

BEHAVIOURAL AND PHYSIOLOGICAL CHANGES
OF BLUE SWIMMING CRAB, *Portunus pelagicus*
AT DIFFERENT CULTURE TEMPERATURES

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DOCTOR OF PHILOSOPHY
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**Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of
Philosophy in the Institute of Tropical Aquaculture and Fisheries Research
Universiti Malaysia Terengganu
2018**

DEDICATION

I am dedicating this thesis to:

My late father, Haji Md Adib Talib

My beloved mother, Hajjah Norsiah Harun and siblings

My loving wife, Siti Zaharah Sulaiman and children and lastly,

My supervisor, Professor Abol Munafi Ambok Bolong, PhD.

For their inspiration, sacrifice, love and guidance

ABSTRACT

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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Main Supervisor : Professor Abol Munafi Ambok Bolong, Ph.D
Co-Supervisor : Professor Mhd Ikhwanuddin Abdullah, Ph.D
Institute : Institute of Tropical Aquaculture and Fisheries
Research (AKUATROP)

Inconsistent seed production and climate change cause problems for the crab culture industry. This study aimed to understand the effects of different water temperatures on the physiological conditions (survival, growth, molting, shell hardening, thermal tolerance, sexual differentiation and fatty acids compositions), behaviour, maturation and stress of blue swimming crab, *Portunus pelagicus*. In this study, *P. pelagicus* from first stage of instar were cultured at three different water temperatures (24 °C, 28 °C and 32 °C). Fatty acids composition in relation to maturation and stress were examined after certain physiological changes. Molting success as well as behaviour and hardening of the carapace were analyzed using a video recording with behavioural coding software and a novel hardness scale to obtain their physiological response. Meanwhile, thermal

tolerance was calculated using a dynamic method and determination of stress on crab were carried out through histological examination of gills. The results indicate that the carapace width increased directly with temperature. Conversely, duration of the intermolt period was negatively correlated with temperature. The time of crabs' molting and carapace hardening were decreased with increasing temperature. The crab movement was positively correlated with temperature. Thermal tolerance increased directly with temperature. Monounsaturated Fatty Acids (MUFA) was the most abundant biochemical component, while Saturated Fatty Acids (SFA) represented a minor fraction of body compositions. The histological of gills showed that the haemocytes number in anterior gills increase proportionately with increasing of temperature. Statistical analyses showed that, physiological changes in term of behaviour, maturation and stress were affected by water temperature. The optimal water temperature to achieve fast growth and good survival with the greatest instar production during the nursery phase was ranging 28 to 32°C. The average water temperature used in the culture of *P. pelagicus* was ranging 25 to 32°C. The ability of this crab to tolerate warm temperature (> 32°C) with associated with global warming issue could result in increasing number of juvenile stage with lower size of carapace. Establishment of optimum water temperature conditions can enhance the production of juveniles in the hatchery of *P. pelagicus*.

ABSTRAK

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

PERUBAHAN TINGKAH LAKU DAN FISIOLOGI KETAM RENJUNG, *Portunus pelagicus* PADA SUHU TERNAKAN YANG BERBEZA-BEZA

MOHAMAD NOR AZRA MD ADIB

2018

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Institut : **Institut Akuakultur Tropika dan Penyelidikan
Perikanan (AKUATROP)**

Penghasilan benih yang tidak konsisten dan perubahan iklim memberi masalah ke atas industri ternakan ketam. Kajian ini bertujuan untuk memahami kesan suhu air yang berbeza terhadap perubahan fisiologi (kemandirian, pertumbuhan, bersalin kulit, pengerasan cengkerang, ketahanan therma, pembezaan seks dan komposisi asid lemak), tingkah laku, kematangan dan tekanan pada ketam renjung, *Portunus pelagicus*. Dalam kajian ini, ketam *P. pelagicus* daripada peringkat instar pertama telah ditenak pada tiga keadaan suhu air (24 °C, 28 °C dan 32 °C). Perkaitan di antara komposisi asid lemak, kematangan dan tekanan juga telah diperiksa selepas penentuan beberapa perubahan fisiologinya. Kejayaan bersalin kulit serta tingkah laku dan pengerasan cengkerangnya telah dianalisa menggunakan perakam video dengan perisian pengkodan tingkah laku dan skala pengerasan yang baharu untuk memperolehi gerak-balas fisiologi

ketam tersebut. Sementara itu, ketahanan therma dikira menggunakan kaedah dinamik dan penentuan tekanan ketam telah dijalankan melalui pemeriksaan histologi ke atas insang. Keputusan menunjukkan bahawa kelebaran cengkerang didapati meningkat secara berterusan dengan suhu. Sebaliknya, tempoh antara bersalin kulit pula adalah berkadaran secara negatif dengan suhu. Tempoh ketam bersalin kulit dan pengerasan cengkerang menurun dengan peningkatan suhu. Pergerakan ketam berkorelasi secara positif dengan suhu. Ketahanan therma meningkat secara langsung dengan peningkatan suhu. Asid lemak tak tepu mono adalah komponen biokimia yang terbanyak, manakala kumpulan asid lemak tepu mewakili pecahan terkecil bagi komposisi badannya. Histologi insang menunjukkan bahawa bilangan haemosit pada insang pula meningkat secara berkadaran dengan peningkatan suhu. Analisis statistik menunjukkan bahawa, perubahan fisiologi dari segi tingkah laku, kematangan dan tekanan telah dipengaruhi oleh suhu air. Julat suhu air yang optimum untuk mencapai tumbesaran yang cepat dan kemandirian yang baik dengan penghasilan benih yang banyak diperingkat pembenihan adalah berjalat 28 hingga 32°C. Purata suhu air yang digunakan untuk ternakan *P. pelagicus* adalah berjalat di antara 25 hingga 32°C. Keupayaan ketam ini untuk bertahan terhadap suhu panas (>32°C) yang dikaitkan dengan isu kepanasan suhu global mungkin boleh menyebabkan pertambahan bilangan anak ketam dengan saiz cengkerag yang lebih kecil. Kewujudan keadaan suhu air yang optimum dapat meningkatkan penghasilan anak ketam di tempat penetasan dan penternakan *P. pelagicus*.