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By

TAN AI NEE

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

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SPAWNING POPULATION CHARACTERISTICS OF HORSESHOE CRAB *Tachypleus gigas* (Müller, 1785) AT PANTAI BALOK

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Chair : Annie Christianus, PhD

Faculty : Agriculture

The population monitoring data for horseshoe crab in its spawning and nursery sites is scarce. Hence, the population status of the horseshoe crab is poorly understood as the basic data for population assessment has not been collected. The public awareness on the ecological importance of the horseshoe crabs is low. Three horseshoe crab species reported in coastal waters of Malaysia, namely *Carcinoscorpius rotundicauda*, *Tachypleus gigas*, and *Tachypleus tridentatus*.

This study aimed to determine size-frequency distribution, length-weight relationship and sex ratio of the population of horseshoe crab *T. gigas*. An attempt was also made to study the infestation of epibiont on the carapace and to report the condition of carapaces.

A total of 86 males and 75 females *T. gigas* sampled from Pantai Balok were examined. Most horseshoe crabs came ashore in amplexus pairs. As compared to Atlantic species, there was no sighting of satellite male competing with the male in amplexus pairs during spawning season. The uncommon occurrence of tandem amplexus was also observed at this study site.

Female *T. gigas* is bigger in size than the male. Size-frequency data indicated 69.8% of male horseshoe crabs belonged to size group of 151-200 mm while 53.3% of females were classified into size group of 201-250 mm. The largest female recorded was with mean prosomal length and width of 154.4 mm and 246.9 mm, respectively. Females were heavier than the males with mean body weight of 824.4 g.

Tail ratio (TR) ranged from 0.21 to 0.57 for males and 0.39 to 0.56 for females *T. gigas*. As for flatness of carapace (FC), males were ranged from 0.60 to 1.14 and females from 0.76 to 1.19. Student's T-test showed significant sex differences for TR and FC ($P < 0.05$). Female *T. gigas* has a flatter carapace and shorter telson than the male.

The length-weight relationships were linear between logarithmic weight and logarithmic length for both sexes. The values of the slopes for both males and females were more than 1 thus exhibited a positive allometry where increment of the weight is more rapid as compared to prosomal length. Analysis of covariance revealed significant difference between the slopes of both sexes ($F = 3085.391$ with df 1,153; $P < 0.05$). Weights of males and females *T. gigas*

increased with exponentials of 2.557 and 2.837, respectively. Values for the coefficient of determination (r^2) for regression of length with weight were, 0.611 for males and 0.726 for females.

All individual horseshoe crabs were adults categorized under fourteenth, fifteenth and sixteenth instar stage. Approximately 64.7% of male individuals belonged under the fourteenth instar stage and 55.3% of female individuals in fifteenth instar stage. Juvenile or young adult was not found at this study site. Males at fourteenth instar stage were more prone to epibiont infestation. Four epibiont species were found on carapaces of *T. gigas*, namely acorn barnacle *Balanus*, pedunculate barnacle *Octolasmis*, conical slipper shells *Calyptraea*, and flat slipper shells *Crepidula*. The epibionts were distributed on the dorsal and ventral sides of the carapace.

Monsoon season and horseshoe crab harvesting influence the sex ratio at the study site. Heavy precipitation, strong surf and flooding occur during monsoon season and hence fewer horseshoe crabs were sighted. As compared to female, higher proportion of males was sampled because female horseshoe crab was harvested to make delicacy dishes and exported to neighboring country, Thailand.

The carapace, lateral eyes and telson of each individual horseshoe crab were carefully examined. Most males had eyes covered by epibiont with traumatic injured carapaces while most females had broken telsons. However, *T. gigas* having covered eyes, injured carapace and broken telson was not exempted for

being an amplexus pair to spawn onshore. Two *T. gigas* having telson abnormalities (stubby, curved) could be at risk of being stranded. The traumatic injuries of carapaces could be due to collision with boats as this study site is a landing port for fishing boats.

This study will serve as a basis for the implementation of effective conservation strategies and management planning for the horseshoe crab species to ensure their continuous survival. It is hoped that the findings of this study will provide both qualitative and quantitative baseline information for future work.

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

CIRI-CIRI POPULASI PEMBIAKAN BELANGKAS *Tachypleus gigas* (Müller, 1785) DI PANTAI BALOK

Oleh

TAN AI NEE

September 2011

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Data pemantauan populasi bagi belangkas di habitat semulajadi adalah tidak mencukupi. Ini menyebabkan status populasi belangkas tidak diketahui kerana data untuk penilaian populasi tidak dikumpul sebelum ini. Kesedaran awam terhadap kepentingan ekologikal belangkas adalah kurang. Tiga spesis belangkas dilaporkan hidup di kawasan pesisiran pantai Malaysia, iaitu *Carcinoscorpius rotundicauda*, *Tachypleus gigas*, dan *Tachypleus tridentatus*.

Matlamat kajian ini adalah untuk menentukan taburan saiz-frekuensi, hubungan panjang-berat, nisbah seks dalam populasi belangkas di Pantai Balok. Selain daripada itu, kajian mengenai epifauna yang terdapat di karapas belangkas dan laporan keadaaan karapas juga dijalankan.

Sejumlah 86 ekor belangkas jantan dan 75 ekor belangkas betina telah disampelkan di Pantai Balok. Saiz belangkas betina adalah lebih besar daripada belangkas jantan. Kebanyakan belangkas yang dijumpai merupakan pasangan mengawan. Belangkas jantan satelit tidak dijumpai manakala suatu pasangan luar biasa dijumpai di mana dua ekor belangkas jantan berpasangan dengan seekor belangkas betina.

Saiz belangkas betina *Tachypleus gigas* adalah lebih besar daripada belangkas jantan. Data saiz-frekuensi menunjukkan 69.8% daripada belangkas jantan dikategori dalam kumpulan saiz 151-200 mm manakala 53.3% daripada belangkas betina dikelaskan dalam kumpulan saiz 201-250 mm. Individu betina yang terbesar mempunyai min panjang prosomal 154.4 mm serta min lebar prosomal 246.9 mm. Belangkas betina adalah lebih berat daripada belangkas jantan, dengan min berat badan sebanyak 824.4 g.

Julat nisbah ekor adalah 0.21 hingga 0.57 bagi belangkas jantan dan 0.39 hingga 0.56 bagi belangkas betina. Manakala bagi julat kerataan karapas, belangkas jantan adalah 0.60 hingga 1.14 serta belangkas betina adalah 0.76 hingga 1.19. Belangkas betina mempunyai ekor yang lebih pendek dan karapas yang lebih mendatar.

Belangkas jantan dan belangkas betina masing-masing menunjukkan hubungan panjang-berat yang linear dan mempamerkan pertumbuhan allometri yang positif di mana pertumbuhan berat badan adalah lebih cepat daripada pertumbuhan panjang prosoma. Berat badan belangkas jantan dan belangkas

betina meningkat dengan eksponen sebanyak 2.557 serta 2.837. Nilai pekali penentuan (r^2) bagi regresi panjang dengan berat adalah 0.611 dan 0.726, bagi belangkas jantan serta belangkas betina masing-masing.

Semua belangkas yang disampel adalah belangkas dewasa dikategori dalam instar 14, instar 15 serta instar 16. Tiada belangkas juvana dijumpai di Pantai Balok. Terdapat lebih kurang 64.7% daripada belangkas jantan adalah tergolong dalam instar ke-14 dan 55.3% daripada belangkas betina adalah instar ke-15. Belangkas jantan instar 14 adalah lebih cenderung kepada koloni epifauna. Empat jenis spesis epifauna didapati hidup di atas karapas belangkas, iaitu *Balanus*, *Octolasmis*, *Calyptraea*, serta *Crepidula*. Epifauna tidak didapati di ekor belangkas.

Musim tengkujuh dan penangkapan belangkas merupakan faktor yang mempengaruhi nisbah seks di Pantai Balok. Keadaan hujan lebat, ombak yang kuat dan banjir di kawasan pantai menyebabkan kurang belangkas disampelkan. Lebih banyak belangkas jantan disampel kerana belangkas betina ditangkap untuk menyediakan sup, ia juga dieksport ke negara jiran seperti Negara Thai.

Karapas, mata serta ekor setiap belangkas diperiksa dengan teliti. Kebanyakan belangkas jantan mempunyai mata yang diliputi epifauna. Mereka juga menghadapi kecederaan karapas yang mungkin disebabkan oleh perlanggaran dengan bot nelayan. Kebanyakan belangkas betina didapati mempunyai ekor yang patah. Akan tetapi, kecacatan badan tidak menghalang belangkas-belangkas untuk mengawan pada musim bertelur. Belangkas yang mempunyai

kelainan ekor mungkin berisiko untuk terkandas di pantai kerana tidak dapat menggunakan ekornya untuk menterbalikkan diri sendiri apabila dipukul ombak.

Kajian ini memainkan peranan dalam implementasi strategi pemuliharaan dan perancangan pengurusan belangkas untuk menjamin kehidupan spesis ini pada masa hadapan. Adalah diharapkan bahawa pencarian dalam kajian ini dapat memberi maklumat dasar yang kualitatif dan kuantitatif untuk kerja masa depan.

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I certify that an Examination Committee has met on 19 September 2011 to conduct the final examination of Tan Ai Nee on her Master of Science thesis entitled "Spawning Population Characteristics of horseshoe crab *Tachypleus gigas* (Müller, 1785) at Pantai Balok" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the relevant degree.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

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TAN AI NEE

Date:

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