PHYSICAL OCEANOGRAPHY OF LEKIR BAY, MANJUNG, PERAK

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DEDICATION

Allah the Almighty…

The Prophet Muhammad, His Messenger and Slave (p.b.u.h)

To my loving wife Normiza, my son Edlyn Muqri, and my family. You are my inspirations…

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Development project on coastline of Malaysia without proper plan will caused problem. However a proper plan in the coastline project requires proper study and one of them is the physical oceanography particularly in Lekir Bay. Lekir Bay is located in Manjung District in the state of Perak, extending from the northern part of Perak River mouth to the southern tip of Pangkor Island (3^o 58.5'N - 4^o 9.6'N, 100^o 34.8'E – 100^o 45.8'E). Lekir Bay is known to have two prominent physical influences i.e., fresh water runoff from the Perak River on the southwest and warm water discharge from Sultan Azlan Shah Power Station (SASPS) the northwest. Occasionally, there are series of jellyfish ingression (*Chrysaora quinquecirrha*) reported and causing problems to SASPS. While on the mud flat of Lekir Bay, seasonal natural spat fall of Blood Cockle (*Anadara granosa*) has been reported. This study aims at the physical oceanography in the aspect of spatial and temporal variability thru three main components i.e., (a) Physical setting i.e., bathymetry of SASPS and Lekir Bay; (b) Water properties distributed on the horizontal i.e., Surface current and direction, Sea Surface Temperature (SST), Sea Surface Salinity (SSS)

and turbidity as well as their physical profile for current, temperature, salinity and turbidity and (c) Other influences (secondary data) i.e., mean monthly rainfall, wind, monsoon and Lowest Astronomical Tide (LAT) influenced to the physical hydrodynamic of the bay and SASPS underwater intake points. A total of 87 sampling stations for physical oceanographic (with five water level classification for sampling i.e., surface, below surface, mid water, below mid water and bottom) and sediment texture study along with two continuous Acoustics Doppler Current Profiler (ADCP) stations at the SASPS's intake point were done. While, detail sounding for bathymetry of SASPS waters and 300 meter interval line transect for Lekir Bay were conducted. The study has successfully determined the objective thru three components and elaborates their connection. Physical setting which is a passive indicator were successfully defined in this thesis i.e., the detail bathymetry chart surrounding the SASPS revealing the SASPS underwater intake system and how other physical parameter influenced by the weather affected. Four zone were identified typical with its physical characteristics i.e., zone A (southern part of SASPS), zone B (Perak River mouth and it closed adjacent), zone C (coastal waters of Lekir Bay) and zone D (Lekir front). The results suggested that bathymetry of Lekir Bay and SASPS overlaid with sediment texture enlightened the possibility of cockle culture (***Anadara granosa***) and jellyfish (***Chrysaora quinquecirrha***) spawning ground at the bottom due to typical physical intermittent i.e., temperature and salinity during LAT along with favorable sediment type in zone B and C. The results also indicated that Lekir front as location of high current speed (0.65 – 1.1 m/s) during all water and monsoon. It situated at the edge of Lekir seafloor towards southern tip of Pulau Pangkor and west of Pulau Sembilang. Sea water properties were showing the main physical characteristics i.e., SST, SSS and turbidity were distributed and moves

in large patches (with variable concentrated) on the surface and water column according to the surface current flow and wind direction. While the residual tide current is showing the potential site of mud deposition situated adjacent to Perak River mouth. Lekir Bay were greatly influenced by the wind blows during Southwest (SW) that caused high current speed (0.320 m/s) during Spring Low Water (SLW) compared to Northeast (NE)(0.281 m/s). While NE influenced high surface current flow during Neap Low Water (NLW)(0.296 m/s) and Neap High Water (HHW)(0.262 m/s) compared to SW with 0.205 m/s and 0.175 m/s respectively. The surface current results suggested that mean surface current were higher during neap water during NE, while higher mean surface current were recorded during SLW. Higher surface current were recorded in Lekir front while at the same time slow surface current were recorded at near shore. Wind Rose data suggested that 5% of the wind blows are from SW, West (W) and South (S) with their magnitude of 1.6 – 5.4 m/s. While, 10% of the wind is blowing from NE with the magnitude of 1.6 – 3.3 m/s. Tidal cycle of Lekir Bay is showing their LAT happened in February. The mean monthly rain results suggested that higher rainfall were recorded during NE causing lower salinity on the seawater surface thus increasing the salinity intermittent in the month of February and coincide with LAT. The current profile at SASPS underwater intake system is showing a constant sub surface current speed (0.4 – 1.0 m/s) regardless of the water levels. This could lead to jellyfish ingression during slack low water when large school of jellyfish that afloat in the surrounding waters of intake heads is sucked into the underwater system. Thus, above all the results are suggested that Lekir Bay is a highly physical hydro-dynamic and influenced the local dweller as well as the cause of jellyfish ingression to SASPS were identified.

Abstrak thesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Master Sains.

OSEANOGRAFI FIZIKAL DI TELUK LEKIR, MANJUNG, PERAK

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Pembangunan projek di persisiran pantai Malaysia tanpa perancangan yang jitu akan mendatangkan masalah. Pembangunan projek seperti ini memerlukan kajian tertentu seperti kajian oseanografi fizikal terutamanya di Teluk Lekir. Teluk ini terletak di negeri Perak bermula dari utara muara Sungai Perak sehinggalah ke selatan Pulau Pangkor (3^o 58.5'N - 4^o 9.6'N, 100^o 34.8'E – 100^o 45.8'E). Teluk Lekir mempunyai dua sumber pengaruh fizikal iaitu limpahan dari Sungai Perak di tenggara dan kumbahan air panas terawat dari janakuasa Sultan Azlan Shah (SASPS) di barat laut Teluk Lekir. Beberapa kejadian serangan obor-obor besar besaran ke sistem air masuk dan mengakibatkan kerugian besar kepada SASPS. Selain beberapa musim kejatuhan benih kerang (*Anadara granosa*) telah dilaporkan. Kajian ini bertujuan untuk mengenal pasti oseanografi fizikal secara spatial dan temporal melalui tiga komponen utama iaitu; (a) Fizikal setting iaitu pemetaan bathymetri di perairan SASPS dan Teluk Lekir; (b) Taburan ciri-ciri fizikal air di permukaan dan dalam air seperti halaju dan arah arus permukaan, suhu permukaan laut (SST), salinity permukaan laut (SSS) dan kekeruhan; (c) Pengaruh lain (data sekunder) seperti

purata kejatuhan hujan bulanan, tiupan dan arah angin, angin monsoon dan air surut purbani (LAT) mempengaruhi fizikal hidrodinamik di perairan Teluk Lekir dan sistem kemasukan air SASPS. Sejumlah 87 stesen persampelan untuk mengutip data fizikal (dengan lima pengkelasan air iaitu permukaan, bawah permukaan, pertengahan air, bawah pertengahan air dan dasar) dan sampel lumpur. Selain dua stesen persampelan profail halaju air akustik (ADCP) berhampiran dengan sistem air masuk bawah laut SASPS telah dijalankan. Pemetaan bathymetry terperinci untuk SASPS dan pemetaan kasar (dengan 300 meter garis transek) Teluk Lekir telah dilakukan. Kajian ini telah mencapai matlamatnya melalui tiga komponen kajian yang berkait antara satu dengan lain serta penjelasannya. Fizikal setting merupakan indikator pasif dan telah diterangkan dengan jelas di dalam thesis ini contohnya pemetaan perairan SASPS dengan memperlihatkan jelas kedudukan sistem kemasukan air awash laut dan bagaimana pengaruh persekitaran dan cuaca mempengaruhinya. Sebanyak empat zon yang mempunyai ciri-ciri fizikal tersendiri telah dikenalpasti contohnya zon A (terletak di selatan SASPS), zon B (muara sungai Perak dan sekitaran yang berhampirannya), zon C (perairan Pantai Lekir) dan zon D (hadapan Lekir). Hasil keputusan pemetaan bathimetri ditindih dengan taburan jenis lumpur mencadangkan lokasi berpotensi untuk ternakan kerang (*Anadara granosa*) dan peneluran obor-obor (*Chrysaora quinquecirrha*) di dasar zon B dan C kerana berlakunya perubahan ulang alik parameter fizikal seperti suhu dan salinity di dasar pada ketika air surut purbani. Keputusan hadlaju arus juga mencadangkan bahawa perairan hadapan Lekir sering mengalami halaju arus yang tinggi dengan bacaan 0.65 – 1.1 m/s ketika air pasang surut pada kedua dua angin monsoon. Loaksi hadapan Lekir ini terletak pada penghujung landai dasar laut Lekir berhampiran dengan Pulau Sembilan sehingga ke selatan Pulau Pangkor. Keputusan penilaian ciri-

ciri air mendapati taburan SST, SSS dan kekeruhan berada dalam kelompok-kelompok besar dengan pelbagai kepekatan dan bergerak di permukaan dan di dalam air mengikut arah arus dan tiupan angin. Selain kadar arus risidual (RTC) menunjukkan lokasi potensi pemendapan yang terletak berhampiran dengan muara sungai Perak dan Pantai Lekir. Teluk Lekir amat dipengaruhi oleh tiupan angin ketika angin monson Barat Daya (SW) dengan catatan halaju arus permukaan 0.320 m/s ketika air surut besar (SLW) berbanding dengan ketika tiupan angin monson Timur Laut (NE) dengan catatan 0.291 m/s. Angin Timur Laut (NE) memberikan kesan yang tinggi kepada pergerakkan arus permukaan terutamanya ketika air surut mati dengan catatan 0.296 m/s dan air pasang mati dengan bacaan 0.262 m/s berbanding dengan 0.205 m/s dan 0.175 m/s untuk tempoh yang sama ketika angin Barat Daya (SW). Data menunjukkan bahawa purata kadar pergerakkan arus permukaan adalah lebih tinggi ketika air mati dimusim NE berbanding dengan SW. Purata kadar pergerakkan arus yang tinggi di hadapan Lekir telah dicatatkan berbanding purata kadar pergerakkan arus yang lemah dicatatkan berhampiran dengan Pantai. Keputusan mata angin mencadangkan bahawa 5% dari tiupan angin datangnya dari arah barat daya (SW), barat (W) dan selatan (S) dengan kadar kekuatan sekitar 1.6 – 5.4 m/s. Manakala 10% dari tiupan angin adalah dari arah Timur Laut (NE) dengan kekuatan 1.6 – 3.3 m/s. Teluk Lekir mengalami air surut purbani pada bulan Februari pada tahun yang dikaji. Purata jatuhan hujan bulanan mencadangkan kadar jatuhan hujan adalah tinggi ketika NE menyebabkan saliniti permukaan laut di Teluk Lekir menurun serentak dengan keadaan air surut purbani tahunan yang berlaku pada bulan Februari. Halaju profile di lokasi sistem kemasukan air dasar laut mencadangkan bahawa kadar halaju arus dibawah permukaan air adalah malar pada kadar 0.4 – 1.0 m/s ketika semua air pasang dan surut. Ini akan

menggalakkan kemasukan obor obor secara besar besaran yang berlaku ketika selang air bawah antara keadaan air surut ke air pasang. Berdasarkan kepada semua keputusan yang diperolehi, adalah didapati Teluk Lekir merupakan satu teluk yang aktif dengan fizikal hidro-dinamik dan memberikan impak kepada habitat dasar selain penyebab kepada serangan besar besaran obor-obor terhadap SASPS telah dikenal pasti.