



# **Macroinvertebrates: Biological Indicators for Local Water Quality**

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**Research Title:** Macroinvertebrates: Biological Indicators for Local Water Quality

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## **Abstract**

Water quality degradation from human activities is a growing concern for local communities. This study evaluates the water quality and macroinvertebrate diversity in two vital water resources: Nong Plong and Huai Wa in Sisaket Province. Residents rely on these sites for agriculture, consumption, and local fishing. By monitoring physical and chemical parameters—temperature, pH, Dissolved Oxygen (DO), and transparency—alongside biological surveys, we assessed the health of these ecosystems. Our findings revealed that Nong Plong maintains better water quality, characterized by higher DO levels and the presence of sensitive species like dragonfly larvae. In contrast, Huai Wa showed signs of organic accumulation indicated by the presence of freshwater leeches. This research confirms that macroinvertebrates serve as effective natural medicine for monitoring environmental health.

**Keywords** Chemical and Physical Parameters ,Macroinvertebrates.

## **Introduction of Literature**

Water is a fundamental natural resource essential for the survival of all living organisms and the balance of ecosystems. However, global climate change and increasing human activities have led to significant water quality degradation, resulting in water scarcity and ecological crises. According to Thailand's pollution situation reports between 1996 and 2021, a substantial portion of surface water remains in "deteriorated" to "fair" conditions.

In Tum Subdistrict, Prang Ku District, Sisaket Province, local water resources such as Nong Plong and Huai Wa serve as lifelines for agriculture, consumption, and daily activities. Despite their importance, these areas face risks from agricultural runoff and domestic wastewater, which may negatively impact native aquatic species and overall ecosystem health.

To monitor these environments effectively, Aquatic Macroinvertebrates—such as insect larvae, mollusks, and crustaceans—are utilized as vital biological indicators (bio-indicators). These organisms are highly sensitive to environmental changes and pollutants. Their presence or absence reflects the long-term health of a water source more accurately than isolated chemical tests. For instance, groups like Mayflies or Dragonfly larvae typically thrive

in high-oxygen, clean water, while pollution-tolerant groups like freshwater leeches or bloodworms can indicate high organic loading.

By integrating physical-chemical parameters with biological diversity data, this study aims to provide a comprehensive assessment of local water quality to support sustainable conservation and community-led water management.

## **Research Questions**

To understand the current status of our local water resources, this study explores the following questions:

1. How does the water quality differ between Nong Plong and Huai Wa?
2. What is the relationship between macroinvertebrate diversity and the water quality of these two sources?

## **Methods**

The study was conducted using a systematic field survey and experimental approach to assess the correlation between water quality and biological diversity. We adopted the international standards of the GLOBE Program for all environmental measurements and sampling procedures.

### **1. Study Site Selection**

We designated two primary study sites in Tum Subdistrict, Prang Ku District, Sisaket Province, to compare different environmental contexts:

Site 1: Nong Plong – A medium-sized freshwater pond surrounded by trees and located near a residential community.

Site 2: Huai Wa (Ban Khi Nak) – A local stream flowing through agricultural areas and community settlements.

### **2. Sampling Schedule**

Field surveys and water sampling were conducted once a month on the 5th day of each month for a period of two months:

Phase 1: June 5, 2025.

Phase 2: July 5, 2025.

### **3. Physical and Chemical Analysis**

At each site, we measured four key water quality parameters using specialized STEM equipment:

Temperature: Measured using a digital thermometer or the LabQuest sensor to determine the thermal state of the water.

pH Level: Measured using a pH Meter or LabQuest to assess acidity/alkalinity.

Dissolved Oxygen (DO): Determined using a chemical test kit or DO sensor to measure the oxygen available for aquatic life.

Transparency: Measured using a Secchi Disk or transparency tube to evaluate water clarity and suspended solids.

#### 4. Biological Survey: Macroinvertebrates

To evaluate the biological health of the water, we followed these steps for sampling and identification:

**Collection:** Water was filtered or sampled using fine-mesh nets (20-50 microns) and collection trays.

**Sorting and Identification:** Samples were separated manually or using magnifying glasses. Identification was based on morphological characteristics, such as body shape and presence of appendages.

**Classification:** Macroinvertebrates were categorized into groups (e.g., Dragonfly larvae, Mayflies, Leeches) based on their sensitivity to pollution according to the GLOBE Program protocols.

#### 5. Data Integration and Entry

After recording all parameters, the data was analyzed by comparing the results with the Surface Water Quality Standards of Thailand. Finally, the collected data was uploaded to the GLOBE Program global database via the Data Entry system (<https://www.globe.gov>) for international reporting and long-term monitoring.

### Research Results

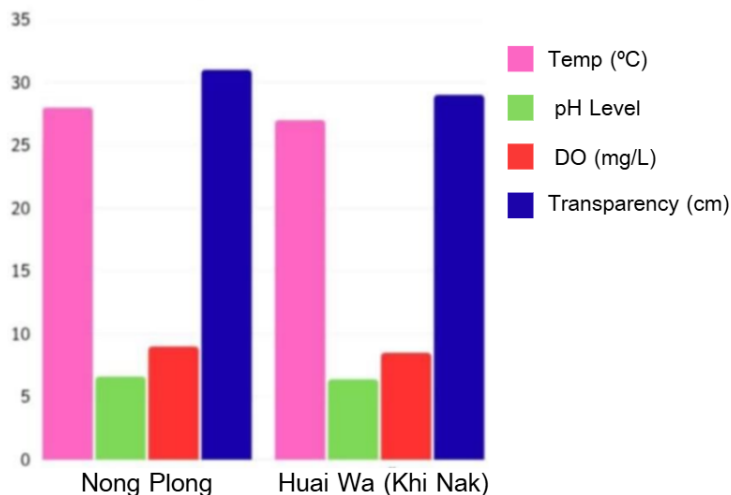
The investigation of water quality and macroinvertebrate diversity at Nong Plong and Huai Wa revealed significant insights into the ecological status of these local water resources. The results are categorized into physical-chemical parameters and biological indicators.

#### 1. Physical and Chemical Water Quality Analysis

The data collected from two sampling events in June and July 2026 showed that both sites generally maintain standards suitable for aquatic life, though slight variations were observed.

Table 1: Results of Water Quality and Macroinvertebrates Monitoring (Trial 1)  
Date: June 5, 2025

Water Source	Temp (°C)	pH Level	DO (mg/L)	Transparency (cm)	Macroinvertebrates Found
Nong Plong	30.0	6.9	8.5	35.0	Freshwater Shrimp
Huai Wa (Khi Nak)	30.0	6.7	7.0	33.0	Freshwater Shrimp

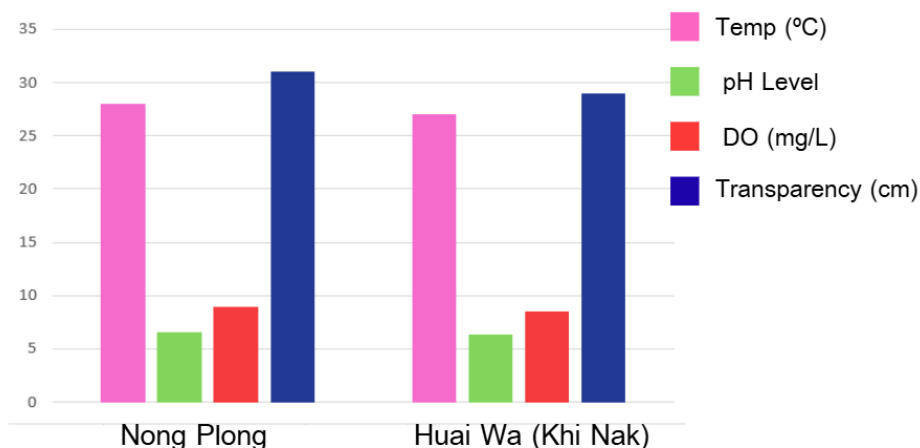


【Figure 1. Comparison Chart of Water Quality Parameters and Macroinvertebrate Survey (Trial 1)】

Results Summary (Trial 1): Both water sources had a temperature of approximately 30°C, which is normal for natural water. The pH levels (6.7–6.9) indicated slightly acidic to neutral conditions. Dissolved Oxygen (DO) levels (7.0–8.5 mg/L) were good for aquatic life. The transparency (33–35 cm) showed moderate clarity. Freshwater shrimp were found at both sites, indicating suitable water quality for common aquatic species.

Table 2: Results of Water Quality and Macroinvertebrates Monitoring (Trial 2)  
Date: July 5, 2025

Water Source	Temp (°C)	pH Level	DO (mg/L)	Transparency (cm)	Macroinvertebrates Found
Nong Plong	28.0	6.6	9.0	31.0	Dragonfly larvae and Freshwater shrimp
Huai Wa (Khi Nak)	27.0	6.4	8.5	29.0	Freshwater shrimp and Freshwater leeches



【Figure 2. Comparison Chart of Water Quality Parameters and Macroinvertebrate Survey (Trial 2)】

Results Summary (Trial 2): Water temperatures were between 27–28°C. The pH levels (6.4–6.6) remained slightly acidic. DO levels (8.5–9.0 mg/L) were excellent for aquatic organisms. Transparency was moderate at 29–31 cm. The presence of dragonfly larvae and freshwater shrimp at Nong Plong indicated good water quality and sufficient oxygen. However, the presence of leeches at Huai Wa may reflect an accumulation of organic matter.

## Discussion

The findings illustrate a clear correlation between physical water parameters and biological diversity.

### 1. Environmental Sensitivity

At Nong Plong, the high transparency and oxygen levels support the survival of Dragonfly larvae. These organisms require clean water to develop, making them reliable indicators of low-pollutant environments.

### 2. Human & Agricultural Impact

At Huai Wa, although the chemical parameters (DO and pH) remained within safe limits, the presence of leeches suggests that the stream is beginning to be affected by surrounding agricultural runoff or domestic waste. Leeches are more tolerant of low-clarity water and organic accumulation compared to dragonfly larvae.

### 3. Seasonal Influence

The slight decrease in pH and transparency observed in July (Trial 2) likely reflects the onset of the rainy season, which introduces more sediment and organic debris into the water bodies.

## Conclusion

This research evaluated the environmental health of Nong Plong and Huai Wa in Sisaket Province. Based on the physical-chemical and biological data collected over two months, the study concludes that

### 1. Physicochemical Status

Both water sources maintain a healthy state with high Dissolved Oxygen (7.0–9.0 mg/L) and neutral to slightly acidic pH levels (6.4–6.9), which are ideal for aquatic biodiversity.

### 2. Biological Status

Macroinvertebrates serve as effective bio-indicators. Nong Plong is classified as having "Good" water quality due to the presence of pollution-sensitive Dragonfly larvae. Meanwhile, Huai Wa is classified as "Fair" quality, indicated by the presence of Freshwater leeches, which suggest a higher concentration of organic matter.

## Citations

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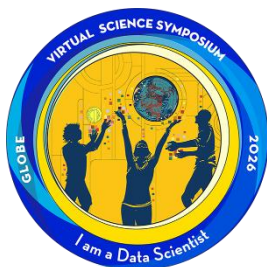
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## 1. I AM A DATA SCIENTIST



Description: Our team analyzed two months of original field data to evaluate the health of our local water resources. We used comparative tables and charts to visualize how water quality differs between Nong Plong and Huai Wa. In our discussion, we honestly addressed the limitations of our research, such as the short sampling period and how seasonal changes might have impacted our pH and transparency readings. By connecting these raw measurements to ecological questions, we were able to draw meaningful conclusions about the environmental status of our community.

## 2. I AM A PROBLEM SOLVER



Description: During our investigation, we identified potential risks to our community's water from agricultural runoff and domestic waste. By using science to diagnose these issues, we identified practical solutions. Our project offers actionable recommendations, such as reducing chemical use and promoting sustainable farming to protect local biodiversity. We believe that by providing evidence-based data, we can empower our neighbors to take informed action toward a healthier and more sustainable environment.

## 3. I AM AN EARTH SYSTEM SCIENTIST



Description: Our project explores the deep connection between the Hydrosphere and the Biosphere. By studying how water quality affects aquatic life, we applied multiple GLOBE protocols, including Water Temperature, pH, Dissolved Oxygen, and Transparency, alongside our macroinvertebrate surveys. Our research explains how the physical and chemical conditions of the water directly influence biological health. For example, we found that sensitive species like dragonfly larvae thrive only when oxygen levels are high, proving that Earth's systems are dynamic and rely on each other for balance.