Research Note

Distribution of *Aedes albopictus* (Diptera: Culicidae) in Guatemala, following colonization in 1995

Yuichiro TABARU¹⁾, Carlota MONROY²⁾, Antonieta RODAS²⁾, Mildred MEJÍA²⁾,
Reginaldo PICHILLA³⁾, Heberto MAURICIO³⁾ and Miguel PEREZ³⁾

¹⁾Japan International Cooperation Agency -JICA. Present address: 100-24,
Makinohara 2, Matsudo, Chiba, 270-2267 Japan

²⁾School of Biology, Faculty of Chemistry and Pharmacology, University of San Carlos de
Guatemala-USAC, Zone 12, Guatemala City

³⁾Malaria Surveillance Department, Ministry of Public Health, Guatemala,
5a. Ave. 11-40, Zone 11, Guatemala City

(Received; 27 April 1998; Accepted: 22 July 1998)

Key words: distribution, *Aedes albopictus*, *Aedes aegypti*, seasonal prevalence,
Guatemala

Abstract: Established populations of *Aedes albopictus* (Sukuse) in Guatemala were first discovered in the Caribbean harbor towns of Puerto Barrios and Puerto de Santo Tomas de Castilla, Department of Izabal, in 1995. We investigated the geographic distribution and seasonal prevalence of this species in Guatemala in 1997. We collected larvae or pupae from artificial water containers in or around houses by random sampling in the dry and rainy seasons (March and August). The distribution of this species is limited to the same area where it was first discovered in 1995. This is very different from the situation in the United States where this species has consistently expanded its distribution. *Aedes albopictus* in Guatemala prefers to breed in small water containers in urban sites, and its density is higher than that of *Ae. aegypti* in the rainy season in the limited localities. We could not find *Ae. albopictus* in villages located along the border with Mexico, Honduras or El Salvador, at harbor towns on the coast of the Pacific Ocean or the Atlantic Highway to the City of Guatemala.

INTRODUCTION

The Asian tiger mosquito, *Ae. albopictus* (Sukuse), has the potential to transmit Dengue virus (Shroyer, 1986). In Guatemala, Ogata and Samayoa (1996) first reported the colonization of this species in the Caribbean harbor towns, Puerto Barrios and Puerto de Santo Tomas de Castilla, Department of Izabal, in Guatemala. In the US, established populations of this mosquito were first discovered in Texas in 1985 (Sprenger and Wuitiranyagool, 1986) and in the following year in the

state of Florida (Peacock *et al.*, 1988). Now it has spread to at least 25 states in the US (Moore, *et al.*, 1988; Ali and Nayar, 1997). O'Meara *et al.* (1995) reported the phenomenon of decline of *Ae. aegypti* after introduction of *Ae. albopictus* in Florida. The presence of *Ae. albopictus* in Guatemala was reported in relation to its potential to transmit Dengue fever and other tropical diseases (Anonymous, 1995). The surveillance of *Ae. albopictus* to determine its movement in this country is an important issue. In the present work, we surveyed the same localities that were studied in 1995 (Ogata and Samayoa, 1996): in addi-

tion, we also studied the border entrances to Guatemala by Mexico, El Salvador and Honduras, and some harbor towns along the Pacific Ocean.

STUDY AREAS

Surveys in Department of Izabal:

The surveys were conducted in 26 localities in the dry season (March) in Puerto Barrios (15°41'N), Puerto de Santo Tomas de Castilla (15°39'N) and some other inland villages in Department of Izabal, and also in 14 rural localities in the rainy season (August) in the former two towns.

Survey along the Atlantic Highway toward the city of Guatemala:

The surveys were carried out in roadside villages of the Atlantic Highway from Puerto Barrios to the capital city of Guatemala (14°35'N) only in the dry season. The distance is 297 km from Puerto Barrios to the center of Guatemala City by odometer. We inspected the villages at 7 km (San Manuel, Izabal), 12 km (Agua Caliente, Izabal), 50 km (Morales, Izabal), 70 km (Los Andes, Izabal), 80 km (Guacamayo, Izabal), 89 km (Los Amates, Izabal), 100 km (Gualan, Dept. of Zacapa), 130 km (Rio Hondo, Zacapa), 158 km (Tecultán, Zacapa), 210 km (Guastatoya, Dept. of El Progreso), and Guatemala City.

Survey in harbour towns along Pacific Ocean:

We surveyed 2 hamlets in Puerto de San Jose (13°50'N), 1 hamlet at Puerto de Quezal and 1 hamlet at Puerto de Ixtapa, Department of Escuintla, in both dry and rainy seasons. We inspected 52 houses and 121 containers in both seasons.

Survey in border entrance to Guatemala:

We studied its distribution in 3 villages in Tecun Uman (14°40'N) bordering Mexico, Departamento of San Marcos, 4 villages bordering Honduras (14°30'–14°50'N), 5 bordering El Salvador (13°45'–14°25'N), in March and August.

In total, we visited 187 houses in 64 localities and inspected 412 containers in both seasons. We divided the locality into three categories according to the scale: a town of more than five hundred houses, a village of more than fifty houses and a hamlet of less than fifty. And the name of the locality includes all types.

METHODS

The surveillance consisted of sampling about 20 houses selected at random in each locality, except roadside villages on the Atlantic Highways. We collected mosquito larvae or pupae from artificial containers: rubber tires, cement washing tanks, drum cans, watering pots for domestic animals, flower pots, abandoned plastic or metal cans, in random sampling by using small dip nets. In the roadside villages we collected larvae or pupae only from stagnant water in used tires in tire-fixing shops.

We picked up at most 10 larvae or pupae with a plastic pipette from each sampling, and they were placed in 70% ethanol, taken to the laboratory for identification. Water condition and the environment at collection sites were recorded for analysis. We put a limitation on sampling numbers (10 larvae/container) because the mosquito numbers varied very much in each container and it was not our purpose to know the total numbers of mosquitos. We excluded other mosquito species from identification and analyses.

We compared the preference or selection for breeding conditions between *Ae. albopictus* and *Ae. aegypti*: urban *vs* rural, sunshine *vs* shade, clean *vs* polluted, and large *vs* small.

RESULTS AND DISCUSSION

1. Surveys in Department of Izabal

Table 1 shows the results of the dry season survey in the Caribbean harbor localities and some inland areas in the Department of Izabal. We divided the

Table 1. Distribution of positive houses for *Aedes albopictus* in the dry season at various localities in Department of Izabal in 1997 and 1995*.

Localities	Rural		Localities	Urban	
	Positive house (%)	1995*		Positive house (%)	1995*
Agua Caliente	26.3	×	Barrio Progreso	78.5	×
El Corrozo	5.0	×	Barrio Frontera	20.0	×
Chiclero	ng	ng	Barrio Turagua	73.9	×
Esperanza	ng	—	Barrio Estrecho	55.0	×
Nueva Palestina	ng	—	Livingston	ng	—
San Pedro Cocona	ng	ng	Morales	ng	—
Q. Pescuezo	100	×	Los Amates	ng	—
Las Escobas	46.7	×	Gualan	ng	—
Punta de Palma	ng	—	San Andres	23.0	—
Las Pavas	ng	ng	Rio Dulce	ng	—
Cayos del Diablo	ng	—			
Sta. Marta	ng	—			
Mariscos	ng	—			
San Felipe	ng	—			
Quirigua	ng	—			
Mayuelas	ng	—			

* The data in 1995 was referred from Ogata and Samayoa, 1996. ×, positive in 1995; ng, negative; —, no investigation in 1995.

localities into two categories: rural and urban. Ogata and Samayoa (1996) divided into three categories: rural, sub-urban and urban. In Table 1 we arranged them into two categories according to our own judgment to compare the two data. Even though our survey was expanded to 26 localities, compared to 15 by Ogata and Samayoa (1996), we identified *Ae. albopictus* in 9 localities in total; 5 in the urban areas and 4 in the rural regions of the department. New positive sites were not found during the dry season. The positive houses for *Ae. albopictus* were very high in the rural areas such as Barrio Progreso, Barrio Turagua and Barrio Estrecho in the town of Puerto Barrios. The fishing town of Livingstone is located 20 km from Puerto Barrios and there is considerable marine transportation between the two towns. However, we could not find *Ae. albopictus*. *Aedes aegypti* was recorded in 13 localities in the department, and coexistence of the two species was only in 6 out of 26 localities. Both species prefer urban to rural localities.

We observed 1,187 larvae or pupae,

meaning 893 (75.2%) was *Ae. aegypti* and 294 (24.8%) was *Ae. albopictus*, while the composition rate of the two species by Ogata and Samayoa in June, 1995 was 77.6% vs 22.4%, respectively. 74.5% of *Ae. albopictus* and 69.8% of *Ae. aegypti* were collected in the urban localities. 67.4% of *Ae. albopictus* was collected in the sunny containers and 48.4% for *Ae. aegypti* in the dry season. There was no remarkable difference between clean vs polluted in breeding sites.

We visited again the Department of Izabal in the rainy season (August), and surveyed 14 localities close to 9 localities where we collected *Ae. albopictus* in March. But new positive sites were not observed.

Table 2 shows the difference of the main breeding sites in both seasons between the two species; *Ae. albopictus* and *Ae. aegypti*. *Aedes albopictus* were collected more in rubber tires, metal cans, and a few from larger containers like washing tanks or drums in the dry season. In the rainy season *Ae. albopictus* was abundant in abandoned water containers dumped around

Table 2. Comparison between both species in rainy and dry seasons in the principal containers at rural localities in Department of Izabal.

Classified containers	Dry season			Rainy season		
	Nos. surveyed	<i>Ae. albopictus</i>	<i>Ae. aegypti</i>	Nos. surveyed	<i>Ae. albopictus</i>	<i>Ae. aegypti</i>
Cement washing tanks	172	3 (1.7)	22 (12.7)	87	7 (8.0)	5 (5.7)
Drums	119	5 (4.2)	41 (34.5)	109	12 (11.0)	23 (21.1)
Rubber tire	51	14 (27.5)	23 (45.1)	17	12 (70.6)	3 (17.6)
Plastic bottles	77	4 (5.2)	9 (11.6)	33	3 (9.1)	3 (9.1)
Metal cans	14	8 (57.1)	8 (57.1)	4	1 (25.0)	3 (75.0)
Animal troughs	16	2 (12.5)	4 (25.0)	11	6 (54.5)	3 (27.3)
Garbages with water	6	1 (16.7)	3 (50.0)	28	23 (82.2)	10 (35.7)
Total/mean	455	37 (8.1)	110 (24.2)	289	64 (22.1)	50 (17.3)

Numbers in parentheses indicate percentage (%) of positive containers with the mosquito larvae in each species.

houses, as well as rubber tires, animal troughs. On the other hand *Ae. aegypti* was common in drums, rubber tires, metal cans in the dry season, and drums, abandoned water containers in the rainy season.

O'Meara and Gettman (1992), Ogata and Samayoa (1996) reported that abandoned tires were important breeding sites for *Ae. albopictus*.

In total, we collected more *Ae. albopictus* than *Ae. aegypti* in the rainy season in the urban sites of Puerto Barrios and Santo Tomas de Castilla, Department of Izabal. This indicates that the population density of *Ae. albopictus* in the limited localities is higher than that of *Ae. aegypti*.

2. Survey on spreading to the Capital of Guatemala

We surveyed the dispersion of *Ae. albopictus* from Puerto Barrios to the capital of Guatemala along the Atlantic Highway. But only within 12 km (Agua Caliente) from the starting point we could collect it, at the same locality which appeared in the data of Ogata and Samayoa (1996). No spreading was observed for *Ae. albopictus* in two years. *Aedes aegypti* inhabited tire-fixing shops, up to Guatemala City (Fig. 1). According to INSIUVUMEH (Institute Nacional de Sisnologia, Vulcanologia, Meteorologia e Hidrologia) the annual temperature in centigrade along the Atlantic

Highway is as follows: Puerto Barrios (max. 29.7–min. 21.4–mean 25.4), Zcapa (34.1–21.2–26.5), El Progreso (34.0–19.7–27.7) and Guatemala (24.5–14.0–18.3). This indicates that the temperature from Puerto Barrios to El Progreso is not very much different.

3. Surveys in the border entrances to Guatemala

After surveying 15 border entrance localities from Mexico, Honduras and El Salvador, and 4 harbor towns along the Pacific Ocean we could not collect any samples of *Ae. albopictus* in each border and the harbor towns. Ibanez-Bernal and Martinez-Campos (1994) reported the occurrence of *Ae. albopictus* in the northern area of Mexico. At the annual meeting with Mexican entomologists on October 2 at the border, Tecun Uman, they demonstrated the occurrence of *Ae. albopictus* in the Monterey state, Mexico bordered by Texas and the USA and no existence of collection data in the State of Chiapas, Mexico, bordered by Guatemala. The Guatemalan major newspaper, the Prensa Libre (1997) reported the existence of *Ae. albopictus* in Honduras. And it also emphasized that the government of Honduras started spraying in border entrances to Guatemala and El Salvador. But we are not confident of the reliability of the news.

We tried again distribution surveys in

Fig. 1. Distribution of *Aedes albopictus* in Puerto Barrios and Puerto de Santo Tomas de Castilla, Departamento of Izabal (right) and in Guatemala (left) in 1995 (after Ogata and Samayoa) and 1997. ■, positive in 1997; □, negative in 1997; ●, positive in 1995 and ○, negative in 1995 for *Ae. albopictus*.

218 houses in the border towns of the three countries and harbour towns in the rainy season (July and August) but failed to collect *Ae. albopictus* this time as well.

Figure 1 indicates the distribution of *Ae. albopictus* in these studies.

ACKNOWLEDGMENTS

We thank Licda. Adriana Costero, Research Entomologist of Notre Dame University, for review of an earlier version of this manuscript. This study was accomplished as a part of the Project of investigation of Tropical Disease under the Technical Cooperation between Guatemala and Japan, GJET-144.

REFERENCES

- Ali, A. and J. K. Nayar (1997) Invasion, spread, and vector potential of *Aedes albopictus* in the USA and its control possibilities. *Med. Entomol. Zool.*, **48**: 1–9.
- Anonymous (1995) Supermosquito; *Aedes albopictus* en Guatemala, Newsletter in the Prensa Libre, Aug. 2, 1995.
- Anonymous (1997) Supermosquito; *Aedes albopictus* en Honduras, Newsletter in the Prensa Libre, June 6, 1997.
- Ibanez-Bernal, S. and C. Martinez-Gomes (1994) *Aedes albopictus* in Mexico. *J. Am. Mosq. Control Assoc.*, **10**: 231–232.
- Moore, C. G., D. Francy, D. Eliason and T. P. Monath (1988) *Aedes albopictus* in the United States: rapid spread of a potential disease vector. *J. Am. Mosq. Control Assoc.*, **4**: 356–361.
- Ogata, K. and A. L. Samayoa (1996) Discovery of *Aedes albopictus* in Guatemala. *J. Am. Mosq. Control Assoc.*, **12**: 503–506.
- O'Meara, G. F., L. F. Evans, Jr., A. D. Gettman and J. P. Cuda (1995) Spread of *Aedes albopictus* and decline of *Ae. aegypti* (Diptera: Culicidae) in Florida. *J. Med. Entomol.*, **32**: 554–562.
- O'Meara, G. F. and A. D. Gettman (1992) The Asian Tiger Mosquito in Florida. *Univ. Florida, Mosq. Control Fact Sheet. FMEL, Vero Beach*, 1–4.
- Peacock, B. E., J. P. Smith, P. G. Gregory, T. M. Loyess, J. A. Mulrennan, Jr., P. R. Simmonds, L. Padgett, Jr., E. K. Cook and T. R. Eddins (1988) *Aedes albopictus* in Florida. *J. Am. Mosq. Control Assoc.*, **4**: 362–365.
- Shroyer, D. A. (1986) *Aedes albopictus* and arboviruses: A concise review of the literature. *J. Am. Mosq. Control Assoc.*, **2**: 424–428.
- Sprenger, D. and T. Wuitiranyagool (1986) The discovery and distribution of *Aedes albopictus* in Harris County, Texas. *J. Am. Mosq. Cont. Assoc.*, **2**: 217–219.

摘 要

グアテマラにおける2年間のヒトス
ジシマカの分布拡大

田原雄一郎¹⁾, Carlota MONROY²⁾,
Antonieta RODAS²⁾, Mildred MEJIA²⁾,
Reginaldo PICHILLA³⁾, Heberto MAURICIO³⁾
and Miguel PEREZ³⁾

¹⁾ 国際協力事業団-JICA
(現住所, 〒270-2267 千葉県松戸市牧ノ原 2-100-24)

²⁾ グアテマラ共和国, サンカルロス大学, 化学・薬学部
(グアテマラ市, 第12街区, 大学町)

³⁾ グアテマラ共和国, 厚生省, マラリア局
(グアテマラ市, 第12街区)

1995年緒方及びSamayoaはグアテマラのカリブ海に面した港町, Puerto Barrios 及び Santo Tomas de Castilla でヒトスジシマカの生息を確認した. 2年間経過後の1997年, 雨季と乾季に再び同じ地域で本種の分布拡大を調査した. 今回, 同市内で調査地域を拡大したにもかかわらず, 生息は1995年と同じ地域からのみ確認できた. グアテマラ市へ至る国道沿線, グアテマラとメキシコ, ホンジュラス, エルサルバドルの国境地域, 太平洋岸の港町などでも調査したが新規な発見はなかった. 本種は同一地域にあっては都市部の比較的小さな水域, 例えば, 古タイヤ, 空き缶に発生した. 雨季には古タイヤと捨てられた空き缶, プラスチックに溜まった水たまりに多く見られた. ヒトスジシマカとネッタイシマカの採集比率を比較したところ, 乾季は後者が, 雨季は前者が多かった.