# Mosquito larvae and water qualities in Chiangrai province, Thailand

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## Abstract

This study investigated (1) the differences in container types, mosquito types, and their numbers between temples and gardens, (2) relationships between mosquito numbers and water qualities, and (3) relationships between altitudes and water qualities. Mosquito larvae were collected from seven temples and two gardens in Chiangrai province in Febrary 2018. Afterwards we checked and collected mosquito larvae from each outside (natural and artificial) container by using fishnets with 0.55 mm mesh size nets. Then we recorded the container types, perimeter, and colors, as well as pH, temperature, turbidity, and presence of weeds in water. All mosquito larvae from each water container were placed in a plastic bag and tied the bag with a rubber band. We preserved mosquito larvae in 70% alcohol and identified them up to genus level.

The result shows that Containers types and numbers differed significantly among the sites. Phrathat pha ngao temple had the highest number of containers, those were mostly flower pots. On the other hand, Phra that doi tung temple and Choui fong tea garden had the lowest number of containers. Rong suea ten temple had the highest number of mosquito larvae. Water qualities and elevation were different among sites. Phra that doi tung temple had the highest elevation with the lowest temperature. Mosquito larvae were found only in three temples (Rong suea ten temple, Phrathat pha ngao temple, and Phra kaew temple). Phra kaew temple was the one where 3 mosquito species were observed. We did not find any mosquito larva in water containers in tea gardens.

**Keywords:** Water containers, *Aedes* species**,** water qualities, mosquito larval index

## Introduction

Mosquitoes are mostly known as a disease carrier. Mosquito problem is a large problem that effects many countries. In each year, many people die with Dengue fever, Malaria, Chikungunya, Japanese Encephalitis and more, they all are caused by mosquitoes (Caraballo, 2014). Different kinds of natural (tree-holes, bamboo, leaf axils, rock-pools, etc.) and man-made/artificial (water tanks, bottles, tires, flower vases, etc.) habitats are used as mosquito breeding sites (Wongkoon et al. 2005, 2007, Thangamathi, 2014). In 2016, nearly 800 million people are affected with diseases transmitted by mosquitoes. In 2017, Thailand health officials reported 10,965 cases of malaria with two deaths and 53,190 cases of dengue fever with 63 deaths (Department of Disease Control, 2017). The patient had been reported more than 50 provinces among 77 provinces, and Chiang Rai was one of them.

Water qualities have effects on mosquito density. temperature, humidity, pH, rainfall, and wind speed affect the incidence of dengue, either through changes in the duration of mosquitoes and parasite life cycles or through their influences on human, vector, or parasite behaviour (Gubler et al. 2001, Wongkoon et al. 2013). For example, increased temperature has been associated with dengue cases in Thailand, Indonesia, Singapore, Mexico and Puerto Rico (LUZ, 2008).

Since Chiang Rai is affected by the mosquito borne diseases, so, the best way to solve the problem is to find out their breeding sites and control them. The objectives of this study are to investigate (1) the differences in container types, mosquito types, and their numbers between temples and gardens, (2) relationships between mosquito numbers and water qualities, and (3) relationships between altitudes and water qualities.

## Materials and methods

### study sites

The study was conducted in Chiang Rai province, Northern Thailand (19.9072° N, 99.8310° E) (Figure 1) from 19-21 February, 2018.

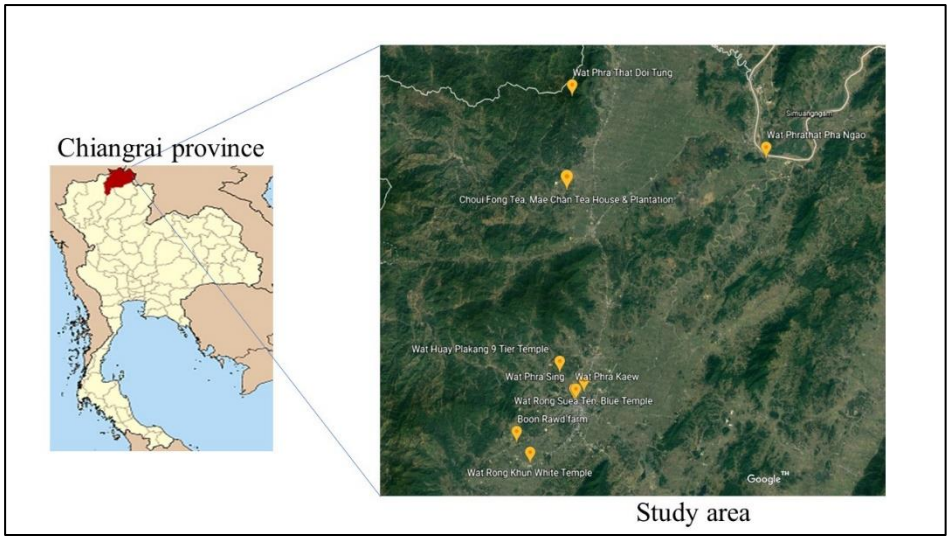


**Figure1** Map of Thailand and study site at Chiang Rai province, Thailand

## Data Collection

We randomly selected seven temples and two gardens for data collection. We checked and collected mosquito larvae from each outside container (natural and artificial). We recorded the altitude (m) of each site. Afterwards we checked and collected mosquito larvae from each outside (natural and artificial) container by using fishnets with 0.55 mm mesh size nets. Then we recorded the container types, perimeter, and colors, as well as pH, temperature, turbidity, and presence of weeds in water. All mosquito larvae from each water container were placed in a plastic bag and tied the bag with a rubber band (Chumsri et al. 2015). We preserved mosquito larvae in 70% alcohol and identified them up to genus level using Rattanarithikul and Panthusiri's keys (Rattanarithikul et al. 1994).

## Results

**Containers types in temples and gardens:** Containers types and numbers differed significantly among the sites. Phrathat pha ngao temple had the highest number of containers, those were mostly flower pots. On the other hand, Phra that doi tung temple and Choui fong tea garden had the lowest number of containers (Table 1).

**Total mosquito larvae, water qualities and elevation in temples and tea gardens:** Rong suea ten temple had the highest number of mosquito larvae. Water qualities and elevation were different among sites. Phra that doi tung temple had the highest elevation with the lowest temperature.

**Status of mosquito larvae in temples and gardens:** Mosquito larvae were found only in 3 temples (Rong suea ten temple, Phrathat pha ngao temple, and Phra kaew temple). Phra kaew temple was the one where 3 mosquito species were observed (Table 2). We did not find any mosquito larva in water containers in tea gardens.

## Discussion

Amoung difference sites of Chiangria province. Similary Chumsri et al. (2018) found that container types and their numbers were difference among subdistrict in Nakhon Si Thammarat province. Farthermore, we observed that mosquito larvae numbers increased with increasing of container numbers in all sub-districts. To our knowledge, no study has shown the direct relationship between container numbers and mosquito larvae numbers. Snow & Medlock (2006) suggested that increasing numbers of water butts (containers used to collect rainwater) might increase the numbers of mosquitoes that breed in them. The results of our study show that number of containers also has an effect on the number of mosquito larvae, along with container types and seasons.

We also observed that *Ae. aegypti* preferred to breed both in indoor and outdoor water containers, but *Ae. albopictus* preferred to breed mostly in outdoor containers than in indoor containers. Previous studies found similar results, Chareonviriyaphap et al. (2003) and Wongkoon et al. (2007) found *Ae. aegypti* larvae both in indoor and outdoor containers but *Ae. albopictus* larvae mostly in outdoor containers. However, our results showed higher numbers of *Ae. aegypti* and *Ae. albopictus* larvae in mangrove forest area than the previous study (Wongkoon et al., 2007). The possible reason could be because we collected our samples in Thasala district but Wongkoon et al., (2007) collected their sample from Pakpanang and Huasai districts. *Ae. aegypti* larvae mostly prefer to breed in drums, jars, concrete tanks and discarded objects (Phong and Nam, 1999), *Ae. albopictus* prefer to breed outside in open spaces with shaded vegetation (Wongkoon et al., 2007; Saleeza et al., 2011).

In this study *Culex* spp., *Armigeres* spp. and *Toxorhynchites* spp. were found only in outdoor containers. Previous studies also observed that, *Culex* spp. larvae were mostly found in outside containers (Preechaporn et al., 2007) such as in plant plates, used pots, plastic cement mixer tubes, and used bowls (Chumsri et al., 2015), and *Armigeres* spp. larvae were found in tree holes and bamboo stumps (Panicker and Rajagopalan, 1978; Amerasinghe, 1982) those were situated outside of the households. In case of *Toxorhynchites* spp. larvae, they preferred to breed in the same containers with *Ae. aegypti*, and *Ae albopictus*, but mostly in bamboo stumps and used tyres (Trpis, 1973; Nyamah et al., 2011) those were situated outside of the houses.

Through this study, we have been informed that which containers are used as breeding sites for *Aedes* spp. *Ae. aegypti* and *Ae. albopictus* are the most important mosquito vectors of dengue fever viruses (Knudsen, 1995; Mousson et al., 2005). If we can suggest to the fishery households to destroy those *Aedes* spp. holding containers, may be it is possible to control dengue fever, as destruction of breeding habitats is an important strategy to reduce the *Aedes* mosquito population; as well to reduce the larval development and adult mosquito population growth (Li et al., 2014).

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**Table 1** Container types in temples and tea gardens in Chiangrai, Thailand

| Study sites | Container types | | | | | | | | | | | Chi-Square |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flower pots | Plant pots | Plastic buckets | Pond | Saucer | Bromeliad | Earthen jars | Flower vase | Bowls | fish ponds | Total containers | |
| Rong suea ten temple | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 13 | $F_{1,72}$=187.92, $P$<0.001 |
| Huay plakang temple | 0 | 2 | 0 | 0 | 0 | 3 | 3 | 0 | 1 | 0 | 9 | |
| Phra that doi tung temple | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 3 | |
| Phrathat pha ngao temple | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 19 | |
| Rong khun temple | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Phra kaew temple | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | |
| Phra sing temple | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 5 | |
| Choui fong tea garden | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | |
| Boon rawd tea garden | 0 | 0 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 5 | |

**Table 2** Mosquito larvae species numbers in temples and tea gardens in Chiangrai, Thailand

| Sites | *Aedes aegypti* | *Aedes*_albopictus | *Culex* spp | *Toxorhynchites* spp | *Armigeres* spp | *Anopheles* spp |
|---|---|---|---|---|---|---|
| Rong suea ten temple | 12 | 0 | 209 | 0 | 0 | 0 |
| Huay plakang temple | 0 | 0 | 0 | 0 | 0 | 0 |
| Phra that doi tung temple | 0 | 0 | 0 | 0 | 0 | 0 |
| Phrathat pha ngao temple | 0 | 3 | 33 | 0 | 0 | 0 |
| Rong khun temple | 0 | 0 | 0 | 0 | 0 | 0 |
| Phra kaew temple | 0 | 0 | 0 | 5 | 75 | 3 |
| Phra sing temple | 0 | 0 | 0 | 0 | 0 | 0 |
| Choui fong tea garden | 0 | 0 | 0 | 0 | 0 | 0 |
| Boon rawd tea garden | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 3** Mosquito larvae, water qualities and elevation in temples and tea gardens in Chiangrai, Thailand

| Sites | Total mosquito larvae | pH | Temperature ($^0$C) | Elevation (m) |
|---|---|---|---|---|
| Rong suea ten temple | 221 | 6.84±0.58 | 23.85±0.69 | 390 |
| Phra kaew temple | 83 | 7.04±0.44 | 24.00±1.16 | 390 |
| Phra sing temple | 0 | 7.76±0.08 | 24.70±0.58 | 390 |
| Rong khun temple | 0 | 6.00±0.00 | 25.00±0.00 | 410 |
| Huay plakang temple | 0 | 6.26±0.83 | 27.56±1.02 | 420 |
| Choui fong tea garden | 0 | 6.00±1.00 | 24.17±0.44 | 420 |
| Phrathat pha ngao temple | 36 | 7.82±0.13 | 25.58±0.53 | 460 |
| Boon rawd tea garden | 0 | 8.00±0.00 | 25.40±1.60 | 760 |
| Phra that doi tung temple | 0 | 8.50±0.76 | 21.67±2.73 | 1340 |
| Statistical test (One-way ANOVA) | - | $F_{8,59}$=1.80, $P$>0.05 | $F_{8,59}$=2.02, $P$>0.05 | - |

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