Water Temperature, pH Level, and Conductivity Affecting Mosquito Larval Occurrence in Waterfaland Island Ecosystems of Trang, Thailand

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Abstract

This research investigates how water temperature, pH level, and conductivity affect the number of mosquito larvae in Trang Province, Thailand. We selected (San Chao Pao Kong, Tantiya Phirom Temple, San Chao Kew Ong Aia, and Kradan Island, collected all mosquito larvae, and measured water temperature, pH level, and conductivity based on the GLOBE Program. The study advocates for alternative, environmentally friendly mosquito control measures and proposes community-based interventions for disease prevention. Collaborative efforts with STEM professionals and advanced data analysis techniques enhance the study's interdisciplinary nature.

Keywords: GLOBE Observer: MHM App, SPARKSvue, Water Temperature, Water pH, water conductivity Mosquito, Thailand

1. Introduction

Mosquitoes carry several infectious diseases, such as malaria, dengue fever, and lymphatic filariasis. It is imperative to identify the determinants that affect the occurrence of mosquito larvae to formulate effective vector control methodologies. This research endeavors to examine the correlation between water temperature, pH, conductivity, and the prevalence of mosquito larvae at Cheng Chu Cho Sue Shrine, Wat Tantayapirom Temple, San Chao Kew Ong Aia Temple, and Kradan in Trang Province, Thailand.

Particular factors include water temperature, pH, and dissolved organic and inorganic substances (Amarasinghe & Ranasinghe, 2019). Enhancing our comprehension of these factors is essential for disease management, as they can substantially influence the survival and expansion of mosquito populations (Pfaehler et al., 2006). Prior investigations have established that pH and salinity can markedly impact the abundance and distribution of mosquito larvae (Multini et al., 2021).

Dengue fever constitutes a significant public health challenge in Thailand (Thisyakorn et al., 2022). More than 70% of the population in Southeast Asia and the Western Pacific Region is susceptible to dengue infection, with Thailand experiencing periodic epidemics (Thisyakorn et al., 2022). The incidence of dengue cases in Thailand typically reaches its zenith during the rainy season (Thisyakorn et al., 2022). Factors such as temperature, rainfall, and humidity are instrumental in influencing the transmission dynamics of the dengue virus (Thisyakorn et al., 2022). In Thailand, 2019 witnessed a notably high incidence of dengue, with 116,647 reported cases and 129 fatalities, whereas 2020 experienced a reduction in cases, documenting 67,538 incidences of dengue fever and 49 deaths.

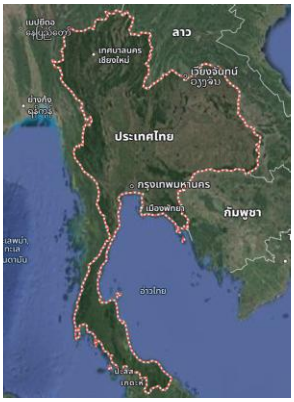
Thailand has a vital role in the global burden of dengue (Gupta & Reddy, 2013). The latter is in second place regarding dengue incidence, making India number one. To assess this, we conducted a survey of mosquito larvae at Thai and Chinese Temples across all outdoor containers, measuring water temperature, pH levels, and conductivity and counting the present mosquito larvae. We identified species up to the genus level: Aedes (Ae. albopictus, Ae. aegypti).

2. Materials and methods

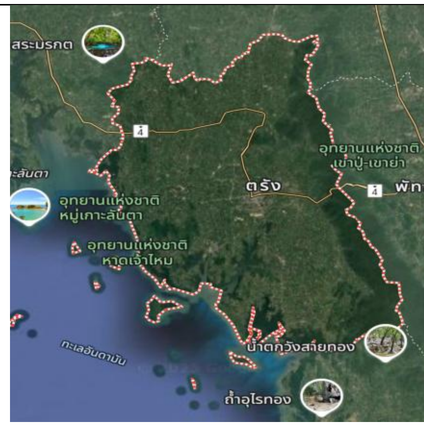
2.1 Study site

In February 2025, a survey of mosquito larvae was conducted in Trang Province, Southern Thailand (14.86242° N, 101.06671° E). There are three seasons in Trang Province:

summer (mid-February to mid-May), rainy (mid-May to mid-October), and winter (mid-October to mid-February).



(a) Map of Thailand

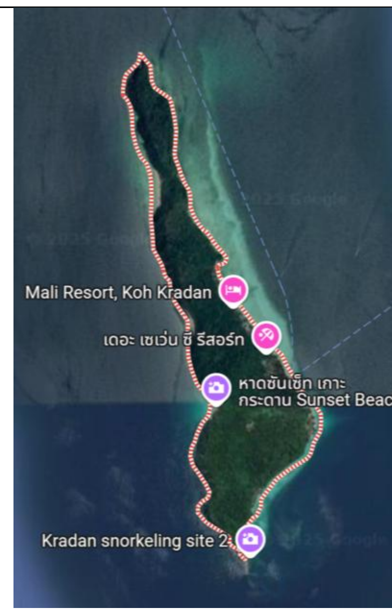


(b) Map of Trang

(c) Map of Pao Kong Shrine

(**d**) Map of Tantiya Phirom Temple

(e) Map of Kew Ong Aia Temple



(f) Map of Kradan Island

Figure 1. (**a**) Map of Thailand. (b) Map of Trang; (c) Pao Kong Temple; **(d)** Map of Tantiya Phirom **(e)** Map of Kew Ong Aia Temple; and **(f)** Map of Kradan Island

2.2 Sampling of mosquito larvae

Figure 2. GLOBE Observer: MHM App

2.2.1 Surveyed all mosquito breeding sites in natural settings, then collected samples of larvae for classification.

2.2.2 Measure the water's pH level temperature and at mosquito breeding sites in natural settings.

2.2.3 Use the GO: MHM app to find the latitude and longitude coordinates of the area where we found mosquito larvae and save the information into the GO MHM app (Figure 2).

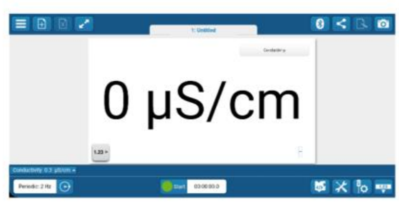
1	2
	
Choose "Build New Experiment"	Open the Wireless Conductivity Sensor
3	**4**
	
Pair the sensor on your phone with the SPARKSvue app	Configure the unit of Measure and press start to record data

Figure 3. SPARKSvue Application: Wireless Conductivity Sensor

3.2.1 Surveyed all mosquito breeding sites in natural settings, then measured the conductivity.

2.3 Data collection

In this study, we conducted our mosquito larval survey at Pao Kong Temple, Tantiya Phirom Temple, San Chao Kew Ong Aia, and Kradan Island in Trang and measured water temperature and pH.

We systematically cataloged and classified all conceivable habitat types at each designated site, performing comprehensive examinations to ascertain the presence or absence of mosquito larvae. Each habitat was subjected to 20 systematic dips utilizing a standardized mosquito dipper to evaluate the aquatic environments. We proficiently gathered specimens using a D-frame dip net with a width of 0.3 m, attached to an elongated pole, and equipped with a conical bag to capture mosquito larvae predators. Subsequently, the collected mosquito larvae were expeditiously preserved in 90% ethanol for later identification. Furthermore, we quantified water pH, temperature, and conductivity utilizing a handheld multi-parameter meter. We employed the GLOBE observer: MHM application to determine the latitude and longitude coordinates at which mosquito larvae were located.

2.4 Statistical analysis

The correlational test assessed the relationship between water temperature, pH level, and conductivity with the mosquito larval count at the Pao Kong Shrine, Tantiya Phirom Temple, Kew Ong Aia Temple, and Kradan Island in Tran.g

3. Results

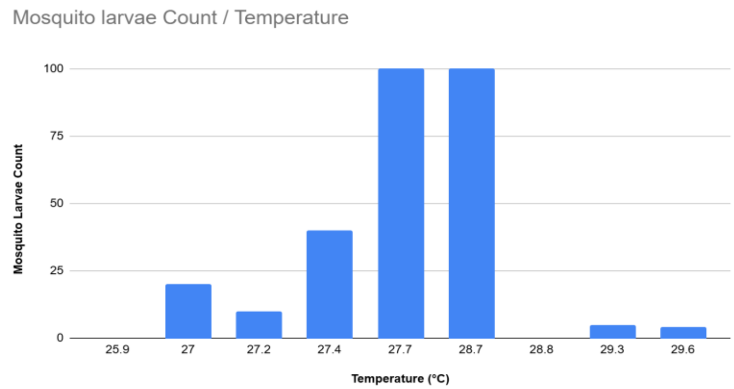
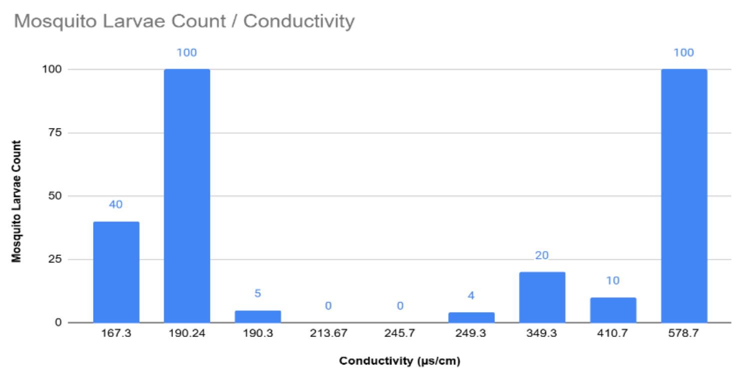
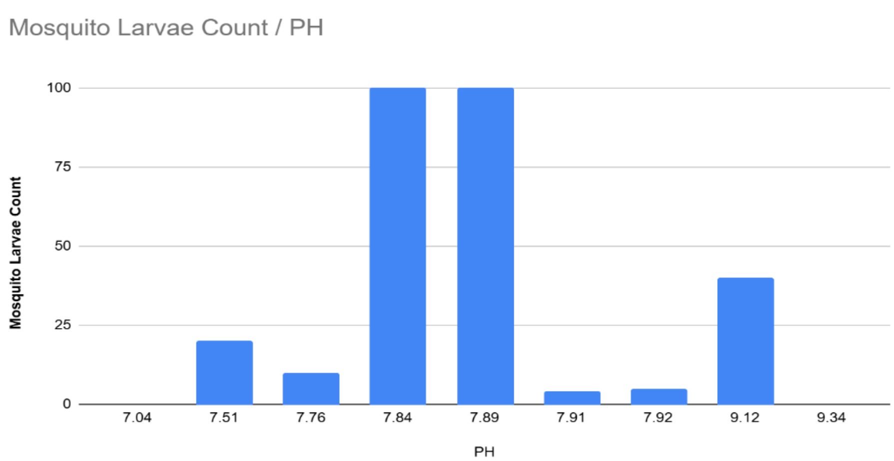
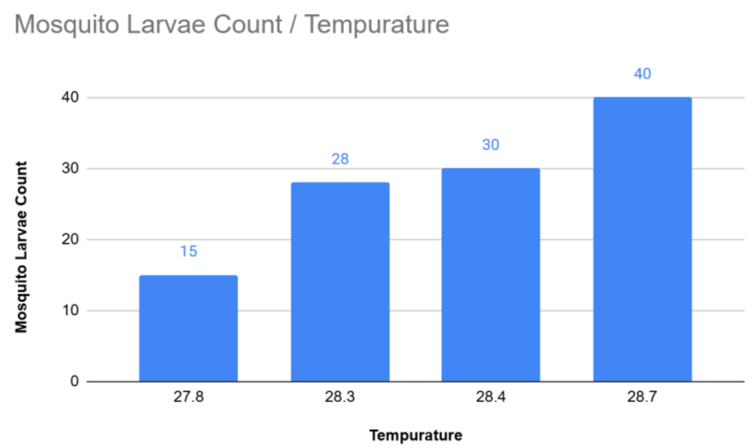
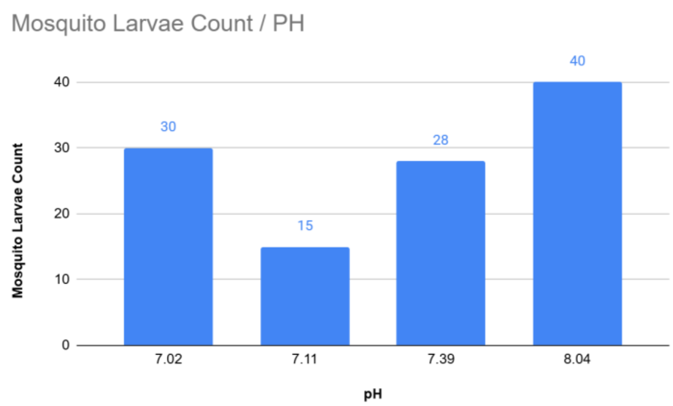
(a)	
(b)	
(C)	

Figure 4. Water parameters and mosquito larvae. (a) water temperature (°C)., (b) water pH, and (c) water conductivity in Tantiya Phirom Temple

(a)



(b)



(C)

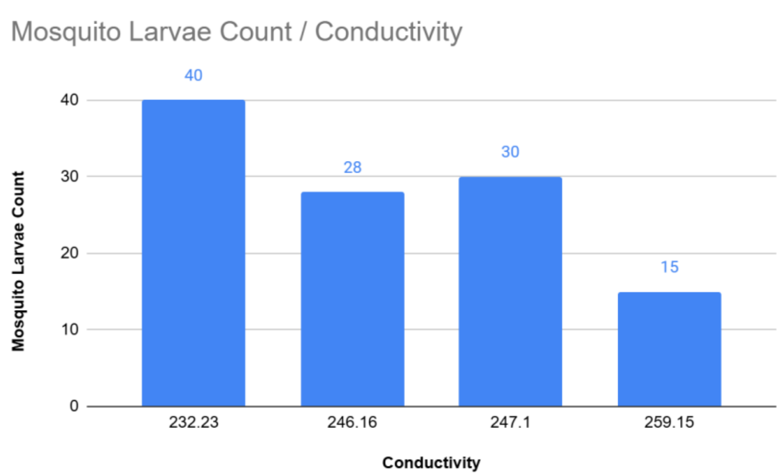


Figure 5. Water parameters and mosquito larvae. (a) water temperature (°C)., (b) water pH, and (c) water conductivity in Kew Ong Aia Temple.

Parameters	Correlation
Temperature	0.99
Conductivity	-0.98
pH	0.75

Figure 6. Parameters in the data and its correlation to the larval count

Water Temperature

According to the database, the water inside containers had an average temperature of 27.7-28.7 °C in the Tantiya Phirom Temple. This means that more larval mosquitoes thrive in the temperature within *27.7-28.7 °C*. Containers with no mosquito larvae had water temperatures of 25.9 °C and 28.8 °C. (Figure 4a). Correlation was used to understand the relationship between temperature and Larvae Count. We have observed a positive correlation of 0.99, indicating that as the temperature rises, there are more mosquitoes in the Thai and Chinese Temples.

Water pH

The Tantiya Phirom Temple shows that when the pH level of the water is between 7.84 and 7.89, the mosquito larvae are very high. On the other hand, in the Kew Ong Aia Temple, the mosquito larvae thrive in an environment with an 8.04 pH level. Correlation was used to understand the relationship between pH and Larvae Count. We have observed a positive correlation of 0.75, indicating that mosquito larvae survive better in an Alkaline environment.

Conductivity

The average conductivity of the water is 288.8 (μs/cm). The graph shows that the larvae count also decreases as the conductivity increases. This was further confirmed by the correlation analysis with a -0.98, which shows that the mosquito larvae fail to survive as the water conductivity increases.

4. Discussion

Water Temperature and Mosquito Larvae

Temperature serves an essential function in the viability and expansion of mosquito larvae populations. Our research findings reveal that the most favorable temperature range for mosquito larvae within the Tantiya Phirom Temple is between 27.7 and 28.7°C. This observation is consistent with prior investigations indicating that elevated temperatures typically expedite larval development and enhance survival by optimizing metabolic activities (Alto & Juliano, 2001; Beck-Johnson et al., 2013). Furthermore, the robust positive correlation (r = 0.99) identified between temperature and larvae abundance implies that an increase in temperature is associated with a higher prevalence of mosquito larvae. This pattern was noted in both the Thai and Chinese temples, underscoring the significance of temperature as a principal factor influencing larval distribution. Nevertheless, containers devoid of larvae exhibited water temperatures of 25.9°C and 28.8°C, implying the existence of potential upper and lower limits for larval survival.

Water pH and Mosquito Larvae

The pH level of aquatic environments significantly influences the physiological processes of aquatic organisms, including the larval stages of mosquitoes. Our findings demonstrate that mosquito larvae exhibit optimal development in conditions characterized by slight alkalinity, with the peak population density recorded at pH levels of 7.84-7.89 in the vicinity of the Tantiya Phirom Temple and at pH 8.04 at the Kew Ong Aia Temple. The observed positive correlation (r = 0.75) implies a preferential inclination of larvae towards alkaline environments, which is consistent with earlier studies that indicate certain mosquito species attain enhanced survival rates in waters that are neutral to slightly alkaline (Strickman & Kittayapong, 2003). The presence of alkaline conditions may facilitate the proliferation of microbial populations, thereby offering a more abundant nutritional resource for larvae and consequently augmenting their population density.

Water Conductivity and Mosquito Larvae

Conductivity is a pivotal metric for assessing the ionic composition of aquatic environments, which subsequently affects the survival rates of larval organisms. The research provides that an elevation in conductivity correlates with a reduction in mosquito larvae, as indicated by the negative correlation (r = -0.98). This observation implies that heightened ionic concentrations may engender a detrimental habitat for mosquito larvae, potentially attributable to osmoregulatory challenges or diminished availability of organic materials essential for larval sustenance. Comparable investigations have documented that mosquito larvae typically evade waters with elevated conductivity, which can disrupt their developmental trajectories and physiological functions (Walton et al., 1998).

Conclusion

This study focuses on the aquatic environments' physicochemical properties' influence on mosquito larvae abundance. Elevated thermal conditions and mildly alkaline pH values promote the proliferation of mosquitoes, whereas increased conductivity serves as a constraining factor. These results can guide vector control strategies, including altering water conditions to establish inhospitable environments for mosquito larvae, diminishing their populations and mitigating the risk of diseases transmitted by mosquitoes.

I would like to claim IVSS badges

1. **I make an impact**

The document delineates the relationship between a community issue and the research inquiries, establishing correlations between local and global effects. The students must illustrate how their research has favorably impacted their community by proposing recommendations or executing actions derived from their empirical findings. Investigating the ecology of mosquito larvae provides valuable insights that can be employed to protect the community against disease transmission via animal vectors, accomplished through the modification or reduction of the utilization of specific container materials.

2. **I am a STEM professional.**

The report clearly highlights the partnership with a STEM expert, which strengthened the research methods, improved accuracy, and enabled more sophisticated analyses and interpretations of the findings. The data was analyzed using independent-sampled t-tests to compare the amounts of mosquito larvae across different container types.

3. **I am a data scientist.**

The report provides an in-depth analysis of the students' original data along with supplementary data sources. Students assess the limitations of these data, make inferences about past, present, or future events, and use the information to answer questions or solve problems within the system presented. This could include integrating data from other schools or external databases. The geographic coordinates (latitude and longitude) of the locations where mosquito larvae were found were logged using the GLOBE Observer: MHM App.

Acknowledgments

We thank Assoc. Prof. Dr. Krisanadej Jaroensutasinee, Assoc. and Prof. Dr. Mullica Jaroensutasinee, Director of Samsenwittayalai School, Miss Aishath Hussain Fayaz and Leoniel Jude Giray for helping with experimental design, fieldwork, data analysis and manuscript preparation. Samsenwittayalai School and the Center of Excellence for Ecoinformatics, Walailak University, partly supported this work.

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