Effects of Temperature on Mosquito Larvae Presence in Different Container Types of Varee Chiang Mai School, Mueang District, Chiang Mai

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This research is a survey-based study designed to compare water temperatures and mosquito larvae species in the areas surrounding Varee Chiangmai School, Mueang District, Chiang Mai Province. The primary objectives are to analyze the correlation between water temperature and larval density, and to identify the specific mosquito larvae species present within the school vicinity to determine the potential presence of disease vectors. Furthermore, the study examines how water temperature affects the developmental stages of mosquito larvae.

Mosquito-borne diseases remain a critical global public health challenge, particularly in tropical and subtropical regions. Currently, climate change has exacerbated this issue by accelerating the developmental process from larvae to adults, increasing the frequency of blood-feeding and oviposition, and extending the flight range of mosquitoes. Consequently, these factors have led to a significant rise in the transmission rates of mosquito-borne illnesses. Despite continuous advancements in research, technology, and vector control measures, these challenges require persistent surveillance and proactive strategies to mitigate the risk of recurrent outbreaks.

This comparative survey aims to provide in-depth insights into the impact of water temperature on the proliferation of mosquito larvae within both the school environment and the broader community. The findings of this research will establish a baseline database to support the development of effective larval eradication strategies and serve as a resource for public health campaigns within the school and neighboring communities.

The results of this study will be disseminated to interested parties, enabling the practical application of this knowledge to benefit public health in daily life.

Research Title: Effects of Temperature on Mosquito Larvae Presence in Different Container Types of Varee Chiang Mai School, Mueang District, Chiang Mai

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Abstract

The objectives of this research were to investigate the effect of water temperature on mosquito larval density, to compare mosquito larvae species found within the vicinity of Varee Chiangmai School, Mueang District, Chiang Mai Province, and to disseminate the findings to the school and surrounding communities. The study area was confined to the grounds of Varee Chiangmai School. Mosquito larvae were collected once a week, every Thursday, over a five-week period from November 13 to December 11, 2025.

The collected larvae were examined using a stereo microscope to identify morphological characteristics. Specimens were placed in Petri dishes with a small amount of water to facilitate clear observation, and morphological data were recorded using the GLOBE Mosquito Habitat Mapper application. Water temperature was measured using a thermometer attached to a string to avoid interference from body heat.

The results showed that water temperatures ranged from 20.5°C to 22.8°C, with the highest mosquito larval density observed at temperatures between 21.8°C and 22.5°C. A total of 1,539 mosquito larvae were recorded, with Culex being the most prevalent species (39.44%), followed by Aedes aegypti (29.76%), Anopheles (18.33%), and Mansonia (12.47%). The Container Index (CI) was calculated to be 3.52%, indicating a low-risk level of mosquito breeding in the study area. Overall, the findings demonstrate a positive relationship between water temperature and mosquito larval abundance. Although water temperature influenced larval density, the relatively low CI suggests that environmental management and sanitation measures in the study area are effective. However, continued surveillance and source reduction are recommended to prevent potential increases in mosquito populations and reduce the risk of dengue transmission.

Keywords: GLOBE Observer: Mosquito Habitat Mapper, Water Temperature, Mosquito Larvae, Thailand

Acknowledgement

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Finally, the research team would like to thank the authors of the academic documents, journals, websites, and various research sources cited in this study. This project would not have been possible without the cooperation and support from all sectors involved. We are profoundly grateful for the kindness and expert advice received throughout this journey.

The research team

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Chapter 1

Introduction

Background and Rationale

Mosquitoes, despite their small size, exert a profound influence on human life as primary vectors of various life-threatening diseases, including dengue fever, malaria, and the Zika virus. Mosquito-borne diseases represent a critical global public health concern, particularly in tropical and subtropical regions. In addition to placing significant strain on public health systems, these diseases cause substantial economic losses, as countries must allocate considerable resources to outbreak management. Despite advancements in research and mosquito control technologies, mosquito-borne diseases remain a persistent challenge requiring continuous and vigilant monitoring.

In Thailand, the Ministry of Public Health places strong emphasis on re-emerging infectious diseases (REIDs), such as dengue and malaria. Continuous surveillance and preventive measures are implemented, particularly in response to climate change. Environmental changes have accelerated mosquito development from larvae to adults, increased feeding frequency, shortened egg-laying cycles, and expanded flight ranges, thereby intensifying disease transmission.

Varee Chiangmai School, located in Mueang District, Chiang Mai Province, includes a workshop area containing numerous materials and equipment capable of retaining water, creating potential breeding sites for mosquito larvae. These areas are often shaded from direct sunlight and contain microorganisms that serve as food sources, facilitating larval growth. In addition, the school is situated adjacent to natural breeding environments characterized by dense vegetation, stagnant water, and inadequate maintenance, which further promote larval development. Furthermore, the presence of water-holding containers in several areas within the school increases the risk of mosquito larval infestation.

This comparative study investigates the effects of water temperature on mosquito larval occurrence by surveying mosquito species to identify potential disease vectors within these breeding sites. The study also examines water temperature and larval emergence rates in different container types, which are critical factors influencing mosquito breeding. This exploratory research aims to enhance understanding of the relationships among water temperature, container characteristics, and larval breeding rates at Varee Chiangmai School. The resulting baseline data will support the development of effective larval control strategies, promote public health awareness within the school and surrounding communities, and provide practical knowledge applicable to daily life.

Research Questions

1. How does water temperature affect mosquito larvae breeding?
2. Does the study area affect the species of mosquito larvae found at Varee Chiangmai School?

Research Hypotheses

1. Mosquito larvae breeding will decrease as water temperature increases.

To be specific, if the water temperature increases, the number of mosquito larvae will decrease, depending on the study area.

Research Objectives

1. To study and compare the species of mosquito larvae at Varee Chiangmai School, Mueang District, Chiang Mai.
2. To disseminate the study's findings within the school and community.

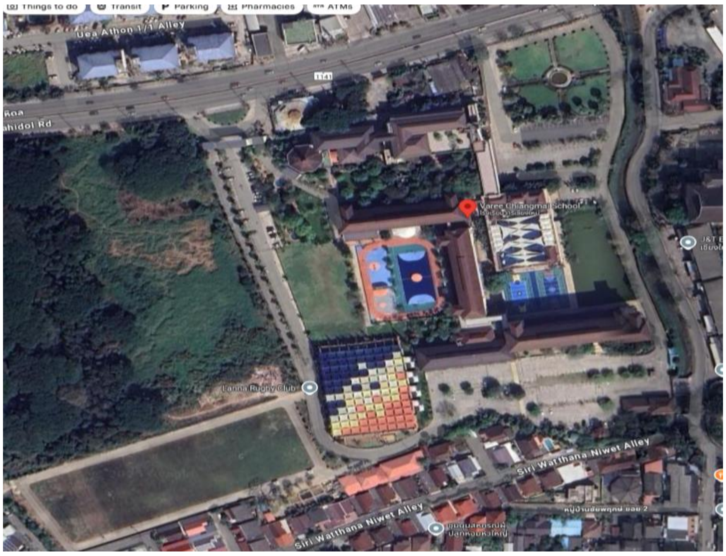
Expected Outputs

1. Data on water temperature that affect mosquito larvae breeding at Varee Chiangmai School, Chiang Mai.

2. A better understanding of water temperature that their impact on mosquito larvae breeding at Varee Chiangmai School, Chiang Mai.
3. The baseline data obtained from this study will be used to eliminate mosquito larvae and prevent their breeding, as well as to disseminate the acquired knowledge to the school and surrounding communities.

Scope of Study

Study Area



Varee Chiangmai School, 59 Moo 6, Mahidol Road, Nong Hoi Subdistrict, Mueang Chiang Mai District, Chiang Mai 50000, located at latitude 18.75859 °N and longitude 99.0154074

Factors to be Studied and Measured

- Species of mosquito larvae
- Water temperature

Research Period

- November - December 2025

Chapter 2

Literature Review and Related Research

This research project, " Effects of Temperature on Mosquito Larvae Presence in Different Container Types of Varee Chiang Mai School, Mueang District, Chiang Mai" involved a review of relevant theoretical literature and research, as detailed below:

2.1 Mosquitoes

2.2 Species of Mosquito Larvae

2.3 Mosquito Life Cycle

2.4 Breeding Grounds

2.5 Mosquito-borne Diseases

2.6 Stereo microscope

2.7 Globe Mosquito Habitat Mapper

2.8 CI (Container Index)

2.9 Related Research

2.1 Mosquitoes

Mosquitoes are insects found worldwide, but they are most prevalent in tropical and subtropical regions. Mosquito larvae typically feed on bacteria, protozoa, yeast, algae, and small aquatic plants. Female mosquitoes feed on nectar and blood, while males usually feed on flower nectar. Mosquitoes are also vectors for various diseases, such as dengue fever. There are approximately 3,450 species of mosquitoes worldwide, with about 412 species found in Thailand. The most familiar species are the Anopheles and Aedes mosquitoes.

Globally, there are over 4,000 species of mosquitoes, classified under the order Diptera and Culicida family. Some mosquito species are vectors for diseases affecting humans and animals. For example, the *Aedes aegypti* and *Aedes albopictus* mosquitoes transmit dengue hemorrhagic fever. *Culex tritaeniorhynchus* mosquitoes transmit Japanese encephalitis, while *Anopheles* mosquitoes transmit malaria. *Mansonia* mosquitoes transmit filariasis or elephantiasis. These diseases occur in humans, but mosquitoes are also significant vectors for various animal diseases. For instance, *Culex quinquefasciatus* mosquitoes transmit heartworm in dogs and avian malaria. Some mosquito species also bite cattle, leading to weight loss and reduced milk production. In addition to the dangers they pose to humans and warm-blooded animals, mosquitoes are also harmful to cold-blooded animals.

Figure 1: Physical Characteristics of a Mosquito

2.2 Species of Mosquito Larvae

Mosquito larvae exhibit distinct morphological and behavioral characteristics that allow for species identification. These characteristics include the presence and structure of the breathing tube (siphon), body position in relation to the water's surface, and movement patterns.

- **Anopheles larvae:** These larvae lack a breathing tube and lie parallel to the water surface. Their movement is characterized by a side-to-side, S-shaped motion.
- **Mansonia larvae:** These larvae possess a short, saw-toothed breathing tube that pierces the roots of aquatic plants. They attach at a 45-degree angle to the water surface and exhibit an S-shaped movement.
- **Culex larvae:** These larvae have a long, slender breathing tube and position themselves at a 45-degree angle to the water surface. Their movement is also S-shaped.

- **Aedes larvae:** Aedes larvae are characterized by a short, stout breathing tube (siphon) and position themselves at a 45-degree angle to the water surface. Their movement is described as a "jerky" or "whiplike" motion. *Aedes aegypti* larvae can be differentiated from *Aedes albopictus* larvae by the number of ventral brushes. *Aedes aegypti* possesses 5 pairs of ventral brushes, while *Aedes albopictus* has only 4 pairs.

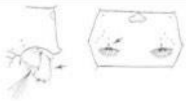
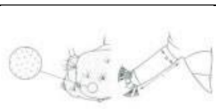
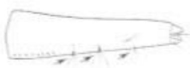
Anopheles larvae	Mansonia larvae	Culex larvae	*Aedes aegypti*	*Aedes albopictus*
				
				
Findings	Findings	Findings	Findings	Findings
- Lack a breathing tube - Lie parallel to the water surface - Exhibit S-shaped motion	- Possess a short, saw-toothed breathing tube - Attach at a 45-degree angle to the water surface - Exhibit S-shaped movement	- Possess a long, slender breathing tube - Position themselves at a 45-degree angle to the water surface - Exhibit S-shaped movement	stout breathing tube - Position themselves at a 45-degree angle to the water surface - Possess "jerky" or "whiplike" motion - Possesses 5 pairs of ventral brushes	- Possess short, stout breathing tube - Position themselves at a 45-degree angle to the water surface - Possess "jerky" or "whiplike" motion - Possesses 4 pairs of ventral brushes

Table 1: Images and description of Mosquito Larvae Species

2.3 Mosquito Life Cycle

Mosquitoes undergo complete metamorphosis, a process involving four distinct stages: egg, larva, pupa, and adult. The characteristics of the eggs, larvae, pupae, and adults vary among different mosquito species. These differences are utilized for species identification in research and study.

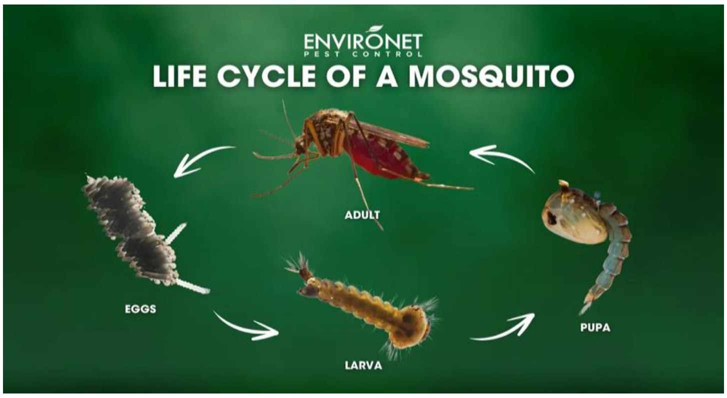


Figure 2: The Life Cycle of a Mosquito

2.4 Breeding Habitats

Different mosquito species exhibit preferences for specific breeding habitats. These preferences are related to water quality, the presence of vegetation, and other environmental factors.

- Anopheles larvae: These larvae typically breed in slow-moving, relatively clean water sources such as rock pools, tree hollows, and rice paddies. They are often found in areas distant from urban centers, such as in forested foothills.
- Mansonia larvae: These larvae primarily breed in stagnant water bodies with abundant aquatic vegetation, such as ponds containing water hyacinths, duckweed, or other aquatic plants, as well as in swampy areas with such vegetation.
- Culex larvae: These larvae prefer stagnant water found in various locations, including puddles, rock pools, drainage pipes, stagnant water under houses, and water in rice fields, animal footprints, and dirty water-holding containers.
- Aedes larvae: These larvae characteristically breed in clean water sources found around homes, such as water storage containers (e.g., jars, tanks, cement basins, and pots), discarded containers (e.g., cans, coconut shells, and tires), flower vases, and fruit peelings.

2.5 Mosquito-borne Diseases

Mosquitoes are vectors for a variety of diseases, some of which are detailed below:

- Malaria: The Anopheles mosquito is the vector for malaria. This disease is prevalent in forested areas, overgrown vegetation, hot and humid climates, and near various water sources. Symptoms include fever, headache, body aches, fatigue, rapid pulse, chills, nausea, vomiting, and pallor due to the destruction of red blood cells. Anemia may develop, leading to jaundice, and urine may be dark, resembling fish sauce in color.

- Filariasis (Elephantiasis): The Mansonia mosquito transmits filariasis. Symptoms include a sudden high fever, inflammation of the lymphatic vessels and lymph nodes, which may be observed in various areas such as the legs, lower abdomen, spermatic cord, or breasts. The affected skin will be swollen and red, with lymphatic fluid accumulation, and may feel lumpy. However, some individuals may not exhibit obvious swelling.

- Japanese Encephalitis: The Culex mosquito is the vector for Japanese encephalitis. This disease is often found in rice paddies due to them being mosquito breeding grounds, and pigs act as reservoirs for the disease. Culex mosquitoes transmit the disease from infected pigs to humans and other animals. Symptoms appear 5-15 days after infection and include high fever, vomiting, headache, and fatigue. Neurological symptoms then develop, such as stiff neck, decreased consciousness, lethargy, delirium, seizures, coma, tremors, or paralysis. Even after recovery, some neurological deficits may persist, such as slurred speech, spasms, or cognitive impairment.

- Dengue Fever: The Aedes mosquito transmits dengue fever. Symptoms appear 5-8 days after being bitten by an infected mosquito and include a sudden high fever, body aches, loss of appetite, and possible vomiting. A red rash may appear on the body, and bleeding may occur easily, including black stools. Severe complications can arise, such as shock, seizures, edema, chest tightness, abdominal pain, or internal bleeding.

2.6 Stereo microscope

A stereo microscope is a type of light microscope specifically designed to produce three-dimensional images. It provides clear depth of field, giving a view similar to that of the naked eye at a magnified scale.

The three-dimensional image is created by paired objective lenses, positioned parallel to each other and slightly offset, mimicking the binocular vision of human eyes. When viewed through the eyepieces, the two images merge, creating a virtual 3D image. Auxiliary objective lenses can be added to further increase magnification.

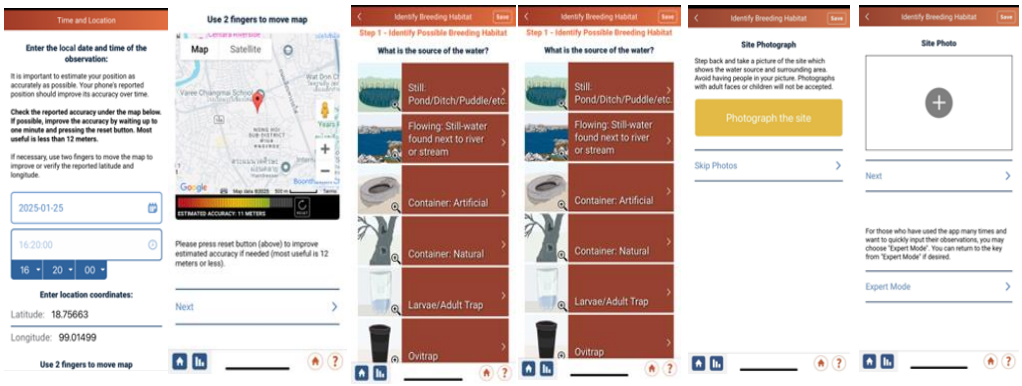
Stereo microscopes typically offer low to medium magnification (approximately 5-100x), making them suitable for viewing opaque objects. They are commonly used in industrial applications for examining and observing surface details of objects such as circuit boards, amulets, diamonds, insects, flowers, etc. The 3D view provides a realistic perspective, revealing texture, structure, and size of very small objects.

Figure 3: Stereo microscope

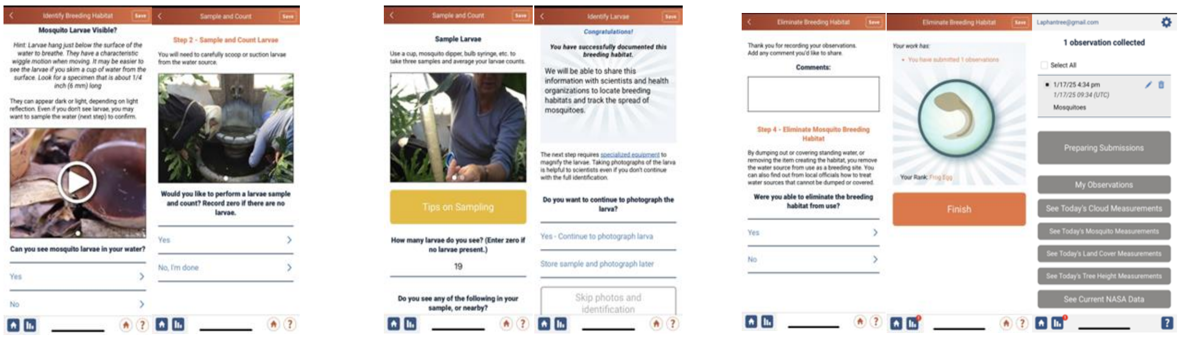
2.7 The GLOBE Mosquito Habitat Mapper App

Figure 4: GLOBE Mosquito Habitat Mapper Application

The GLOBE Mosquito Habitat Mapper (MHM) app, a NASA-sponsored initiative, contributes to the mitigation of mosquito-borne diseases, including dengue, Zika, and malaria. The MHM app pursues the goals of increased public awareness and decreased disease risk through three primary avenues: (1) the collection and analysis of scientific data on mosquito habitats; (2) the empowerment of individuals to actively reduce local mosquito populations by eliminating standing water sources; and (3) the education of younger generations and citizen scientists regarding the breeding sites of Aedes aegypti and Aedes albopictus, the primary vectors for dengue and Zika viruses.



Step 1 Identify Potential Mosquito Habitats



Step 2 Sample and Count Step 3 Identify Larva Type Step 4 Eliminate

Figure 5: The GLOBE Mosquito Habitat Mapper App and its four steps

2.8 Container Index (CI)

The "CI" in Aedes breeding refers to the Container Index, a key indicator in mosquito control showing the percentage of water-holding containers infested with Aedes larvae, commonly found in clean, stagnant water in household items like flower pots, tires, and tanks, with global spread linked to climate change and urbanization, requiring habitat removal to control dengue transmission.

The Container Index (CI) is a metric used to indicate the prevalence of mosquito breeding sites. It is primarily used to assess environmental risks, evaluate the efficiency of sanitation management, and measure the effectiveness of breeding site elimination measures.

However, according to World Health Organization (WHO) guidelines, CI cannot be used to predict Dengue Hemorrhagic Fever (DHF) outbreaks directly. It must be considered in conjunction with other epidemiological data and indices.

Calculation Formula

The CI value is calculated using the following formula

$$CI = \frac{\text{Number of containers with larvae and pupae}}{\text{Number of containers searched}} \text{ X } 100$$

The following threshold values are used to evaluate the risk level of dengue transmission based on the CI:

CI VALUE (%)	RISK LEVEL OF DENGUE TRANSMISSION
0	Safe
<5	Low risk
5-9	High risk
≥10	Very high risk

2.9 Related Research

1. Mosquito Species and Container Types in the Vicinities of Sawatrattanapimuk School and Ban Nong Sai School, Trang, Thailand.

This study compared mosquito larvae abundance and species composition between Sawatrattanapimuk School and Ban Nong Sai School, Na Yong District, Trang Province, Thailand. Larval samples were collected four times weekly at each school over a two-week period during March and April. Identified larvae at Sawatrattanapimuk School were predominantly Culex (87.5%), with Aedes albopictus comprising the remaining 12.5%. At Ban Nong Sai School, Aedes albopictus was the dominant species (87.5%), followed by Culex (12.5%). Common larval habitats at both schools included discarded tires, pools, potted plants, ditches, ponds, and water tanks. These results indicate the presence of similar mosquito larval species at both locations, although their relative abundances differed.

2. Regional Analysis of GLOBE Mosquito Data in Asia: Examining Species Diversity, Breeding Sites, and Container Index

This study analyzes data collected through the GLOBE Mosquito Habitat Mapper in Asia to investigate mosquito species diversity, breeding site preferences, container indices, and their potential links to disease transmission. Asia, a region with diverse ecosystems and dense populations, is a hotspot for mosquito-borne diseases. Understanding the ecological dynamics of mosquito populations is crucial for effective vector control. This research explicitly examines (1) mosquito species distribution across Asian countries, (2) the types of breeding containers utilized by mosquitoes in different regions, and (3) the container index (percentage of infested water-holding containers). This study aims to identify key factors influencing mosquito populations and assess their role in disease transmission by integrating GLOBE data with environmental and epidemiological information. The findings will contribute to a deeper understanding of mosquito ecology in Asia and inform the development of evidence-based vector control strategies to protect public health.

Chapter 3

Research Methodology

This research project employed a comparative survey methodology to investigate mosquito larvae species. The study comprised the following sequential methods:

1. Formulate research questions
2. Define the Study Area for Mosquito Larvae
3. Study Water temperature in the Survey Area
4. Collect Mosquito Larvae
5. Study Mosquito Larvae Species
6. Record the results on GLOBE Mosquito Habitat Mapper

The research process was conducted in the following sections:

3.1 Research Plan

This research is a survey-based study.

3.2 Equipment and Materials

3.2.1 Beaker 3.2.2 Bucket 3.2.3 Dropper

3.2.4 Forceps 3.2.5 Petri dish 3.2.6 Spoon

3.2.7 Stereo microscope 3.2.8 Thermometer

3.3 Methodology

3.3.1 Collection of Mosquito Larvae for Study and Investigation of Mosquito Larvae Species.

Part 1: Defining the Study Area for Mosquito Larvae:

1.1 Prepare equipment for collecting mosquito larvae.

1.2 Survey the environment within the school vicinity to identify water-holding areas that may serve as mosquito breeding sites.

1.3 Mosquito larvae were collected and placed in prepared containers once weekly on Thursdays over a five-week period, from November 13 to December 11, 2025.

Part 2: Studying Mosquito Larvae Species:

2.1 Prepare equipment for studying mosquito larvae characteristics: stereomicroscope, petri dish, beaker, inoculation needle and dropper.

2.2 Place mosquito larvae in the petri dish and add a small amount of water.

2.3 Place the petri dish onto the stage plate of the stereo microscope.

2.4 Study the characteristics of the mosquito larvae.

2.5 Record the results on GLOBE Mosquito Habitat Mapper

3.3.2 Studying Water temperature

1. Prepare a thermometer and tie a string to it to avoid direct hand contact.

2. Hold the string and immerse the thermometer in the water at three different points.

3. Record the results.

Chapter 4

Research Results

This study examined mosquito larvae species and measured water temperature in the designated survey areas. The findings are detailed below:

4.1 Water temperature

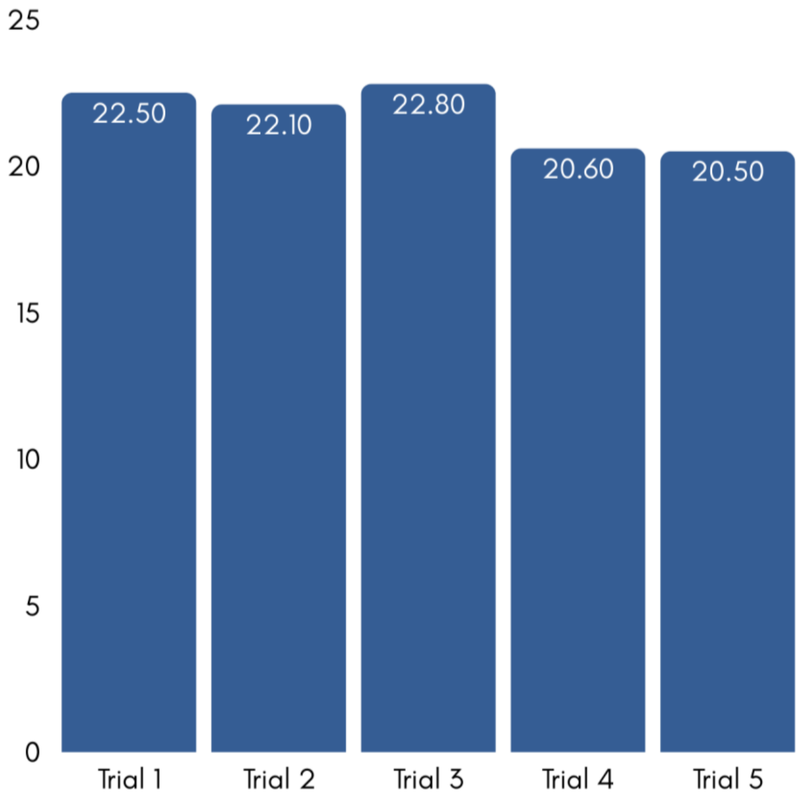


Figure 6: The average of water temperature in each trial

The data in the figure above presents water temperature measurements recorded across five trials. The temperatures ranged from 20.50°C to 22.80°C. The highest temperature was observed in Trial 3 (22.80°C), while the lowest was recorded in Trial 5 (20.50°C). Trials 1 and 2 showed relatively similar temperatures at 22.50°C and 22.10°C, respectively. Overall, the results indicate moderate variation in water temperature across the experimental trials. Based on these measurements, the average water temperature across the five trials was 21.5°C.

4.2 Mosquito larvae species

Containers / Mosquito larvae species	Aedes	Anopheles	Culex	Mansonia
Can or bottle	61	33	65	22
Dish or pot	56	37	70	42
Flower or plant pot / Tray	56	28	70	22
Fountain	55	40	74	22
Plastic tank	59	36	77	25
Pool	51	38	82	16
Rain gutter or other architectural feature	60	34	89	19
Tire	0	0	0	0
Trash container	60	36	80	24
Total Larvae	**458 (29.76%)**	**282 (18.33%)**	**607 (39.44%)**	**192 (12.47%)**

Table 2: the number of mosquito larvae species found.

The data presented in the table show that a total of 1,539 mosquito larvae were collected, comprising 458 Aedes larvae (29.76%), 282 Anopheles larvae (18.33%), 607 Culex larvae (39.44%), and 192 Mansonia larvae (12.47%). Analysis of larval distribution across different types of water-holding containers revealed the presence of four mosquito genera: Aedes, Anopheles, Culex, and Mansonia. Overall, Culex larvae were the most abundant across all container types, with the highest counts observed in rain gutters or other architectural structures, pools, and trash containers. Aedes larvae were frequently found in cans or bottles, plastic tanks, and trash containers, while Anopheles larvae occurred in moderate numbers across most container types, particularly in fountains and pools. In contrast, Mansonia larvae showed the lowest overall abundance, with relatively higher counts observed in dishes or pots and plastic tanks. These findings indicate that mosquito species distribution varies according to container type, reflecting differences in breeding habitat preferences among mosquito genera.

4.3 Calculation of the Container Index (CI)

$$CI = \frac{8}{227} \times 100$$
$$= 3.52$$

A total of 227 containers were inspected, and larvae from several mosquito genera (Aedes, Culex, Anopheles, and Mansonia) were identified. Aedes larvae were detected in eight containers, resulting in a Container Index (CI) of 3.52%, which is classified as low risk.

Chapter 5

Discussion, Conclusions and Recommendations

This study investigated mosquito larvae species water temperature in a specific survey area. The following summarizes the research findings and provides recommendations for future research.

5.1 Discussion and Conclusions

This study aimed to compare mosquito larvae species and disseminate the findings within the school and local community. The research focused on several factors related to mosquito larvae development, including larvae species, water temperature. The research revealed the following:

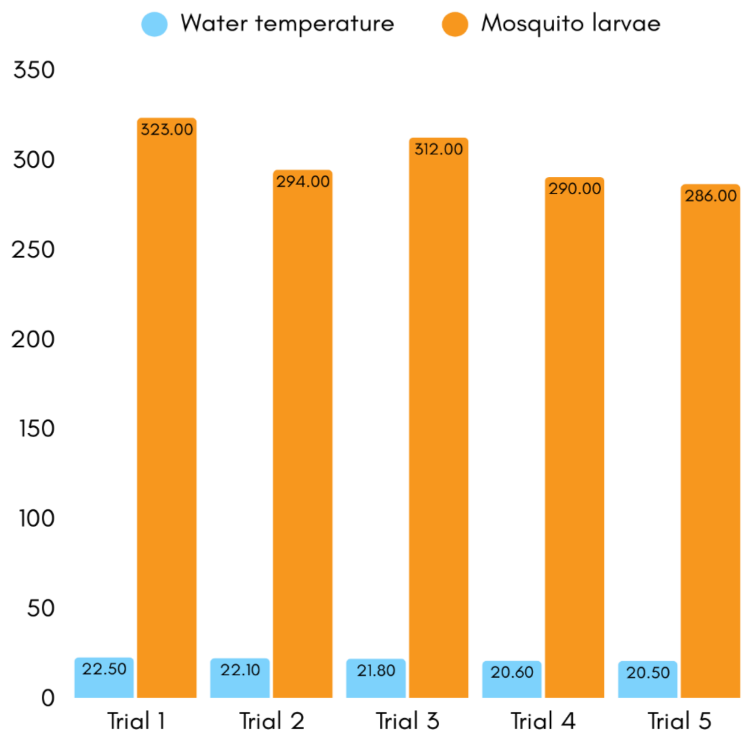


Figure 7: The comparison of water temperature with mosquito larvae in each trail.

The study revealed that the water temperature in the area was 21.5 degrees Celsius, with a total of 1,539 mosquito larvae. The most prevalent species was Culex larvae, accounting for 39.44% of the total.

The findings indicate that mosquito larval abundance tends to increase at higher water temperatures, particularly within the range of 21.8–22.5 °C, where higher larval counts were observed compared to lower temperature conditions. These results demonstrate a positive relationship between water temperature and mosquito larval abundance, supporting the research hypothesis that higher water temperatures are associated with increased mosquito populations.

However, despite the influence of water temperature on larval abundance, the overall level of mosquito breeding in the study area remained low. Based on the calculation of the Container Index (CI), which was found to be 3.52%, the study area was classified as low risk. This indicates that only a small proportion of water-holding containers were infested with mosquito larvae, suggesting that the general environmental conditions are not highly favorable for large-scale mosquito breeding and that existing environmental management and sanitation measures are relatively effective. Nevertheless, the presence of larvae in some containers highlights the need for continuous surveillance and source reduction to prevent potential increases in mosquito populations and reduce the risk of dengue transmission in the future.

5.2 Recommendations

Based on the findings of this study on mosquito larvae breeding, the following recommendations are made for future research:

1. Future studies should investigate mosquito larvae breeding across different seasons.
2. The findings of this research should be integrated into classroom instruction and disseminated to interested individuals within the community.

IVSS badges

1. I MAKE AN IMPACT

The research explains the connection between a local community issue and research questions. Students show how their research has helped the community, such as by offering recommendations or taking action based on their findings. Studying the ecology of mosquito larvae helps us understand how mosquito larvae breed in order to reduce spread of diseases which is crucial for reducing the spread of diseases carried by mosquitoes.

2. I AM A PROBLEM SOLVER

The students learn that they can be part of possible solutions to the problems they are investigating. The study of mosquito larvae provides valuable insights into the complex interactions within the Earth's systems, highlighting the importance of an integrated approach to environmental science.

3. I AM A STEM STORYTELLER

This research is related to creative storytelling because the research team not only investigated how water temperature affects mosquito larval density, but also creatively communicated the research findings to the school and surrounding communities. Various creative media, such as dramatic performances, blogs, infographics, and online platforms, were used to present the scientific results in an accessible and engaging way. This approach helped audiences better understand mosquito breeding prevention, raised awareness of environmental management, and contributed to reducing the risk of dengue transmission.

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Appendix

The tables below present the water temperature measurements obtained in each container.

Container	Trial 1				Trial 2				Trial 3				Trial 4				Trial 5			
	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
Can or bottle	22.6	22.8	22.7	**22.7**	22.8	23.4	23.2	**23.1**	23.6	23.8	23.4	**23.6**	21.6	21.8	21.7	**21.7**	20.8	20.4	20.2	**20.4**
Dish or pot	21.9	22.1	22.5	**22.1**	23.1	22.7	22.6	**22.8**	21.4	21.5	21.3	**21.4**	20.8	20.4	20.7	**20.6**	20.8	20.9	20.4	**20.7**
Flower or plant pot / Tray	23.4	22.8	22.1	**22.7**	21.8	21.6	22.4	**21.9**	21.5	20.9	21.4	**21.2**	20.4	20.8	20.1	**20.4**	20.4	20.6	20.4	**20.4**
Fountain	21.6	21.9	21.5	**21.6**	21.9	22.2	22.1	**22.1**	22.7	22.9	22.4	**22.6**	20.6	20.9	20.5	**20.6**	20.9	21.2	21.1	**21.0**
Plastic tank	22.8	22.4	22.6	**22.6**	21.8	21.9	22.2	**21.9**	21.5	21.7	21.8	**21.6**	20.6	20.4	20.3	**20.4**	20.7	20.5	20.4	**20.5**
Pool	22.8	23.2	22.4	**22.8**	21.6	21.5	21.7	**21.6**	21.3	21.4	21.5	**21.4**	20.4	20.5	20.6	**20.5**	20.4	20.8	20.3	**20.5**
Rain gutter or other architectural feature	22.5	22.4	22.3	**22.4**	21.9	22.3	22.5	**22.2**	21.6	21.4	21.7	**21.5**	20.1	20.6	20.3	**20.3**	20.4	20.6	20.7	**20.5**
Tire	22.6	22.8	22.7	**22.7**	21.8	22.5	21.7	**22.0**	21.5	21.4	21.6	**21.5**	20.4	20.6	20.5	**20.5**	20.4	20.6	20.1	**20.3**
Trash container	22.6	22.7	22.4	**22.5**	21.6	21.4	21.3	**21.4**	21.3	20.9	21.2	**21.1**	20.7	20.8	20.4	**20.6**	20.4	20.6	20.7	**20.5**

The table below presents the number of mosquito larvae species found in each container.

Container	Trial 1				Trial 2				Trial 3				Trial 4				Trial 5			
	Aedes	Anopheles	Culex	Mansonia	Aedes	Anopheles	Culex	Mansonia	Aedes	Anopheles	Culex	Mansonia	Aedes	Anopheles	Culex	Mansonia	Aedes	Anopheles	Culex	Mansonia
Can or bottle	10	8	11	4	12	9	14	5	13	8	15	8	12	4	12	4	14	4	13	1
Dish or pot	10	7	15	22	11	7	15	4	12	7	14	7	11	8	12	5	12	8	14	4
Flower or plant pot / Tray	9	5	14	3	9	5	13	5	11	9	15	5	12	5	13	4	15	4	15	5
Fountain	11	7	18	1	8	9	14	6	12	8	14	6	12	9	14	4	12	7	14	5
Plastic tank	12	8	15	4	7	7	15	7	13	6	16	4	14	7	15	6	13	8	16	4
Pool	10	9	19	1	10	8	16	3	12	7	14	5	9	5	16	2	10	9	17	5
Rain gutter or other architectural feature	11	4	22	5	14	6	17	1	9	8	15	5	12	8	17	2	14	8	18	6
Tire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trash container	14	7	21	6	12	7	14	4	8	9	14	3	12	6	14	4	14	7	17	7