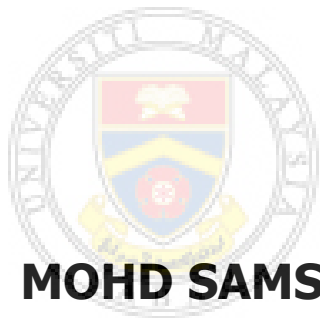


**THE STATUS OF *Macrobrachium* spp. AND STOCK  
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*Macrobrachium rosenbergii* IN A COMMUNITY-  
BASED PROJECT IN PETAGAS RIVER, SABAH,  
MALAYSIA**



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**MOHD SAMSUL ROHIZAD BIN MAIDIN**

**BORNEO MARINE RESEARCH INSTITUTE  
UNIVERSITI MALAYSIA SABAH**

**2018**

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MALAYSIA**



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**THESIS SUBMITTED IN FULFILMENT FOR THE  
DEGREE OF MASTER OF SCIENCE**

**BORNEO MARINE RESEARCH INSTITUTE  
UNIVERSITI MALAYSIA SABAH**

**2018**

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## **DECLARATION**

I hereby declare that material in this thesis is my own except for quotations, citation, equations, summaries and references, which have been accordingly acknowledged.

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Mdm. Grace Joy Chin Wei Lie \_\_\_\_\_

## ACKNOWLEDGEMENT

Alhamdulillah, first and foremost, I am very grateful and all praises to Allah S.W.T., the Most Gracious and Most Merciful for His blessings and guidance throughout my life and for granting me knowledge to complete this study.

I would like to express my sincere gratitude to my supervisory committee; Prof. Datin Seri Panglima Dr. Ann Anton, Assoc. Prof. Dr. Annita Yong Seok Kian and Mdm. Grace Joy Chin Wei Lie for their continuous support of my master study and research, their patience, motivations and immense knowledge. Their tremendous guidance has helped me a lot throughout my study period. It is also my pleasure to acknowledge Prof. Dr. Rossita Shapawi as the Director of Borneo Marine Research Institute for providing technical assistant during the study.

My sincere thanks also go to my fellow sampling partners Yusdi Ismail, Aqilah Musfirah Abdul Rahman, Farianah Enwui Molusin, Nina Maryam Bakhtiar Bathie, Farahin, Mariam Syarmilah Musa, Rafeah, Ghafur Rahim, and fellow labmates Haniza, Salley Venda Law, Ranjita and Din, lecturers, Dr. Mohammad Tamrin Mohamad Lal and Mr. Muhammad Ali Syed Hussein for stimulating discussions, helping me analysed data and for all the fun things we have done in lab. To all my best friends, brothers and sisters, Masran Tamin, Syafiqah Saufie, Noor Amalia Shaiful kahar, Diana Hassan, Norcikeyonn Samuni, Hanirah Ramli, Dr. Nik Nurhusna Nik Sin, Yeon Amsalie, Carla Goncalves, Nurbasiah Ismail, Dayang Nadia Mawi, Mashor Awang Long, Fadhleena Ali, Putri Shafini Natasha, Rabbiatul Adawiyah, Asmahani Ismail, Mohd Shafiq Kassim, Khairuddin Ahmad, Raja Hariz Raja Ibrahim, Nurulnida Hamdan, Mohd Fairul Mamat, Mohd Zafri Ahmad, Muhammad Ashraf faizzi and Balqis Mohd Zahis, thank you very much for your helps, moral supports, friendships and always reminding me that I was still on track and not to give up. I also wish to thank all the committee members of Petagas River Project (Dr. John Madin, Dr. Faihanna Ching Abdullah, Ms Audrey Daning Tuzan, Flora Anne Asalin, Bernard Tzing, Mustakizah Azelan, Ismail Tajul, Ajahar Abd Sahar, Liew Chun Fong and Marthelreda Choo), Prof. Dr. Saleem Mustafa who initiated the stock enhancement project, shrimp hatchery staffs, lab

assistants and administration staffs from Borneo Marine Research Institute (BMRI), Biotechnology Research Institute (BRI) and Centre of Postgraduate Studies (CPS), Assoc. Prof. Dr. Amran Harun, Dr. Rahimie Abd. Karim, Dr. Jakaria Dasan, Kak Zuraya Murny Taufik, Puan Elizabeth Malanjun, Abang Fadzirul Hafez, Abang Jalil Abdullah, Kak Zaiahsheila Sidik and Kak Norjaidah Jaffar, for their advices and helps, in completing my research.

Last but not least, my deepest appreciation goes to both my parents, my mother, Samsiah Abdul Manap, my father, Maidin Mat Saat, family members Along, Angah, Ude, Afi, Abang Faizal, Kak Hawa and Kak Diana for supporting me spiritually and financially throughout my life. Their unlimited understanding advices and moral supports have always been my greatest foundation that motivates me to stay strong until the completion of my master project.

Mohd Samsul Rohizad Maidin

26 January 2018



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## ABSTRACT

The decline of the freshwater giant prawn, *Macrobrachium rosenbergii*, in rivers can be attributed to overfishing, habitat loss and pollution. In order to offset the pressure, a community-based stock enhancement project was initiated by Borneo Marine Research Institute (BMRI), University Malaysia Sabah, to increase the number of *M. rosenbergii* in Petagas River, Putatan, Sabah. This study was conducted to determine the distribution and abundance of different life stages of the freshwater prawn, population estimates and habitat preferences of adult freshwater prawn and molecular characterization of the prawns caught in Petagas River following the stock enhancement programme of *M. rosenbergii* juveniles produced from BMRI shrimp hatchery. Series of samplings were conducted at Petagas River after each stock enhancement programme from September 2013 to May 2015. The different life stages of the freshwater prawn were caught using hand net and modified prawn trap. A total of 539 specimens were caught and separated into PL, juvenile and adult. The distribution of PL prawn was found to be increased with increasing salinities ( $R^2=0.95$ ) while for juvenile ( $R^2=0.98$ ) and adult prawns ( $R^2=0.921$ ) were inversely correlated. Abundance of PL (53%) was found at the downstream region of Petagas River. Highest percentage of juvenile was found at the midstream region of Petagas River with 18.06% while 81.63% of adult prawn found at the upstream region. Highest percentage of adult individual caught was found at station with the presence of substrate (54.43%), followed by vegetation (27.22%) and mud sand (18.35%). The CPUE of PL, juvenile and adult were positively correlated with the increase of stocking juvenile following stocking programme with  $R^2=0.89$ ,  $R^2=0.73$  and  $R^2=0.87$  accordingly. Estimated population sizes of adult prawn at the start, middle and end of the present study were 239, 351 and 559 individuals respectively. The result was corresponding to the enhancement programme which indicates the number of freshwater prawn in the river increased following stocking programme. However, two morphologically different species of adult freshwater prawn were found; WA (white colour adult with light brown carapace and shorter rostrum), and BA (blue colour adult with light blue carapace and extended rostrum) with composition of 97.7% and 2.3% respectively. Molecular analyses were then carried out on the adult and juvenile prawns caught in the Petagas River and compared with adult and juvenile from BMRI shrimp hatchery. Sequence similarity analyses showed the two distinct species of adult samples from Petagas River were determined as *M. rosenbergii* (89% to 95% sequence similarity) and *M. mammilodactylus* (83% to 99%) while all samples from BMRI shrimp hatchery were identified as *M. rosenbergii* (89% to 99%). Other juvenile samples from the Petagas River were determined as *Macrobrachium* sp. (84% to 86%), *Caridina gracilipes* (91% to 92%), *Caridina* sp. (81% to 87%), *Litopenaeus stylirostris* (83%) and *Metapenaeus ensis* (99%). The sequence similarity and phylogenetic tree analyses showed that *M. rosenbergii* from Petagas River is closely related to *M. rosenbergii* from BMRI shrimp hatchery. The phylogenetic tree of *COI* gene produced three clusters of *Macrobrachium* genus, separated with its closely related species. Genetic distances between *M. rosenbergii* from BMRI shrimp hatchery and *M. rosenbergii* caught in Petagas River ranged from 0.00% to 13.8%. It suggested that the *M. rosenbergii* released in stock enhancement programme were closely related to the *M. rosenbergii* caught in the river. Based on the results, it showed that *M. rosenbergii* is able to live and adapt in Petagas River as its population increased following the stocking



programme. Although the percentage of *M. rosenbergii* in the river is still low compared to *M. marmillodactylus*, however the appearance of ovigerous females of *M. rosenbergii* in the study indicates the possibility of future establishment of the stocking species in the river. The stock enhancement programme is suggested to be implemented continuously in order to improve the population of *M. rosenbergii* in the Petagas River. This study will provide baseline information on the effectiveness of stock enhancement programme of giant freshwater prawn especially in Malaysia.



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## ABSTRAK

### **PENILAIAN PROJEK KOMUNITI TERHADAP PENAMBAHBAIKAN STOK UDANG GALAH, *Macrobrachium rosenbergii* DI SUNGAI PETAGAS, SABAH**

Penurunan populasi udang galah, *Macrobrachium rosenbergii* di dalam sungai boleh disebabkan oleh penangkapan berlebihan, kehilangan habitat dan pencemaran. Bagi mengurangkan permasalahan ini, satu program komuniti penambahbaikan stok telah dilancarkan oleh Institut Penyelidikan Marin Borneo (IPMB) bertujuan meningkatkan populasi udang galah di Sungai Petagas, Putatan, Sabah. Kajian ini dilakukan untuk menentukan taburan dan kelimpahan setiap peringkat hidup udang galah, keutamaan habitat, anggaran populasi udang dewasa dan analisis molekul udang galah yang ditangkap di Sungai Petagas berikutan daripada program penambahbaikan. Beberapa siri kajian lapangan telah dilakukan selepas setiap program penambahbaikan stok udang galah dari September 2013 sehingga May 2015. Setiap peringkat udang galah telah ditangkap dengan menggunakan sauk tangan dan perangkap udang yang telah diubah suai. Sebanyak 539 spesimen telah ditangkap dan dikategorikan kepada postlarva (PL), juvenil dan udang dewasa. Taburan PL udang didapati meningkat apabila kemasinan air meningkat ( $R^2=0.95$ ) manakala untuk juvenil ( $R^2=0.98$ ) dan sebaliknya korelasi songsang berlaku untuk udang dewasa ( $R^2=0.921$ ). Limpahan PL paling tinggi adalah di bahagian muara Sungai Petagas (53%). Manakala bagi juvenil di temui tertinggi di pertengahan sungai (18.06%) dan bagi udang galah dewasa pula 81.63% di bahagian atas atau hilir sungai. Peratusan tertinggi udang galah dewasa ditangkap pada stesen dengan kehadiran substrata (54.43%) diikuti dengan vegetasi (27.22%) dan lumpur sahaja (18.35%). Hasil tangkapan per unit usaha (CPUE) bagi PL, juvenil dan udang galah dewasa menunjukkan peningkatan secara positif berikutan program penambahbaikan stok udang galah ( $R^2=0.89$ ,  $R^2=0.73$  and  $R^2=0.87$ ). Anggaran saiz populasi udang galah di Sungai Petagas pada mula, pertengahan dan akhir kajian ialah masing-masing 239, 351 and 559 individu. Hasil kajian ini sesuai dengan program penambahbaikan, dimana jumlah udang galah di dalam sungai meningkat kesan daripada program penambahbaikan stok. Secara fizikal, dua spesis udang galah yang berbeza iaitu WA (cengkerang bewarna coklat muda dan rostrum yang pendek) dan BA (cengkerang bewarna biru muda dan rostrum yang panjang) telah ditemui di Sungai Petagas dengan komposisi masing-masing 97.7% dan 2.3%. Analisis molekul telah dilakukan pada udang galah juvenil dan dewasa dari Sungai Petagas dan dibandingkan dengan udang galah juvenil dan dewasa dari hatcheri udang IPMB. Analisis persamaan siri menunjukkan kedua-dua spesis udang galah dewasa yang berbeza fizikalnya ditangkap dari Sungai Petagas telah dikenalpasti sebagai *M. rosenbergii* (89% to 95%) dan *M. mammilodactylus* (83% to 99%). Semua sampel dari hatcheri udang IPMB pula dikenalpasti sebagai *M. rosenbergii* (89% to 99% persamaan) sahaja. Sampel juvenil yang lain dari Sungai Petagas dikenalpasti sebagai *Macrobrachium* sp. (84% to 86%), *Caridina gracilipes* (91% to 92%), *Caridina* sp. (81% to 87%), *Litopenaeus stylirostris* (83%) dan *Metapenaeus ensis* (99%). Hasil analisis filogenetik dan persamaan siri menunjukkan *M. rosenbergii* yang ditangkap dari Sungai Petagas adalah berkait rapat dengan *M. rosenbergii* dari hatcheri IPMB. Analisis filogenetik menunjukkan terdapat tiga bahagian genus *Macrobrachium*, terpisah daripada spesis yang berkait rapat. Jarak genetik antara sampel *M.*

*rosenbergii* dari Sungai Petagas dan hatcheri IPMB adalah antara 0.00%-13.8%. Ini membuktikan *M. rosenbergii* yang dilepaskan ke dalam Sungai Petagas melalui program penambahbaikan stok adalah berkait rapat dengan *M. rosenbergii* yang ditangkap di Sungai Petagas. Hasil kajian ini menunjukkan *M. rosenbergii* mampu untuk hidup dan beradaptasi di Sungai Petagas sepertimana dapat dilihat melalui peningkatan populasinya sepanjang program penambahbaikan stok dilaksanakan. Walaupun peratusan *M. rosenbergii* di dalam sungai itu rendah berbanding peratusan *M. mammillodactylus*, namun kehadiran udang galah betina *M. rosenbergii* di dalam kajian ini membuktikan bahawa spesies ini mempunyai potensi untuk terus hidup dan meningkat. Penambahbaikan stok udang galah dicadangkan untuk diteruskan pada masa akan datang sehingga populasi *M. rosenbergii* menjadi mapan. Kajian ini menunjukkan tahap keberkesanan dalam program penambahbaikan stok udang galah seterusnya menyediakan data asas bagi penilaian tahap keberkesananannya di Malaysia.



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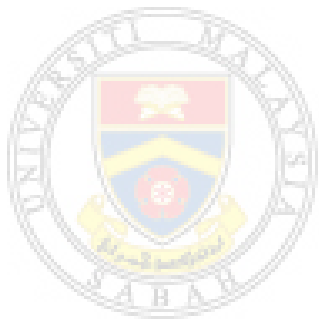
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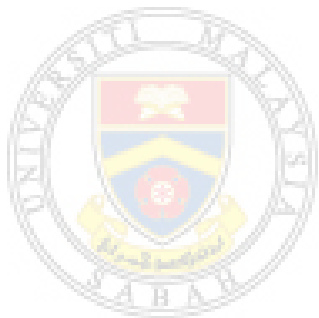
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## LIST OF ABBREVIATIONS

BA	Light blue carapace and extended rostrum
BA	Adult prawn with light blue carapace and extended rostrum caught from Petagas River
BAM	<i>M. rosenbergii</i> male
BANOF	<i>M. rosenbergii</i> non-ovigerous female
BAOF	<i>M. rosenbergii</i> ovigerous female
BLAST	Basic local alignment search tool
BS	Broodstock of <i>M. rosenbergii</i> from BMRI hatchery
CL	Confidence level
COI	Cytochrome oxidase subunit 1
CPUE	Catch per unit effort
DNA	Deoxyribonucleic acid
DO	Dissolved oxygen
FAO	Food and agriculture organization
GPS	Global positioning system
HDPE	High-density polyethylene
JH	Juvenile <i>M. rosenbergii</i> from BMRI hatchery
JS	Juvenile prawns caught from Petagas River
K2P	Kimura-two-parameter
M1	Mud sand 1
M2	Mud sand 2
ML	Maximum likelihood
ML	Maximum Likelihood
mtDNA	Mitochondrial DNA
NCBI	<i>National Center for Biotechnology Information</i>
nDNA	Nuclear DNA
NJ	Neighbor joining
PCR	Polymerase chain reaction
PL	Postlarva
rDNA	Ribosomal deoxyribonucleic acid
rRNA	Ribosomal ribonucleic acid

S1	Substrates 1
S2	Substrates 2
SPSS	Statistical package for social sciences
ST	Station
TL	Total length
UV	Ultraviolet
V1	Vegetation 1
V2	Vegetation 2
WA	Light brown carapace and shorter rostrum
WA	Adult prawn with light brown carapace and shorter rostrum caught from Petagas River



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## LIST OF SYMBOLS

<b>ppt</b>	Part per thousand
<b>mm</b>	Millimeter
<b>%</b>	Percent
<b>L</b>	Liter
<b>km</b>	Kilometer
<b>mg/L</b>	Milligram per liter
<b>cm</b>	Centimeter
<b>g</b>	Gram
<b>cm<sup>2</sup></b>	Centimetre square
<b>m</b>	Meter
<b>mg</b>	Milligram
<b>µl</b>	Microliter
<b>°C</b>	Degree celcius
<b>ml</b>	Milliliter
<b>s</b>	Second
<b>rpm</b>	Revolutions per minute
<b>V</b>	Volt
<b>µM</b>	Micrometer
<b>U</b>	Unit
<b>km<sup>2</sup></b>	Kilometer square
<b>µg/ml</b>	Microgram per milliliter
<b>bp</b>	Base pair
<b>kb</b>	Kilobyte
<b>m<sup>3</sup></b>	Meter cubic



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