



UNIVERSITI PUTRA MALAYSIA

**SPECIES DIVERSITY AND DISTRIBUTION OF PLANKTONIC
COPEPODS IN THE STRAITS OF MALACCA**

JOHAN BIN ISMAIL

FSAS 2001 1

SPECIES DIVERSITY AND DISTRIBUTION OF PLANKTONIC COPEPODS
IN THE STRAITS OF MALACCA

JOHAN BIN ISMAIL

MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA
2001



**SPECIES DIVERSITY AND DISTRIBUTION OF PLANKTONIC COPEPODS
IN THE STRAITS OF MALACCA**

By

JOHAN BIN ISMAIL

**Thesis Submitted in Fulfillment of the Requirements for the Degree of
Master of Science in the Faculty of Science and Environmental Studies
Universiti Putra Malaysia**

November 2001



DEDICATION

To my

Wife, Nolly,

Son, Jazli,

Mom and Dad

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

**SPECIES DIVERSITY AND DISTRIBUTION OF PLANKTONIC COPEPODS
IN THE STRAITS OF MALACCA**

By

JOHAN ISMAIL

November 2001

Chairman : Drs. Idris Abd. Ghani

Faculty : Science and Environmental Studies

Planktonic copepods were collected from 18 stations during JICA/MASDEC Malacca Straits Scientific Expedition, in November 1998 (Northeast monsoon) and April 1999 (Presouthwest monsoon). A total of 88 species of copepods, comprised 4 orders, 17 families and 24 genera were recorded in the Straits of Malacca. Amongst them eleven species were new records to Malaysian waters. They were *Eucalanus subtenuis*, *Delius nudus*, *Scolecithricella minor*, *Clausocalanus farrani*, *Euchaeta wolfendeni*, *Centropages* sp., *Pseudocalanus* sp., *Lucicutia flavicornis*, *Candacia tuberculata*, *Corycaeus longisyttis*, and *Copilia lata*. The abundance of the copepod fauna was higher during the presouthwest monsoon (35,429 ind/m³) as compared to the northeast monsoon (20,023 ind/m³). In both monsoon periods, the abundance of



copepods were higher in coastal waters and generally higher in the middle and southern zone of the Straits. The copepod composition was dominated by herbivorous species from the family Paracalanidae, Euterpinidae and Oithoniidae that were distributed especially in the coastal waters. Rare copepod species showed a more distinct pattern of abundance occurring only in certain areas of the Straits. The abundance pattern also showed that the middle and the southern zones were the most heterogenous areas where fluctuations of abundance were evident. This could be seen through the low values of richness and diversity indices. Comparatively, the northern zone was more homogenous and stable.

The diversity and richness index in the northern zone was the highest compared to the other zones during both monsoon seasons. Dominant copepod species formed distinct ecological groups, each species assemblages represented relatively stable units in which each species had a particular niche. Three areas could be identified to be most distinct and heterogenous which were the coastal waters of Matang mangrove forest reserve (st. 14), Port Klang (st. 18) and South Johore (st. 24). The copepods recorded their highest abundance in these areas and can be reflected as areas of very high productivity.

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

**DIVERSITI SPECIES DAN TABURAN KOPEPODA PLANKTONIK
DI SELAT MELAKA**

Oleh

JOHAN ISMAIL

November 2001

Pengerusi : Drs. Idris Abd. Ghani

Fakulti : Sains dan Pengajian Alam Sekitar

Kopepoda planktonik disampel di 18 stesen semasa Ekspedisi Selat Melaka JICA-MASDEC, di bulan November 1998 (Monsun Timur Laut) and bulan April 1999 (Monsun Pra Barat Daya). Sebanyak 88 species dikenalpasti terdiri daripada empat order, 17 families dan 24 genera. Sebelas species dikenalpasti sebagai rekod species baru di perairan Malaysia. Copepoda ini terdiri daripada *Eucalanus subtenuis*, *Delius nudus*, *Scolecithricella minor*, *Clausocalanus farrani*, *Euchaeta wolfendeni*, *Centropages* sp., *Pseudocalanus* sp., *Lucicutia flavicornis*, *Candacia tuberculata*, *Corycaeus longisytis*, dan *Copilia lata*. Densiti copepoda didapati lebih tinggi pada monsun prabarat daya (35,429 ind/m³) berbanding monsun timur laut (20,023

ind/m³). Pada masa kedua-dua monsun, density adalah lebih tinggi di kawasan persisiran pantai berbanding laut terbuka dan secara umumnya lebih tinggi di zon tengah dan zon selatan Selat Melaka. Komposisi copepoda didominasi oleh family Paracalanidae, Euterpinae dan Oithonidae terutamanya di kawasan persisiran pantai. Kopepod resesif menunjukkan corak taburan density yang lebih unik di mana ia hadir hanya di kawasan tertentu sahaja. Corak density kopepoda menunjukkan zon tengah dan zon selatan adalah kawasan paling bersifat heterogenous. Ini boleh dilihat dari nilai-nilai indeks diversity dan richness yang rendah di kawasan ini. Zon utara adalah kawasan yang lebih homogenous dan stabil.

Pada kedua-dua monsun, semua indeks diversity menunjukkan nilai yang lebih tinggi di zon utara berbanding zon tengah dan zon selatan. Kopepod dominan membentuk kumpulan ekologi di mana setiap kumpulan memperlihatkan unit yang stabil di mana setiap species mempunyai niche yang tersendiri. Tiga kawasan dikenalpasti sebagai kawasan paling heterogenous yang merangkumi kawasan perairan hutan simpan bakau Matang (st.14), Pelabuhan Klang (st.18) dan Johor selatan (st.24). Kawasan ini boleh dilihat sebagai kawasan sangat produktif kerana mempunyai density yang tinggi.

ACKNOWLEDGEMENTS

All praises to Allah whose countless blessings enabled me to complete this thesis. I am very grateful to my supervisor, Drs. Idris Abd. Ghani for his guidance and encouragement during this study. I also thank my co-supervisors, Associate Prof. Dr. Ahmad Ismail and Dr. Hishamuddin Omar for their constructive comments and suggestions during this study.

I thank MASDEC-JICA UPM for allowing me to participate and collect samples for this study during the expedition. Due thanks also to the Fisheries Department Penang for their resources and assistance during the expedition. I would like to express my appreciation to the members of the expedition and to the crew of the research vessel for their assistances. I also wish to acknowledge the financial support from UPM.

I am greatly indebted to my wife and family. Their relentless support, love and sacrifices were the key forces that pull me through the study period.

I certify that an Examination Committee met on 23rd November 2001 to conduct the final examination of Johan Bin Ismail on his Master of Science thesis entitled “Species Diversity and Distribution of Planktonic Copepods in the Straits of Malacca” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

JAMBARI BIN ALI, Ph.D.,
Associate Professor,
Department of Biology,
Faculty of Science and Environmental Studies,
Universiti Putra Malaysia.
(Chairman)

IDRIS BIN ABDUL GHANI, M.Sc.,
Department of Biology,
Faculty of Science and Environmental Studies,
Universiti Putra Malaysia.
(Member)

AHMAD BIN ISMAIL, Ph.D.,
Associate Professor,
Department of Biology,
Faculty of Science and Environmental Studies,
Universiti Putra Malaysia.
(Member)

HISHAMUDDIN BIN OMAR, Ph.D.,
Department of Biology,
Faculty of Science and Environmental Studies,
Universiti Putra Malaysia.
(Member)



AINI IDERIS, Ph.D.,
Professor,
Dean of Graduate School,
Universiti Putra Malaysia

Date : 30 DEC 2001

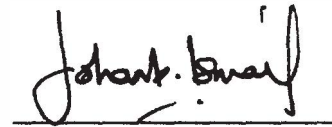
This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfillment of the requirement for the degree of Master of Science.

AINI IDERIS, Ph.D.,
Professor,
Dean of Graduate School,
Universiti Putra Malaysia.

Date:

DECLARATION

I hereby declare that this 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 UPM or other institutions.

A handwritten signature in black ink, reading "Johan B. Ismail", written over a horizontal line.

JOHAN B. ISMAIL

Date :

TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAK	v
ACKNOWLEDGEMENTS	vii
APPROVAL SHEETS	viii
DECLARATION	x
LIST OF TABLES	xiii
LIST OF FIGURES	xvii
GLOSSARY	xxiv

CHAPTER

I.	INTRODUCTION	
	Classification of Copepods	4
	Morphology of Copepods	5
	Research Objectives	7
II.	LITERATURE REVIEW	
	Status of Copepod Fauna in Malaysian Waters	8
	Community Structure of Copepods	17
	Seasonal Distribution of Copepods	19
	Statistical Methods in Copepod Studies	24
	Coefficient of Variations	24
	Species-abundance Relations	25
	Community Classification	26
	Community Ordination	27
	Environmental Characteristics of Malacca Straits	27
III.	METHODOLOGY	
	Study Area	32
	Sampling Design	35
	Hydrography	35
	Copepod Sampling	35
	Copepod Analysis	38
	Statistical Analysis	41

IV. RESULTS AND DISCUSSION	
Copepod Fauna	45
Calanoida	51
Species Composition	51
Abundance and Species Dominance	55
Community Structure	63
Poecilostomatoida	67
Species Composition	67
Abundance and Species Dominance	69
Community Structure	76
Cyclopoida	80
Species Composition	80
Abundance and Species Dominance	80
Community Structure	86
Harpacticoida	89
Species Composition	89
Abundance and Species Dominance	89
Community Structure	95
V. CONCLUSION	100
BIBLIOGRAPHY	103
APPENDICES	
A	117
B	127
C	180
D	198
BIODATA	208

LISTS OF TABLES

Tables		Page
1	Compilation species list of copepods recorded in Malaysia waters.	12
2	Summary of methods by various authors on copepod/zooplankton studies.	14
3	Range/mean of physical and chemical parameters reported in the Straits of Malacca.	31
4	Arbitrary grouping of stations in the Straits of Malacca.	34
5	Number of species in genera and families of the copepod fauna in the Straits of Malacca.	46
6	Species lists of copepods identified in the Straits of Malacca.	47
7	Frequency, abundance and dominance of calanoid species in the Straits of Malacca during northeast monsoon and presouthwest monsoon.	52
8	The occurrence of rare calanoid species during the northeast and presouthwest monsoon in accordance to latitudinal zone in the straits of Malacca.	61
9	The occurrence of rare calanoid species during the northeast and presouthwest monsoon in accordance to shoreline distances in the straits of Malacca.	61
10	Species diversity indices for calanoid copepods for coastal (CS) and open neritic waters and Northern, Middle and Southern zones during Northeast (NE) and Presouthwest (PSW) monsoon.	62
11	Frequency, abundance and dominance of poecilostomatoid species in the Straits of Malacca during northeast monsoon and presouthwest monsoon.	68
12	The occurrence of rare poecilostomatoid species during the northeast and presouthwest monsoon in accordance to latitudinal zone in the Straits of Malacca.	74

13	The occurrence of rare poecilostomatoid species during the northeast and presouthwest monsoon in accordance to shoreline distances in the Straits of Malacca.	74
14	Species diversity indices for poecilostomatoid copepods for coastal (CS) and open neritic waters and Northern, Middle and Southern zones during Northeast (NE) and Presouthwest (PSW) monsoon.	75
15	Frequency, abundance and dominance of cyclopoid species in the Straits of Malacca during northeast monsoon and presouthwest monsoon.	81
16	Species diversity indices for cyclopoid copepods for coastal (CS) and open neritic waters and Northern, Middle and Southern zones during Northeast (NE) and Presouthwest (PSW) monsoon.	85
17	Frequency, abundance and dominance of harpacticoid species in the Straits of Malacca during northeast monsoon and presouthwest monsoon.	91
18	Species diversity indices for harpacticoid copepods for coastal (CS) and open neritic waters and Northern, Middle and Southern zones during Northeast (NE) and Presouthwest (PSW) Monsoon.	96
19	Provisional keys to the identification of planktonic copepods in the Straits of Malacca based on the present study.	117
20	Abundance of copepods with corresponding stations during northeast monsoon.	180
21	Abundance of copepods with corresponding stations during northeast monsoon.	183
22	Abundance of copepods with corresponding stations during northeast monsoon.	186
23	Abundance of copepods with corresponding stations during presouthwest monsoon.	189
24	Abundance of copepods with corresponding stations during presouthwest monsoon.	192

25	Abundance of copepods with corresponding stations during presouthwest monsoon.	195
26	T-test result on abundance of copepoda during northeast (NE) and presouthwest monsoon (PSW).	198
27	T-test result on abundance of Calanoida during northeast (NE) and presouthwest monsoon (PSW).	198
28	T-test result on abundance of Poecilostomatoida during northeast (NE) and presouthwest monsoon (PSW).	198
29	T-test result on abundance of Cyclopoida during northeast (NE) and presouthwest monsoon (PSW).	199
30	T-test result on abundance of Harpacticoida during northeast (NE) and presouthwest monsoon (PSW).	199
31	Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Calanoida abundance data during northeast monsoon.	200
32	Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Calanoida abundance data during Presouthwest monsoon.	201
33	Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Poecilostomatoida abundance data during northeast monsoon.	202
34	Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Poecilostomatoida abundance data during Presouthwest monsoon.	203
35	Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Cyclopoida abundance data during northeast monsoon.	204

- 36 Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Cyclopoida abundance data during presouthwest monsoon. 205
- 37 Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Hrapacticoida abundance data during northeast monsoon. 206
- 38 Results of MULTIPLE LINEAR Regression of PRINCIPAL COMPONENT Coordinates [PC] onto ENVIRONMENTAL FACTORS [EF] based on Hrapacticoida abundance data during presouthwest monsoon. 207



LISTS OF FIGURES

Figures	Page
1 Copepod habitats.	6
2 Ventral view of a female copepod.	6
3 The monsoonal circulation over the Straits of Malacca.	29
4 Sampling stations in the Straits of Malacca with their corresponding GPS location.	33
5 The sampling net. A modified version of WP-2 net.	37
6 Physical characteristics in the Straits of Malacca.	45
7 Relative abundance of copepod during the northeast monsoon.	49
8 Relative abundance of copepod during the presouthwest monsoon.	49
9 Abundance of copepods during the northeast monsoon and presouthwest monsoon.	49
10 Abundance of Calanoida copepod during the northeast and presouthwest monsoon.	57
11 Abundance of calanoid species during the northeast and presouthwest monsoon.	57
12 Abundance of calanoid species during the northeast and presouthwest monsoon.	58
13 PCA ordination of important calanoid species from both NE and PSW.	65
14 PCA ordination of stations during NE and PSW.	65
15 Abundance of Poecilostomatoida copepod during the northeast and presouthwest monsoon.	71
16 Abundance of poecilostomatoid species during the northeast and presouthwest monsoon.	71

17	Abundance of poecilostomatoid species during the northeast and presouthwest monsoon.	72
18	PCA ordination of poecilostomatoid species from both NE and PSW.	77
19	PCA ordination of stations during NE and PSW.	77
20	Abundance of Cyclopoida copepod during the northeast and presouthwest monsoon.	82
21	Abundance of cyclopoid species during the northeast and presouthwest monsoon.	82
22	Abundance of cyclopoid species during the northeast and presouthwest monsoon.	83
23	PCA ordination of cyclopoid species from both NE and PSW.	87
24	PCA ordination of stations during NE and PSW.	87
25	Abundance of Harpacticoida copepod during the northeast and presouthwest monsoon.	92
26	Abundance of harpacticoid species during the northeast and presouthwest monsoon.	92
27	Abundance of harpacticoid species during the northeast and presouthwest monsoon.	93
28	PCA ordination of harpacticoid species from both NE and PSW.	97
29	PCA ordination of stations during NE and PSW.	97
30	A, <i>Lucicutia gaussae</i> (female, dorsal); B, <i>L. gaussae</i> (lateral); C, leg 1; D, leg 5; E, <i>Lucicutia gaussae</i> (male); F, leg 5.	127
31	A, <i>Lucicutia flavicornis</i> (male); B, rostrum; C, leg 5.	128
32	A, <i>Unidula vulgaris</i> (female); B, leg 5; C, <i>U. vulgaris</i> (male); D, leg 5; E, leg 2; F, <i>Canthocalanus pauper</i> (female, lateral); G, <i>C. pauper</i> (female, dorsal); H, leg 5; I, leg 1.	129

- 33 A, *Centropages orsini* (female); B, *C. orsini* (male); C, leg5;
D, leg 1; E, *Centropages* sp. (female, lateral); F, *C. sp.* (female,
dorsal); G, leg 5; H, *C. sp.* (male); I, leg 5. 130
- 34 A, *Centropages furcatus* (female); B, leg 5; C, leg5 (male);
D, *Centropages tenuiremis* (female); E, leg 5; F, *C. tenuiremis*
(male); G, leg 5. 131
- 35 A, *Candacia catula* (female); B, leg 5; C, *C. catula* (male); D,
leg 5; E, *Candacia tuberculata* (female); F, genital segment; G,
leg 5; H, leg 5 (male); I, *Candacia discaudata* (female); J,
urosome (lateral); K, leg 5; L, *C. discaudata* (male); M, leg 5. 132
- 36 A, *Labidocera acuta* (female); B, urosome; C, leg 5;
D, *L. acuta* (male); E, leg 5. 133
- 37 A, *Labidocera euchaeta* (female); B, leg 5; C, *Labidocera minuta*
(male); D, leg 5; E, *L. minuta* (female); F, leg 5. 134
- 38 A, *Labidocera kroyeri* (male); B, leg 5; C, *L. kroyeri* (female);
D, leg 5; E, urosome. 135
- 39 A, *Labidocera* sp. (female); B, leg 5; C, *L. sp.* (male); D, leg 5;
E, urosome. 136
- 40 A, *Calanopia elliptica* (female); B, leg 5; C, leg 5 (male);
D, *Calanopia thompsoni* (male); E, leg 5; F, leg 5 (female); G,
Calanopia minor (female); H, leg 5; I, *C. minor* (male); J, leg 5. 137
- 41 A, *Tortanus barbatus* (female); B, leg 5; C, *T. barbatus* (male);
D, leg 5; E, *Tortanus forcipatus* (male); F, leg 5; G, leg 5 (male);
H, *Tortanus gracilis* (female); I, leg 5; J, *T. gracilis* (male);
K, leg 5. 138
- 42 A, *Acartia erytraea* (female); B, leg 5; C, urosome; D, leg 5
(male); E, *Acartia pacifica*; F, urosome; G, leg 5; H, leg 5 (male). 139
- 43 A, *Clausocalanus minor* (male); B, leg 5; C, *C. minor* (female);
D, leg 5; E, genital segment; F, *Clausocalanus furcatus* (female);
G, leg 5; H, genital segment; I, leg 5 (male); J, *Clausocalanus*
farrani (female). 140
- 44 A, *Eucalanus mucronatus* (female); B, *Eucalanus crassus*
(female); C, *Eucalanus subcrassus* (female); D, *Eucalanus*
subtenuis (female). 141

- 45 A, *Euchaeta wolfendeni* (female); B, genital segment;
C, *Euchaeta concinna* (female); D, genital segment. 142
- 46 A, *Temora stylifera* (female); B, leg 5; C, *Temora discaudata*
(female); D, leg 5; E, leg 5 (male); F, *Temora turbinata* (female);
G, leg 5; H, leg 5 (male). 143
- 47 A, *Calocalanus pavo* (female); B, *C. pavo* (male); C,
C. styliremis (female); D, leg 5; E, leg 5 (male); F, *Scolecithricella*
minor (female); G, rostrum; H, leg 5; I, *Pseudocalanus* sp. (female);
J, leg 5; K, leg 1. 144
- 48 A, *Bestiolina similis* (female); B, leg 5; C, *B. similis* (male);
D, leg 5; E, *Delius nudus* (female); F, urosome; G, leg 5; H,
rostrum; I, *Acrocalanus gracilis* (female); J, leg 4;
K, *Acrocalanus longicornis* (female); L, leg 5; M, *A. gibber*
(female); N, leg 5. 145
- 49 A, *Paracalanus denudatus* (female); B, leg 5; C, *P. crassirostris*
(female); D, leg 5; E, *P. crassirostris* (male); F, leg 5; G,
P. aculateus (female); H, leg 5; I, leg 5; J, leg 5 (male);
K, *P. parvus* (female); L, leg 5; M, leg 5 (male); N, *P. elegans*
(female); O, leg 1; P, leg 5; Q, leg 5 (male). 146
- 50 *Macrosetella gracilis*. A, Female; B, leg 1; C, leg 2; D, leg 3;
E, leg 4; F, leg 5; G, antenna; H, antennule. 147
- 51 *Clytemnestra scutellata*. A, Female; B, leg 1; C, leg 2; D, leg 3;
E, leg 4; F, leg 5; G, antenna; H, antennule; I, maxilliped; J,
maxilla; K, mandibel. 148
- 52 *Euterpina acutifrons*. Female; A, lateral; B, leg 1; C, leg 2;
D, leg 3; E, leg 4; F, leg 5; G, antenna; H, antennule. 149
- 53 *Microsetella norvegica*. A, Female; B, leg 1; C, leg 2; D, leg 3;
E, leg 4; F, leg 5; G, antenna; H, antennule; I, *Microsetella rosea*;
J, leg 5. 150
- 54 A, *Oithona plumifera* (female, dorsal); B, *O. plumifera* (lateral);
C, leg 1; D, leg 2; E, leg 3; F, leg 4. 151
- 55 A, *Oithona decipiens* (female, dorsal); B, *O. decipiens* (lateral);
C, leg 1; D, leg 2; E, leg 3; F, leg 4. 152

- 56 A, *Oithona simplex* (female, dorsal); B, *O. simplex* (lateral);
C, leg 1; D, leg 2; E, leg 3; F, leg 4. 153
- 57 A, *Oithona rigida* (female, dorsal); B, *O. rigida* (lateral); C, leg 1;
D, leg 2; E, leg 3; F, leg 4; G, leg 5; H, mandible; I, labrum. 154
- 58 A, *Oithona nana* (female, dorsal); B, *O. nana* (lateral); C, leg 1;
D, leg 2; E, leg 3; F, leg 4; G, leg 5; H, *Oithona attenuata* (female,
dorsal); I, *O. attenuata* (lateral). 155
- 59 A, *Sapphirina angusta* (female, dorsal); B, leg 1; C, leg 2;
D, leg 3; E, leg 4; F, antenna; G, antennule. 156
- 60 A, *Sapphirina angusta* (male, dorsal); B, leg 4; C, caudal rami;
D, antennule; E, Sapphiriella-like copepod. 157
- 61 A, *Sapphirina nigromaculata* (female, dorsal); B, leg 1; C, leg 2;
D, leg 3; E, leg 4; F, leg 5; G, antenna; H, antenna (zoom);
I, antennule; J, maxilla; K, caudal rami. 158
- 62 A, *Copilia mirabilis* (male, dorsal); B, antenna; C, maxilla;
D, *Copilia lata*; E, antenna. 159
- 63 A, *Copilia mirabilis* (female, dorsal); B, leg 1; C, leg 2; D, leg 3;
E, leg 4; F, leg 5; G, antenna; H, antennule. 160
- 64 A, *Oncaea clevei* (female, dorsal); B, *O. clevei* (lateral); C, leg 1;
D, leg 2; E, leg 3; F, leg 4; G, maxilla; H, antenna; I, mandibel.;
J, leg 5; K, labium. 161
- 65 A, *Oncaea media* (female, dorsal); *O. media* (lateral); B, leg 1;
C, leg 2; D, leg 3; E, leg 4; F, maxilla; G, antenna; H, mandibel.;
I, *O. media* (male, dorsal); J, *O. media* (lateral). 162
- 66 A, *Oncaea venusta* (female, dorsal); B, *O. venusta* (lateral);
C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, maxilla; H, antenna;
I, mandibel; J, labrum; K, *O. vebusta* (male, dorsal);
L, *O. venusta* (lateral). 163
- 67 A, *Farranula concinna* (female, dorsal); B, *F. concinna* (lateral);
C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla; I,
F. concinna (male, dorsal); J, *F. concinna* (male, lateral). 164

- 68 A, *Farranula gibbula* (female, dorsal); B, *F. gibbula* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilliped; I, mandibel. 165
- 69 A, *Farranula gibbula* (male, dorsal); B, *F. gibbula* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla. 166
- 70 A, *Corycaeus* (O) *pacificus* (female, dorsal); B, *C. pacificus* (lateral); C, urosome; D, *Farranula carrinata* (female, dorsal); E, *F. carrinata* (lateral); F, urosome; G, *F. carrinata* (male). 167
- 71 A, *Corycaeus* (Urocorycaeus) *longisyttis* (female, dorsal); B, *C. longisyttis* (lateral); C, leg 4; D, *Corycaeus* (Urocorycaeus) *speciosus* (female, dorsal); E, *C. speciosus* (lateral). 168
- 72 A, *Corycaeus* (Onychocorycaeus) *agilis* (female, dorsal); B, *C. agilis* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla. 169
- 73 A, *Corycaeus* (O) *catus* (female, dorsal); B, *C. catus* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, caudal rami; I, maxilla. 170
- 74 A, *Corycaeus* (O) *catus* (male, dorsal); B, *C. catus* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla; I, urosome. 171
- 75 A, *Corycaeus* (O) *pumilus* (female, dorsal); B, *C. pumilus* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla; I, urosome; J, caudal rami. 172
- 76 A, *Corycaeus* (D) *dahli* (female, dorsal); B, *C. dahli* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla. 173
- 77 A, *Corycaeus* (D) *erythraeus* (female, dorsal); B, *C. erythraeus* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla. 174
- 78 A, *Corycaeus* (D) *erythraeus* (male, dorsal); B, *C. erythraeus* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla. 175
- 79 A, *Corycaeus* (D) *subtilis* (female, dorsal); B, *C. subtilis* (lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H, maxilla; I, urosome. 176

- 80 A, *Corycaeus* (Ditrichocorycaeus) *andrewsi* (female, lateral);
B, *C. andrewsi* (dorsal; C, leg 1; D, leg 2; E, leg 3; F, leg 4; G,
antenna; H, urosome. 177
- 81 A, *Corycaeus* (D) *andrewsi* (male, dorsal); B, *C. andrewsi*
(lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna;
H, urosome; I, maxilla. 178
- 82 A, *Corycaeus* (D) *asiaticus* (female, dorsal); B, *C. asiaticus*
(lateral); C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, antenna; H,
urosome; I, maxilla. 179