sunset (18.00 hr) and increased after that time, reaching the first peak at 19.00-20.00 hr (average: 10 mosquitoes/hour) and increased to a second peak at 21.00-22.00 hr. The highest peak from a half-night trapping was at 22.00-23.00 hr. (average: 12 mosquitoes/hour). The landing peak of each species is as shown in Fig 4.

At site B, mosquito landing activity increased from 18.00 hr, reaching the first peak at 20.00-21.00 hr, increasing to a second peak at 22.00-23.00 hr, and reaching a second peak at 23.00-24.00 hr (average: 21 mosquitoes/hour). The landing peak of each species is shown in Fig 5.

Discussion

Five species of mosquito larvae were found breeding inside Nava Nakorn Industrial Estate, Pathum Thani Province. *Cx. quinquefasciatus* was the most dominant species, followed by *Cx. gelidus*. A few of *Cx. sitiens*, *Cx. vishnui*

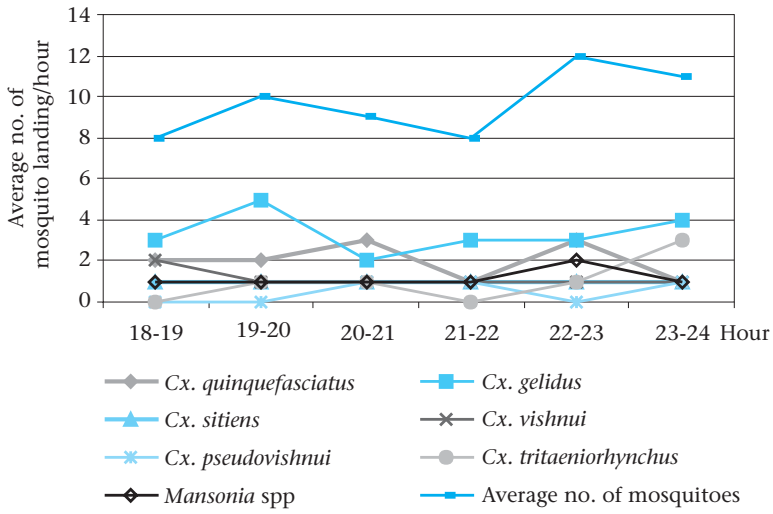

Fig 4 Average number of mosquito landing/hour at site A.

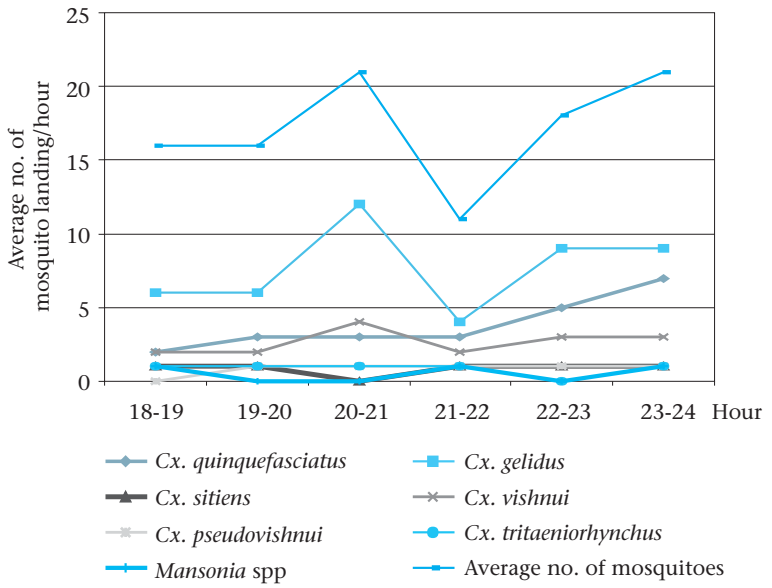

Fig 5 Average number of mosquito landing/hour at site B.

and *Cx. pseudovishnui* were also recorded. *Cx. quinquefasciatus* is the vector of *Wuchereria bancrofti* urban type [4] and *Cx. gelidus* is the vector of Japanese Encephalitis (JE) [5]. *Cx. sitiens* is the vector of filariasis [6], and *Cx. vishnui* and *Cx. pseudovishnui* have been reported as vectors of JE in Thailand [7-8]. The estimated larval density at site A (47 larvae/dip) was higher than site B (37 larvae/dip), which may have been because wastewater in front of the wastewater pond contained more inorganic substances and was possibly more toxic to larvae than the wastewater in front of the factories. The association of *Cx. quinquefasciatus* with water having a high nitrogen concentration appears to indicate a strong preference or tolerance for polluted water [9]. Rutz *et al* reported a decline in mosquito abundance with a high level of pollution [10]. A survey of wastewater ponds in the Darwin area, in northern Australia, reported a large number of *Cx. gelidus* larvae in piggery wastewater ponds in a rural area. Prolific breeding was also found in primary sewerage ponds [11].

An abundance of *Cx. tritaeniorhynchus* and *Cx. vishnui* adults was reported from light trap captures in this area, and both species have been reported as important vectors of JE in Thailand [7]. The preferred breeding places of *Cx. tritaeniorhynchus* are pools left in rice fields toward the end of harvesting, and this industrial area is still surrounded with such rice fields; *Cx. tritaeniorhynchus* adults, therefore, are abundant in that areas. When the light traps were set in the industrial area adjacent to their breeding places in the rice fields, *Cx. tritaeniorhynchus* adults which are attracted to light flied toward it and were caught. A few *Cx. bitaeniorhynchus* were noted, but, there were no reports of this mosquito transmitting filariasis in Thailand. *Ma. indiana* was found at site A and this mosquito have been reported as a vector of filariasis [6]. The average mosquito density/trap/night at site A was twice that at site B, which was related to larval density.

Cx. gelidus was the greatest nuisance attracted to people in this area, followed by *Cx. quinquefasciatus*. For this reason, it may be promising for mosquito surveillance, because of the high potential of these mosquitoes is to transmit JE and filariasis, if the reservoir host is present in the area. Malainual *et al* reported *Cx. tritaeniorhynchus* and *Cx. gelidus* were abundant in animal sheds in Pathum Thani [12]. *Ma. uniformis* and *Ma. dives* were also attracted to humans; even though few in number, these mosquitoes have been reported as filaria vector [6, 13]. The highest mosquito landing activity was found at 19.00-21.00 hr and 23.00-24.00 hr, with the highest density of 21 mosquitoes/ hour recorded in front of wastewater treatment pond.

These results may be useful as baseline information for mosquito surveillance around industrial areas.

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