



**UNIVERSITI PUTRA MALAYSIA**

**HEAVY METAL CONCENTRATION LEVEL IN FIDDLER CRAB (*UCA ANNULIPES*) AND SOLDIER CRAB (*DOTILLA MYCTIROIDES*) IN INTERTIDAL AREAS OF THE WEST COAST, PENINSULAR MALAYSIA**

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**MOHD IKRAM BIN MOHAMMAD**

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By

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**March 2010**

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The study investigated the distribution concentration levels of heavy metals Zn, Cu, Cd and Pb in *Uca annulipes* and *Dotilla myctiroides* crabs with addition to sediment samples that were collected from the intertidal areas of Selangor (5 sites) and Negeri Sembilan (3 sites), west coast of Peninsular Malaysia. The particle size distribution (clay, silt and sand fraction) and organic matter content in sediment samples collected were also determined because these factors can play important roles in influencing the heavy metals concentration level in crabs.

The mean heavy metals concentration level ( $\mu\text{g/g}$  dry weight) in whole body of *U. annulipes* and *D. myctiroides* were found to range from 69.94 – 77.20, 45.81 – 104.93, 1.65 – 2.40 and 21.35 – 30.32 for Zn, Cu, Cd and Pb, respectively. The patterns of heavy metals distribution in both crab species of the different sampling stations were found to be  $\{\text{Cu} > \text{Zn}\}$  or  $\{\text{Zn} > \text{Cu}\} > \text{Pb} > \text{Cd}$ , where the highest were usually found for Zn and Cu which were not consistent in their order, and the lowest were found for Cd and Pb. This was explained due to the different function of

heavy metals in crabs such as for essential purpose, sequestration and even to be excreted. As for sediments, the mean heavy metals concentration level ( $\mu\text{g/g}$  dry weight) were found to range from 7.26 – 47.59, 1.51 – 15.19, 0.11 – 0.37 and 5.83 – 47.59 for Zn, Cu, Cd and Pb, respectively. The present levels of heavy metals in sediments of the different sampling stations were found to be low when compared to few sediment quality guideline and background level, indicating the relatively uncontaminated metal pollution conditions in which crabs inhabited.

A higher heavy metals concentration level was generally recorded in *U. annulipes* when compared to those of *D. myctiroides*. This difference was related to the particle size distribution and organic matter percentages (%) of the crab microhabitat sediment settings. Results showed that a significantly ( $p < 0.05$ ) higher distribution of the fine particles (clay and silt) and organic matter content were found in sediments inhabited by *U. annulipes* when compared to those sediments inhabited by *D. myctiroides* which had significantly ( $p < 0.05$ ) lower distribution. The fact that fine particles and organic matter of sediments have capability to bind heavy metals and crabs feed by scraping of surface sediments, hence the crabs potential to bioaccumulate heavy metals bonded onto fine particles and organic matter of sediments can assume to be higher for *U. annulipes* when compared to *D. myctiroides*. This therefore might explain the differences in heavy metals concentration level observed in *U. annulipes* and *D. myctiroides* which is much related to crabs preferences for different microhabitat sediment settings and daily crab activity of feeding. This ability of *U. annulipes* and *D. myctiroides* to bioaccumulate heavy metals from sediments may also be important in order to

facilitate them as potential biomonitor organism for the monitoring of heavy metal pollution in the intertidal area of west Peninsular Malaysia.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

**ARAS KEPEKATAN LOGAM BERAT DALAM KETAM FIDDLER (*UCA ANNULIPES*) DAN KETAM SOLDIER (*DOTILLA MYCTIROIDES*) DI KAWASAN PASANG SURUT PERSISIRAN PANTAI BARAT, SEMENANJUNG MALAYSIA**

Oleh

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Kajian ini menyiasat aras kepekatan distribusi logam berat Zn, Cu, Cd and Pb dalam ketam *Uca annulipes* dan *Dotilla myctiroides* seiringan sampel sedimen yang dikumpulkan daripada kawasan pasang surut Selangor (5 kawasan) dan Negeri Sembilan (3 kawasan), persisiran pantai barat Semenanjung Malaysia. Distribusi saiz partikel (bahagian liat, kelodak dan pasir) dan kandungan bahan organik dalam sampel sedimen yang dikumpulkan itu turut juga diukur kerana faktor ini boleh memainkan peranan penting dalam mempengaruhi aras kepekatan logam berat dalam ketam.

Aras kepekatan ( $\mu\text{g/g}$  berat kering) purata logam berat dalam keseluruhan badan *U. annulipes* dan *D. Myctiroides* adalah berada dalam lingkungan 69.94 – 77.20, 45.81 – 104.93, 1.65 – 2.40 dan 21.35 – 30.32 untuk Zn, Cu, Cd dan Pb. Corak distribusi logam berat dalam kedua spesis ketam yang dikaji daripada setiap lokasi kajian didapati sebagai  $\{\text{Cu} > \text{Zn}\}$  or  $\{\text{Zn} > \text{Cu}\} > \text{Pb} > \text{Cd}$ , di mana Zn dan Cu adalah

tidak konsisten coraknya iaitu berubah-ubah serta mempunyai nilai kepekatan paling tinggi, manakala Cd dan Pb mempunyai nilai kepekatan rendah. Ini diterangkan melalui perbezaan fungsi logam berat di dalam ketam iaitu sama ada digunakan untuk tujuan kemandirian, diasingkan dan juga perlu disingkirkan. Bagi sedimen, aras kepekatan ( $\mu\text{g/g}$  berat kering) purata logam berat adalah berada dalam lingkungan 7.26 – 47.59, 1.51 – 15.19, 0.11 – 0.37 dan 5.83 – 47.59 untuk Zn, Cu, Cd dan Pb. Aras kepekatan logam berat dalam sedimen daripada setiap lokasi kajian didapati masih di tahap rendah berbanding dengan beberapa tahap garis panduan kualiti sedimen dan juga aras latar belakang logam berat tersedia ada, dan seterusnya menandakan tahap pencemaran logam berat dalam sedimen yang didiami ketam masih tidak tercemar.

Aras kepekatan logam berat secara umumnya direkodkan lebih tinggi dalam *U. annulipes* berbanding dalam *D. myctiroides*. Perbezaan ini dikaitkan dengan peratusan (%) distribusi saiz partikel dan kandungan bahan organik yang terdapat di dalam sedimen persekitaran mikro ketam. Keputusan kajian telah mendapati distribusi saiz partikel sedimen yang kecil (liat dan kelodak) serta kandungan bahan organik adalah paling tinggi dan signifikan ( $p < 0.05$ ) nilai peratusannya dalam sedimen yang didiami oleh *U. annulipes* berbanding sedimen yang didiami *D. myctiroides* yang rendah dan signifikan ( $p < 0.05$ ) distribusinya. Oleh kerana saiz partikel sedimen yang kecil dan bahan organik mempunyai keupayaan untuk mengikat logam berat serta tabiat ketam yang memakan secara mengambil cebisan permukaan sedimen, maka potensi untuk *U. annulipes* mengambil logam berat yang mengikat kepada saiz partikel sedimen yang kecil dan bahan organik boleh dianggap tinggi berbanding dengan *D. myctiroides*. Ini secara tidak langsung menerangkan

perbezaan dalam aras kepekatan logam berat yang didapati dalam *U. annulipes* dan *D. myctiroides* yang sangat berkisar terhadap pemilihan sedimen oleh ketam dalam persekitaran mikro mereka, dan aktiviti seharian ketam iaitu memakan sedimen. Keupayaan *U. annulipes* dan *D. myctiroides* untuk memakan dan mengambil logam berat yang mengikat kepada sedimen juga penting dalam menentukankan potensi ketam sebagai agen penunjuk biologi bagi pencemaran logam berat di kawasan pasang surut persisiran pantai barat Semenanjung Malaysia.



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I certify that a Thesis Examination Committee has met on 4 March 2010 to conduct the final examination of Mohd Ikram Bin Mohammad on his thesis entitled “Heavy Metal Concentration Level in Fiddler Crab (*Uca annulipes*) and Soldier Crab (*Dotilla myctiroides*) in Intertidal Areas of the West Coast, Peninsular Malaysia” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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Date : 15 July 2010

## **DECLARATION**

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

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**MOHD IKRAM BIN MOHAMMAD**

Date : 27 May 2010

## TABLE OF CONTENTS

	<b>Page</b>
<b>ABSTRACT</b>	ii
<b>ABSTRAK</b>	v
<b>ACKNOWLEDGEMENTS</b>	viii
<b>APPROVAL</b>	ix
<b>DECLARATION</b>	xi
<b>LIST OF TABLES</b>	xv
<b>LIST OF FIGURES</b>	xxi
<b>LIST OF ABBREVIATIONS</b>	xxiv
<b>CHAPTER</b>	
<b>1 INTRODUCTION</b>	
1.1 General	1
1.2 Objectives of the Study	4
<b>2 LITERATURE REVIEW</b>	
2.1 Pollution in the Straits of Malacca	6
2.2 Geochemical Properties of the Sediments	10
2.3 Intertidal Crab as <i>Insitu</i> Biomonitor Indicator	18
2.4 Crustacean <i>Uca annulipes</i> (Fiddler crabs)	25
2.5 Crustacean <i>Dotilla myctiroides</i> (Soldier crabs)	29
<b>3 MATERIALS AND METHODS</b>	
3.1 Study Area	34
3.2 Sample Collection, Storage and Preparations (Water, Sediment, Pellet and Crab)	37
3.2.1 Water Samples	37
3.2.2 Sediment Samples	40
3.2.3 Pellet Samples	41
3.2.4 Crab Samples	44
3.3 Measurements of <i>Insitu</i> Water Physicochemical Parameters	47
3.4 Digestion of Samples (Sediment, Pellet and Crab) for Heavy Metals Determination	47
3.4.1 Acid Digestion (Sediment, Pellet and Crab Samples)	48
3.4.2 Sequential Extraction Technique (SET)	50
3.5 Heavy Metal Analysis	55
3.6 Determination of Organic Matter Content	56
3.7 Quality Assurance and Assessment	57
3.7.1 Equipment Cleaning and Preparation for Laboratory Analysis	57
3.7.2 Blank: Checking for External Contamination	58
3.7.3 Analytical Quality Control Sample	59
3.8 Particle Size Distribution Analysis	64
3.9 Bioconcentration Factor (BCF) Calculations	71
3.10 Statistical Analysis	71

<b>4</b>	<b>RESULTS</b>	
4.1	<i>In situ</i> overlaying water physicochemical parameters	73
4.2	Heavy metals concentration level in overlaying water	76
4.3	Heavy metals concentration level in sediments	78
4.4	Heavy metals concentration level in intertidal crabs	84
4.5	Geochemical fraction (SET) of heavy metals concentration level in sediments	87
4.6	Correlation of heavy metals concentration level in intertidal crabs with sediments (SET and Total acid digestion) and water	95
4.7	Bioconcentration Factor (BCF)	98
4.8	Heavy metals concentration level in <i>U. annulipes</i> and <i>D. myctiroides</i> feeding pellets	102
4.9	Particle size distribution	108
4.9.1	Particle size distribution (clay, silt and sand fraction) in <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediments	108
4.9.2	Particle size distribution (clay, silt and sand fraction) in <i>U. annulipes</i> and <i>D. myctiroides</i> feeding pellets	113
4.10	Organic matter content	119
4.10.1	Organic matter content in <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediments	119
4.10.2	Organic matter content in <i>U. annulipes</i> and <i>D. myctiroides</i> feeding pellets	121
4.11	Correlation between heavy metals concentration level with body weight and carapace width of <i>U. annulipes</i> and <i>D. myctiroides</i> crabs	126
<b>5</b>	<b>DISCUSSION</b>	
5.1	<i>In situ</i> physicochemical parameters of overlaying water samples from <i>U. annulipes</i> and <i>D. myctiroides</i> habitat surroundings	131
5.2	Heavy metals concentration level in overlaying water samples from <i>U. annulipes</i> and <i>D. myctiroides</i> habitat surroundings	143
5.3	Heavy metals concentration level in <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediments	149
5.4	Heavy metals concentration level in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs	169
5.5	Comparison between ‘resistant’ and ‘non-resistant’ geochemical fraction (SET) of heavy metals concentration level in <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediments	179
5.6	Geochemical fraction (SET) of heavy metals concentration level in <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediments and their relationship with the intertidal crabs	180
5.7	Intertidal crabs as biomonitors through correlation analysis of heavy metals concentration level in crabs with sediments (SET and Total acid digestion) and water	185
5.8	Bioconcentration of heavy metals in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs	188
5.9	Heavy metals uptake through analysis of <i>U. annulipes</i> and <i>D. myctiroides</i> feeding pellets	193
5.10	Particle size distribution and its association with heavy metals concentration level in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs	196

5.11	Organic matter and its association with heavy metals concentration level in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs	203
5.12	Relationships between heavy metals concentration level with body weight and carapace width of <i>U. annulipes</i> and <i>D. myctiroides</i> crabs	209
<b>6</b>	<b>CONCLUSIONS</b>	
6.1	General Conclusions	215
6.2	Recommendations for Future Research	223
	<b>REFERENCES</b>	226
	<b>APPENDICES</b>	248
	<b>BIODATA OF STUDENT</b>	254
	<b>LIST OF PUBLICATIONS</b>	254

## LIST OF TABLES

Table		Page
1	Sources of heavy metal pollution in the Straits of Malacca, west coast of Peninsular Malaysia	9
2	The levels of heavy metals concentration in different species of fishes, bivalves, gastropods and crustaceans from few Malaysian studies. Values are presented as $\mu\text{g/g}$ dry weight basis, except where stated otherwise	21
3	The location, geographical position, sediment type (USDA classification scheme), crab species collected, sampling dates and site description of sampling stations for the sampling of <i>U. annulipes</i> and <i>D. myctiroides</i> crab species, sediment, feeding pellet and overlaying water samples collected from the intertidal areas of Selangor and Negeri Sembilan, west coast of Peninsular Malaysia. (St = Station; Lat = Latitude; Long = Longitude)	36
4	The instrument setting and sensitivity of the air-acetylene flame atomic absorption spectrophotometer (FAAS) model AAnalyst800	55
5	A comparison of the measured results ( $\mu\text{g/g}$ dry weight) of the CRM (Certified Reference Material) for soil (International Atomic Energy Agency, Soil-5, Vienna, Austria) and dogfish liver (DOLT-3, National Research Council Canada) with their certified concentration for Zn, Cu, Cd and Pb. (Note: NA - Not available)	59
6	Correlation coefficient and comparative results of metals analysis by total acid digestion and sequential extraction technique in sediment samples (N = 46) based on mean concentrations ( $\mu\text{g/g}$ dry weight) of Zn, Cu, Cd and Pb	60
7	The percentage (%) of recovery between measured value of overlaying water sample (unspiked sample) and measured value of spiked (1 mg/L) overlaying water sample for the heavy metal Zn collected from the different sampling stations of Selangor and Negeri Sembilan, west coast of Peninsular Malaysia. (St = Station; SE = Standard Error)	62
8	The percentage (%) of recovery between measured value of overlaying water sample (unspiked sample) and measured value of spiked (1 mg/L) overlaying water sample for the heavy metal Cu collected from the different sampling stations of Selangor and Negeri Sembilan, west coast of Peninsular Malaysia. (St = Station; SE = Standard Error)	62



9	The percentage (%) of recovery between measured value of overlaying water sample (unspiked sample) and measured value of spiked (0.2 mg/L) overlaying water sample for the heavy metal Cd collected from the different sampling stations of Selangor and Negeri Sembilan, west coast of Peninsular Malaysia. (St = Station; SE = Standard Error)	63
10	The percentage (%) of recovery between measured value of overlaying water sample (unspiked sample) and measured value of spiked (1 mg/L) overlaying water sample for the heavy metal Pb collected from the different sampling stations of Selangor and Negeri Sembilan, west coast of Peninsular Malaysia. (St = Station; SE = Standard Error)	63
11	<i>In situ</i> physicochemical parameter measurements in the overlaying water samples (mean $\pm$ standard error) taken from <i>U. annulipes</i> and <i>D. myctiroides</i> habitat surroundings of the different sampling stations. (N = 9)	74
12	Levels of heavy metals concentration in the overlaying water samples (mean mg/L $\pm$ standard error) collected from <i>U. annulipes</i> and <i>D. myctiroides</i> habitat surroundings of the different sampling stations. (N = 9)	77
13	Levels of heavy metals concentration in the <i>U. annulipes</i> microhabitat sediments (mean $\mu\text{g/g}$ $\pm$ standard error) collected from the different sampling stations. (N = 9)	79
14	Levels of heavy metals concentration in the <i>D. myctiroides</i> microhabitat sediments (mean $\mu\text{g/g}$ $\pm$ standard error) collected from the different sampling stations	80
15	Levels of heavy metals concentrations in the <i>U. annulipes</i> and <i>D. myctiroides</i> crab species (mean $\mu\text{g/g}$ $\pm$ standard error) collected from the different sampling stations and their heavy metals occurrence pattern. The heavy metals occurrence patterns are not based on statistical analysis	85
16	Geochemical fraction of Zn in the <i>U. annulipes</i> microhabitat sediments (Mean $\mu\text{g/g}$ $\pm$ standard error) (N = 3)	88
17	Geochemical fraction of Cu in the <i>U. annulipes</i> microhabitat sediments (Mean $\mu\text{g/g}$ $\pm$ standard error) (N = 3)	88
18	Geochemical fraction of Cd in the <i>U. annulipes</i> microhabitat sediments (Mean $\mu\text{g/g}$ $\pm$ standard error) (N = 3)	89
19	Geochemical fraction of Pb in the <i>U. annulipes</i> microhabitat sediments (Mean $\mu\text{g/g}$ $\pm$ standard error) (N = 3)	89

20	Geochemical fraction of Zn in the <i>D. myctiroides</i> microhabitat sediments (Mean $\mu\text{g/g} \pm$ standard error) (N = 3)	92
21	Geochemical fraction of Cu in the <i>D. myctiroides</i> microhabitat sediments (Mean $\mu\text{g/g} \pm$ standard error) (N = 3)	92
22	Geochemical fraction of Cd in the <i>D. myctiroides</i> microhabitat sediments (Mean $\mu\text{g/g} \pm$ standard error) (N = 3)	93
23	Geochemical fraction of Pb in the <i>D. myctiroides</i> microhabitat sediments (Mean $\mu\text{g/g} \pm$ standard error) (N = 3)	93
24	The Pearson's correlation coefficient of heavy metal concentrations (Zn, Cu, Cd and Pb) in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs with SET geochemical fractions of heavy metal concentrations (Zn, Cu, Cd and Pb) in their respective microhabitat sediments ( <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediments) based on $\log_{10}(\text{mean} + 1)$ transformed data ( <i>U. annulipes</i> , N = 24; <i>D. myctiroides</i> , N = 21)	95
25	The Pearson's correlation coefficient of heavy metal concentrations (Zn, Cu, Cd and Pb) in <i>U. annulipes</i> crabs with heavy metal concentrations (Zn, Cu, Cd and Pb) in their respective microhabitat sediments and water samples based on $\log_{10}(\text{mean} + 1)$ transformed data (N = 72)	97
26	The Pearson's correlation coefficient of heavy metal concentrations (Zn, Cu, Cd and Pb) in <i>D. myctiroides</i> crabs with heavy metal concentrations (Zn, Cu, Cd and Pb) in their respective microhabitat sediments and water samples based on $\log_{10}(\text{mean} + 1)$ transformed data (N = 63)	98
27	Bioconcentration factors (BCF) of heavy metals in <i>U. annulipes</i> and <i>D. myctiroides</i> in the sampling period of June–August	99
28	Levels of heavy metals concentration in the feeding pellets (mean $\mu\text{g/g} \pm$ standard error) produced by the <i>U. annulipes</i> crabs collected from the different sampling stations	103
29	Levels of heavy metals concentration in the feeding pellets (mean $\mu\text{g/g} \pm$ standard error) produced by the <i>D. myctiroides</i> crabs collected from the different sampling stations	104
30	The uptake ratio of heavy metals in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs. Calculations are based on the mean concentration values of heavy metals within crabs respective microhabitat sediment and pellet samples from the overall sampling stations	108

31	The mean $\pm$ standard error of particle size distribution (clay%, silt% and sand% fraction) in the microhabitat sediments occupied on by the <i>U. annulipes</i> crabs collected from the different sampling stations. Soil texture class (USDA) given are based on the mean percentage (%) value of the clay, silt and sand fraction of sediments	109
32	The mean $\pm$ standard error of particle size distribution (clay%, silt% and sand% fraction) in the microhabitat sediments occupied on by the <i>D. myctiroides</i> crabs collected from the different sampling stations. Soil texture class (USDA) given are based on the mean percentage (%) value of the clay, silt and sand fraction of sediments	109
33	Sampling stations and mean $\pm$ standard error of particle size distribution (clay%, silt% and sand% fraction) in the feeding pellets produced by the <i>U. annulipes</i> crabs. Soil texture class (USDA) given are based on the mean percentage (%) value of clay, silt and sand fraction in the pellet samples	114
34	Sampling stations and mean $\pm$ standard error of particle size distribution (clay%, silt% and sand% fraction) in the feeding pellets produced by the <i>D. myctiroides</i> crabs. Soil texture class (USDA) given are based on the mean percentage (%) value of clay, silt and sand fraction in the pellet samples	114
35	The particle size uptake percentage (%) of clay, silt and sand fraction in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs. Calculations are based on the mean percentage (%) values of clay, silt and sand fraction within the crabs microhabitat sediment and pellet samples from the overall sampling stations	118
36	Sampling stations and mean $\pm$ standard error values of organic matter content (%) in the feeding pellets produced by the <i>U. annulipes</i> and <i>D. myctiroides</i> crabs. (Note: NA - Not Available)	122
37	The estimation percentage (%) of organic matter uptake in <i>U. annulipes</i> and <i>D. myctiroides</i> crabs which were calculated based on the mean percentage values of organic matter content in the crabs microhabitat sediment and pellet samples from the overall sampling stations	125
38	Levels of heavy metals concentration in the <i>U. annulipes</i> and <i>D. myctiroides</i> crab species that were independently processed at the level of individual samples (mean $\mu\text{g/g}$ wet weight basis $\pm$ standard error) collected from the different sampling stations	127
39	Comparisons of physicochemical parameter measurements from other reported studies	133

40	Comparisons of heavy metals concentration in water samples with those of other studies and legal standards set by different countries. All values are presented in mg/L	146
41	Comparisons of heavy metals concentrations in crabs microhabitat sediments with other reported studies, background levels, ERL and ERM. All values are presented in $\mu\text{g/g}$ dry weight	167
42	Comparisons of heavy metals occurrence patterns and levels of concentrations with those of other reported studies for crabs and crustaceans. The heavy metals occurrence patterns are not based on statistical analysis. Values are presented as $\mu\text{g/g}$ dry and wet weight basis	174
43	Comparisons of heavy metals in crabs with those of other reported studies on different taxonomic (gastropods, bivalves and barnacle) group species. Values are presented as $\mu\text{g/g}$ dry weight basis, except where stated otherwise	176
44	The means $\pm$ standard error of particle size distribution (%) in the microhabitat sediments occupied on by the <i>U. annulipes</i> crabs collected from eight different sampling stations. Soil texture class (USDA) given are based on the mean percentage (%) value of the clay, silt and sand fraction of sediments	248
45	The means $\pm$ standard error of particle size distribution (%) in the microhabitat sediments occupied on by the <i>D. myctiroides</i> crabs collected from seven different sampling stations. Soil texture class (USDA) given are based on the mean percentage (%) value of the clay, silt and sand fraction of sediments	248
46	The means $\pm$ standard error of particle size distribution (%) in the pellets produced by the <i>U. annulipes</i> crabs. Soil texture class (USDA) given are based on the mean percentage (%) value of clay, silt and sand fraction in the pellet samples	249
47	The means $\pm$ standard error of particle size distribution (%) in the pellets produced by the <i>D. myctiroides</i> crabs. Soil texture class (USDA) given are based on the mean percentage (%) value of clay, silt and sand fraction in the pellet samples	249
48	Levels of heavy metals concentration (mean $\mu\text{g/g}$ dry weight) in the <i>U. annulipes</i> microhabitat sediments collected from the different sampling stations in the sampling period of June–August	250
49	Levels of heavy metals concentration (mean $\mu\text{g/g}$ dry weight) in the <i>D. myctiroides</i> microhabitat sediments collected from the different sampling stations in the sampling period of June–August	251

- 50 The heavy metals (Zn, Cu, Cd and Pb) concentration in surface sediments, overlaying water samples, *U. annulipes* and *D. myctiroides* crab species collected from the different sampling stations in the sampling period of June–August 252

## LIST OF FIGURES

Figure		Page
1	Map and the sampling stations along the Selangor and Negeri Sembilan intertidal coastal area, west coast of Peninsular Malaysia. (A) Muddy substrates inhabited by <i>U. annulipes</i> ; (B) <i>U. annulipes</i> ; (C) Sandy substrates inhabited by <i>D. myctiroides</i> ; and (D) <i>D. myctiroides</i>	35
2	A general systematic chart diagram on the sample collection of water, sediment, feeding pellet and crab species, the samples preparation stages in the laboratory, and the different analysis subjected onto the samples collected	38
3	The feeding pellets or tiny ball like structures produced by <i>U. annulipes</i> crab species during feeding activities that were found scattered on the surface microhabitat sediments surrounding their burrow entrance	42
4	The feeding pellets produced by <i>D. myctiroides</i> crab species that were found scattered on the surface microhabitat sediments surrounding their burrow entrance	42
5	The <i>U. annulipes</i> crab species collected for heavy metal analysis	45
6	The <i>D. myctiroides</i> crab species collected for heavy metal analysis	45
7	Acid digestion procedure of <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediment and pellet samples	49
8	Acid digestion procedure of <i>U. annulipes</i> and <i>D. myctiroides</i> crab samples (dry and wet/fresh weight basis)	50
9	The modified SET procedure for the analysis of geochemical fractions of heavy metals in the <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediment samples adopted from the method of Badri and Aston (1983)	52
10	Determination of organic matter content in <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediment and pellet samples	57
11	The different steps of particle size distribution analysis of <i>U. annulipes</i> and <i>D. myctiroides</i> microhabitat sediment and pellet samples	68
12	The USDA soil classification scheme	70

- 13 The total mean comparison of Zn (a), Cu (b), Cd (c) and Pb (d) concentrations between *U. annulipes* (N = 63) and *D. myctiroides* (N = 70) microhabitat sediments. The mean concentrations of Zn, Cu, Cd and Pb for the *U. annulipes* microhabitat sediments in station 8 was excluded out from the total mean comparison since none *D. myctiroides* microhabitat sediments were available for comparison with the *U. annulipes* microhabitat sediments. Bars with dissimilar alphabetical letters for the concentrations of Zn, Cu, Cd and Pb of *U. annulipes* and *D. myctiroides* microhabitat sediments are significantly different ( $p < 0.05$ ) as determined by Independent T-Test 83
- 14 The total mean comparison of Zn (a), Cu (b), Cd (c) and Pb (d) concentrations between *U. annulipes* (N pooled samples = 1245) and *D. myctiroides* (N pooled samples = 4220) crab species. The mean concentrations of Zn, Cu, Cd and Pb for the *U. annulipes* crabs in station 8 was excluded out from the total mean comparison since none *D. myctiroides* crabs were available for comparison with the *U. annulipes* crabs. Bars with dissimilar alphabetical letters for the concentrations of Zn, Cu, Cd and Pb of *U. annulipes* and *D. myctiroides* crabs are significantly different ( $p < 0.05$ ) as determined by Independent T-Test 86
- 15 The total mean comparison of Zn, Cu, Cd and Pb concentrations between sediment and pellet samples. Figures (a), (b), (c) and (d) shows the comparison of heavy metals between sediment (N = 72) and pellet (N = 71) samples for *U. annulipes* from the overall sampling stations. Bars with dissimilar alphabetical letters for the concentrations of Zn, Cu, Cd and Pb of sediment and pellet samples are significantly different ( $p < 0.05$ ) as determined by Independent T-Test 106
- 16 The total mean comparison of Zn, Cu, Cd and Pb concentrations between sediment and pellet samples. Figures (a), (b), (c) and (d) shows the comparison of heavy metals between sediment (N = 70) and pellet (N = 69) samples for *D. myctiroides* from the overall sampling stations. Bars with dissimilar alphabetical letters for the concentrations of Zn, Cu, Cd and Pb of sediment and pellet samples are significantly different ( $p < 0.05$ ) as determined by Independent T-Test 107
- 17 The total mean comparison of clay (a), silt (b) and sand (c) fraction percentage (%) between *U. annulipes* (N = 21) and *D. myctiroides* (N = 22) microhabitat sediments. The mean percentage (%) value of clay, silt and sand fraction for the *U. annulipes* microhabitat sediments in station 8 was excluded out from the total mean comparison since none *D. myctiroides* microhabitat sediments were available for comparison with the *U. annulipes* microhabitat sediments. Bars with dissimilar alphabetical letters for the clay (a), silt (b) and sand (c) fraction of *U. annulipes* and *D. myctiroides* 112

microhabitat sediments are significantly different ( $p < 0.05$ ) as determined by Independent T-Test

- 18 The total mean comparison of clay (a), silt (b) and sand (c) fraction percentage (%) between *U. annulipes* microhabitat sediment (N = 24) and pellet (N = 24) samples. Bars with dissimilar alphabetical letters for the clay (a), silt (b) and sand (c) fraction of sediment and pellet samples are significantly different ( $p < 0.05$ ) as determined by Independent T-Test 116
- 19 The total mean comparison of clay (a), silt (b) and sand (c) fraction percentage (%) between *D. myctiroides* microhabitat sediment (N = 22) and pellet (N = 23) samples. Bars with dissimilar alphabetical letters for the clay (a), silt (b) and sand (c) fraction of sediment and pellet samples are significantly different ( $p < 0.05$ ) as determined by Independent T-Test 117
- 20 The comparisons of organic matter content (%) between *U. annulipes* (N = 36) and *D. myctiroides* (N = 36) microhabitat sediment samples in each of the sampling stations. Station 8 (Tongkah - water canal area) was excluded since none *D. myctiroides* microhabitat sediments were available for comparison with the *U. annulipes* microhabitat sediments (Note: NA - Not Available), however, mean organic matter percentage values for *U. annulipes* microhabitat sediments were shown. Bars with dissimilar alphabetical letters for each sampling stations are significantly different ( $p < 0.05$ ) as determined by Independent T-Test 120
- 21 The total mean comparison of organic matter content (%) between *U. annulipes* microhabitat sediment (N = 288) and pellet (N = 288) samples. Bars with dissimilar alphabetical letters are significantly different ( $p < 0.05$ ) from each other as determined by Independent T-Test 124
- 22 The total mean comparison of organic matter content (%) between *D. myctiroides* microhabitat sediment (N = 252) and pellet (N = 252) samples. Bars with similar alphabetical letters are not significantly different ( $p > 0.05$ ) from each other as determined by Independent T-Test 124
- 23 The relationships between Zn, Cu, Cd and Pb concentrations [ $\text{Log}_{10}$  (mean +1)] with body weight and carapace width [ $\text{Log}_{10}$  (mean +1)] of *U. annulipes* (N = 547) crab samples. [with negative regressive equation as  $\log(Y) = \log(a) - b \log(X)$  except for Pb] 128
- 24 The relationships between Zn, Cu, Cd and Pb concentrations [ $\text{Log}_{10}$  (mean +1)] with body weight and carapace width [ $\text{Log}_{10}$  (mean +1)] of *D. myctiroides* (N = 466) crab samples. [with negative regressive equation as  $\log(Y) = \log(a) - b \log(X)$ ] 129



## LIST OF ABBREVIATIONS

$\mu\text{m}$	micrometre
mm	millimetre
cm	centimetre
m	metre
ml	millilitre
mg/L	milligram per litre
$\mu\text{g/L}$	microgram per litre
$\mu\text{g/g}$	microgram per gram
ppm	parts per million
M	molar volume
g	gram
%	percentage
$^{\circ}\text{C}$	degree Celsius
$\text{HClO}_4$	perchloric acid
HCl	hydrochloric acid
$\text{HNO}_3$	nitric acid
$\text{H}_3\text{PO}_4$	phosphoric acid
$\text{H}_2\text{O}_2$	hydrogen peroxide
$\text{H}_2\text{O}$	water
$\text{Na}_2\text{CO}_3$	sodium carbonate
NaOH	sodium hydroxide
$\text{NH}_4\text{CH}_3\text{COO}$	ammonium acetate
$\text{NH}_2\text{OH}\cdot\text{HCl}_2$	hydroxyl ammonium chloride