

SAN RAFAEL NATIONAL HIGH SCHOOL
TIGAON, PHILIPPINES

Assessment of Fresh Water Macroinvertebrate as Bioindicator for River Health

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INTRODUCTION

- Water contamination in the Philippines is a serious problem that impacts the country's health, economy, and ecosystem. With 421 major rivers and 221 lakes, the Philippines provides 50% of its drinking water from these sources. (Koons, 2024b)
- Measurements related to macroinvertebrates are useful tools for assessing water quality and the general health of aquatic ecosystems. (Tampo et al., 2021).
- In the Philippines, biomonitoring has yet to become a fundamental component of government initiatives aimed at assessing the status of its water resources. Rather, existing water quality standards focus on tracking at least 10 key physicochemical parameters. (Magbanua et al., 2023).

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HYPOTHESIS

Alternative: There is a correlation with the water quality parameters and the count of macroinvertebrates.

Null: there is no correlation between the water quality parameters and the count of macroinvertebrates

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OBJECTIVES

- To assess the water quality parameters such as pH, TDS, salinity, electrical conductivity, DO, water temperature and nitrates in:
a. Rangas river b. Sagpon river
- How many and what kinds of macroinvertebrates are found in:
a. Rangas b. Sagpon
- Determine the biodiversity index of macroinvertebrates in:
a. Rangas River b. Sagpon River
- To correlate all the Macro invertebrates to the overall water quality parameters in:
a. Rangas river b. Sagpon river

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METHODOLOGY

Location of study:
The rivers or streams are Sagpon river in Tigaon and Rangas in Matala, Goa Camarines sur.

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STATEMENT OF THE PROBLEM

This study aims to assess the river's health and current status in order to provide baseline data that could support its conservation and sustainable management. This following question will be answered by this study:

- What is the water nitrate level, pH level and dissolved oxygen, total dissolved solids, salinity, electrical conductivity, water temperature, and turbidity in the following river[d1] s:
a. Rangas b. Sagpon
- How many and what are the kinds of macroinvertebrates found in:
a. Rangas b. Sagpon
- What is the biodiversity index of macroinvertebrates in:
a. Rangas b. Sagpon
- Is there a correlation with the water quality and the number or population of macroinvertebrates in:
a. Rangas river b. Sagpon river

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METHODOLOGY

Date of study:
This study was conducted on December 16, 2025 during the wet season in the Philippines.

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METHODOLOGY

Materials:

- Multiparameter water quality tester tool
- 1sqm. quadrant
- d nets

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METHODOLOGY

Water Sampling:
Water samples were collected following the GLOBE Program bucket field guide. Each sample was transferred into a 1000 ml beaker, where the multiparameter equipment was used to measure water quality. The process was repeated three times per quadrant to ensure accuracy. Parameters tested included salinity, pH, electrical conductivity (EC), total dissolved solids (TDS), and water temperature.

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METHODOLOGY

Water temperature was measured because it is a critical environmental parameter that influences the chemical, biological, and physical properties of water, as well as potential health effects (Hancock, 2022). Alongside this, pH levels were tested by transferring water samples into a 1000 ml beaker and dipping the probe. Measurements were allowed to stabilize before recording both temperature and pH values.

METHODOLOGY

Dissolve oxygen:

Three water samples will be collected and tested using a dissolved oxygen meter borrowed from ParSU, following their instructions. Each sample will be placed in a beaker, the probe submerged, and the reading allowed to stabilize before recording the measurement.



METHODOLOGY

Nitrate:

A 50-meter stream section will be marked, with quadrants set every 15 meters. One 5 ml water sample will be collected from each quadrant and sent to Partido State University for testing. In the lab, the syringe and test tubes are rinsed with distilled water, then each sample is placed in a test tube. Ten drops of Solution 1 are added and shaken, followed by ten drops of Solution 2 and shaken again. After five minutes, the color is compared with nitrate test strips to determine nitrate levels.



METHODOLOGY

Macroinvertebrate:

Using the GLOBE's protocol for macroinvertebrate the researcher collected specimen from rangas and sagpon river.



To compute for the biodiversity of the Macroinvertebrates the researcher used the Shannon-Weiner Index.

The Shannon-Weiner Index assesses biodiversity through assessing species richness and evenness. Higher numbers indicate greater diversity. It is computed using the base-2 logarithm of each species' percentage. When all species are evenly represented, the index reaches its maximum, and comparing values between similar ecosystems reveals which are more resilient and robust. (GLOBE, 2005)

$$BI = -\sum_{i=1}^k x_i \log_2 x_i$$

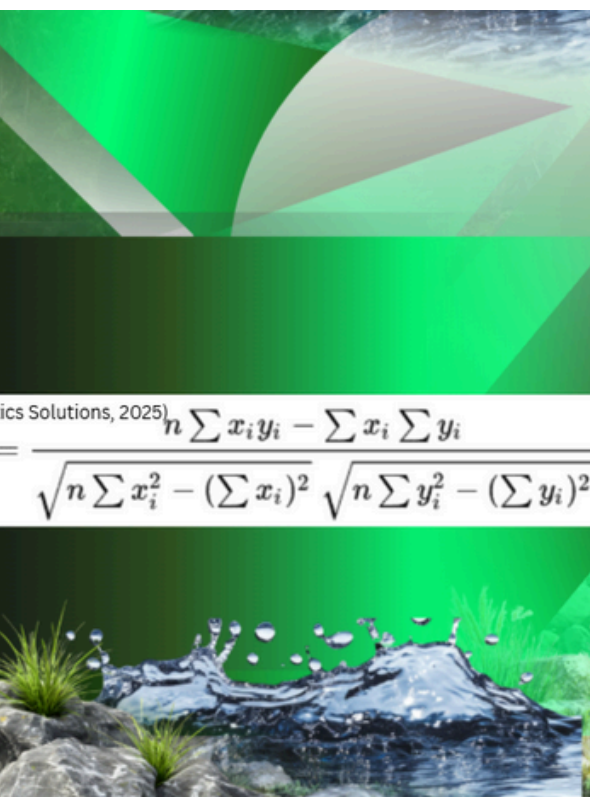
(GLOBE, 2005)

To correlate the Water quality parameters the researchers used the Pearson r correlation

The Pearson Correlation is a statistical technique that assesses the relationship or correlation between two data items by evaluating their attributes and computing a score that ranges from -1 to +1. A score close to +1 signifies a strong similarity, whereas a score around zero suggests there is no correlation. This approach is parametric and depends on the mean parameter of the items, which makes it more applicable to data that follows a normal distribution. (Berman, 2016)

$$r_{xy} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}$$

(Statistics Solutions, 2025)



Results

Table 1. Water Quality of two rivers

	Water Quality							
River site	pH	Temp (°C)	Turbidity (cm)	EC (µs/cm)	Salinity (ppm)	TDS (ppm)	DO (mg/L)	Nitrate (mg/L)
Rangas	4.810	26.770	43.220	473.330	236.440	235.780	7.57	5
Sagpon	7.4	29.94	113.33	184.89	93.33	93.44	7.57	5

RESULTS

MACROINVERTEBRATES SITE 1 RANGAS

Table 2 A

MACRO	phylum	genus	common name	total count
q1	Coleoptera	Elimidae	Riffle beetle	1
q2	Odanata	Neurothemis	Dragonfly	1
	Arthropoda	Argyroneta	Spider	1
q3	Odanata	Neurothemis	Dragonfly	1
total				4

RESULTS

MACROINVERTEBRATES SITE 2 SAGPON

Table 2. B

Macro	Phylum	Genus	Common Name	Total count
Q1	Ephemeroptera	Ephemera	Mayfly	6
	Bivalia	Unionidae	Mussel	1
Q2	Odoanata	Neurothemis	dragon fly	2
	Ephemeroptera	Ephemera	mayfly	2
	Coleoptera	Tenedrionidae	litter beetle	1
Q3	Ephemeroptera	Ephemera	Mayfly	4
	Anthropoda	Dermacantor	Mayfly nymph	1
Total				17

RESULTS

BIODIVERSITY INDEX OF RANGAS

Table 3. A

species	number in sample (count)	p_i	$\ln p_i$	$p_i \ln p_i$
Riffle beetle	1	0.25	-1.39	-0.35
Dragonfly	1	0.25	-1.39	-0.35
Spider	1	0.25	-1.39	-0.35
Dragonfly	1	0.25	-1.39	-0.35
sum (total)	4	1		-1.39
H'				1.39

low diversity

RESULTS

BIODIVERSITY INDEX OF SAGPON

Table 3. B

species	number in sample (count)	p_i	$\ln p_i$	$p_i \ln p_i$
May fly	6	0.35	-1.04	-0.37
Mussel	1	0.06	-2.83	-0.17
Mragon fly	2	0.12	-2.14	-0.25
May fly	2	0.12	-2.14	-0.25
Litter beetle	1	0.06	-2.83	-0.17
May fly	4	0.24	-1.45	-0.34
May fly nymph	1	0.06	-2.83	-0.17
sum (total)	17	1.00		-1.71
H'				1.71

Low diversity

RESULTS

Table 4. A. Correlation of macroinvertebrates to water quality parameter in Rangas River

RANGAS			
Variable	Statistical correlation (r)	Direction of relationship	Interpretation
pH	-0.592	Moderate to Strong Negative	Lower (more acidic) pH levels are strongly tied to lower organism counts.
Temp	0.000	No Relationship	Temperature remained stable and had no impact on the count variation.
Turbidity	-0.182	Negligible Negative	Turbidity variations at this site have very little influence on the macro count.
EC	0.125	Negligible Positive	Electrical conductivity does not significantly drive the population changes here.
Salinity	-0.055	Negligible Negative	Salinity has no statistically significant impact on the population at this site.
TDS	0.096	Negligible Positive	TDS levels are high but do not fluctuate enough to explain the count variation.

Legend: Pearson r value	Strength
±0.70 to ± 1.00	Very Strong relationship
±0.40 to ± 0.69	Moderate to Strong relationship
±0.30 to ± 0.39	Weak relationship
±0.20 to ± 0.29	Very weak relationship
±0.00 to ± 0.19	Negligible or No relationship



RESULTS

Table 4. B. Correlation of macroinvertebrates to water quality parameter in Sagpon River

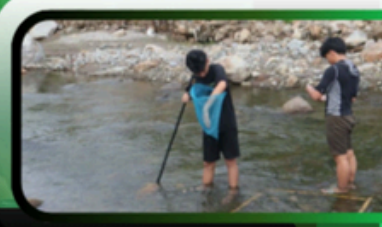
SAGPON			
Variable	Statistical correlation (r)	Direction of relationship	Interpretation
pH	0.321	Weak Positive	Abundance slightly increases as the water becomes more alkaline.
Temp	-0.280	Weak Negative	Minimal relationship; slight variations in heat did not drive the abundance.
Turbidity	-0.485	Moderate Negative	Cloudier water (higher turbidity) is associated with fewer organisms.
EC	0.301	Weak Positive	Electrical conductivity had a minor non-dominant positive relationship with counts.
Salinity	-0.612	Moderate to Strong Negative	Increasing salt content shows a strong trend of decreasing macroinvertebrate abundance.
TDS	-0.625	Moderate to Strong Negative	As dissolved solids increase, macro counts decrease significantly.

Legend: Pearson r value	Strength
±0.70 to ± 1.00	Very Strong relationship
±0.40 to ± 0.69	Moderate to Strong relationship
±0.30 to ± 0.39	Weak relationship
±0.20 to ± 0.29	Very weak relationship
±0.00 to ± 0.19	Negligible or No relationship



CONCLUSION

Rangas and Sagpon rivers show contrasting water quality conditions. Rangas is more acidic and contains higher levels of dissolved materials, with elevated total dissolved solids, salinity, and conductivity, alongside murkier water. Sagpon, on the other hand, has neutral pH, lower concentrations of dissolved substances, and clearer water. Both rivers share similar dissolved oxygen and nitrate levels, though Sagpon is slightly warmer. Overall, Sagpon's water is cleaner and less concentrated, while Rangas exhibits greater acidity and dissolved content.



CONCLUSION

The macroinvertebrate findings highlight a significant difference between the two sites. Rangas had a total of only four organisms: one riffle beetle, two dragonflies, and one spider. Meanwhile, Sagpon showed a much richer community with seventeen macroinvertebrates, made up of twelve mayflies, one mussel, two dragonflies, one litter beetle, and one mayfly nymph. These results indicate that Sagpon provides a more suitable and supportive environment for macroinvertebrate life compared to Rangas.



CONCLUSION

The Shannon–Wiener Diversity Index further shows that Sagpon has a higher level of biodiversity than Rangas. Rangas has a diversity value of 1.38, while Sagpon has a slightly higher value of 1.71. These results support our earlier findings, showing that Sagpon provides conditions that allow for a greater variety of macroinvertebrates compared to Rangas.



CONCLUSION

The study found that in the Rangas River, most water quality parameters had little impact on macroinvertebrate populations, except for pH, where lower values were linked to reduced abundance. In contrast, the Sagpon River showed a broader range of correlations—several water quality indicators, such as turbidity, dissolved oxygen, and nitrate levels, were associated with changes in macroinvertebrate counts. This suggests that macroinvertebrates in Sagpon are more sensitive to water quality fluctuations and can serve as effective indicators of river health.

