THE DISTRIBUTIONS AND BEHAVIOUR OF NITROGEN-BASED NUTRIENTS IN TERENGGANU RIVER ESTUARY

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**Thesis Submitted in Fulfillment of the Requirements for the
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DEDICATION

Alhamdullilah

ALMIGHTS ALLAH

To my beloved and my source of inspiration parents
Abdul Aziz (bak) & Noriah (ma)

To my special soulmate, my backbone, my superb husband
Mohd Hisham

To my beloved, and supportive parents-in-law
Zali (ayah) & Latifah (mak)

To my motivator and beloved siblings
Aznan, Roshayati, Alffian, Azlina, Aniza, Khairul, Azuan & Rozita

To my knowledgeable supervisor, co-supervisor and advisor
Assoc. Prof. Dr. Suhaimi, Prof. Dr. Norhayati, Prof Dr. Tim Jickells

To my super-duper senior
Rasyidah, Nur Hayati, Izwan, & Yet Yin,

To my excellent examiners and chair person
Prof. Talib, Dr Hafiza & Dr Saifullah

To my best supporter and expertise
All of laboratory staffs INOS
All of postgraduate students INOS,
&
All of administration staffs INOS

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Main Supervisor	**:**	**Associate Professor Suhaimi Suratman, Ph.D.**
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This study was carried out to determine the distribution and behaviour of nitrogen (N)-based nutrients for surface water in Terengganu River estuary (TRE). The N-based nutrients measured were dissolved inorganic N (nitrite, nitrate and ammonia) and organic N (dissolved organic nitrogen (DON) and particulate organic nitrogen (PON)). Surface water samples were collected during longitudinal and diurnal surveys under different tidal conditions from February to September 2012. Low concentration of nitrite (0.002-0.393 µM) and nitrate (0.3-4.7 µM) were found during longitudinal surveys. Meanwhile, the concentration of ammonia, DON and PON were 1.0-35.4 µM, 3.2-40.6 µM and 1.5-23.6 µM, respectively. The results also indicated that the percentage concentrations of dissolved inorganic N (longitudinal = 35%; diurnal = 19%) were lower than organic N (longitudinal = 65%; diurnal = 81%). Generally, distributions of N-based nutrients were higher in freshwater region which indicated a strong riverine influenced in TRE. In addition, most of N-based nutrients showed higher concentration during spring tide suggesting contribution from the resuspension of bottom sediments. Most of the parameters measured appear to behave non-conservatively with an addition tendency. The additional source of N-

based nutrients in TRE was attributed by anthropogenic input from the surrounding activities and the presence of narrow opening between breakwater which restricted the flow of nutrients to the coastal area. Higher N-based nutrients recorded in comparison to previous studies can be related to the increase of discharge from rapid development activities. The relative abundance of N-based nutrients showed that DON as major constituents of total N. Meanwhile, the percentage of low molecular weight (LMW) DON (<10 kDa) accounted for 35-95% of total DON. The results also indicated that chlorophyll-a concentration has a strong relationship with LWM DON during ebb tide conditions. Overall, the neap-spring tidal cycle also play a predominant role in controlling the distribution of N-based nutrients. This research suggests that TRE act as a source for most of N-based nutrients. Therefore, it is important to monitor the nutrients status in order to prevent the eutrophication in TRE and for future protection of the estuary.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu
sebagai memenuhi keperluan untuk ijazah Sarjana Sains

TABURAN DAN PERLAKUAN NUTRIEN BERASASKAN NITROGEN DI MUARA SUNGAI TERENGGANU

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April 2016

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Kajian ini telah dijalankan untuk menentukan taburan dan pelakuan nutrien berasaskan-nitrogen (N) untuk air permukaan di muara Sungai Terengganu (TRE). Nutrien berasaskan-N yang diukur adalah N tak organik terlarut (nitrit, nitrat dan ammonia) dan N organik (nitrogen organik terlarut (DON) dan nitrogen organik partikulat (PON)). Sampel air permukaan telah diambil semasa pensampelan longitunal dan harian dari bulan Febuari hingga September 2012. Kepekatan nitrit (0.002-0.393 µM) dan nitrat (0.3-4.7 µM) adalah rendah semasa pensampelan longitunal. Sementara itu, kepekatan ammonia, DON dan PON masing-masing adalah 1.0-35.4 µM, 3.2-40.6 µM, dan 1.5-23.6 µM,. Keputusan kajian juga menunjukkan peratusan kepekatan N tak organik terlarut (longitunal = 35%; harian = 19%) adalah lebih rendah berbanding N organik (longitunal = 65%, harian = 81%). Secara umumnya, taburan nutrien berasaskan-N adalah lebih tinggi di kawasan air tawar dan ini menunjukkan pengaruh air sungai yang kuat di TRE. Di samping itu, kepekatan nutrien berasaskan-N kebanyakkannya lebih tinggi semasa pasang-surut perbani berbanding pasang-surut anak yang mencadangkan sumbangan daripada pengampaian sedimen di bawah air. Kebanyakan parameter diukur didapati

berkelakuan secara tidak konservatif dengan kecederungan berlakunya penambahan. Sumber tambahan kepekatan nutrien berasaskan-N disumbangkan oleh pelepasan antropogenik daripada aktiviti sekitar dan kehadiran pembukaan sempit di antara pemecah ombak yang menghalang pengaliran keluar nutrien ke kawasan pantai. Kepekatan nutrien berasaskan-N menunjukkan peningkatan jika dibandingkan dengan kajian yang sebelumnya adalah disebabkan peningkatan pelepasan daripada aktiviti pembangunan yang pesat. Kelimpahan relatif nutrien berasaskan-N menunjukan bahawa DON adalah komponen majoriti daripada keseluruhan jumlah N. Sementara itu, peratusan LMW DON (<10 kDa) adalah antara 35-95% daripada jumlah keseluruhan DON. Keputusan kajian juga menunjukkan bahawa klorofil-a mempunyai kolerasi yang kuat dengan LMW DON semasa keadaan air surut. Secara kesuluruhan, kitaran pasang-surut anak dan perbani memainkan peranan utama dalam mengawal taburan nutrien berasaskan-N. Kajian ini menunjukkan bahawa TRE bertindak sebagai sumber untuk kebanyakan nutrien berasaskan-N. Oleh itu, adalah penting untuk memantau status nutrien untuk mengelakkan eutrofikasi dalam TRE dan untuk melindungi muara pada masa akan datang.