

STUDIES ON THE DENSITY AND BUT CONTENTS OF THE  
THREE DOMINANT SPECIES OF SEA BROWN IN  
MARINE PARK, REDANG

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KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA  
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**STUDIES ON THE DENSITY AND GUT CONTENTS OF THE THREE DOMINANT  
SPECIES OF SEA URCHIN IN MARINE PARK, REDANG**

**By**

**Lau Mun Heang**

**Research Report submitted in partial fulfillment of  
the requirements for the degree of  
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## LIST OF ABBREVIATIONS

<u>Symbols</u>	<u>Meanings</u>
h	hour
km	kilometer
m	meter
mm	millimeter
$^{\circ}\text{C}$	degree Celsius
$\text{m}^3$	meter cube
1 <sup>st</sup>	first
2 <sup>nd</sup>	second
3 <sup>rd</sup>	third
%	percentage
>	more than
$\pm$	plus, minus
S.D	standard deviation
$\text{g individual}^{-1} \text{ day}^{-1}$	gram per individual per day
$\text{g algae m}^{-2} \text{ year}^{-1}$	gram algae per meter square per year
$\text{g CaCO}_3 \text{ m}^{-2} \text{ year}^{-1}$	gram Calcium carbonate per meter square per year

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## ABSTRACT

Studies on the density and gut contents of 3 dominant sea urchin species *Echinothrix diadema*, *Echinothrix calamaris* and *Diadema setosum*, were conducted in a shallow-water coral reef at the Redang Island Marine Park, Terengganu. Gut contents of sea urchins were analyzed for organic and inorganic fractions. The inorganic fractions were further separated into calcium carbonate and non-soluble residual. The feeding rates of the three dominant sea urchins were compared in three different environmental components. The data obtained were used to estimate the role of sea urchins on the carbon balance in reefs and their role in food web. The total sea urchin density was 16 individuals /100m<sup>2</sup>. *Echinothrix diadema* exhibited the highest density at 10 individuals /100m<sup>2</sup>, followed by *E. calamaris* with densities of 4 individuals /100m<sup>2</sup> and *D. setosum* at 2 individual /100m<sup>2</sup>. The studied site was covered by coral rubble (47%), Acropora (43%), dead coral (1%) and sand (9%). A total of 74% of the gut contents consisted of CaCO<sub>3</sub> eroded from the reef, 11.6% consisted of organic matter and 14% of non-soluble residual. Sea urchin bioerosion was greater than herbivory for all species studied. The smallest size species *D. setosum* (5.4 ± 0.65 cm) exhibited highest bioerosion and herbivory rates (2.42 ± 1.6 g CaCO<sub>3</sub> individual<sup>-1</sup>

day<sup>-1</sup> and  $0.33 \pm 0.14$  g algae individual<sup>-1</sup> day<sup>-1</sup>), followed by the large bodied *E. diadema* ( $6.6 \pm 1.05$  cm) at  $1.33 \pm 1.3$  g CaCO<sub>3</sub> individual<sup>-1</sup> day<sup>-1</sup> and  $0.22 \pm 0.14$  g algae individual<sup>-1</sup> day<sup>-1</sup>, and *E. calamaris* ( $6.8 \pm 1.6$  cm) at  $1.29 \pm 0.8$  g CaCO<sub>3</sub> individual<sup>-1</sup> day<sup>-1</sup> and  $0.24 \pm 0.14$ g algae individual<sup>-1</sup> day<sup>-1</sup>. Feeding rates of both large bodied species *E. diadema* and *E. calamaris* was not affected by disturbance such as stress of aeration problems and wave action. However *D. setosum* just consumed a small amount of substrata due to the stress. *D. setosum* significantly ingest greater in the calm condition and they can consume up to  $4.8 \pm 1.0$  g CaCO<sub>3</sub> individual<sup>-1</sup> day<sup>-1</sup>, followed by *E. diadema* at  $2.8 \pm 2.2$  CaCO<sub>3</sub> individual<sup>-1</sup> day<sup>-1</sup> and *E. calamaris*  $2.4 \pm 1.0$  CaCO<sub>3</sub> individual<sup>-1</sup> day<sup>-1</sup> during good sea condition.



## ABSTRAK

Kajian dilakukan ke atas taburan kepadatan dan kandungan perut untuk tiga jenis spesies landak laut yang dominan iaitu *Echinothrix diadema*, *Echinothrix calamaris* dan *Diadema setosum*. Kajian ini dijalankan di kawasan cetek terumbu karang Marine Park, Pulau Redang, Terengganu. Kandungan. Isi perut landak laut dianalisa kepada bahan organik dan bukan organik. Bahan bukan organik pula terdiri daripada kalsium karbonat dan sisa tidak larut. Kadar pemakanan bagi ketiga-tiga jenis landak laut yang dominan telah dibandingkan dalam tiga komponen persekitaran yang berbeza. Data yang diperolehi digunakan untuk meramalkan peranan mereka dalamimbangan karbon dan rantai makanan. Taburan kepadatan landak laut adalah 16 individu /100m<sup>2</sup>. *Echinothrix diadema* menunjukkan kepadatan yang tertinggi pada 10 individu /100m<sup>2</sup>, diikuti dengan *E. calamaris* dengan kepadatan sebanyak 4 individu /100m<sup>2</sup> dan *Diadema setosum* pada 2 individu /100m<sup>2</sup>. Lokasi kajian diliputi oleh serpihan karang (47%), *Acropora* (43%), karang mati (1%) dan pasir (9%). Sebanyak 74% daripada kandungan perut terdiri daripada kalsium karbonat yang dihakis daripada karang, 11.6% adalah bahan organik dan 14% adalah sisa yang tidak terlarut. Kadar bioerosi melebihi kadar herbivori untuk semua spesies landak laut yang dikaji. Spesies yang bersaiz paling kecil iaitu *D. setosum* (5.4±0.65sm) menunjukkan kadar bioerosi dan kadar herbivore yang tertinggi (2.42±1.6g CaCO<sub>3</sub> individu<sup>-1</sup> hari<sup>-1</sup> dan 0.33 ± 0.14g alga individu<sup>-1</sup> hari<sup>-1</sup>). Kadar pemakanan kedua-dua spesies *E. diadema* dan *E. calamaris* yang bersaiz besar tidak dipengaruhi oleh gangguan seperti tekanan yang disebabkan oleh tindakan ombak yang kuat dan juga masalah aerasi dalam

kajian ini. Walaubagaimanapun, *Diadema setosom* hanya memakan sedikit substrata apabila menghadapi tekanan. *Diadema setosom* nyata memakan lebih dalam keadaan yang tenang dan boleh memakan sebanyak  $3.64 \pm 1.0$  g  $\text{CaCO}_3$  individu<sup>-1</sup> hari<sup>-1</sup>, diikuti dengan *E. diadema*  $2.8 \pm 2.2$  g  $\text{CaCO}_3$  individu<sup>-1</sup> hari<sup>-1</sup> g dan *E. calamaris*  $2.4 \pm 1.0$  g  $\text{CaCO}_3$  individu<sup>-1</sup> hari<sup>-1</sup>.