TROPICAL LIFE SCIENCES RESEARCH

# Assessment on Water Quality Parameter and Nutrients Level of Nyatuh River in Relations with *Macrobrachium rosenbergii* Prawn Populations

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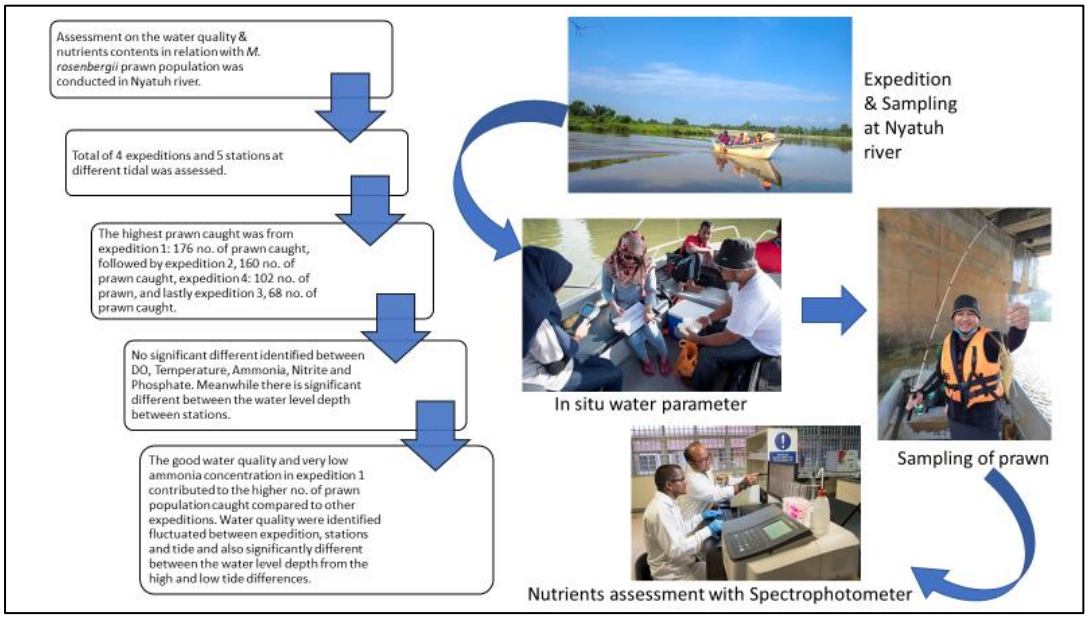
## Highlights

- Water quality monitoring and assessment is important to indicate the quality of pollution in the river as well as an indicator for the prawn population.
- Water quality in Nyatuh river were identified fluctuated between expeditions, stations and tide.
- Heterogeneous mixture for the number of prawns caught caused by the significant differences of water level depth and also by the fluctuation on water quality and ammonia level concentrations.
- Good water quality parameter and very low ammonia concentration in expedition 1 contributed to the higher number of prawn population caught.



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# Assessment on Water Quality Parameter and Nutrients Level of Nyatuh River in Relations with *Macrobrachium rosenbergii* Prawn Populations

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Running head: Assessment on Water Quality and Nutrients

**Abstract.** Assessment of water quality parameter is crucial in help recognising the safety level of water parameter and nutrients contents in the natural environment of fish and freshwater prawn area of Nyatuh River, Terengganu, Malaysia. Due to its important, a study was conducted to assess the water quality parameter and nutrients contents from Nyatuh River of Setiu Terengganu in relations with the population of freshwater prawn, *Macrobrachium rosenbergii* caught along the Sg. Nyatuh river basin. Total of 4 expeditions and 5 stations at different tidal condition for the water quality parameter were assessed during the study. From the results achieved, the overall temperature ranged was between (26.56-29.30°C), dissolved oxygen, DO (3.59-6.50 mg/L), pH (4.99-7.01), salinity (0.01-4.22 ppt), depth (2.71-5.54 m) while for ammonia (0.01-0.24mg/L), nitrite (0.01-0.05mg/L) and phosphate (0.01-0.12mg/L). For the prawn population, the highest caught was from expedition 1; 176 no. of prawns caught, followed by expedition 2; 160 no. of prawn, expedition 4; 102 number of prawns caught and lastly expedition 3; 68 no. of prawn caught. The heterogeneous mixture for the number of prawns caught might be caused by the significant differences of water level depth during high and low tide and also might be triggered by a bit fluctuation on ammonia concentration level in each of stations and expedition. For statistical analysis, the temperature showed no significant different between the expedition, stations and tidal where p:0.280, p>0.05 and F: 1.206, dissolved oxygen, DO, showed no significant different where p:0.714, where p>0.05 and F:0.737. The level of water depth was significantly different between expedition, station and tidal, where p:0.000, p<0.05 and F:3.120. Ammonia were identified no significantly different between expedition, station and tidal where p:0.476, p>0.05 and F:0.973. Nitrite was identified no significantly difference where p:0.569, p>0.05 and F: 0.879 and phosphate concentration was identified not significantly difference where p:0.247, p>0.05, F:1.255 between expedition, stations and tidal. The good water quality parameter and very low ammonia concentration in expedition 1 contributed to the higher prawn population caught in Expedition 1 as compared to other expedition. There is non-uniform of prawn distribution or heterogeneous mixture between differences station for the number of prawns caught caused by the significant differences of water level depth and also by the water quality of a bit fluctuation on ammonia level concentrations. As a conclusion, water quality in Nyatuh River were identified fluctuated

between expeditions, stations and tide and also significant differences on the water level depth from the high and low tide differences. Due to the rapid growth and importance of industrial and aquaculture operations along the river, extra attention should be devoted to avoid the impact of excessive pollutant in order to protect our future ecosystem.

**Keywords:** Water parameter, nutrients concentration, Nyatuh River, prawn population, *M. rosenbergii.*

## INTRODUCTION

Rivers was known as a crucial water sources for the daily human activities such as for drinking water sources, agriculture activity, industrial and for the recreational activity's purposes (Suratman *et al.* 2015). However, the growth of industrial development, population of humans and extreme land use, aquaculture and agriculture around the world cause an increase of stress on the natural environment (Kitsiou & Karydis 2011). According to the Department of Environment's 2013 environmental quality assessment, 5.3 % of 473 Malaysia's rivers were polluted, with 36.6 % mildly polluted (Zaideen *et al*. 2017). Rapid development not only yields a lot of waste into the aquatic environment, in fact it can even change the balance of the system within its ecology (Alssgeer *et al.* 2018). The deterioration of river water usually from both organic and inorganic pollutants which it enters into the river system frequently and eventually transported to the marine environment (Suratman *et al.* 2016).

Having an excellent water quality is necessary for a healthy, clean river and ecosystem. There are some basic conditions that must be required for aquatic life to grow in the water. If the conditions are poor, it may cause species populations to die. In addition, if the conditions are not optimal, the organisms become stressed. Hence, water quality parameters need to be measured in order to discover the quality of river water therefore it is safe to use for any purpose (Ma'arof *et al.* 2015). Many parameters were used to determine water quality and, in this study, quality parameters chosen are in situ parameters which are temperature, dissolved oxygen (DO), pH, salinity, depth and ex-situ parameters which are ammonia, nitrite and phosphate which effectively in accessing water quality (Hairoma *et al.* 2016).

Besides, relationship between tidal water fluctuation and water quality parameters is crucial in order to study the different aspects of ecosystem and natural environment (Kumar *et al.* 2012). The oxygen content in water is affected by temperature which is oxygen levels become lower as temperature increase. In addition, the river absorbed heat from the sea's tidal stream and the inflow of sea water from downstream to upstream caused the water temperature to rise at high tide (Fatema *et al.* 2016). Many organisms become stressed when the water temperature changes abruptly. DO concentration refers to the amount of oxygen present in water (Vasistha & Ganguly 2020) and a crucial indicator of a river health. In most cases, oxygen dissolves quickly in water, however the amount of oxygen dissolved in water varies which influenced by temperature, atmospheric pressure, and salinity (Zafar et al., 2016). Contamination in the water can lower the amount of dissolved oxygen in the water and can affect aquatic life. The percentage of hydrogen ions ($H^+$) in a solution is known as pH (Nalado et al. 2018). The acidity of water has an impact on the plant and animal life that lives in it. In general, a range of 6.5 to 8.5 is appropriate (Vasistha & Ganguly 2020).

The concentration of dissolved salts in water is referred to salinity. Aquatic species have evolved to live in specific salinity ranges. The monsoon may cause high precipitation of

rainfall which can lower the salinity of water in Peninsular Malaysia (Gasim et al. 2015). Ammonia levels that are above than the recommended limits can be harmful to aquatic life. Although the ammonia molecule is a necessary nutrient for life, too much of it can build up in the body, causing changes in metabolism and an elevation in body pH (Ma'arof et al. 2015). Nitrite concentrations in wastewater are moderate, while in the effluent of nitrifying biological treatment plants can be greater (Uddin et al. 2015). Nitrite and phosphate in groundwater can come from both point and non-point sources, such as sewage disposal systems and livestock facilities (Dey et al. 2021).

The deterioration in water quality is a huge sign of the river basin's environmental health worsening. The prevention of pollution in river needs effective monitoring, hence the aims of this study is to evaluate water quality parameters and nutrient content in order to determine the quality trend of Nyatuh River of Setiu Terengganu in relations with the population of Giant freshwater prawn, *M. rosenbergii* that might linkages the water parameter and nutrients level with the prawn populations caught in the expeditions conducted.

## METHODOLOGY

The analyses of water quality from Nyatuh River were determined by different expeditions, where (expedition 1 (September 2019), expedition 2 (July 2020) , expedition 3 (November 2020) and expedition 4 conducted in (April 2021) at 5 different stations along the Nyatuh River (station 1, station 2, station 3, station 4 and station 5) referring to the specific stations in Fig. 1 and details GPS coordinate in Table 1.

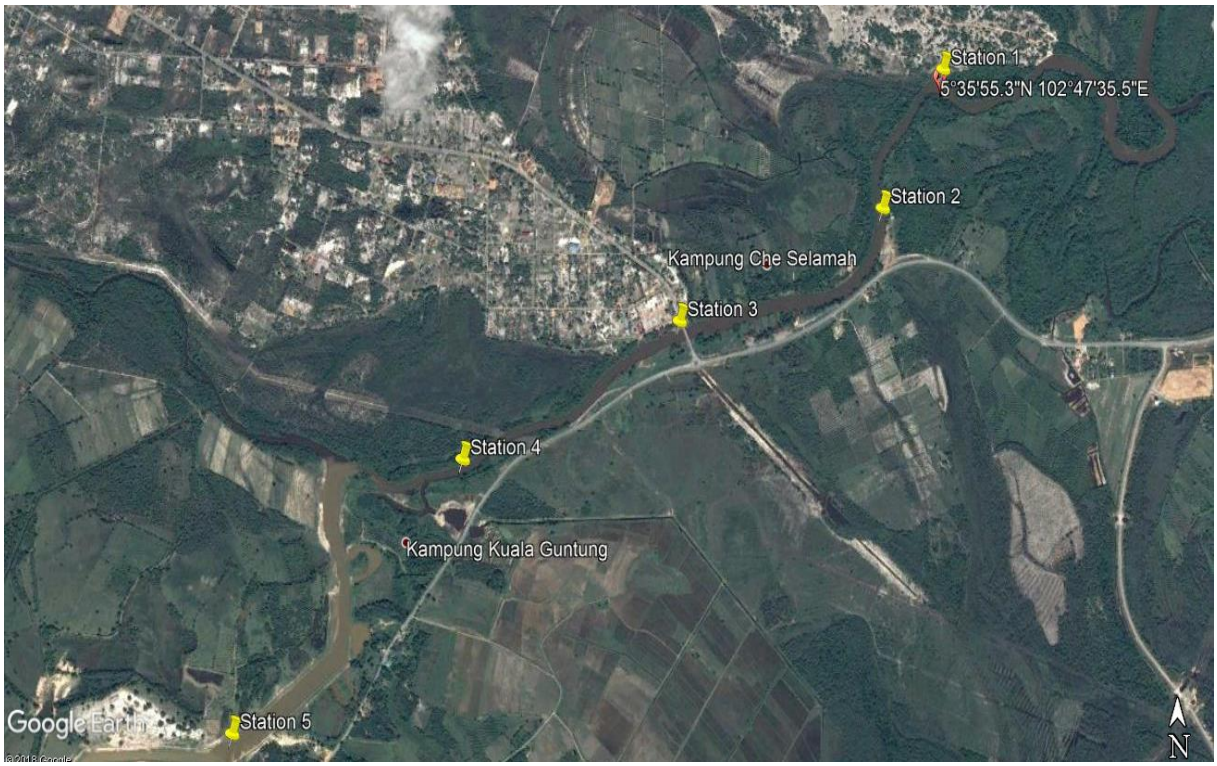


**Figure 1.** Location of the sampling station at Nyatuh river of Setiu, Terengganu.

**Table 1.** GPS coordination for each sampling station of station 1 until station 5 of Nyatuh river, Setiu, Terengganu.

| No. | Station | GPS coordinate | Location |
|---|---|---|---|
| 1 | Station 1 | N 05°35.921' E 102°47.592' | downstream |
| 2 | Station 2 | N 05°35.628' E 102°47.439' | upstream |
| 3 | Station 3 | N 05°35.386' E 102°46.934' | upstream |
| 4 | Station 4 | N 05°35.103' E 102°46.401' | upstream |
| 5 | Station 5 | N 05°34.532' E 102°45.844' | upstream |

Tidal referred to water level and can be differentiated by the low tide and high tide using portable depth meter. The analyses were carried out using *in-situ* parameters of YSI multiprobe Pro Plus for temperature, dissolved oxygen (DO), pH, and salinity. For nutrients such as ammonia, nitrite and phosphate, samples were collected triplicates of 1 Litre water for the water quality analyses. The nutrients concentration was measured using Shimadzu UV-1800 UV-vis spectrophotometer by applying the phenate method and cadmium reduction method followed Pearson 1984 protocol (APHA 2012).

For the giant freshwater prawn population assessments, three methods were applied which are fishing using prawn fishing rod, caught using fishing net and using of prawn trap. The same methods for prawn caught were used in every expedition. Sampling was conducted based on low tide and high tide referred to the tide chart. All the prawn caught and number of prawn samples were recorded in every expedition for further assessment on the relation of number of prawns caught with the water quality parameter achieved in every expedition.

## DATA ANALYSIS

SPSS 25.0 package was used for the analytical analyses on the water quality assessment of all data collection. Three-way ANOVA was used to determine the interaction effect between three independent variables of expedition, station, and tide on the dependent variables of temperature, DO, pH, salinity, depth and on the nutrients of ammonia, nitrite and phosphate.

## RESULTS

The highest prawn caught was identified from Expedition 1 with 176 no. of prawns, followed by expedition 2 around 160 no. of prawn caught, expedition 4 around 102 prawn caught and the lowest was from expedition 3 around 68 number of prawns caught. The good water quality parameter and a very low ammonia concentration in expedition 1 might contributed to the higher prawn caught during expedition 1 as compared to other expedition. Meanwhile in expedition 3, the lowest prawn caught was identified might be due to a little bit high of ammonia concentration around 0.10-0.39mg/ L and high of phosphate concentration around 0.04-0.15 mg/ L. The significant differences on the water level depth also might contributed to the no. of prawn population caught during each expedition. For other parameters such as temperature, DO and salinity the value was not really differentiate between the expeditions. From statistical analysis conducted, the temperature showed no significant different between the expedition, stations and tidal where p:0.280, $p>0.05$ and F: 1.206, dissolved oxygen, DO, showed no significant different where p:0.714, where $p>0.05$ and F:0.737. The depth was

significantly different between expedition, station and tidal, where p:0.000, p < 0.05 and F:3.120. Ammonia were identified no significantly different between expedition, station and tidal where p:0.476, p > 0.05 and F:0.973. Nitrite was identified no significantly difference where p:0.569, p > 0.05 and F: 0.879 and phosphate concentration was identified not significantly difference where p:0.247, p>0.05, F:1.255 between expedition, stations and tidal. Fig. 2 showed the result for the analyses of in-situ water quality parameters of Nyatuh River by different stations and tidal for expedition 1. The temperature of the low tide was increased from station 1 to station 3 (28.23°C to 28.54°C) and then decreased at station 4 and 5 (28.40°C and 28.12°C). For high tide, the temperature was increased from station 1 and station 2 (27.43°C and 27.77°C) and then decreased at station 3 and station 5 (27.52°C to 26.56°C). The minimum value of DO of low tide and high tide was at station 5 which are 3.59 mg/l and 3.76 mg/l. Meanwhile, the maximum value of DO of low tide and high tide was at station 1 which are 4.14 mg/l and 4.04 mg/l. The pH values of low tide were ranged between 4.99 and 5.68 while for high tide were ranged between 5.02 and 5.64. The salinity of low tide for each station is same which is 0.02 ppt while minimum value of salinity for high tide was 0.01 at station 5 and maximum value was 0.03 at station 1. Lastly, the depth for low tide and high tide were fluctuated which ranged between 2.71 m and 4.27 m for low tide and 3.34 m and 5.54 m.

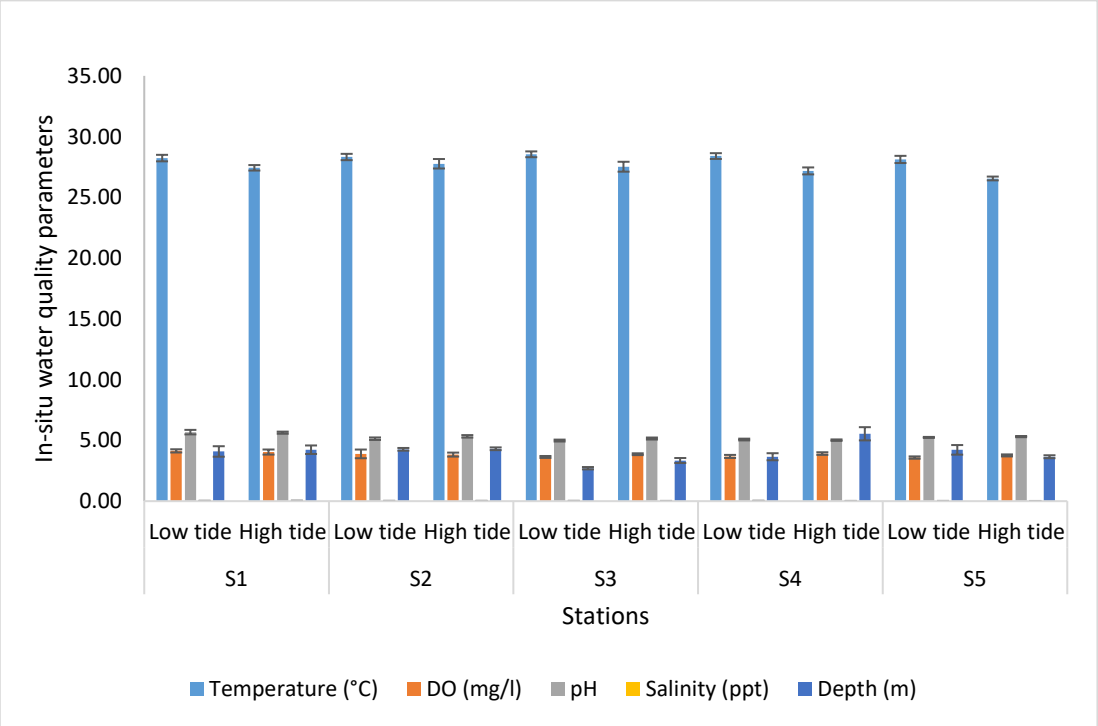


**Figure 2.** Analyses of in-situ water quality parameters of Nyatuh River by different stations and tidal for expedition 1.

Fig. 3 showed the analyses of ex-situ water quality parameters of Nyatuh River by different stations and tidal. The ammonia of low tide was maintained which is 0.10 mg/L and increased at station 4 and station 5 which is 0.13 while for high tide was varied between 0.11 and 0.15. The nitrite of low tide was increased at station 1 and station 2 (0.02 to 0.04) and remain unchanged at following stations which is 0.02 while for high tide was same for each station which is 0.02 except station 1 which is 0.03. Lastly, the minimum value of phosphate during low tide was 0.06 at station 3 and maximum value was 0.12 at station 5 while during high tide, the minimum value of phosphate was 0.05 and maximum value was 0.09.

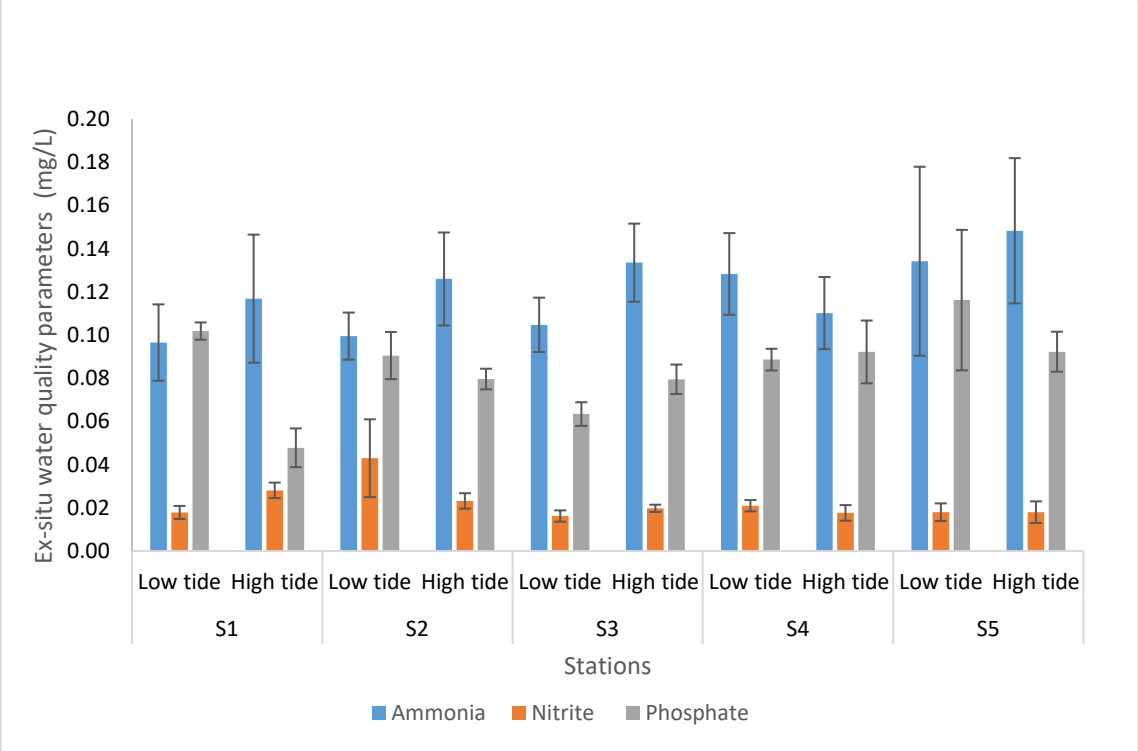


**Figure 3.** Analyses of ex-situ water quality parameters of Nyatuh river by different stations and tidal for expedition 1. Unit of nutrients level was in (mg/ L).

Fig. 4 showed the result for the analyses of *in-situ* water quality parameters of Nyatuh River by different stations and tidal for expedition 2. The temperature of the low tide was ranged from 28.83°C to 29.30°C while for high tide, the temperature was ranged from 27.78°C to 29°C. The value of DO during low tide were fluctuated (4.98 mg/l to 5.12 mg/l) while for high tide were increased (4.06 mg/l to 5.30 mg/l). The minimum value of pH for low tide and high tide was at station 4 which are 5.99 and 6.31 while maximum value for low tide was 7.01 at station 5 and high tide at station 2 which is 6.95. The salinity of low tide was decreased until reached station 4 and then increased at station 5 which is 0.04 ppt while the salinity for high tide was decreased rapidly from 4.22 ppt at station 1 to 0.02 ppt at station 5. Lastly, the depth for low tide was ranged between 3.72 m and 4.55 m, for high tide were ranged between 3.30 m and 4.32 m.

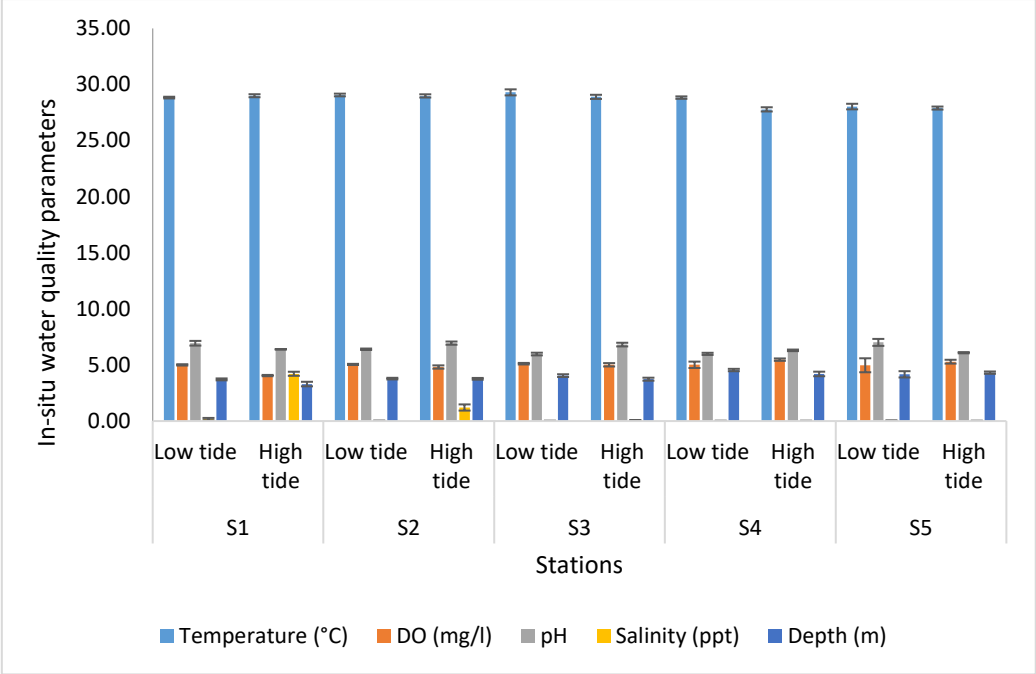


**Figure 4.** Analyses of in-situ water quality parameters of Nyatuh river by different stations and tidal for expedition 2.

Fig. 5 illustrated the analyses of ex-situ water quality parameters of Nyatuh River by different stations and tidal. The ammonia content of low tide was maintained at station 1, station 2, station 3 and station 5 which is 0.05 except at station 4 which is 0.07 while for high tide was varies between 0.07 and 0.16. The nitrite of low tide and high tide for each station remains unchanged which is 0.01. Lastly, the phosphates content during low tide was same until station 4 which is 0.02 and then increased at station 5 which is 0.03 while during high tide, the phosphates were maintained at station 1 to station 3 which is 0.03 and decreased at station 4 and station 5 which is 0.02.

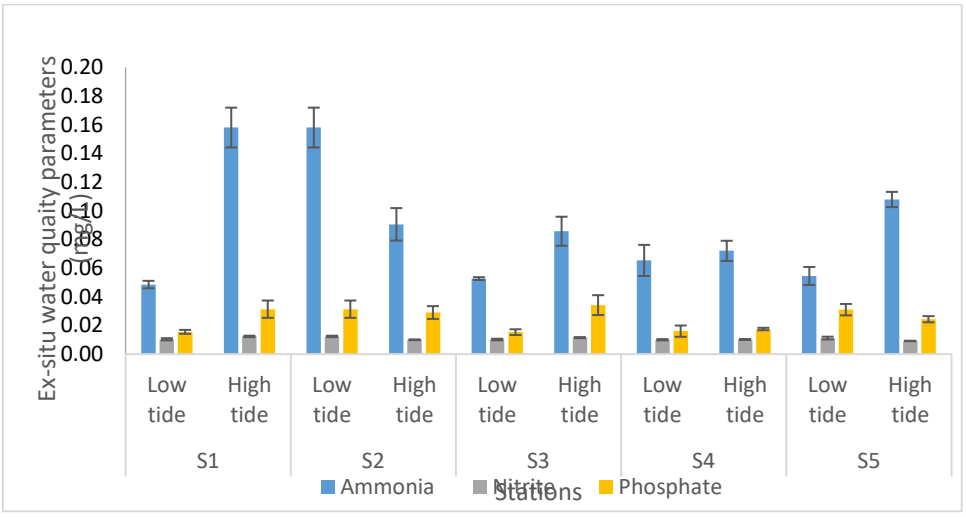


**Figure 5.** Analyses of ex-situ water quality parameters of Sg. Nyatuh by different stations and tidal for expedition 2. Unit of nutrients was in mg/ L.

Furthermore, Fig. 6 revealed the result for the analyses of *in-situ* water quality parameters of Nyatuh River by different stations and tidal for expedition 3. The temperature of each station was quite evenly which are between 27.90°C and 29.07°C for low tide while for high tide are between 26.30°C and 26.68°C. The minimum value of DO for low tide was 5.26 mg/l at station 4 and maximum value was 5.68 mg/l at station 5, while for high tide, the minimum value of DO was 5.56 mg/l at station 1and maximum value was 6.14 mg/l at station 5. The pH value for each station during low tide (6.03 to 6.54) and high tide (6.01 to 6.44) were maintained steadily. The salinity of low tide was fall (0.10 ppt to 0.02 ppt) until station 4 and then increased at station 5 which is 0.03 ppt while the salinity for high tide was decreased from 0.37 ppt at station 1 to 0.02 ppt and stayed the same through the following stations. Lastly, the depth for low tide was ranged between 3.48 m and 4.50 m, for high tide were ranged between 4.01 m and 4.71 m.

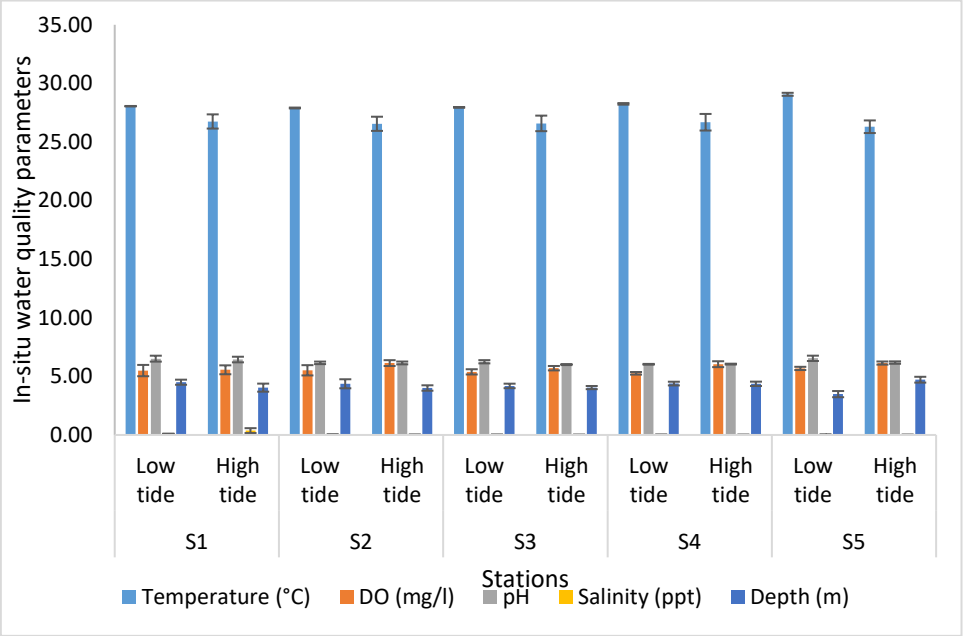


**Figure 6.** Analyses of in-situ water quality parameters of Sg. Nyatuh by different stations and tidal for expedition 3.

Fig. 7 illustrated the analyses of ex-situ water quality parameters of Nyatuh River by different stations and tidal. The ammonia content during low tide was increased from station 1 to station 5 which is 0.14 to 0.24mg/L while for high tide remains unchanged for each station which is 0.16 except for station 1 and station 2 which are 0.15 and 0.13. The nitrite of low tide and high tide was same for station 1 and station 2 which is 0.03 as well as station 3 and station 4 which is 0.04 while station 5 has 0.04 for low tide and 0.03 for high tide. Lastly, the phosphate during low tide of each station was varied between 0.07 and 0.12 as well as at high tide which is between 0.07 and 0.08.

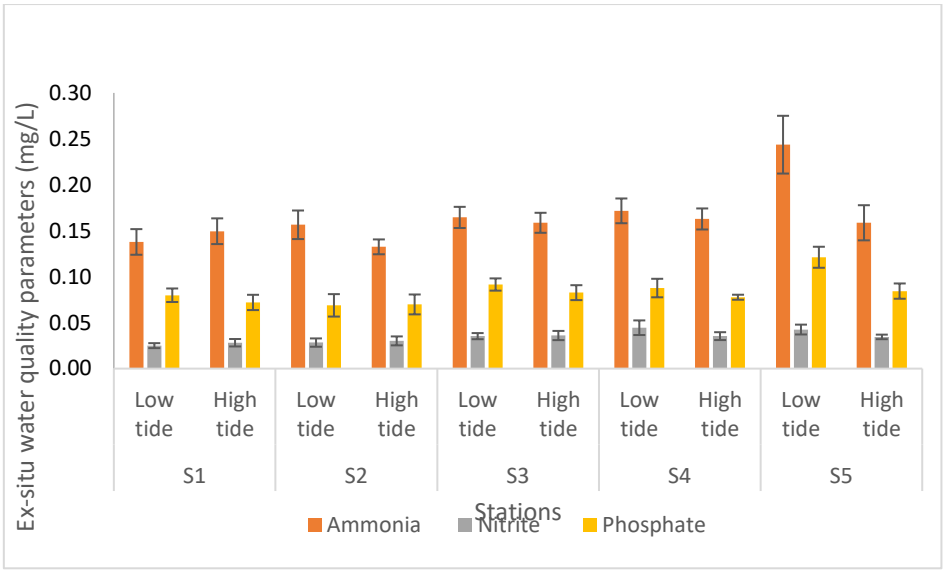


**Figure 7.** Analyses of ex-situ water quality parameters of Nyatuh river by different stations and tidal for expedition 3. Unit of nutrients was in mg/L.

Moreover, Fig. 8 displayed the result for the analyses of *in-situ* water quality parameters of Nyatuh River by different stations and tidal for expedition 4. The temperature of low tide was drop from 28.15°C at station 1 to 27.33°C at station 4 and increased at station 5 which is 27.53°C while for high tide were varied between 27.12°C and 28.50°C. The values of DO for low tide were increased from station 1 (5.63 mg/l) to station 5 (6.18 mg/l) as well as for high tide were increased from station 1 (5.46 mg/l) to station 5 (6.50 mg/l). The pH values during low tide were dropped from 6.96 at station 1 to 6.06 at station 5 while pH values during high tide were fluctuated which are between 5.67 and 6.22. The salinity of low tide was fall from station 1 (0.22 ppt) until station 3 (0.02 ppt/) stayed the same through the following stations, for high tide were decreased from 2.21 ppt at station 1 to 0.02 ppt and remain unchanged until station 5. Lastly, the depth for low tide was ranged between 2.95 m and 5.15 m, for high tide were ranged between 3.35 m and 4.97 m.

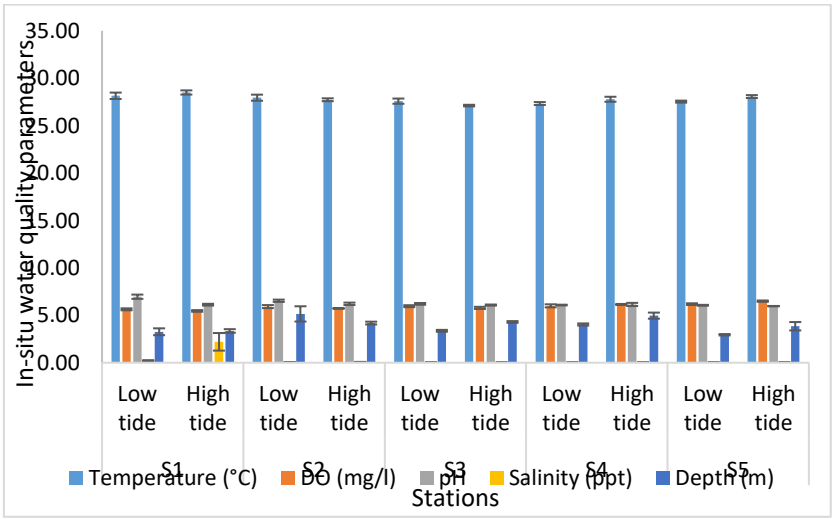


**Figure 8.** Analyses of in-situ water quality parameters of Sg. Nyatuh by different stations and tidal for expedition 4.

Fig. 9 illustrated the analyses of ex-situ water quality parameters of Nyatuh river by different stations and tidal. The amount of ammonia during low tide was varied from station 1 to station 5 which is between 0.01 and 0.03 while for high tide remains unchanged for station 1 and station 2 which is 0.03 as well as station 4 and station 5 which is 0.02 except station 3 which is 0.06. The nitrite during low tide and high tide was same for station 1 to station 5 which is 0.04 except for station 2 and 3 during high tide which is 0.05. Lastly, the phosphates of low tide were decreased from 0.03 to 0.01 while for high were ranged between 0.01 and 0.02.

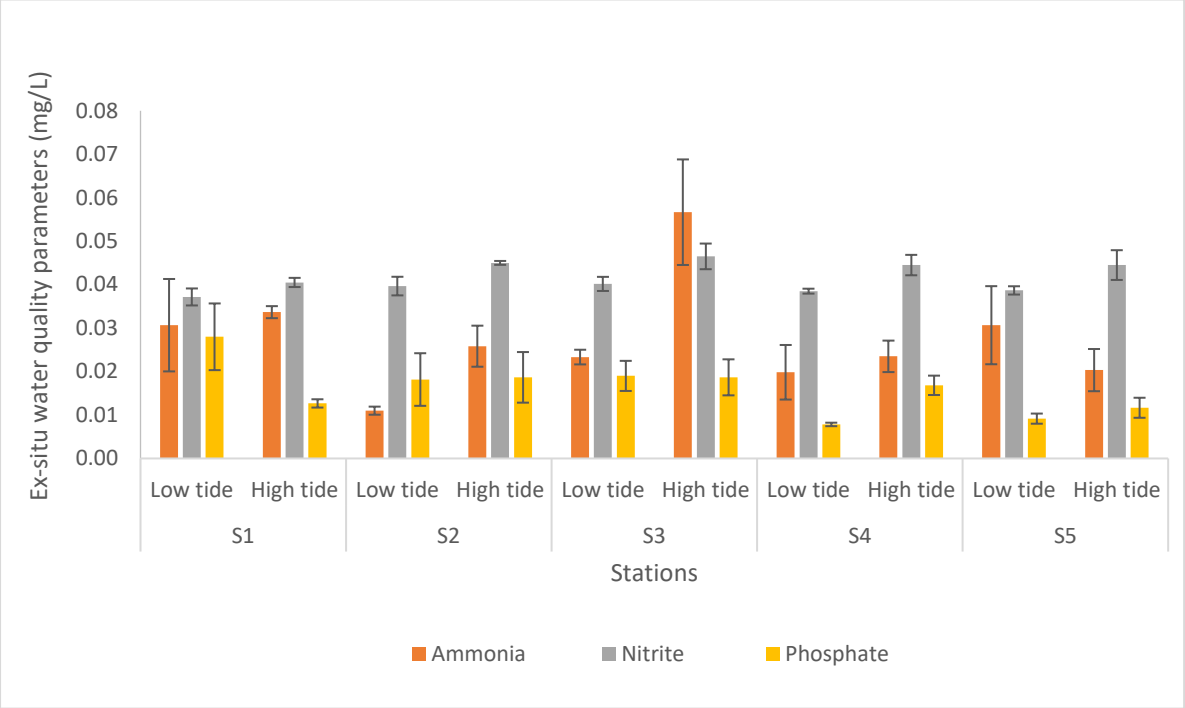


**Figure 9**. Analyses of ex-situ water quality parameters of Sg. Nyatuh by different stations and tidal for expedition 4. Unit of nutrients was in mg/L.

## DISCUSSION

According to Kurup & Harikrishnan (2020), monitoring the stocking population of giant freshwater prawn, *M. rosenbergii* is necessary to identify the response and reaction of this species to the various ecological changing in its natural habitat. Throughout the entire expedition, the higher prawn population from the sampling conducted was from Expedition 1. The salinity is in good range for freshwater environment around 0.01-0.04 and the pH also in the good range around 4.77-6.75 for the freshwater environment. Ammonia concentration almost reached zero which is in a good condition where ammonia reading was at 0.00-0.37 mg/L. The good water parameter conditions and the very low ammonia concentrations might be the reason that contributes to the higher prawn population sampled during expedition 1 as compared to others expedition.

The lowest prawn was caught in expedition 3 around 68 number of prawns as compared to other expeditions. The nutrients level of ammonia (0.1-0.39 mg/L) and phosphate (0.04-0.15 mg/L) was a little bit higher in this expedition compared to other expedition that might trigger stress to the prawn that resulted in the lower prawn population caught during expedition 3. According to Gasim et al. (2015); O'Brien. (1995) they found out that some

disturbance on the water quality of the freshwater such as by the influx of the saline water might give stress to the fish especially to the juvenile and egg stages that might cannot tolerate the water quality fluctuation. Thus, the disturbance on the water quality in term of nutrients concentration of a bit higher ammonia and phosphate concentration than other expeditions might be the reason for the lower prawn population caught in Expedition 3.

The temperature of the water is important because of the wide range of temperature tolerance in aquatic life. However, temperature may have different effects on dissolved oxygen or DO in polluted water. It is probably because of influences by the chemical and biological rate and also can be affected by man-made structures such as dams and weirs (Uddin et al., 2015). From the results of each expedition, it shows that during low tide is slightly greater than high tide which was fluctuated between 26°C and 29°C. These temperature levels are below 32°C and it quite suitable for the aquatic life living in the river. The temperature in the warm water stream should not exceed 32°C. This is because high temperatures will reduce available of DO in the water and may cause fish dead (Rauf, 2010). Next, DO is one of the water quality parameters that indicates the level of oxygen dissolved in water upon contact with air in the atmosphere and it is important for the respiration process. The level of DO below 1 mg/l is not suitable for life below water or it can be assumed that there is water pollution while the normal level that is usually required should be 6 or above 7 mg/L (JAS, 2008). The results of the analysis showed that most of the DO values for the five stations were in the range of 3 mg/L to 6 mg/L and this condition proves there is little water pollution. The DO values were recorded high during low tide at station 1 to station 3 compared to high tide in contrast to station 4 and station 5 which recorded high DO values during high tide compared to low tide. These differences may be due to ample amount of DO at the area of cooler water and water that is flowing at higher velocities can hold more DO than slower water (Kasan, 2006).

The pH value parameter can measure acid or base content of minerals and organic matter in river water. The range of pH values is between 0 to 14 and is important in determining the viability of organisms and bacteria. This is because of the pH value too high or too low is unsuitable for the life of organisms and bacteria. According to National Water Quality Standard (NWQS) for Malaysia, the normal pH range for water supply and used as habitat for sensitive aquatic species is 6.5 to 9.5. In this study, the average of pH values was approaching normal pH where the minimum value is 4.99 at station 3 of expedition 1 and the maximum value is 7.01 at station 5 of expedition 2 (low tide). The low of pH value in water is because of the high concentration of ammonium, nitrate and acid sulphate soils (Xie, 2004).

Salinity is one of parameter that measures dissolved salts in the water. Water that contains too much dissolve matter is not suitable for common uses (Uddin et al., 2015). The results showed the variations between the value of each station. The lowest value of salinity is 0.02 ppt. However, there is prominent and highest value during high tide at station 1 for expedition 2 and expedition 4 which are 4.22 ppt and 2.21 ppt respectively. This is probably because station 1 is located nearest the sea than other stations. Other factor that contributes may be the speed of water flow during high tide that caused salt water from the sea entering into area of the station. The fluctuations in salinity between high and low tide are due to tidal limit of rivers in particular areas which flow into the sea.

Based on the analyses on the ex-situ water quality of nutrients concentration, the value of ammonia was fluctuated for each station but the values are below than 1 mg/L where the highest value is 0.24 mg/L at station 5 during low tide of expedition 3. The highest quantity of ammonia was found in the upper zone of the river during low tide, which could be attributed to anthropogenic activity in the area, as well as the fact that the upstream gets major sewage

and waste inputs (Rashid et al., 2013). Next, nitrite value is slightly maintained from station 1 to station 5 during low tide and high tide which range from 0.01 to 0.05mg/L. Nitrite values from this analysis are below 0.25 mg/l and save for shrimp or prawn farm based on the tolerance value recommended for prawn culture (Kasnir, 2014). Lastly, the phosphate value also was fluctuated where mostly high during high tide from station 1 to station 5. The range of phosphate is between 0.01 and 0.12. Based on Kasnir (2014), the recommended value limit for shrimp culture activity is 0.05 to 0.5 mg/l. The amount of phosphate content from this analysis was in the recommended value even though a slightly high around 0.12mg/L identified during expedition 3 in station 5. This is most likely may due to its presence in agricultural and livestock activities around the stations (Zaideen et al., 2017). Overall, the nutrients concentrations were still in the recommended value and in safe level for nutrients concentration from the analyses conducted in expedition 1 until expedition 4.

## CONCLUSION

Water quality monitoring and assessment is important to indicate the quality of pollution in the river as well as an indicator for the prawn population in the Nyatuh River. The highest prawn population caught was from Expedition 1 that might be due to the good water quality parameter and nutrients level assessed. Meanwhile, the lowest prawn population in expedition 3 was triggered by the significant different on the water depth during high tide and low tide and also triggered by a little bit higher of ammonia and orthophosphate level that might cause stress to the prawn physiological behaviour resulted on the decreased of prawn population in expedition 3. There is heterogenous mixture for numbers of prawn caught between each expedition which non-uniform distribution of number of prawns caught that caused by the significant differences of water depth during high and low tide and also might triggered by the water quality of ammonia fluctuation. Meanwhile, the dial variation of water quality parameters presented a clear tidal signature. This study also revealed that the concentration of several water quality parameters in the river water has affected by the tide. From the above results this study revealed that water quality parameters which are temperature, DO, pH, salinity and nutrient concentrations showed no significant different among expedition, sampling stations and tides except for depth that display a significant different. Although there are increasing and diminishing patterns, water quality levels have remained reasonably steady. The assessment of pollution and pollution control should be proposed in order to reduce the effect of pollution in the Nyatuh river.

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## ETHICAL APPROVAL

All the applicable International, National and Institutional guidelines for the care and use of animals and chemicals were followed by the authors.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.


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## DATA AVAILABILITY

Data are available upon reasonable request from the corresponding author

## AUTHORS CONTRIBUTIONS

Nor Azman Kasan: sub-project leader for water quality analyses, and commenting on the critical part of the manuscript, Mhd Ikhwanuddin: Project Leader, commenting on critical part of manuscript, Hidayah Manan: wrote on original manuscript, conduct on the statistical analyses and final revision of the manuscript, Nur Syafirah Zakaria: wrote on the original manuscript & conduct on the data analysis, Amyra Suryatie Kamaruzzan: samples collection, data analysis and conducted on the laboratorial analyses, Ahmad Ideris Abdul Rahim: Data collection and samples collection in-situ, Ahmad Najmi Ishak: Samples and data collection, and conducting on the samples analyses.

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