

DENGUE VECTOR MOSQUITOS AT A TOURIST ATTRACTION, KO SAMUI, IN 1995

Usavadee Thavara¹, Apiwat Tawatsin¹, Prakong Phan-Urai¹,
Wichai Ngamsuk¹, Chitti Chansang¹, Liu Mingtuan² and Li Zhijun²

¹Division of Medical Entomology, Department of Medical Sciences,
Ministry of Public Health, Thailand; ²Guangxi Health and Anti-Epidemic Center, Nanning,
Guangxi, People's Republic of China

Abstract. On Ko Samui, Thailand there were two epidemics of dengue hemorrhagic fever (DHF) in 1966 and 1967, followed by endemics up to 1994. *Aedes aegypti* and *Aedes albopictus* were the vectors. From January to July 1995, 51 cases of DHF were reported, out of these were many foreigners who still suffer from dengue fever and return home with negative impression. We carried out an entomological survey around the island and collected the mosquitos to detect dengue virus by digoxigenin-cDNA probe. The data revealed that *Aedes aegypti* and *Aedes albopictus* still were abundant and some were infected with dengue virus. Visual larval survey indices (HI, CI and BI) were 90.4, 61.3 and 301.3 respectively. Biting rate (BR) of *Aedes mosquitos* was high, the average indoor and outdoor BR were 9.7 and 100.8 mosquitos/man-hour. From 13 pools of mosquitos, 8 strains of dengue virus were detected (61.5%). The results may encourage the local authorities to improve vector surveillance and control before the famous island becomes an unpleasant island.

INTRODUCTION

Dengue hemorrhagic fever (DHF) has been recognized as a serious disease in Thailand since 1958. It is caused by dengue virus, which has four serotypes and is transmitted by *Aedes aegypti* (Scanlon, 1965). On Ko Samui there were epidemics of DHF in 1966 and 1967; *Aedes aegypti* and *Aedes albopictus* were found to be abundant and responsible for transmission of dengue virus (Gould *et al*, 1968; Russell *et al*, 1968; 1969). Then, there have been endemics up to 1994. Although there are two species of vectors in Ko Samui (Gould *et al*, 1970), vector surveillance and control are rather poor. From January to July 1995 there were 51 cases of DHF on the island, including foreign tourists. This report presents data from an entomological survey and determination of dengue virus in collected mosquitos from Ko Samui in 1995, with a view to providing a basis for improvement of vector control.

MATERIALS AND METHODS

Study sites

Ko Samui is the biggest of a group of several dozen islands in the southern Gulf of Thailand and a part of Surat Thani Province. It is about 19 km

long and 16 km wide, with an area of about 304 km² and a population of about 32,000. Many regard it as the biggest "coconut island" in the world. The climate of Ko Samui is dominated by the tropical monsoons. Climatologic features (precipitation, humidity and temperature) recorded at Ko Samui weather station from July 1994 to June 1995 are shown in Fig 1. In July 1995, larval and adult *Aedes* surveys were performed in the 6 villages of Ang Thong, Ma Ret and Na Muang subdistricts (Fig 2).

Mosquito collection methods

The indices of population density of *Aedes* mosquitos were determined by visual larval survey

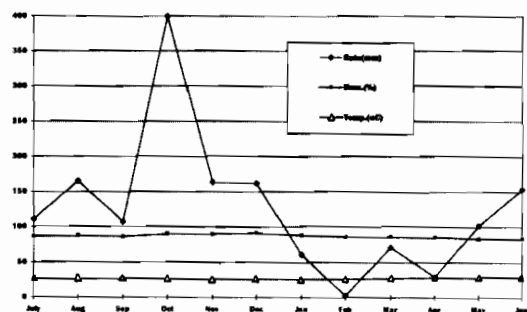


Fig 1—Climatologic features of Ko Samui (July 1994–June 1995).

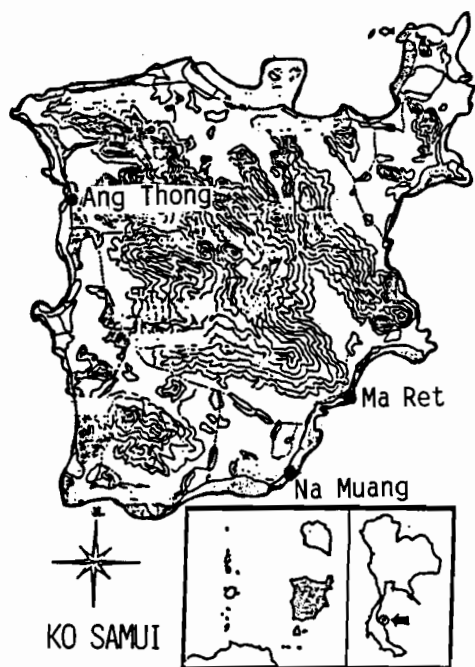


Fig 2—Map of Ko Samui showing study sites.

technique and the collection of adult mosquitos by human-bait collection according to WHO methods in patients' houses and neighborhoods, as well as other suspected infected areas both indoors and outdoors on the island. The collected mosquitos were counted for landing and biting rates and identified with respect to species, then reared ~ 24 hours until their stomachs were empty, pooled by collection site, kept in liquid nitrogen and brought back to the laboratory for determination of viruses.

Detection of dengue virus

Dengue RNA was extracted from collected mosquitos by phenol/chloroform technique, then hybridized with digoxigenin labeled cDNA probe (Dig-cDNA probe) developed by Guangxi Health and Anti-Epidemic Center, China (Liu *et al*, 1992). Dig-cDNA probe, 190 base-pairs long is specific for the 4 serotypes of dengue virus. Sensitivity and specificity of this probe are ~ 90% and 70% respectively (Liu, unpublished). The details of this method will be presented in a separate paper.

RESULTS

A total of 285 mosquitos from 6 locations of 3 subdistricts on Ko Samui were identified: 132

Aedes aegypti, 140 *Aedes albopictus* and 13 *Armigeres subalbatus*. The biting rate of *Aedes albopictus* outside the houses was 7.2-194.4 mosquitos/man-hour. Biting rates of both species of *Aedes* inside the houses was 5.8-15.5 mosquitos/man-hour (Table 1). We could collect both species inside the houses; however, most were *Aedes aegypti*, whereas outside were only *Aedes albopictus*. The data from our surveys confirmed that *Aedes aegypti* was endophilic and *Aedes albopictus* was exophilic. Results from visual larval survey showed that there was high density of *Aedes* mosquito larvae with 85.7-93.8% house index (HI) 54.4-72.2% container index (CI) and 227-419 Breteau index (BI) (Table 2). From 13 pools of mosquitos, 8 strains of dengue virus were detected by Dig-cDNA probe (Table 3).

DISCUSSION

There was a high density of *Aedes aegypti* and *Aedes albopictus* on Ko Samui according to WHO Density Figure (Anonymous, 1972) and some were infected with dengue virus. Differences in the preferred habitats and behavior of these two species led to more frequent vector contact with man and made the island a risk area to dengue fever than the other areas with only *Aedes aegypti*. We were able to detect the dengue virus in both species of *Aedes* and to confirm that both are implicated in the transmission of dengue viruses on Ko Smui as in the epidemic of 1966-1976 (Gould *et al*, 1968; 1970). Thus, dengue fever is a threat to the local people and to visitors, for the island is an international tourist attraction. Using rapid detection methods to monitor the dengue virus in vector mosquitos is important for surveillance and control of dengue epi-demics since they provide tools for assessment of infection rate and hence for epidemic forecasting.

In our surveys we found that the biting behavior of *Aedes* mosquitos was different from those in the other places. Usually the biting peaks of *Aedes aegypti* in the rainy season are at 0900-1100 hours and 1300-1700 hours (Yasuno and Tonn, 1970), but the biting peak of these mosquitos on Ko Samui appeared to be different and the outdoor biting rate of *Aedes* spp (100.8) was higher than the indoor biting rate (9.7), and different from the results of the survey by Gould *et al* (1968). There-

Table 1

Biting and landing rate of *Aedes* mosquitos from human-bait collections on Ko Samui, July 1995.

Location	BR ^a (mosquito/man-hr)		LR ^b (mosquito/man-hr)	
	Indoor	Outdoor	Indoor	Outdoor
Ang Thong	7.7	ND	10.9	ND
Ma Ret	5.8	7.2 ^c	8.4	8.5
Na Muang	15.5	194.4 ^d	17.7	194.4
Average	9.7	100.8	12.3	101.5

ND : Not done, because of rain.

^a : Biting rate = The number of female *Aedes* mosquitos.^c : Coconut plantations, 150 meters far from houses.^b : Landing rate = The total number of *Aedes* mosquitos.^d : A fruit orchard, 150 meters far from houses.

Table 2

Aedes larva index from visual larval survey on Ko Samui, July 1995.

Location	HI ^e	CI ^f	BI ^g
Ang Thong	85.7	72.7	227
Ma Ret	91.7	54.4	258
Na Muang	93.8	56.8	419
Average	90.4	61.3	301.3

^e : House Index = The number of house positive for *Aedes* per 100 houses.^f : Container Index = The number of container positive for *Aedes* per 100 containers.^g : Breteau Index = The number of container positive for *Aedes* per 100 houses.

fore, it is worthwhile to undertake further ecological studies there. The major controlling measure of dengue fever is reducing the density of vector mosquitos if possible eliminating them. It is suggested that efficient control methods should be applied on Ko Samui, because the average BI on Ko Samui was 301 and the result of Chansang *et al* (1993) revealed that areas with average BI of over 100 are at risk for dengue infection (Chansang *et al*, 1993).

ACKNOWLEDGEMENTS

The authors are grateful to Prof Wang Shusheng, Prof Wu Neng from Guangxi Health and Anti-Epidemic Center, China for assistance in detection of dengue virus in mosquitos by dig-cDNA probe, to Dr Jumroon Mikhanorn and Dr ML Ratanasuda Phan-Urai for their kind advice and supporting the joint project, to Dr Krongthong Thimasarn, Miss

Table 3

Detection of dengue virus by dig-cDNA probe.

Species	No. of tested pools	No. of positive pools	% positive
<i>Ae. aegypti</i> (female)	6	5	83.3
<i>Ae. aegypti</i> (male)	1	0	0
<i>Ae. albopictus</i>	5	3	60.0
<i>Armigeres</i> spp	1	0	0
Total	13	8	61.5

Jotika Boon-long and Mr Nat Malainual who kindly commented on this paper. Thanks are also due to Miss Norm Nalakhorn for providing facilities on Ko Samui during this survey.

REFERENCES

- Anonymous. A system of world-wide surveillance for vectors. *WHO Wkly Epidemiol Rec* 1972; 47: 73-84.
- Chansang C, Chansang U, Thavara U, *et al.* The distribution of *Aedes aegypti* in rural areas during 1989-1991. *Bull Dept Med Sci* 1993; 35: 91-106.
- Gould DJ, Mount GA, Scanlon JE, *et al.* Ecology and control of dengue vectors on an island in the Gulf of Thailand. *J Med Ent* 1970; 7: 499-508.
- Gould DJ, Yuill TM, Moussa MA, *et al.* An insular outbreak of dengue haemorrhagic fever. III. Identification of vectors and observations on vector ecology. *Am J Trop Med Hyg* 1968; 17:609-18.
- Liu MT, Wang SS, Wu N. Rapid detection of dengue virus infections using a digoxigenin-labeled cDNA probes. In: XIII International Congress for Tropical Medicine and Malaria. Pataya, Thailand, 1992; 1:371.
- Russell PK, Gould DJ, Yuill TM, *et al.* Recovery of dengue-4-viruses from mosquito vectors and patients during an epidemic of dengue hemorrhagic fever. *Am J Trop Med Hyg* 1969; 18:580-3.
- Russell PK, Yuill TM, Nisalak A, *et al.* An insular outbreak of dengue hemorrhagic fever. II. Virologic and serologic studies. *Am J Trop Med Hyg* 1968; 17:600-8.
- Scanlon JE. The distribution of *Aedes aegypti* in Thailand. *Mosq News* 1965; 25 : 199-203.
- Winter PE, Yuill TM, Suchinda U, *et al.* An insular outbreak of dengue hemorrhagic fever. I. Epidemiologic observations. *Am J Trop Med Hyg* 1968; 17: 590-9.
- Yasuno M, Tonn RJ. A study of biting habits of *Aedes aegypti* in Bangkok, Thailand. *WHO/VBC/70.177*, 1970: 14 pp.