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Nutrients Variation in Reclaimed Island of Southern Peninsular Malaysia

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Abstract: All living organisms required the nutrients phosphorus and nitrogen for their metabolism, growth and reproduction including seagrass ecosystem. Seagrass required dissolved inorganic nitrogen (N) and phosphorus (P) to maintain growth, where ammonium is considered as the main source of nitrogen, while the main phosphorus sources is phosphate. However, the nutrient cycling process was disturbed by anthropogenic activities. Reclaimed island near to seagrass bed affected the sedimentation and indirectly impacted the nutrient cycling. The purpose of this study is to investigate the nutrient variation in seawater from seagrass meadow. The study was conducted at Merambong seagrass meadow located between the Causeway second link and the Pulau Merambong, Southwest of Johor. Samples were well collected bimonthly from August 2016 until June 2017 and from 10 sampling points. The nutrients studied were including total ammonium nitrogen (TAN), nitrate nitrogen, nitrite nitrogen and soluble reactive phosphorus (SRP). All the nutrients results were compared with Malaysia Marine Water Quality Criteria and Standard (IMWQS). The lowest concentration (2.3 ppb) of nitrite was observed in South area in June 2017 whereas the highest concentration (40.8 ppb). The highest concentration was 32.5 ppb (North) in April 2017 and the lowest concentration was 4.7 ppb in August 2016. In April 2017, low ammonium concentration was 3.5 ppb in North. The highest concentration (57.8 ppb) was detected in North area in October 2016. The highest concentration was detected in North area with 321.8 ppb whereas exceeded the limit (75 ppb) and the lowest concentration was 16.1 ppb in August 2016 of South area. In general, the results of this study show the nutrients concentration in all sampling duration are below the limit lined by IMWQS except for phosphorus concentration detected in June 2017.

Keyword: Nutrients; seagrass ecosystem; anthropogenic activities; reclaimed island; nitrogen; phosphorus.

1. Introduction

Nutrients are required by all plants. Iron (Fe), Copper (Cu), Mangan (Mn), and Zinc (Zn) are important in trace quantities while Nitrogen (N), Calcium (Ca), Phosphorus (P), Sulphur (S), Magnesium (Mg) and Kalium (K) and are required in considerable amounts [1]. Nitrogen and phosphorous are important roles in the growth of seagrass meadow [2]. Seagrasses use phosphate, nitrate and ammonium as ambient sources of phosphorus and nitrogen. These compounds are found in the sediment porewater and the water column. The nutrients from water column was uptake through seagrass leaves while their root system uptake the nutrients from sediment porewater [3].

Heavy development activities in the surrounding area and increasing land reclamation rate are serious threats to the marine habitat including seagrass ecosystems [4, 5]. Land reclamation is a process to create a new land near the riverbeds or riverbeds by filling the area with fill material such as marine sediment [6]. The changes of topography and bathymetry might be occurred due to reclamation activities [7]. It is also alter sediment transport pathways and tidal currents, thus increase in suspended concentration, heavy metals, organic material and other pollutants. Thus impacts the nutrient cycling in seagrass ecosystem where nutrient levels in the water column of seagrass meadows are typically low [8]. However, an excess of these nutrient can have deleterious. The purpose of this study is to investigate the nutrients variation in seawater from seagrass meadow.

2. Methodology

Sampling location

Merambong seagrass meadow is located between Pulau Merambong and the Causeway

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second link Johor (Figure 1). All water samples were well collected bimonthly from August 2016 until June 2017 using vertical water samplers [9]. There were 4 sampling points (St. 1-E 01° 20.154 N 103° 36.026, St. 2-E 01° 20.219 N 103° 36.179, St. 3-E 01° 20.281 N 103° 36.104, St. 4-E 01° 20.363 N 103° 36.232) in North (N) of seagrass bed and 6 sampling point in the South (S) of the seagrass bed (St. 5-E 01° 19.739 N 103° 35.857, St. 6-E 01° 19.772 N 103° 35.895, St. 7-E 01° 19.847 N 103° 35.939, St. 8-E 01° 19.777 N 103° 35.916 , St 9-E 01° 19.913 N 103° 35.998 and St. 10-E 01° 19.865 N 103° 35.876) (Fig. 1).

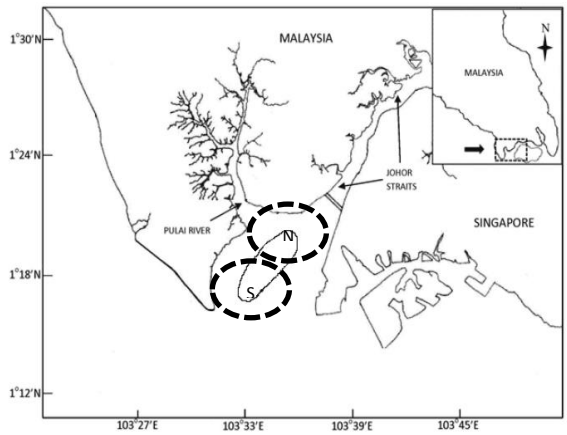

Fig. 1 The sampling location Merambong seagrass bed, Johor.

Nutrient analyses

Nitrate + Nitrite Nitrogen (NO_3-N + NO_2-N)

Potassium nitrate (KNO3) was heated at 110°C for 1 hour. It was cool in desiccators before weighted 7.2179 g and dissolved in 1L Milli-Q water as standard stock solution [10]. From the stock solution (1000 mg/L of NO_3-N) a series of standard solutions (0-1 mg/L) was prepared by mixing with Milli-Q water. Standards and samples were measured after 20 minutes by using UV-Visible Spectrophotometer model Biomate 3S at 540 nm.

Nitrite (NO_2-N)

Natrium nitrite ($NaNO_2$) was weighted 4.9259 g after dried for 1 hour with temperature 110°C. The $NaNO_2$ was dissolved in 1000 mL Milli-Q water as standard stock solution [11]. From the stock solution (1000 mg L^{-1} of NO_2-N), a series of standard solutions was prepared by mixing with Milli-Q water. Samples and standard solutions were measured by using UV-Visible Spectrophotometer model Biomate 3S at a wavelength of 543 nm.

Soluble reactive phosphorous (SRP)

Phosphorous was determined according to ascorbic acid method [12]. 0.2195 g of potassium dihydrogen phosphate, KH_2PO_4 was weighted. It was dissolved in 1000 mL Milli-Q water as standard stock solution. A series of standard solutions was prepared by mixing stock solution (1000 mg L^{-1} of PO_4-P) with Milli-Q water. The standards and samples were measured at 880 nm using UV-Visible Spectrophotometer model Biomate 3S.

Total ammonium nitrogen (TAN)

Anhydrous grade $(NH_4)_2SO_4$ was dried for 1 hour with temperature 110°C and cooled in dessicator. It was weighted 9.343 g and dissolved in 1000 mL deionized water as standard solution [11]. From the stock solution (1000 mg L^{-1} of total ammonia-nitrogen), a series of standard solutions was prepared by mixing with appropriate ratio of Milli-Q water. The standards and samples were measured at 640 nm with UV-Visible Spectrophotometer model Biomate 3S.

3. Results and Discussion

All the nutrients results were compared with Malaysia Marine Water Quality Criteria and Standard (IMWQS) [13] (Table 1) (Fig. 2-5).

The lowest concentration (2.3 ppb) of nitrite was observed in South area in June 2017 whereas the highest concentration (40.8 ppb) was observed in North area in October 2017. All nitrite concentrations were below than IMWQS limit (Fig. 2).

Nitrate concentrations in North and South area were below than 60 ppb which were less than limit of IMWQS (Fig. 3). The highest concentration was 32.5 ppb (North) in April 2017 and the lowest concentration was 4.7 ppb (South) in August 2016.

Table 1 Nutrients in seawater

Nutrients	Location	Concentration (ppb)						
		Aug	Oct	Dec	Feb	Apr	June	IMWQS
Nitrite	North	12	40.8	18.8	11.5	35.8	5.3	55
	South	5.5	29.6	10.7	11.8	23.2	2.3	
Nitrate	North	6.5	29	13.8	6.75	32.5	10.25	60
	South	4.7	20.3	6	6.3	14.7	7	
Ammonium	North	13.3	57.8	29.5	4	3.5	17.3	70
	South	10.3	41	16.2	12	3.7	8.7	
Phosphorus	North	25.3	32.6	48	26.3	38	321.8	75
	South	16.1	27.8	22.2	29.4	29.2	196.2	

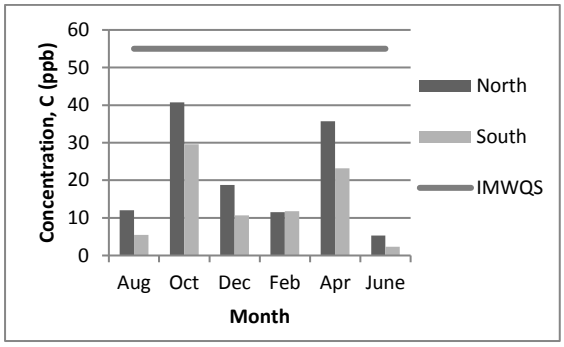

Fig. 2 Nitrite concentration in seawater.

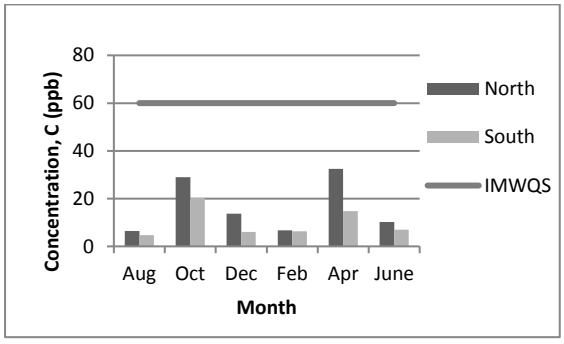

Fig. 3 Nitrate concentration in seawater.

The IMWQS limit for ammonium concentration was 70 ppb and all the ammonium concentrations detected were below than 60 ppb. In April 2017, both areas detected at almost same low concentration 3.5 ppb in North and 3.7 ppb in South (Fig. 4). The highest concentration (57.8 ppb) was detected in North area in October 2016. Phosphorus concentrations in five month sampling were below than IMWQS limit (75 ppb). However, the concentration increased 2-4 times more than limit concentration by IMWQS in June 2017 for both areas. The highest concentration was detected in North area with 321.8 ppb whereas the lowest concentration was 16.1 ppb in August 2016 of South area.

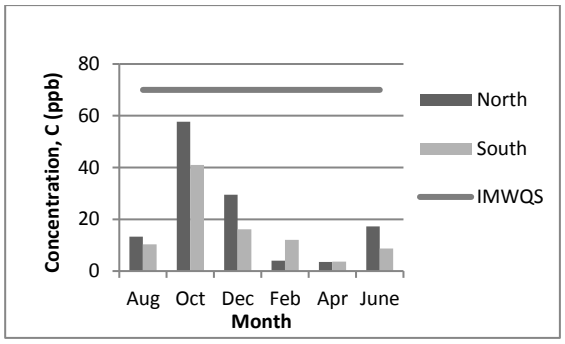

Fig. 4 Ammonium concentration in seawater.

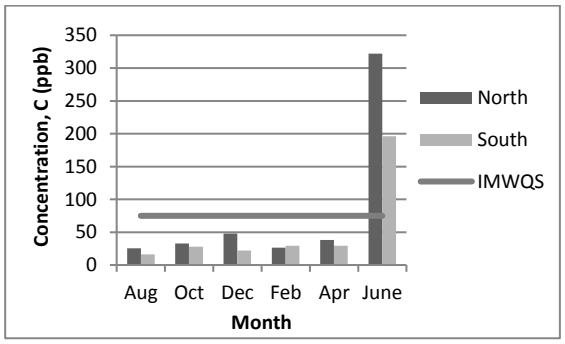

Fig. 5 Phosphorus concentration in seawater.

Most nutrients in seawater (Fig. 2-5) of North area were higher than South area. This is because of the reclamation area in North area is become bigger compared to South area. Nitrogen is a key limiting nutrient in many aquatic systems [14]. This implies that the risk of nutrient release from sediment may be enhanced under certain environmental conditions. Most nutrients for seagrasses are come from sediment pore water and water column as additional sources [3]. As reclamation activities are still on going, the

nutrient potentially increased and eutrophication will occur when excessive nutrient. Nutrients concentration in seawater (Fig. 1-4) show fluctuate as reclamation area changed the sedimentation where nutrients become N-limited for seagrass when growing in sandy or organic sediment and P-limited in carbonate sediment [3].

4. Conclusion

In general, the results of this study show the nutrients concentration in all sampling duration are below the limit lined by IMWQS except phosphorus in June 2017. As reclamation activities still on working, the nutrient concentration is unpredict.

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