# BREEDING HABITATS OF *AEDES AEGYPTI* (L) AND *AEDES. ALBOPICTUS* (SKUSE) IN VILLAGES OF BARRU, SOUTH SULAWESI, INDONESIA

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**Abstract.** The breeding habitats of the dengue vector, *Aedes aegypti* and *Aedes albopictus,* were studied using larval collection method inside and outside houses in 6 villages of Barru, South Sulawesi, Indonesia from July 1994 to August 1995. *Aedes aegypti* was the dominant species, being abundant indoors especially in the coastal areas. *Aedes albopictus* was breeding primarily in outdoor containers in the hill and mountain areas. Earthen jar was the most common breeding habitat of *Aedes aegypti* in all villages surveyed. Drum can was the most common outdoor breeding habitat of *Aedes albopictus* in the hill and mountain areas. The high Breteau indices of *Aedes aegypti* and *Aedes albopictus* suggests that these species may play an important role in the transmission of dengue hemorrhagic fever in Barru where epidemics of the fever occur occasionally.

## INTRODUCTION

*Aedes aegypti* is the principal vector of dengue hemorrhagic fever (DHF) and *Ae. albopictus* is an important vector of dengue fever in Southeast Asia (Chan *et al,* 1971 a, c; Jumali *et al,* 1979; Macdonald and Rajapaksa, 1972; Oda *et al,* 1983; Schultz, 1993; Soedarmo, 1993; Soekiman *et al,* 1984).

In Indonesia, *Ae. aegypti* is a domestic mosquito (Soekiman *et al,* 1984) while *Ae. albopictus* is a semidomestic mosquito in urban areas. *Ae. aegypti* breeds exclusively in artificial containers such as earthen jars which contain relatively clean water in and around human houses in Southeast Asia (Chan *et al,* 1971b; Nelson *et al,* 1976). The typical habitats of *Ae. albopictus* are artificial containers, tree holes and bamboo stumps (Hawley, 1988). Generally, *Ae. aegypti* shows greater preference for indoor breeding than does *Ae. albopictus* in Southeast Asia (Chan *et al,* 1971 a, b; Hawley, 1988).

Dengue hemorrhagic fever cases and deaths have been occurring annually in South Sulawesi since the first outbreak reported in 1988 (Annual Report, unpublished). In Indonesia, the incidence of DHF has been significantly increasing since the first outbreak in 1968 (Soedarmo, 1993). For control of *Ae. aegypti* and *Ae. albopictus,* detailed information on their breeding habitats as well as human behavior are important. However, there is little published information on the biology of these dengue vector mosquito in Sulawesi. Therefore in this study, the breeding habitats of *Ae. aegypti* and *Ae. albopictus* were clarified and questionnaires on vector mosquito were also carried out in Barru, South Sulawesi.

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## MATERIALS AND METHODS

### Study areas

Barru is located about 102 km north of Ujungpandang, the capital of South Sulawesi, and consists of 52 villages with a total population of about 150,000 people (Fig 1). Meteorologically this area belongs to the tropical monsoon region with rainy season from November to March and dry season from June to October, while April and May are transition period. The annual precipitation is

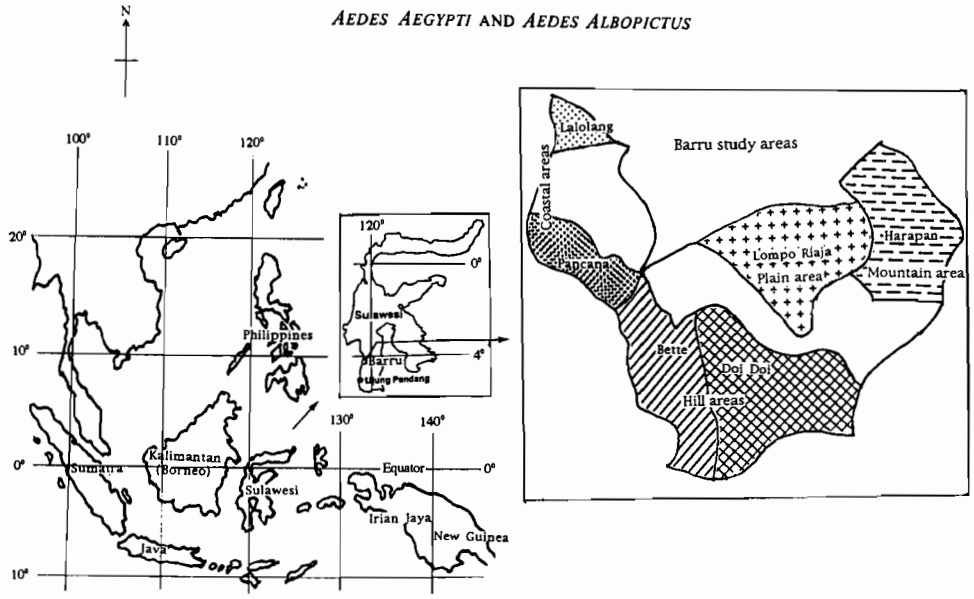


Fig 1–Map of larval study areas in Barru, South Sulawesi, Indonesia.

about 3,800 mm and the temperature ranges from 22 to 33°C throughout the year. Six villages in Barru were selected as larval study areas, namely Pancana and Lalolang in coastal, Lompo Riaja in plain, Doi Doi and Bette in hill and Harapan in mountain areas. Indoor and outdoor larval mosquito surveys in all villages of Barru were carried out 3 times from July 1994 to August 1995, with the exception of one time in Harapan in July 1994. Most houses in these areas are constructed of wood. Domestic water sources in coastal areas relied primarily on wells, while in the hill and mountain areas water was supplied as piped water from simple water reservoirs in the areas. Therefore the households in coastal areas kept water in many containers such as earthen jars and plastic containers indoors, and drum cans or cement tanks outdoors.

**Collection methods**

Mosquito larvae were collected by pipettes, dippers and fish nets from the water-storage containers inside and outside houses. The number of water-filled containers and larvae in each container were recorded. As many of the larvae as possible were collected from one of the positive containers indoors and outdoors and preserved in separate small vials with McGregor's solution and brought back to the Laboratory of Medical Zoology, University of the Ryukyus for identification. Identification of *Aedes* were made using the keys by Toma and Miyagi (1986) and Huang (1972, 1979).

Questionnaire sheets on the biology of the dengue vector mosquito were distributed to 208 households of the 6 villages surveyed in August 1995.

House index (percentage of house having container with mosquito), container index (percentage of containers with mosquito) and Breteau index (total number of containers with mosquitos per 100 houses) for *Ae. aegypti* and *Ae. albopictus* were calculated in accordance with standard methods (Service, 1976).

## RESULTS

A total of 615 houses in 6 villages of Barru was examined for breeding habitats of *Ae. aegypti* and *Ae. albopictus* during 3 times of survey. *Aedes aegypti* was the dominant species, breeding primarily indoors in all villages, except in the mountain area (Harapan). On the other hand, *Ae. albopictus* bred primarily outdoors, mainly in the hill (Doi Doi, Bette) and mountain (Harapan) villages (Table 1)

Larval indices (house, container and Breteau) for *Ae. aegypti* and *Ae. albopictus* in each of the 6 villages during 3 times of survey are show in Table 2. The indices were high especially in Pancana and Lalolang (coastal), but apparently low in Bette (hill) and Harapan (mount). The house index ranged

Table 1

Breteau index and percentage of containers with *Aedes aegypti* and *Ae. albopictus* in 6 villages of Barru, South Sulawesi, Indonesia.

| Locality | No. houses examined | Breteau index | Containers with mosquitos | | | |
|---|---|---|---|---|---|---|
| | | | No. identified | Percentage with | | |
| | | | | *Ae. aegypti* | *Ae. albopictus* | *Ae. aeg-alb** |
| **Indoor** | | | | | | |
| Pancana | 139 | 113.7 | 99 | 99.0 | 1.0 | 0.0 |
| Lalolang | 116 | 99.1 | 62 | 100.0 | 0.0 | 0.0 |
| L. Riaja | 141 | 32.6 | 31 | 96.8 | 0.0 | 3.2 |
| Doi Doi | 97 | 67.0 | 37 | 89.2 | 5.4 | 5.4 |
| Bette | 86 | 18.6 | 12 | 100.0 | 0.0 | 0.0 |
| Harapan | 36 | 0.0 | 0 | 0.0 | 0.0 | 0.0 |
| **Outdoor** | | | | | | |
| Pancana | 139 | 60.4 | 64 | 89.1 | 7.8 | 3.1 |
| Lalolang | 116 | 51.7 | 41 | 95.1 | 2.4 | 2.4 |
| L Riaja | 141 | 51.8 | 52 | 88.5 | 5.8 | 5.8 |
| Doi Doi | 97 | 67.0 | 32 | 59.4 | 18.8 | 21.9 |
| Bette | 86 | 16.3 | 12 | 41.7 | 41.7 | 16.7 |
| Harapan | 36 | 8.3 | 3 | 0.0 | 66.7 | 33.3 |

Breteau index = total number of containers with mosquitos per 100 houses
**Ae. aeg-alb* = *Ae. aegypti* and *Ae. albopictus*

Table 2

Larval indices for *Aedes aegypti* and *Ae. albopictus* in 6 villages of Barru, South Sulawesi, Indonesia.

| Locality | No. houses examined | House index | Container index | Breteau index |
|---|---|---|---|---|
| Pancana | 139 | 82.0 | 53.4 | 174.1 |
| Lalolang | 116 | 67.2 | 40.1 | 150.9 |
| L Riaja | 141 | 55.3 | 17.5 | 84.4 |
| Doi Doi | 97 | 72.2 | 36.1 | 134.0 |
| Bette | 86 | 26.7 | 9.2 | 34.9 |
| Harapan | 36 | 8.3 | 2.6 | 8.3 |
| Total | 615 | 59.5 | 29.5 | 113.7 |

from 8.3% in Harapan to 82.0% in Pancana, with a mean index of 59.5% for the 6 villages. Like the house index, the container and Breteau indices ranged from 2.6% and 8.3% in Harapan to 53.4% and 174.1% in Pancana, with the mean indices of 29.5% and 113.7% respectively.

On the breeding habitats, 29.5% (699) of the 2,371 containers with water examined in the 6 villages, were positive with *Ae. aegypti* and or *Ae. albopictus* (Table 3). Out of 699 positive containers, 445 containers with 3,574 immatures were examined to determine the mosquito species; 90.1% of the containers were found with *Ae. aegypti,* 5.6% with *Ae. albopictus* and 4.3% with both *Ae. aegypti* and *Ae. albopictus*. Earthen jar was the most common water-storage container both indoors and outdoors in all villages and the most common breeding habitat of *Ae. aegypti*. Plastic container was the next most common indoor container, but its container index was very low. Drum can was the most common outdoor container and the most common outdoor breeding habitat of *Ae.albopictus*, mainly in the hill and mountain villages. Generally, the container index for outdoor was higher than that for indoor in all villages. Also, the number of containers with a large number (>50) of immature mosquito was more common outdoors than indoors in all villages (Table 4). This might be due to the outdoor water-storage container being larger and less clean (Table 5).

Table 3

Larval habitats* of *Aedes aegypti* and *Ae. albopictus* in Barru, South Sulawesi, Indonesia.

| Container | No. with water (% positive) | Containers with mosquitos | | | |
|---|---|---|---|---|---|
| | | No. identified | Percentage with | | |
| | | | *Ae. aegypti* | *Ae. albopictus* | *Ae. aeg-alb*** |
| **Indoor** | | | | | |
| Earthen jar | 800 (37.6) | 179 | 97.8 | 0.6 | 1.7 |
| Plastic | 634 (11.2) | 46 | 100.0 | 0.0 | 0.0 |
| Cement tank | 42 (21.4 | 8 | 75.0 | 25.0 | 0.0 |
| Drum can | 46 (41.3) | 8 | 100.0 | 0.0 | 0.0 |
| **Outdoor** | | | | | |
| Earthen jar | 331 (45.0) | 114 | 89.5 | 6.1 | 4.4 |
| Plastic | 121 (23.1) | 13 | 84.6 | 15.4 | 0.0 |
| Cement tank | 173 (26.6) | 31 | 77.4 | 12.9 | 9.7 |
| Drum can | 224 (33.9) | 46 | 63.0 | 19.6 | 17.4 |
| Total | 2,371 (29.5) | 445 | 90.1 | 5.6 | 4.3 |

*Data from 615 houses in 6 villages were combined

**Same as Table 1

(% positive) show percentage of container with *Aedes* mosquitos.

Table 4

Percentage of containers with different numbers of *Aedes aegypti* and *Ae. albopictus* in Barru, South Saulawesi, Indonesia.

| Container | No. positive containers | % with different no. of mosquitos | | |
|---|---|---|---|---|
| | | Low | Middle | Large |
| **Indoor** | | | | |
| Earthen jar | 301 | 44.9 | 35.9 | 19.3 |
| Plastic | 71 | 49.3 | 43.7 | 7.0 |
| Cement tank | 9 | 22.2 | 44.4 | 33.3 |
| Drum can | 19 | 36.8 | 52.6 | 10.5 |
| **Outdoor** | | | | |
| Earthen jar | 149 | 27.5 | 36.9 | 35.6 |
| Plastic | 28 | 42.9 | 28.6 | 28.6 |
| Cement tank | 46 | 37.0 | 32.6 | 30.4 |
| Drum can | 76 | 34.2 | 47.4 | 18.4 |
| Total | 699 | 39.3 | 38.2 | 22.5 |

Low: 1-10 larvae per container, Middle: 11-50 larvae per container

Large: >50 larvae per container

Table 5

Results (%) from the questionnaires on the biology of dengue vector mosquitos in Barru, South Sulawesi, Indonesia, August 1995.

| Village | Pancana | Lalolang | L Riaja | Doi Doi | Bette | Harapan | Total No. (%) |
|---|---|---|---|---|---|---|---|
| Number of respondent | 45 | 45 | 27 | 30 | 31 | 30 | 208 (100.0) |
| Sex : Male | 42.2 | 24.4 | 48.1 | 33.3 | 54.8 | 36.7 | 81 (38.9) |
| Female | 57.8 | 75.6 | 51.9 | 66.7 | 45.2 | 63.3 | 127 (61.1) |
| Aged 10-20 | 11.1 | 15.6 | 14.8 | 23.3 | 25.8 | 6.7 | 33 (15.9) |
| Aged 21 or more | 88.9 | 84.4 | 92.6 | 76.7 | 74.2 | 93.3 | 177 (85.1) |
| Education: None school | 42.2 | 53.3 | 29.6 | 50.0 | 64.5 | 63.3 | 105 (50.5) |
| Elem school | 46.7 | 26.7 | 33.3 | 33.3 | 19.4 | 30.0 | 67 (32.2) |
| High school | 8.9 | 20.0 | 33.3 | 16.7 | 12.9 | 6.7 | 33 (15.9) |
| University | 2.2 | 0.0 | 3.7 | 0.0 | 3.2 | 0.0 | 3 (1.4) |
| Name of DHF | 40.0 | 37.8 | 55.6 | 56.7 | 48.4 | 40.0 | 94 (45.2) |
| Information from: | | | | | | | |
| Audiovisual | 61.1 | 82.4 | 66.7 | 64.7 | 66.7 | 58.3 | 63 (67.0) |
| Health Center | 0.0 | 7.1 | 30.0 | 18.2 | 30.0 | 28.6 | 11 (17.5) |
| Neighbor | 38.9 | 11.8 | 13.3 | 23.5 | 13.3 | 25.0 | 20 (21.3) |
| DHF case | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 (0 .0) |
| Transmission by mosq | 33.3 | 52.9 | 73.3 | 70.6 | 33.3 | 50.0 | 49 (52.1) |
| Vector of DHF | 22.2 | 111.8 | 46.7 | 41.2 | 13.3 | 8.3 | 23 (24.5) |
| Mosquito coil | 33.3 | 23.5 | 66.7 | 41.2 | 13.3 | 16.7 | 31 (33.0) |
| Breeding in domestic | 22.2 | 5.9 | 46.7 | 41.2 | 6.7 | 8.3 | 21 (22.3) |
| Cleaning containers: | | | | | | | |
| Indoor containers | 57.8 | 84.4 | 70.4 | 60.0 | 71.0 | 46.7 | 137 (65.9) |
| Cement tank* | 50.0 | 50.0 | 73.3 | 60.0 | 52.0 | 50.0 | 41 (57.7) |
| Outdoor containers | 31.1 | 57.8 | 55.6 | 53.3 | 58.1 | 33.3 | 99 (47.6) |

*Bathroom/water tank in Pancana: 6; Lalolang: 2; L Riajar: 15; Doi Doi: 15; Bette: 25; Harapan: 8

The result obtained by questionnaires on the biology of the dengue vector mosquito in each of the 6 villages in Barru are shown in Table 5. Most of the respondents were female (61.1%), with low level of education (82.7%). 45.2% of the 208 respondents know the name of dengue fever which was acquired mostly through the education program such as television and radio (67.0%). About half (52.1%) of the respondents knew the relationship of mosquito and dengue infection in man, and 24.5% of then know the name of the dengue vector mosquito, *Ae. aegypti* breeding in domestic containers (22.3%). For the prevention of mosquito bites, 33.0% of the respondents used mosquito coil in the day time in all village except in Bette (13.3%) and Harapan (16.7%).

About 66% of the 208 respondents cleaned or brushed their water storage containers in the house once a week. Outdoor containers were less frequently cleaned than those indoors.

## DISCUSSION

The high larval indices (house, container and Breteau) for *Ae. aegypti* in coastal villages (Pancana and Lalolang) in Barru were similar to those in Sabah (Macdonald *et al,* 1972) where very high Breteau index for *Ae. aegypti* was found in small coastal village (325-590), but the index for *Ae. albopictus* was low (0-37). *Ae. aegypti* was found only in coastal areas with high human densities, in Sabah and Sarawak (Macdonald *et al,* 1972) and in Halmahera, Indonesia (Mogi *et al,* 1996). High indices were also found in the hill area of Doi Doi in this study. This may be due to limited sources of

water in the village; therefore the households always kept rain water in drum cans and cement tanks without cleaning the inner surface of the container. Bette had low indices because a considerable volume of water was supplied albeit interruptedly from simple reservoirs throughout the hilly village.

The average Breteau index for *Ae. aegypti* in the 6 villages of Barru was high (113.7) compared with other localities of Indonesia - 12.0 at village in Halmahera (Mogi *et al*, 1996), 58.0 in Bantul, Central Java (Jumali *et al*, 1979) and 60.1 in Jakarta (Nelson *et al*, 1976 ). Generally, the high Breteau index for *Ae. aegypti* may be correlated closely with an abundance of earthen jars in the house, the habits of the household in cleaning water-storage containers and limited sources of water in the village. The results of the questionnaires indicated that the households acquired knowledge on dengue and the vector mosquito through TV education programs in TV and knew very well about mosquito breeding habitats. However, they kept many earthen jars as water storage containers in the houses and neglected to clean or brush frequently the inner walls of the containers.

The breeding habitats of *Ae. aegypti* in this study were similar to those of other studies in Indonesia. Soedarmo (1993) reported that water jar (earthen jar) was the most common positive container for *Ae. aegypti*, but the highest container index was for cement or water tanks. Cement cisterns or tanks in rural Central Java (Jumali *et al*, 1979) and Jakarta (Orda *et al*, 1982) were also the major indoor breeding habitat of *Ae. aegypti*. Earthen jar outdoors in Singapore (Chan *et al*, 1971b) and drum in Sarawak, Malaysia (Chang *et al*, 1994), were the most common breeding habitats of *Ae. aegypti*.

That outdoor drum was the most common source of *Ae. aegypti* and *Ae. albopictus* in kampong-type residential houses, was also reported by Macdonald *et al* (1972) in Borneo. On the other hand, in Jakarta (Oda *et al*, 1982), Kao, Halmahera (Mogi *et al*, 1996) and Singapore (Chan *et al*, 1971), discarded tin can was the most common outdoor breeding habitat of *Ae. albopictus*. In rural area of Central Java (Jumali *et al*, 1979), *Ae. albopictus* was found primarily in cut bamboo stumps outdoors.

The wide distribution of *Ae. aegypti* indoors especially in the coastal areas and *Ae. albopictus* outdoors in the hill and mountain areas, and the high Breteau index suggest that these species may play an important role in the transmission of dengue hemorrhagic fever in Barru.

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