MONSOONAL EFFECTS ON HYDRODYNAMIC AND WATER QUALITY AT SETIU WETLAND, TERENGGANU

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DOCTOR OF PHILOSOPHY
UNIVERSITI MALAYSIA TERENGGANU

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ZURAINI BINTI ZAINOL

Thesis Submitted in Fulfilment of the Requirement for the Degree of Doctor of Philosophy in the Institute of Oceanography and Environment
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DEDICATION

To my parents

Rojimah Omar & Zainol Abd Lateh

To my husband

Afifi Johari

To my siblings

Aishah, Zuraidah, Zaleha, Zakiah & Asyraf

&

To my in-laws

Jamilah Rahmat, Johari Samidi, Azizi, Atikah, Ammar & Aisyah

Thank you for your love and support

This humble work is a sign of my appreciation to you!

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfilment of the requirements for the degree of Doctor of Philosophy

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August 2020

Main Supervisor : **Associate Professor Mohd Fadzil Mohd Akhir, Ph.D**

School/Institute : **Institute of Oceanography and Environment**

Setiu Wetland is facing shoreline alterations, which caused relocation of the inlet through a natural closing of the old river mouth and the opening of a new one. Research has shown that continuous actions of monsoonal wind, wave, and current were the reason of this alteration. To our knowledge, very few of the previous researches in Setiu Wetland are focusing at the new inlet area. Thus, this study attempts to understand the hydrodynamics and water quality in Setiu Wetland from the new inlet perspective. The repositioning of this inlet raises questions such how the current flow in the lagoon has changed and how capable this ecosystem in maintaining its water quality since most of the sources of anthropogenic activities are situated at the old inlet. In order to have a general overview of the current status at the new inlet, *in situ* field surveys were carried out during August 2017, December 2017, and February 2018 which represent the southwest monsoon, wet period of northeast monsoon, and dry period of northeast monsoon, respectively. Statistical analysis was performed on the environmental parameters to demonstrate relationships among variables. Numerical modelling was also executed to improve the restrictions of field observations while providing a better understanding of the dynamics of this water body. The results indicated that the current flow in Setiu Wetland is tidally dominated, following the ebb and flood as well as neap and spring tides cycles. Larger size of Setiu River produced slightly stronger tidal current at the south of the inlet area. Freshwater discharge played a great role in modulating the physical characteristics of the lagoon, giving rise to stratification and salt wedges formation especially during the northeast monsoon, where heavy rainfalls were

documented. Sufficient nutrients supplied through the river flows controlled the distribution of phytoplankton biomass in Setiu Wetland. Longer residence time near the aquaculture farms corresponded well with high chlorophyll *a* concentrations, thus raising a concern on its water quality due to the poor flushing and minimal water exchange. Further research with extensive field samplings and numerical experiments is required to strengthen the knowledge about this shallow and narrow coastal lagoon.

Perpustakaan Sultanah Nur Zahirah
Universiti Malaysia Terengganu.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

KESAN MONSUN PADA HIRODINAMIK DAN KUALITI AIR DI TANAH BENCAH SETIU, TERENGGANU.

ZURAINI BINTI ZAINOL

Ogos 2020

Penyelia : **Profesor Madya Mohd Fadzil Mohd Akhir, Ph.D**

Pusat Pengajian/Institut : **Institut Oseanografi dan Sekitaran**

Tanah Bencah Setiu mengalami perubahan garis pantai yang telah menyebabkan perpindahan lokasi muara melalui penutupan semulajadi muara lama dan pembukaan muara baharu. Kajian telah menunjukkan tindakan angin, ombak, dan arus monsun yang berterusan merupakan penyebab kepada perubahan ini. Menurut pengetahuan kami, terlalu sedikit penyelidikan yang telah dijalankan di Tanah Bencah Setiu difokuskan di muara sungai yang baharu. Justeru, kajian ini berusaha untuk memahami hidrodinamik dan kualiti air di Tanah Bencah Setiu melalui perspektif muara yang baharu. Perubahan lokasi muara ini telah mewujudkan persoalan seperti bagaimana pergerakan arus di dalam lagun telah berubah dan sejauh mana kemampuan ekosistem ini untuk mengekalkan kualiti airnya memandangkan kebanyakan sumber aktiviti antropogenik terletak di muara yang lama. Bagi mendapatkan gambaran umum berkaitan dengan status terkini di muara baharu, kajian lapangan *in situ* telah pun dijalankan pada bulan Ogos 2017, Disember 2017, dan Februari 2018 yang masing-masing mewakili monsun barat daya, musim hujan monsun timur laut, dan musim kering monsun timur laut. Analisis statistik turut dilaksanakan ke atas parameter-parameter persekitaran bagi menunjukkan hubungan di antara pembolehubah. Permodelan berangka juga dijalankan untuk menambahbaik keterbatasan pemerhatian lapangan sambil memberi pemahaman yang lebih baik tentang dinamik perairan yang cetek ini. Dapatan kajian telah menunjukkan bahawa pergerakan arus di Tanah Bencah Setiu dikuasai oleh pasang surut, mengikut kitaran air surut dan air pasang serta pasang surut anak dan pasang surut perbani. Saiz Sungai Setiu yang lebih besar menghasilkan arus pasang

surut yang lebih kuat di kawasan selatan muara. Kemasukan air tawar memainkan peranan yang penting dalam mengubah ciri-ciri fizikal di dalam lagun, lalu menjana pembentukan strata dan baji garam terutamanya semasa monsun timur laut, di mana hujan lebat direkodkan. Nutrien mencukupi yang dibekalkan melalui aliran sungai mengawal taburan biojisim fitoplankton di Tanah Bencah Setiu. Masa mastautin yang lebih lama berdekatan dengan kolam akuakultur sejajar dengan kepekatan klorofil *a* yang tinggi. Hal ini menimbulkan kerisauan tentang kualiti air di kawasan ini yang mempunyai pendirusan yang kurang baik dan pertukaran air yang sedikit. Kajian pada masa hadapan dengan kerja lapangan yang lebih intensif dan eksperimen berangka adalah diperlukan bagi mengukuhkan kefahaman berkaitan lagun pesisir pantai yang cetek dan sempit ini.