

**ECOLOGY OF EGRETS (ARDEIDAE) AT THE PALM  
OIL MILL EFFLUENT PONDS IN CAREY ISLAND,  
SELANGOR, PENINSULAR MALAYSIA**

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## **DEDICATION**

Specially dedicated to my beloved parents, brothers, sisters, and also to my wife and kids (Wafaa, Amani, Hassen and Saif Aleslam)

## ABSTRACT

Egrets (Aves: Ardeidae) are gregarious and cosmopolitan wading birds, widely distributed throughout the world and associated with wetland habitat particularly with shallow water covered with short vegetation or without vegetation for foraging. A wetland habitats are facing overwhelming pressure due to anthropogenic activities such as urbanization and conversion into agricultural fields which causes habitat loss and degradation that ultimately affects the population of different egret species. Egrets employ different foraging behaviours to exploit the wide range of prey items for their survival and reproduction. Study on egrets' relative abundance, foraging strategies, food diversity, and its relationships to the quality of water of various Palm Oil Mill Effluent (POME) ponds in Carey Island, Selangor, Peninsular Malaysia was conducted from January 2008 to December 2008. Egret's abundance was recorded using binoculars and a digital video camera, availability of their food resources was sampled by scope net, and water quality parameters were measured using YSI hydro lab. A total of 14,077 sightings of egrets was recorded. These egrets belong to five species, i.e. Little Egret (*Egretta garzetta*), Great Egret (*Casmerodius albus*), Cattle Egret (*Bubulcus cormorandus*), Intermediate Egret (*Mesophoyx intermedia*) and Chinese Egret (*Egretta eulophotes*). The ANOVA and Tukey's test showed that the relative abundance of Cattle, Intermediate and Chinese Egrets were significantly different from Little and Great Egrets ( $F_{4, 55} = 17.58, P < 0.05$ ). Results also indicated that Little Egrets had the highest probing activity (52 probes/minute) while Great Egrets had the lowest probing activity (5 probes/minute). It was observed that egrets employed different foraging strategies in obtaining aquatic invertebrates. Only Little Egret employs foot shuffling technique and only Cattle Egret glean the prey hidden

under soft mud. A total of 119,126 invertebrate larvae (belong to twelve species) were sampled by scoop nets. Larvae were sampled from POME ponds No. 3 (51.40%) and No. 1 (48.60%) but none were recorded from ponds two and four. Mosquito (*Aedes* sp.) larva was abundantly recorded (40.71%) while water scavenger beetles (*Hydrophilus* sp.) were the rarest (2.52%). The highest invertebrate species diversity was recorded in POME pond No. 1 (Shannon's  $N_1 = 2.21$ ) and POME pond No. 3 ( $N_1 = 2.17$ ) while the highest species evenness was recorded in June 2009 (Pielou's  $E = 0.89$  in pond No. 1 and  $E = 0.87$  in pond No. 3). The highest relative abundance of egrets was recorded in January 2008 (14.00%) and the lowest was recorded in August 2008 (3.36%). It was also found that egrets were active (22.33%) during the morning (from 0900 to 1000 hours) and less active (5.72%) during mid-day (1300 to 1400 hours). Relative abundance of egrets in POME pond No. 2 and No. 4 was significantly different ( $F_{3, 16} = 5.70, P < 0.05$ ). The highest egret's species diversity ( $N_1 = 3.82$ ) and evenness ( $E = 0.83$ ) were recorded in pond No. 1 but the highest egret's species richness was recorded in pond number three ( $R_1 = 0.46$ ). For water parameters, the highest water temperature ( $35.36^{\circ}\text{C}$ ), conductivity ( $5685 \mu\text{s}$ ), and turbidity ( $89.6\text{NTU}$ ) were recorded in pond No. 1 in January 2009 while the highest record for the dissolve oxygen ( $3.73\text{mg/l}$ ), pH (8.97), and ammonium concentration ( $28.05\text{mg/l}$ ) were recorded in February 2009. Pearson's Correlation Coefficient (PCC) test revealed that egret species have a weak relationship with water quality parameters, invertebrate abundance and a weak positive relationship between egret foraging activities. Based on the findings of this research, it is concluded that POME ponds one and three are highly important habitats and foraging sites for egrets. Food abundance and distribution are the most important factor in determining the quality of the feeding areas and habitat selection by egrets.

## ABSTRAK

Kajian tentang kelimpahan relatif, strategi mencari makanan, kepelbagaian makanan dan hubungan burung bangau (Aves: Ardeidae) terhadap kualiti air di pelbagai kolam buangan kilang minyak sawit (POME) di Pulau Carey, Selangor, Semenanjung Malaysia telah dijalankan dari Januari 2008 hingga Disember 2008. Kelimpahan burung bangau direkodkan dengan menggunakan teropong dan kamera video digital, kewujudan sumber makanan mereka telah disampel dengan menggunakan penyodok jaring dan parameter kualiti air telah diukur menggunakan makmal hidro YSI. Sebanyak 14,077 pemerhatian bangau telah direkodkan. Bangau ini terbahagi kepada lima spesies iaitu Little Egret (*Egretta garzetta*), Great Egret (*Casmerodius albus*), Cattle Egret (*Bubulcus cormorandus*), Intermediate Egret (*Mesophoyx intermedia*) dan Egret Cina (*Egretta eulophotes*). Ujian ANOVA dan Tukey menunjukkan bahawa kelimpahan relatif di antara Cattle Egret, Intermediate Egret dan Egret Cina adalah berbeza secara bererti daripada Little Egret dan Great Egret ( $F_{4, 55} = 17.58, P < 0.05$ ). Dapatan juga menunjukkan bahawa Little Egret mempunyai aktiviti pendugaan tertinggi (52 kali/minit) manakala Great Egret mempunyai aktiviti pendugaan terendah (5 kali/minit). Juga telah diperhatikan bahawa strategi bangau mencari invertebrata akuatik adalah berbeza. Hanya Little Egret menggunakan teknik mengocak kaki dan hanya Cattle Egret mengutip mangsa tersembunyi di bawah lumpur lembut. Sejumlah 119,126 larva invertebrata (tergolong kepada dua belas spesies) telah disampel dengan penyodok jaring. Larva telah disampel dari kolam POME nombor tiga (51.40%) dan nombor satu (48.60%), tetapi tidak direkodkan dari kolam nombor dua dan empat. Larva nyamuk (*Aedes* sp.) telah direkodkan dengan banyaknya (40.71%) manakala kumbang air pemakan bangkai (*Hydrophilus* sp.) amat

jarang ditemui (2.52%). Jumlah tertinggi kepelbagaian spesies invertebrata telah direkodkan di kolam POME satu (Shannon  $N_1 = 2.21$ ) dan kolam POME tiga ( $N_1 = 2.17$ ) manakala kesamaan spesies tertinggi telah direkodkan pada Jun 2009 (Pielou  $E = 0.89$  dalam kolam satu dan  $E = 0.87$  dalam kolam tiga). Jumlah kelimpahan relatif tertinggi bangau dicatatkan pada Januari 2008 (14.00%) dan jumlah terendah direkodkan pada Ogos 2008 (3.36%). Juga didapati bangau aktif (22.33%) pada waktu pagi (jam 09.00 – 10.00) dan kurang aktif (5.72%) pada waktu tengah hari (jam 13.00 – 14.00). Kelimpahan relatif bangau di kolam POME dua dan empat adalah berbeza secara bererti ( $F_{3, 16} = 5.70$ ,  $P < 0.05$ ). Kepelbagaian tertinggi spesies bangau ( $N_1 = 3.82$ ) dan kesamaan ( $E = 0.83$ ) telah direkodkan di kolam satu tetapi kekayaan spesies bangau tertinggi dicatatkan di kolam tiga ( $R_1 = 0.46$ ). Bagi parameter air, suhu tertinggi air ( $35.36^{\circ}\text{C}$ ), konduktiviti ( $5685 \mu\text{s}$ ), dan kekeruhan ( $89.6^{\circ}$ ) direkodkan di kolam satu pada Januari 2009 manakala rekod tertinggi bagi kemasinan (2.1%), oksigen terlarut ( $3.73\text{mg/l}$ ), pH (8.97) dan kepekatan ammonium ( $28.05\text{mg/l}$ ) telah direkodkan pada Februari 2009. Ujian Hubungkait Pearson's Correlation Coefficient (PCC) mendedahkan spesies bangau menunjukkan hubungkait lemah dengan parameter kualiti air, kelimpahan invertebrata, dan hubungkait lemah dengan aktiviti pemakanan. Keputusan kajian ini menunjukkan kolam POME merupakan habitat penting dan medan mencari makanan bangau. Kelimpahan dan taburan makanan merupakan factor penting di dalam menentukan kualiti kawasan pemakanan dan pemilihan habitat oleh bangau.

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## TABLE OF CONTENTS

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	Page
DECLARATION	i
ACKNOWLEDGEMENTS	ii
DEDICATION	iii
ABSTRACT	iv
TABLE OF CONTENTS	viii
LIST OF TABLES	xvii
LIST OF FIGURES	xvii
LIST OF APPENDICES	xxiv
CHAPTER	
1 INTRODUCTION	1
1.1 General Background	1
1.2 Distribution and Habitat Selection by Egrets	1
1.3 Egrets' Diet	2
1.4 Species Descriptions	6
1.4.1 Great Egret ( <i>Casmerodius albus</i> )	6
1.4.2 Little Egret ( <i>Egretta garzetta</i> )	7
1.4.3 Intermediate Egret ( <i>Mesophoyx intermedia</i> )	8
1.4.4 Cattle Egret ( <i>Bubulcus cormorandus</i> )	9
1.4.5 Chinese Egret ( <i>Egretta eulophotes</i> )	11
1.5 Palm Oil Mill Effluent (POME) Ponds	12
1.6 Problem Statement	15
1.7 Objectives	16
	viii



1.8	Null Hypothesis	17
1.9	Why Egrets Were Selected For the Ecological Study?	18
1.10	Research Framework	19
2	EGRETS ABUNDANCE AND DIVERSITY	21
2.1	Introduction	21
2.2	Objectives	23
2.3.1	Study Site	24
2.3.2	Egrets Surveys	29
2.4.	Data Analysis	31
2.4.1	Egret Relative Abundance	31
2.4.2	Analysis of Variance	31
2.4.3	Tukey's (HSD) Test	33
2.4.4	Egret Species Diversity	34
2.5	Results	35
2.5.1	Species Composition	35
2.5.2	Hourly Relative Abundance	36
2.5.3	Monthly and Hourly Relative Abundance of Egrets	39
2.5.3.1	Monthly and Hourly Relative Abundance of Little Egrets	39
2.5.3.2	Monthly and Hourly Relative Abundance of Great Egrets	39
2.5.3.3	Monthly and Hourly Relative Abundance of Cattle Egrets	42
2.5.3.4	Monthly and Hourly Relative Abundance of Intermediate Egrets	44
2.5.3.5	Monthly and Hourly Relative Abundance of Chinese Egrets	44
2.5.4	Monthly Variation in Egrets Relative Abundance	47

2.5.5	Variation in Egrets Relative Abundance According to Ponds	47
2.5.5.1	Relative Abundance of Little Egret among Four POME Ponds for Twelve Consecutive Months	49
2.5.5.2	Relative Abundance of Great Egret in Four POME Ponds for Twelve Consecutive Months	51
2.5.5.3	Relative Abundance of Cattle Egret at Four POME Ponds for Twelve Consecutive Months	51
2.5.5.4	Relative Abundance of Intermediate Egret at Four POME Ponds for Twelve Consecutive Months	54
2.5.5.5	Relative Abundance of Chinese Egret at Four POME Ponds	54
2.6	Egrets Diversity	57
2.6.1	Egrets Diversity among Four POME ponds	57
2.6.2	Diversity of Little Egret in All Ponds	57
2.6.3	Diversity of Great Egret in All Ponds	60
2.6.4	Diversity of Intermediate Egret in All Ponds	60
2.6.5	Diversity of Cattle Egret in All Ponds	62
2.6.6	Diversity of Chinese Egret in All Ponds	62
2.7	Discussions	65
2.7.1	Species Abundance	65
2.7.2	Species Diversity	68
3	<b>DIVERSITY OF AQUATIC INSECTS AS FOOD RESOURCES FOR EGRETS THAT UTILIZE POME PONDS</b>	70
3.1	Introduction	70
3.2	Objectives	72

3.3	Materials and methods	72
3.3.1	Study Site	72
3.3.2	Sampling Food Resources	72
3.4	Data Analysis	73
3.4.1	Relative Abundance	73
3.4.2	Diversity Indices	75
3.4.3	Testing Significant Difference	75
3.4.4	Correlationship Between Egret and Aquatic Insect Relative Abundance	75
3.5	Results	76
3.5.1	Aquatic Insect Species Composition and Relative Abundance	76
	Mosquito ( <i>Aedes</i> sp.) Larvae	77
	Hoverflies ( <i>Eristalis</i> sp.)	78
	Water Beetles ( <i>Stenolopus</i> sp.)	80
	Water Diving Beetle ( <i>Eretes</i> sp.)	81
	Solitary Midges ( <i>Thaumalea</i> sp.)	82
	Midge Fly ( <i>Chironomus</i> sp.) Larvae	84
	Great Diving Beetles ( <i>Dytiscus</i> sp.)	85
	Water Bugs ( <i>Sphaerodema</i> sp.)	86
	Watersnipe Fly ( <i>Atherix</i> sp.) Larvae	88
	Predaceous Diving Beetle ( <i>Cybister</i> sp.)	89
	Horsefly ( <i>Tabanus</i> sp.)	90
	Water Scavenger Beetle ( <i>Hydrophilus</i> sp.)	91

3.5.2	Aquatic Insects Relative Abundance	92
3.5.3	Monthly Relative Abundance of Aquatic Insects in POME Pond Number One	94
3.5.4	Monthly Relative Abundance of Aquatic Insect in POME Pond Number Three	97
3.5.5	Diversity Indices of Aquatic Insects	100
3.5.5.1	Diversity of Aquatic Insects in POME Pond Number One	100
3.5.5.2	Diversity of I Aquatic Insects in POME Pond Number Three	100
3.5.6.1	Correlation between Little Egret's and Aquatic Insect's Relative Abundance in POME Pond Number One	102
3.5.6.2	Correlation between Little Egret's Aquatic Insect's Relative Abundance in POME Pond Number Three	103
3.5.6.3	Correlation between Great Egret's and Aquatic Insect's Relative Abundance in POME Pond Number One	104
3.5.6.4	Correlation between Great Egret's and Aquatic Insect's Relative Abundance in POME Pond Number Three	105
3.5.6.5	Correlation between Cattle Egret's and Aquatic Insect's Relative Abundance in POME Pond Number One	106
3.5.6.6	Correlation between Cattle Egret's and Invertebrate's Relative abundance in POME pond number Three	107
3.5.6.7	Correlation between Intermediate Egret's and Aquatic Insect's Relative Abundance in POME Pond Number One	108
3.5.6.8	Correlation between Intermediate Egret's and Aquatic	109

	Insect's Relative Abundance in POME Pond Number Three	
3.5.6.9	Correlation between Chinese Egret's and Aquatic Insect's Relative Abundance in POME Pond Number One	110
3.5.6.10	Correlation between Chinese Egret's and Aquatic Insect's Relative Abundance in POME Pond Number Three	111
3.6	Discussion	112
4	FORAGING STRATEGY OF EGRETS IN POME POND AREA	115
4.1	Introduction	115
4.2	Objectives	118
4.3	Materials and methods	118
4.3.1	Study Site	118
4.3.2	Observation of Foraging Behaviour	118
4.4	Data analysis	121
4.4.1	Relative Abundance	121
4.4.2	Analysis of Variance	122
4.4.3	Tukey's HSD Test	122
4.4.4	Correlation of Egret Probing and other Foraging Strategies with Aquatic Invertebrate Relative Abundance in POME ponds	122
4.5	Results	122
4.5.1	Probing Per Minutes	123
4.5.2	Other Foraging Strategies Employed by Egrets	126
4.5.3	Correlation of Egret Probing per Minute and Aquatic Insect	128

	Relative Abundance in POME pond Number one and pond number three	
4.5.4	Correlationship of Egret Foraging Strategies and Aquatic Insect Relative Abundance in POME pond Number one and pond number three	128
4.6	Discussion	129
5	THE QUALITY OF WATER OF VARIOUS POME PONDS	136
5.1	Introduction	136
5.2	Objectives	141
5.3	Materials and Methods	142
5.3.1	Study Site	142
5.3.2	Measurement of Water Quality Parameters	142
5.4	Data Analysis	143
5.4.1	Standard Deviation	143
5.4.2	Correlation between Egret's Relative Abundance and Water Quality Parameters	144
5.5	Results	144
5.5.1	Water Quality Parameters of POME Pond Number One	144
5.5.2	Water Quality Parameters of POME Pond Number Two	146
5.5.3	Water Quality Parameters of POME Pond Number Three	146
5.5.4	Water Quality Parameters of POME Pond Number Four	149
5.5.5	Mean Water Quality Parameters and Their Standard Deviation	149
5.6.1	Correlation between Little Egret Relative Abundance and	152

	Water Quality Parameters in POME Pond Number One	
5.6.2	Correlation between Little Egret Relative Abundance and Water Quality Parameters in POME Pond Number Three	152
5.6.3	Correlation between Great Egret Relative Abundance and Water Quality Parameters in POME Pond Number One	153
5.6.4	Correlation between Great Egret Relative Abundance and Water Quality Parameters in POME Pond Number Three	153
5.6.5	Correlation between Cattle Egret Relative Abundance and Water Quality Parameters in POME Pond Number One	154
5.6.6	Correlation between Cattle Egret Relative Abundance and Water Quality Parameters in POME Pond Number Three	154
5.6.7	Correlation between Intermediate Egret Relative Abundance and Water Quality Parameters in POME Pond Number One	155
5.6.8	Correlation between Intermediate Egret Relative Abundance and Water Quality Parameters in POME Pond Number Three	155
5.6.9	Correlation between Chinese Egret Relative Abundance and Water Quality Parameters in POME Pond Number One	156
5.6.10	Correlation between Chinese Egret Relative Abundance and Water Quality Parameters in POME Pond Number Three	156
5.6.11	Correlation between Aquatic Insects Relative Abundance and Water Quality Parameters in POME Pond Number One and Three	157

5.7	Discussion	157
6	General Discussion	164
	Conclusion	168
	Significance of Research	169
	Benefits of the Study	172
	Recommendations for Future Conservation and Management of POME Ponds of Carey Island, Peninsular Malaysia	173
7	References	174
8	Appendices	211

---



---

LIST OF TABLES

---

	Page
2.1 Comparison of four POME pond characteristics in Carey Island	25
2.2 Bird surveys schedule	30
2.3 Relative abundance of egrets sighted in POME ponds from January to December, 2008	36
2.4 Hourly and monthly relative abundance of all egret's species sighted at POME ponds in Carey Island	37
2.5 Monthly relative abundance of resident and migrant egret's species sighted at POME ponds in Carey Island	38
2.6 Monthly and hourly relative abundance of Little Egret	40
2.7 Monthly and hourly relative abundance of Great Egret	41
2.8 Monthly and hourly relative abundance of Cattle Egret	43
2.9 Monthly and hourly relative abundance of Intermediate Egret	45
2.10 Monthly and hourly relative abundance of Chinese Egret	46
2.11 Monthly variation in egrets relative abundance at Carey Island	48
2.12 Comparison of relative abundance of five egret species recorded at POME ponds of Carey Island	49
2.13 Monthly relative abundance of Little Egret among four POME ponds of Carey Island in 2008	50
2.14 Monthly relative abundance of Great Egret among four	52

	POME ponds of Carey Island	
2.15	Monthly relative abundance of Cattle Egret utilizing four POME ponds in Carey Island	53
2.16	Monthly relative abundance of Intermediate Egret in four POME ponds	55
2.17	Monthly relative abundance of Chinese Egret at four ponds	56
2.18	Diversity of egrets among four POME ponds in Carey Island	58
2.19	Diversity indices value of Little Egret utilizing four POME ponds in Carey Island	59
2.20	Diversity of Great Egret in all POME ponds of Carey Island	61
2.21	Diversity of Intermediate Egret in all POME ponds of Carey Island	61
2.22	Diversity of Cattle Egret in all POME ponds in Carey Island	63
2.23	Diversity of Chinese Egret in all POME ponds in Carey Island	64
3.1	List of invertebrates species sampled from POME ponds	77
3.2	List of invertebrates species with relative abundance recorded from all POME ponds	93
3.3	Monthly relative abundance of invertebrates recorded in POME pond number one from January to June 2010	95
3.4	Comparison of relative abundance of invertebrates in POME pond number one at Carey Island, Peninsular Malaysia	96
3.5	Monthly relative abundance of invertebrates inhabiting POME pond number three sampled from January to June	98

	2010	
3.6	Comparison of invertebrates relative abundance in POME pond number three at Carey Island, Peninsular Malaysia	99
3.7	Comparison of invertebrates diversity from January to June 2010 in POME pond number one	101
3.8	Comparison of invertebrates diversity from January to June 2010 in POME pond number three	101
3.9	Pearson's correlation coefficient between Little Egret relative abundance and invertebrate relative abundance in POME pond number one	102
3.10	Pearson's correlation coefficient between Little Egret relative abundance and invertebrate relative abundance in POME pond number three	103
3.11	Pearson's correlation coefficient between Great Egret relative abundance and invertebrate relative abundance in POME pond number one	104
3.12	Pearson's correlation coefficient between Great Egret relative abundance and invertebrate relative abundance in POME pond number three	105
3.13	Pearson's correlation coefficient between Cattle Egret relative abundance and invertebrate relative abundance in POME pond number one	106
3.14	Pearson's correlation coefficient between Cattle Egret relative abundance and invertebrate relative abundance in	107

	POME pond number three	
3.15	Pearson's correlation coefficient between Intermediate Egret relative abundance and invertebrate relative abundance in POME pond number one	108
3.16	Pearson's correlation coefficient between Intermediate Egret relative abundance and invertebrate relative abundance in POME pond number three	109
3.17	Pearson's correlation coefficient between Chinese Egret relative abundance and invertebrate relative abundance in POME pond number one	110
3.18	Pearson's correlation coefficient between Chinese Egret relative abundance and invertebrate relative abundance in POME pond number three	111
4.1	Average daily sightings and mean probing activity (in parenthesis) of Egrets utilizing POME ponds at different hours	125
4.2	Comparison of probing activity per minute between five Egrets species at POME ponds in Carey Island, Selangor	126
4.3	Frequency of foraging strategies employed by Egrets species in POME ponds of Carey Island, Peninsular Malaysia (n = total number of sightings)	127
5.1	The value of various water parameters sampled from POME pond number one in Carey Island	145
5.2	The value of various water parameters sampled from POME	147

pond number two in Carey Island

5.3	The values of various water parameters sampled from POME pond number three in Carey Island	148
5.4	The values of various water parameters sampled from POME pond number four in Carey Island	150
5.5	Value of various water parameters sampled from POME ponds in Carey Island	157

---

---

LIST OF FIGURES

---

	Page
1.1 Great Egret ( <i>Casmerodius albus</i> )	7
1.2 Little Egret ( <i>Egretta garzetta</i> )	8
1.3 Intermediate Egret ( <i>Mesophoyx intermedia</i> )	9
1.4 Cattle Egret ( <i>Bubulcus cormorandus</i> )	10
1.5 Chinese Egret ( <i>Egretta eulophotes</i> )	12
2.1 Location of study site in Carey Island, Selangor, Peninsular Malaysia	26
2.2 Location of POME ponds in Carey Island, Selangor, Peninsular Malaysia	27
2.3 Condition of POME pond number one of Carey Island, Selangor, Peninsular Malaysia	28
2.4 Condition of POME pond number two of Carey Island, Selangor, Peninsular Malaysia	28
2.5 Condition of POME pond number three of Carey Island, Selangor, Peninsular Malaysia	29
2.6 Condition of POME pond number four of Carey Island, Selangor, Peninsular Malaysia	29
3.1 Scoop net and square metal container	74
3.2 Plastic containers that contain water samples of POME pond's	74
3.3 Larvae of <i>Aedes</i> sp.	78
3.4 Hoverfly ( <i>Eristalis</i> sp.) larvae	79
3.5 Water beetle ( <i>Stenolophus</i> sp.) larvae	81

3.6	Water diving beetle ( <i>Eretes</i> sp.)	82
3.7	Solitary midges ( <i>Thaumalea</i> sp.)	83
3.8	Midge fly ( <i>Chironomus</i> sp.) larvae	85
3.9	Great diving beetles ( <i>Dytiscus</i> sp.) larvae	86
3.10	Water bugs ( <i>Sphaerodema</i> sp.)	87
3.11	Watersnipe flies ( <i>Atherix</i> sp.) larvae	88
3.12	Predaceous Diving Beetle ( <i>Cybister</i> sp.)	89
3.13	Housefly ( <i>Tabanus</i> sp.) larvae	91
3.14	Water scavenger beetles ( <i>Hydrophilus</i> sp.)	92
4.1	A tent was used as a hide during observation sessions	119
5.1	Number of mills, crushes and refineries in Malaysia	137
5.2	Water quality sampling using YSI 6600 Multi Parameters	142
5.3	YSI 6600 Multi Parameters	143

---

---

LIST OF APPENDICES

---

		Page
2.1	List of foraging behaviours employed by members of family Ardeidae	211
3.1	Analysis variance of relative abundance of invertebrates in POME pond number one at Carey Island, Peninsular Malaysia	215
3.2	Analysis variance of relative abundance of invertebrates in POME pond number three at Carey Island, Peninsular Malaysia	215

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