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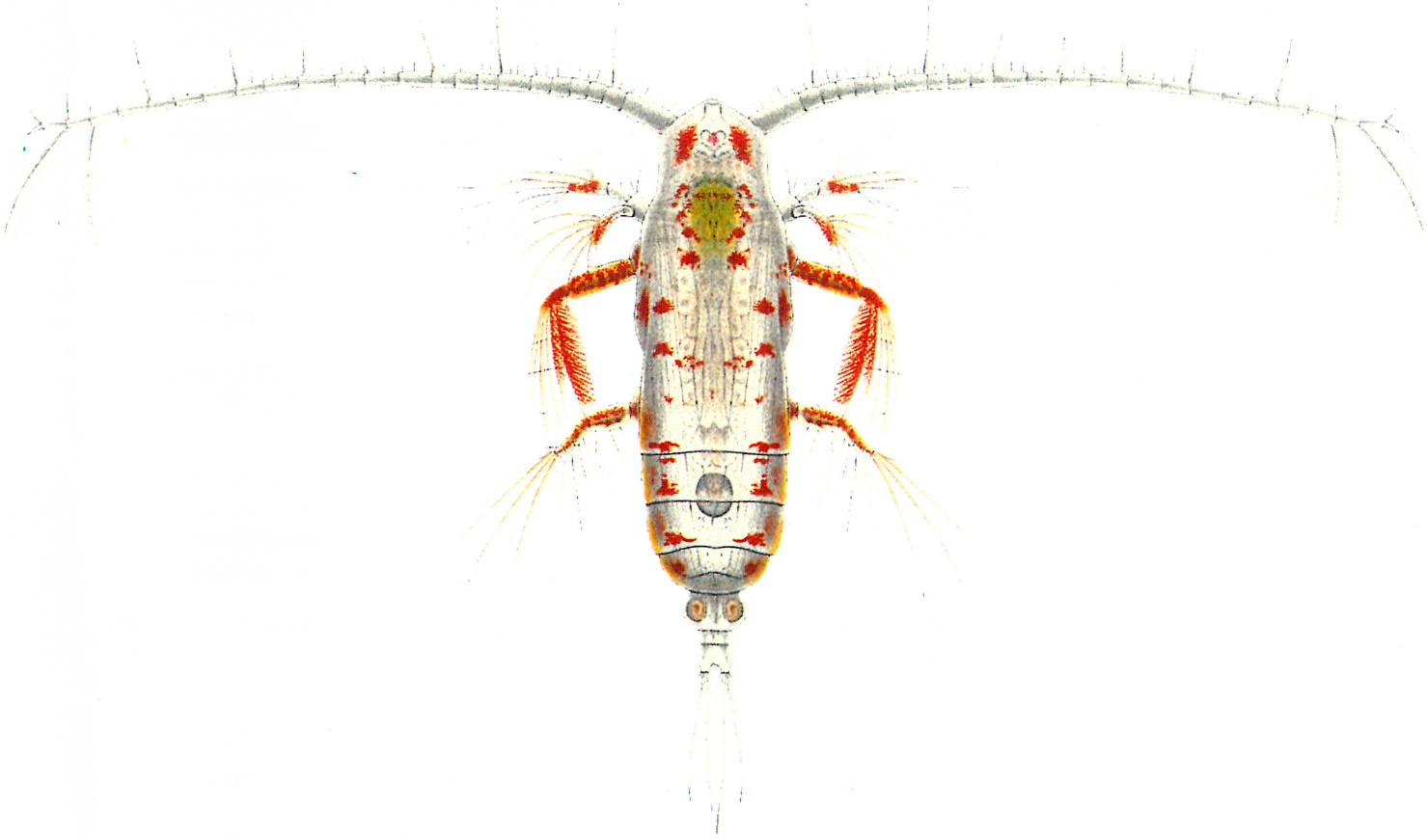

The Marine Fauna of New Zealand:

Pelagic Calanoid Copepoda:

Megacalanidae, Calanidae, Paracalanidae, Mecynoceridae, Eucalanidae, Spinocalanidae, Clausocalanidae

J.M. Bradford-Grieve

New Zealand Oceanographic Institute Memoir 102

COVER PHOTO:

Subeucalanus crassus (Giesbrecht, 1888) reproduced from Giesbrecht (1892) as *Eucalanus crassus.*

NATIONAL INSTITUTE OF
WATER AND ATMOSPHERIC RESEARCH (NIWA)

The Marine Fauna of New Zealand: Pelagic Calanoid Copepoda :

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by

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New Zealand Oceanographic Institute
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The Marine Fauna of New Zealand: Pelagic Calanoid Copepoda :

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ABSTRACT

The distribution and taxonomy of calanoid Copepoda (families Megacalanidae, Calanidae, Paracalanidae, Mecynoceridae, Eucalanidae, Spinocalanidae and Clausocalanidae) from the New Zealand region of the Southwest Pacific (20–64°S, 146–164°W) are recorded. The families Ryocalanidae, Pseudocyclopiidae, Stephidae and Mesaiokeratidae are also included even though species in these families have not yet been recorded in this region. The material reported comes from the collections of the New Zealand Oceanographic Institute, Auckland University Zoology Department, Victoria University of Wellington Zoology Department, and Portobello Marine Laboratory of Otago University; all previous records from the area are also included.

All genera in the families are defined and a list of their species provided even though no examples of some genera and families have been recorded from the Southwest Pacific. Sixty-three species of the following genera are described and figured: *Megacalanus, Calanoides, Calanus, Canthocalanus, Cosmocalanus, Mesocalanus, Nannocalanus, Neocalanus, Undinula, Acrocalanus, Bestiolina, Calocalanus, Paracalanus, Mecynocera, Eucalanus, Pareucalanus, Rhincalanus, Subeucalanus, Mimocalanus, Spinocalanus, Clausocalanus, Ctenocalanus, Drepanopus, Microcalanus.* Seven species (*Megacalanus princeps, Calocalanus minutus, C. namibiensis, C. neptunus, C. pavoninus, Spinocalanus longicornis,* and *S. spinosus*) are new records for the area. The males of *Calocalanus namibiensis* and *C. minutus* are partially described and the male of *Drepanopus pectinatus* is described from Campbell Island. The definition of the family Paracalanidae is further clarified by re-emphasising Giesbrecht's (1892) description of the male antenna 2. This limb in the male has an exopod with an elongate second segment and a very short seventh segment; the first and second segments are without setae and the terminal segment is without the three terminal setae, present in the female. This structure of the male antenna 2 is a consistent feature of all paracalanids.

Keywords: Taxonomy, distribution, Southwest Pacific, Copepoda, Calanoida, Calanoidea, Eucalanoidea, Ryocalanoidea, Spinocalanoidea, Clausocalanoidea, Megacalanidae, Calanidae, Paracalanidae, Mecynoceridae, Eucalanidae, Ryocalanidae, Spinocalanidae, Clausocalanidae, Pseudocyclopiidae, Stephidae, Mesaiokeratidae, new records, *Megacalanus princeps, Calocalanus minutus, C. namibiensis, C. neptunus, C. pavoninus, Spinocalanus longicornis, S. spinosus*

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INTRODUCTION

This is the third monograph in a series on the taxonomy and distribution of pelagic Copepoda in the New Zealand region of the Southwest Pacific (*see* Bradford & Jillett 1980; Bradford *et al.* 1983). Treatment of the material follows the style used by Bradford and Jillett (1980). I now arrange the genera and families into the superfamilies of Andronov (1974a) (*see* also Park 1986; Mauchline 1988; Andronov 1991). The previous two monographs (Bradford & Jillett 1980; Bradford *et al.* 1983) dealt with some of the families of Clausocalanoidea. The Bathypontioidea will be dealt with in the next volume because of the uncertainty surrounding the unity of the only family in this superfamily. The records of Chiba and Hirakawa (1972) and Park (1982, 1983a, b, 1988) are added to the list of previous records of pelagic copepods from the Southwest Pacific compiled by Bradford and Jillett (1980) (Fig. 1).

The purpose of this volume is to record species and distributions from recent collections, include previous records from the region, and also provide a handbook for those wishing to go a stage further and identify a species not recorded from the region previously. Planktobenthic species are also included as a number are already in works on pelagic copepods when plankton nets fished near the bottom and there is no other formal vehicle for recording these species. Where appropriate or possible any taxonomic ambiguities which exist have been investigated.

For each family a definition is given and one species in the family, common in the Southwest Pacific, is figured in full as an example of the family. Each genus, treated alphabetically, is also defined even when no example has been taken in the Southwest Pacific. A list of all species in each genus is provided with their junior synonyms noted. Synonyms of each species recorded are generally not given as they have been fully listed by other workers (e.g., Vervoort 1957, 1963, 1965). In a few cases where a new synonym has been discovered, usually one particularly relevant to the New Zealand region, it has been included before the description of the species concerned. Text under "Description" refers principally to the original description and appropriate references are listed in brackets at the end of the section. Any differences in the Southwest Pacific specimens are noted under "Remarks".

The ultimate goal of this work is to gain a knowledge of the fauna of the New Zealand region of the Southwest Pacific and to analyse the distributional patterns and their relationships to the known physical environment and behaviour of the species when understood.

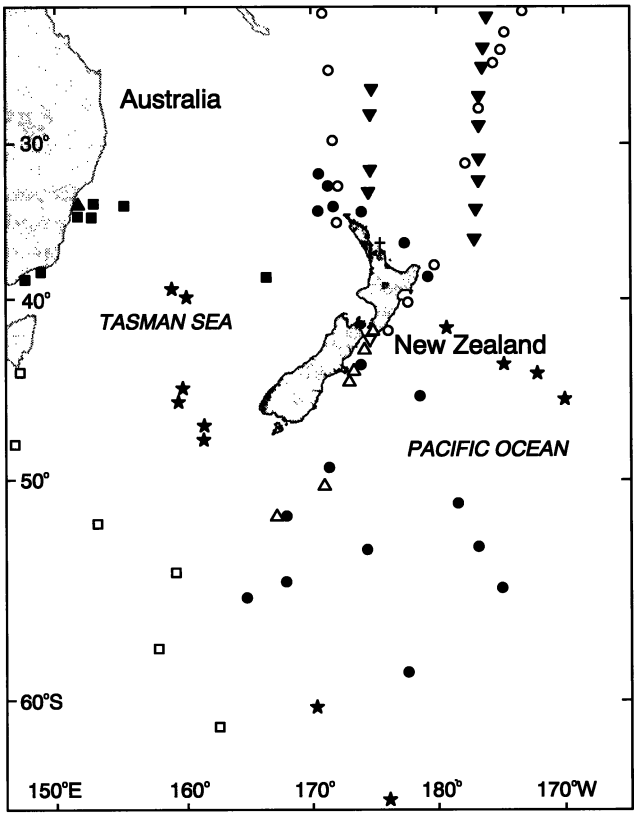


Fig. 1. Map of the Southwest Pacific Ocean indicating the positions of stations from which copepods have been previously recorded in the literature: □ = Vervoort 1957; ▲ = Dakin & Colefax 1949; ■ = Brady 1883; • = Farran 1929; Δ = Bary, 1951; o = Heinrich 1968; + = Jillett 1971; ∇ = Bradford 1972; ▼ = Chiba & Hirakawa 1972; * = Park 1978, 1980; ◊ = Greenwood 1976.

MATERIALS AND METHODS

The material used in this study was collected by the New Zealand Oceanographic Institute (NZOI), Victoria University of Wellington Zoology Department (VUZ), Auckland University Zoology Department (AUZ), and Portobello Marine Laboratory of Otago University (Mu). The stations (Figs 2, 3) were occupied by a variety of vessels using various combinations of sampling gear (*see* List of Stations and Table 1 below).

Samples had been preserved in 5% formalin in sea water. Limbs were dissected from the animals and examined in lactic acid or were mounted permanently in euparal, Canada Balsam, or polyvinyl alcohol lactophenol, and drawings were made using a camera lucida.

Table 1

Details of Gear Used at Stations.

Symbol	Net	Closing	Mesh Aperture (μm)	Diam. (m)	Source
B	Bongo Net attached to trawl wire	no	500	0.61	Posgay & Marak (1980)
CB	Clarke-Bumpus Sampler	yes	200–130	0.125	Clark & Bumpus (1940)
FMMT	Fine Mesh Mid-water Trawl	no	10,000	10	Hislop (1970)
IKMT	Isaacs-Kidd Mid-water Trawl	no	12,500	3	Tait *et al.* (1965) Isaacs & Kidd (1953)
N70	Discovery N70 Net	yes	240	0.7	Kemp & Hardy (1929)
N50	Discovery N50 Net	no	53	0.5	Kemp & Hardy (1929)
N15	-	no	240	0.15	-
L50	Lachlan 50 Net	no	240	0.5	Bary (1956)
MPS	Bé Multiple Plankton Sampler	yes	200	0.7 x 0.7	Bé (1962)
MT	Modified Menzies Trawl	no	1,200	1 x 0.15	Menzies (1962)
PN	Modified Tucker Trawl	yes	1,000	2 x 2	Tucker (1951)
Pump	Plankton Pump (hose on output side)	-	60	-	Miller & Judkins (1981)
S	Stramin Net	no	1,400	1	Jillett (pers. comm.)
WP2	WP2 Net	no	200	0.57	Heron (1982)
0.5m	0.5 m Cone Net	no	250	0.5	Jillett (1971)
0.6mC	0.6 m Cone Net	no	650	0.61	Roberts (1972)
1mC	1 m Cone Net	no	1,225	1	Tait *et al.* (1985)
4m	4 m Conical Net*	no	25,000	4	Records held in Island Bay Marine Laboratory, VUW.

* Copepods were captured by this net only when it became dogged with medusae, etc.

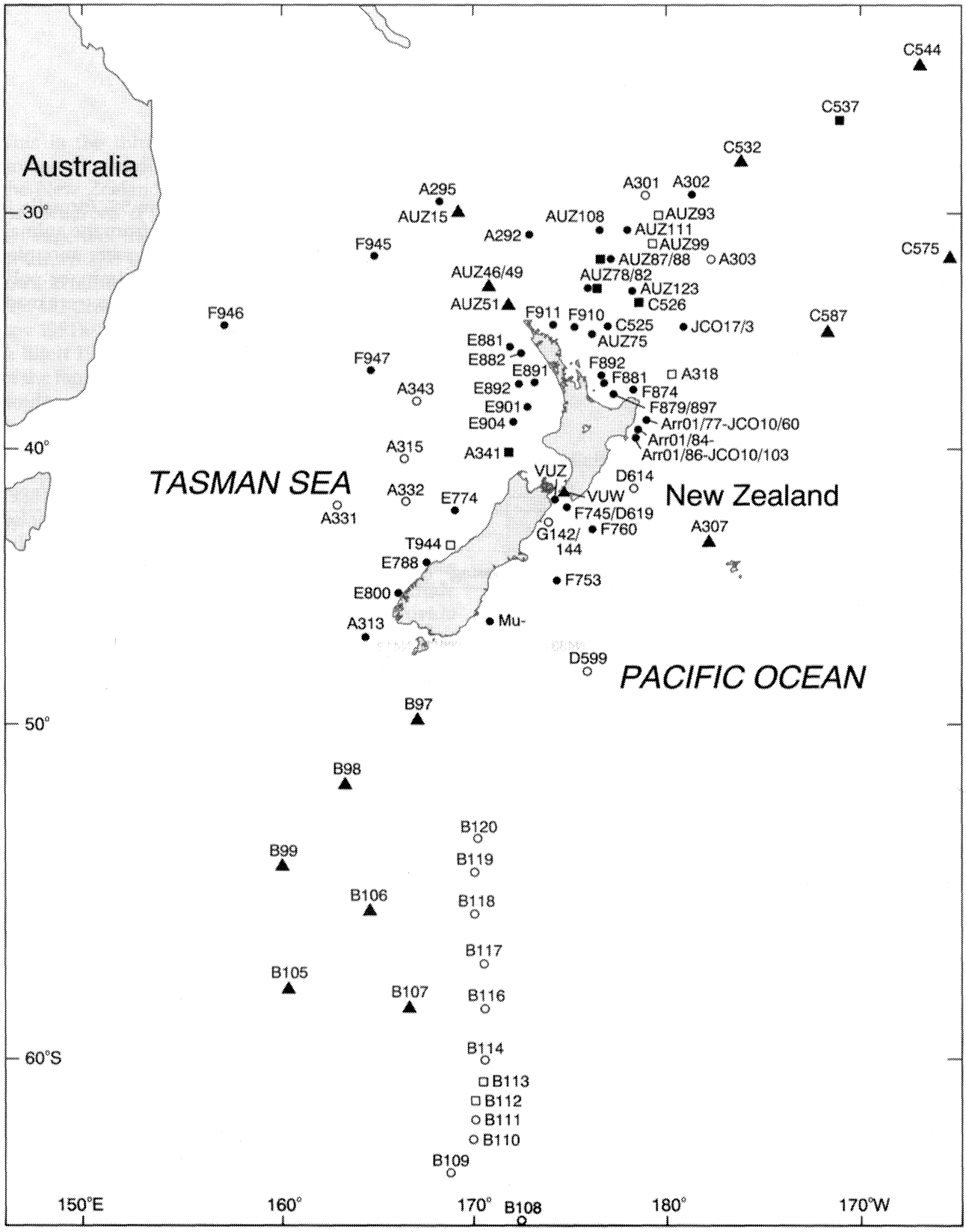


Fig. 2. Map of the Southwest Pacific Ocean indicating the positions of stations from which material was considered, with the maximum sampling depth indicated: ▲ = surface; □ = 0–125 m; ■ = 126–250 m; o = 251–500 m; • = > 501 m.

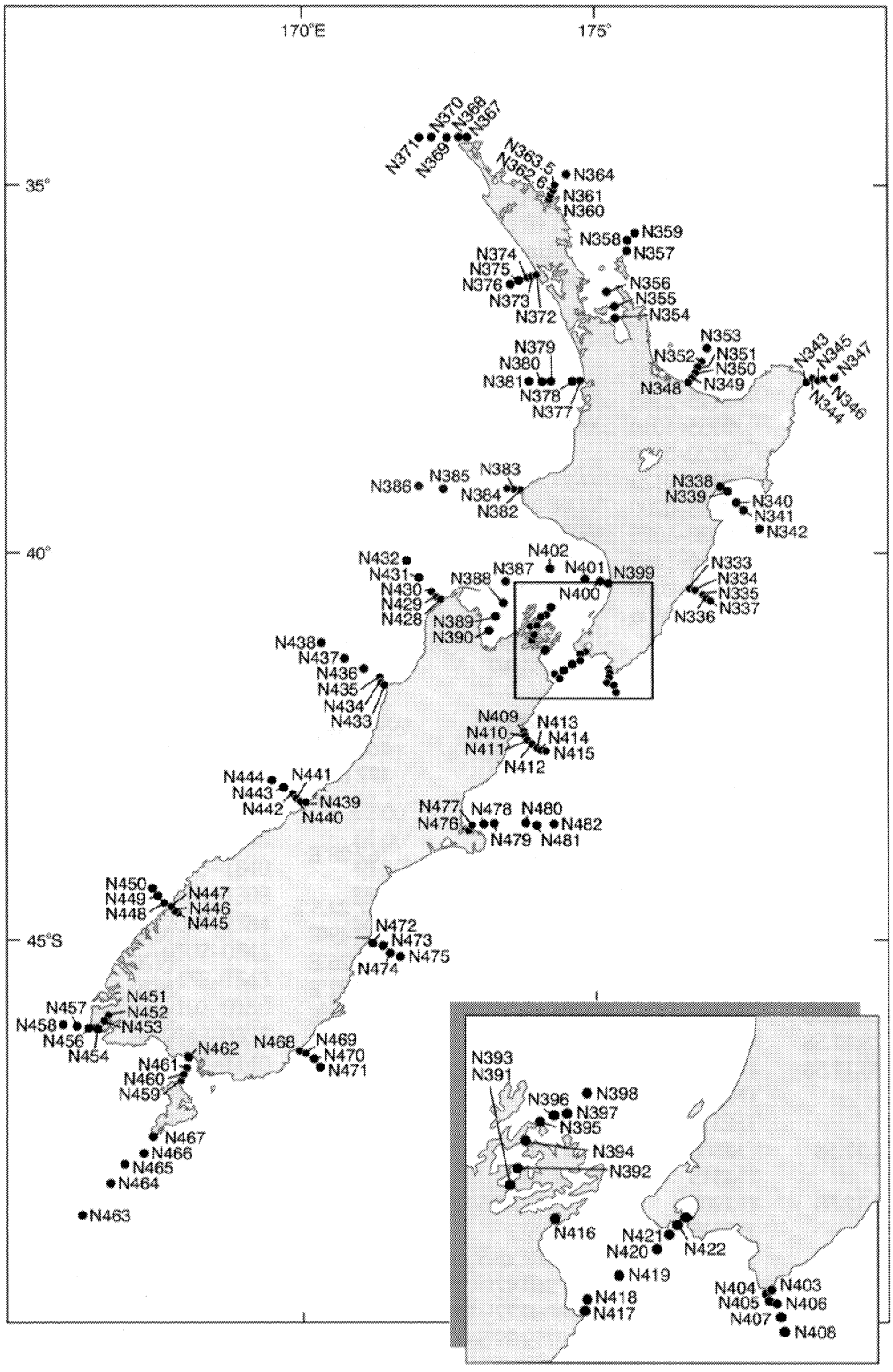


Fig. 3. Map of New Zealand coastal waters indicating the positions of stations from which material was considered. Maximum sampling depth was 200 m or near the seafloor.

LIST OF STATIONS

Stn No.	Date	Time	Latitude (° S)	Longitude	Gear *	Depth of Haul (m)
New Zealand Oceanographic Institute Stations						
A292	5.6.56	1530	30 45'	173 16'E	N70	500–1000
		1050–1150			L50	Surface
A295	7.6.56	2210–2227	29 03.5'	168 36'E	N70	400–1000
		2255–2308			N70	0–500
		2115–2345			L50	Surface
A301	1.7.56	0955–1010	28 56'	179 56'W	N70	0–500
A302	1/2.7.56	2220–2320	28 52'	178 05'W	L50	Surface
		0108–0125			N70	500–1000
		0148–0200			N70	0–500
A303	3.7.56	0920–1025	31 40'	177 33'W	L50	Surface
		1440–1447			N70	450–1000
A307	20.7.56	1630–2000	42 55'	177 26'W	N50	Surface
A313	17.8.56	0245–0606	46 46'	164 35'E	N70	0–914
A315	19.8.56	-	39 56'	167 45'E	N70	0–500
A318	10.1.57	0845–1430	36 36'	179 18'W	N50	Surface
					L50	0–88
A331	1.2.57	0430–0810	41 46'	163 51'E	N70	Surface
A332	1/2.2.57	2300–0225	41 41'	167 03'E	N70	Surface
A341	12.2.57	0912–1012	39 41'	172 06'E	L50	Surface
		1030			N70	0–250
		2230–2400			L50	Surface
A343	13.2.57	1400–1700	37 46'	167 28'E	N70	0–500
		1412–1520			L50	Surface
B97	23.11.58	1630–1650	49 32'	167 22.5'E	N70	Surface
B98	24.11.58	1110–1130	51 41.5'	163 49'E	N70	Surface
B99	25.11.58	0955–1015	54 05.5'	160 26'E	N70	Surface
B105	26.11.58	1430–1450	57 36'	161 02'E	N70	Surface
B106	27.11.58	1450–1500	55 42.5'	165 23'E	N70	Surface
B107	28.11.58	1015–1025	58 19'	167 18'E	N70	Surface
B108	30.11.58	2245–2255	63 45.65'	172 30'E	N15	Surface
		2300			N15	0–125
		2315			N15	0–500
B109	1.12.58	1500	62 37'	169 51'E	N15	0–125
		1515			N15	0–500
B110	1.12.58	1900	61 55.5'	170 26'E	N15	0–125
		1915			N15	0–500
B111	2.12.58	0830	61 25.5'	170 41'E	N15	0–500
B112	2.12.58	1408	60 47'	170 44'E	N15	0–125
B113	2.12.58	1900	60 22'	170 54'E	N15	0–125
B114	3.12.58	0115	59 39'S	171 02'E	N15	0–125
		0130			N15	0–500
B116	3.12.58	1730	58 20'	171 14'E	N15	0–125
		1745			N15	0–500

* Symbol only, details of the gear used at stations are given in Table 1.

Stn No.	Date	Time	Latitude (° S)	Longitude	Gear *	Depth of Haul (m)
B117	4.12.58	0330	57 11'	171 06'E	N15	0–500
B118	4.12.58	1145	55 34.5'	170 27'E	N15	0–125
		1200			N15	0–500
B119	4.12.58	2330	54 31'	170 20'E	N15	0–500
B120	5.12.58	0700	53 26.34'	170 15'E	N15	0–400
		0715			N15	0–150
C525	7.9.60	1140–1210	34 40'	177 46'E	N70	Surface
		1215–1235			N70	0–250
C526	17.9.60	1139–1148	33 40'	179 09'E	N70	0–250
		1125–1155			N70	Surface
C532	20.9.60	2105–2135	27 49'	175 53'W	N70	Surface
C537	22.9.60	2130–2200	25 46'	170 16'W	N70	Surface
		2215–2235			N70	0–250
C544	24.9.60	0550–0620	23 01.2'	166 19'W	N70	Surface
C575	13.10.60	1100–1130	31 49'	164 30'W	N70	Surface
C587	15.10.60	1430–1500	35 10'	170 55'W	N70	Surface
D599	10.4.67	1732–2240	47 58'	176 10'E	MPS	0–100
						100–250
						250–500
D614	16.4.67	0318	41 20'	178 48'E	MPS	0–100
						100–250
						250–500
D619	18.4.67	1030	41 56'	175 17.5'E	MPS	0–100
						100–250
						250–500
E774	15.10.67	0921–1011	42 00'	169 15'E	MT	0–1165
E788	17.10.67	1620–1748	44 00'	168 11'E	MT	0–1193
E800	20.10.67	1805–1840	45 20'	166 41.5'E	MT	0–700
E881	22.3.68	0954–1308	35 20'	172 15'E	MT	0–1371
E882	22.3.68	2037–2384	36 00'	172 42'E	MT	0–1212
E891	24.3.68	0507–0545	36 40'	173 27'E	MT	0–1245
E892	24.3.68	1458–1543	37 20'	173 35'E	MT	0–1224
E901	25/26.3.68	0107–0150	38 00'	173 19'E	MT	0–1248
E904	28.3.68	0249–0335	38 39'	172 24'E	MT	0–1243
F745	4.4.66	1123–1440	41 47'	175 22'E	MT	0–1170
F753	18.8.66	1857–1932	44 45'	174 30'E	MT	0–790
F760	20.8.66	0949–1030	42 45'	176 30'E	MT	0–710
F874	3.10.68	0703–0848	37 18'	178 11'E	MT	0–1357
F879	4.10.68	0040–1224	37 25.5'	177 30'E	MT	0–1267
F881	4.10.68	1000–1125	37 07.5'	177 14'E	MT	0–1260
F892	5.10.68	1945–2146	36 58.5'	176 41'E	MT	0–1260
F897	6.10.68	0240–0329	37 25'	177 30'E	MT	0–1269
F910	10.10.68	1548–1734	34 56'	175 23'E	MT	0–1397
F911	11.10.68	0147–0321	34 38'	174 36'E	MT	0–1697
F945	22.10.68	1458–1505	31 19.5'	165 19'E	N70	0–200
		1538–1555				0–500
		1645–1700				500–1000
F946	2/3.11.68	2308–2315	34 32.5'	157 31.5'E	N70	0–200
		2335–2344				200–500
		0025–0100				0–1000

Stn No.	Date	Time	Latitude (° S)	Longitude	Gear *	Depth of Haul (m)
F947	5.11.68	1350–1355	36 18.5'	165 05.5'E	N70	0–200
		1446–1500				0–500
		1529–1540				500–1000
G142	20/21.9.67	2100	42 24.5'	174 01.8'E	MPS	0–100
						100–250
						250–500
		2400	42 24.5'	174 01.8'E	MPS	0–100
						100–250
						250–500
		0600	42 24.5'	174 01.8'E	MPS	0–100
						100–250
						250–500
		1200	42 24.5'	174 01.8'E	MPS	0–100
						100–250
						250–500
G144	21.9.67	1800	42 24.8'	174 01.6'E	MPS	0–100
						100–250
						250–500
N333	1.12.74	0920	40 30.25'	176 38.0'E	WP2	0–30
N334	3.12.74	1050	40 31.2'	176 39.0'E	WP2	0–50
N335	3.12.74	1130	40 32.85'	176 41.9'E	WP2	0–100
N336	3.12.74	1305	40 36.4'	176 47.9'E	WP2	0–200
N337	3.12.74	1520	40 42.7'	176 58.3'E	WP2	0–200
N338	4.12.74	0620	39 11.8'	177 13.6'E	WP2	0–25
N339	4.12.74	0739	39 15'	177 18'E	WP2	0–50
N340	4.12.74	1945	39 25.8'	177 30.6'E	WP2	0–100
N341	4.12.74	1330	39 37.8'	177 43.9'E	WP2	0–200
N342	4.12.74	1535	39 45'	177 54.6'E	WP2	0–200
N343	5.12.74	0735	37 344.1'	178 33.3'E	WP2	0–25
N345	5.12.74	0950	37 43.7'	178 41.7'E	WP2	0–100
N346	5.12.74	1140	37 44.2'	178 49.4'E	WP2	0–200
N347	5.12.74	1335	37 44.2'	178 57.0'E	WP2	0–200
N348	6.12.74	0610	37 49.1'	176 38.8'E	WP2	0–25
N349	6.12.74	0717	37 45.7'	176 40.6'E	WP2	0–50
N350	6.12.74	0845	37 40.8'	176 44'E	WP2	0–100
N351	6.12.74	0950	37 38.7'	176 45.6'E	WP2	0–200
N352	6.12.74	1235	37 30'	176 50.7'E	WP2	0–200
N353	6.12.74	1430	37 21.3'	176 58'E	WP2	0–200
N354	7.12.74	0534	36 54.1'	175 22.2'E	WP2	0–25
N355	7.12.74	0725	36 44'	175 20.1'E	WP2	0–40
N356	7.12.74	0945	36 31.3'	175 17.6'E	WP2	0–50
N357	7.12.74	1340	35 58.9'	175 34.5'E	WP2	0–100
N358	7.12.74	1555	35 49.8'	175 34.5'E	WP2	0–200
N359	7.12.74	1743	35 44.1'	175 44.2'E	WP2	0–180
N360	8.12.74	0543	35 13.6'	174 06.4'E	WP2	0–24
N361	8.12.74	0650	35 11'	174 10.4'E	WP2	0–50
N364	8.12.74	1220	34 56.4'	174 31.4'E	WP2	0–200
N365	8.12.74	1450	35 16.4'	174 16.4'E	WP2	0–200
N366	8.12.74	1540	35 07.1'	174 17.7'E	WP2	0–100
N367	10.12.74	0623	34 24.5'	172 40.4'E	WP2	0–25
N368	10.12.74	0647	34 23.9'	172 39.0'E	WP2	0–50
N369	10.12.74	0910	34 24.6'	172 26.3'E	WP2	0–100

Stn No.	Date	Time	Latitude (° S)	Longitude	Gear *	Depth of Haul (m)
N370	10.12.74	1215	34 23.5'	172 06'E	WP2	0–200
N371	10.12.74	1445	34 23.4'	171 54.5'E	WP2	0–200
N372	11.12.74	0745	36 19.5'	173 58.8'E	WP2	0–25
N373	11.12.74	0905	36 20.1'	173 56.1`E	WP2	0–50
N374	11.12.74	1030	36 22.1'	173 50.5'E	WP2	0–100
N375	11.12.74	1150	36 23.6'	173 45.5'E	WP2	0–200
N376	11.12.74	1405	36 28.9'	173 33'E	WP2	0–200
N377	12.12.74	0638	37 48'	174 45.8'E	WP2	0–25
N378	12.12.74	0819	37 48.9'	174 39.4'E	WP2	0–50
N379	12.12.74	1105	37 48.9'	174 13.2'E	WP2	0–100
N380	12.12.74	1250	37 48.7'	174 04.9'E	WP2	0–200
N381	12.12.74	1500	37 48.4'	173 49.0'E	WP2	0–200
N382	13.12.74	0945	39 15'	173 42.4'E	WP2	0–25
N383	13.12.74	1017	39 15.7'	173 42.6'E	WP2	0–50
N384	13.12.74	1117	39 15.9'	173 39.4'E	WP2	0–100
N385	13.12.74	1833	39 14.9'	172 22.3'E	WP2	0–200
N386	13.12.74	2150	39 14.9'	171 56.4'E	WP2	0–200
N387	14.12.74	0905	40 28.8'	173 30.2'E	WP2	0–70
N388	14.12.74	1137	40 44.3'	173 22.8'E	WP2	0–50
N389	14.12.74	1334	40 53.2'	173 19.0'E	WP2	0–47
N390	14.12.74	1554	41 04.1'	173 09.6'E	WP2	0–25
N391	15.12.74	0902	41 12.6'	173 51.9'E	WP2	0–30
N392	15.12.74	0958	41 06.5'	173 51.4'E	WP2	0–50
N393	15.12.74	1140	41 05.3'	173 47.1'E	WP2	0–19
N394	15.12.74	1315	41 02.8'	173 55.4'E	WP2	0–50
N395	15.12.74	1430	40 58.2'	173 58..4'E	WP2	0–60
N396	15.12.74	1520	40 55.8'	174 03.5'E	WP2	0–100
N397	15.12.74	1620	40 55.1'	174 08.4'E	WP2	0–40
N398	15.12.74	1825	40 49.5'	174 16'E	WP2	0–100
N399	16.12.74	0630	40 27.3'	175 11.2'E	WP2	0–25
N400	16.12.74	0943	40 26.8'	175 09.2'E	WP2	0–50
N401	16.12.74	0943	40 24'	174 52.0'E	WP2	0–100
N402	16.12.74	1327	40 17.6'	174 13.6'E	WP2	0–100
N403	17.12.74	0610	41 37.2'	175 18.4'E	WP2	0–20
N404	17.12.74	0630	41 38'	175 18.8'E	WP2	0–50
N405	17.12.74	0655	41 38.5'	175 19.3'E	WP2	0–100
N406	17.12.74	0728	41 39.2'	175 20.2'E	WP2	0–200
N407	17.12.74	0853	41 44'	175 22.9'E	WP2	0–200
N408	17.12.74	1005	41 48.6'	175 24.4'E	WP2	0–200
N409	18.12.74	0630	42 26.3'	173 40.1'E	WP2	0–25
N410	18.12.74	0648	42 26.75'	173 41'E	WP2	0–50
N411	18.12.74	0728	42 28'	173 43'E	WP2	0–100
N412	18.12.74	0810	42 29.2'	173 45.2'E	WP2	0–190
N413	18.12.74	0920	42 32.5'	173 49.9'E	WP2	0–200
N414	18.12.74	1040	42 35.4'	173 55.0'E	WP2	0–200
N415	18.12.74	1205	42 39'	173 59.8'E	WP2	0–200
N416	19.12.74	0044	41 18.85'	174 09.6'E	WP2	0–22
N417	19.12.74	1327	41 42.5'	174 16.6'E	WP2	0–24
N418	19.12.74	1347	41 41.85'	174 17.8'E	WP2	0–50
N419	19.12.74	1602	41 35.2'	174 28'E	WP2	0–90
N420	19.12.74	1815	41 38.2'	174 338.2'E	WP2	0–190
N421	19.12.74	1957	41 24.4'	174 45'E	WP2	0–100

Stn No.	Date	Time	Latitude (° S)	Longitude	Gear *	Depth of Haul (m)
N422	19.12.74	2027	41 22.8'	174 46.6'E	WP2	0–50
N423	19.12.74	2100	41 21.5'	174 49.5'E	WP2	0–25
N428	29.1.75	0615	40 41.8'	172 20'E	WP2	0–25
N429	29.1.75	0715	40 40.2'	172 17.7'E	WP2	0–50
N430	29.1.75	0935	40 34.7'	172 11.6'E	WP2	0–100
N431	29.1.75	1215	40 23.8'	171 59.3'E	WP2	0–200
N432	29.1.75	1525	40 11'	171 44.8'E	WP2	0–200
N433	30.1.75	0655	41 46.1'	171 25.9'E	WP2	0–25
N434	30.1.75	0735	41 45.4.'	171 24.5'E	WP2	0–50
N435	30.1.75	0825	41 43.6'	171 20.7'E	WP2	0–100
N436	30.1.75	1135	41 34'	170 57.9'E	WP2	0–200
N437	30.1.75	1435	41 24.4'	170 35.7'E	WP2	0–200
N438	30.1.75	1730	41 16.1'	170 18'E	WP2	0–200
N439	31.1.75	0650	43 20'	169 57'E	WP2	0–25
N440	31.1.75	0725	43 19.8'	169 55.1'E	WP2	0–50
N441	31.1.75	0820	43 18.3'	169 52.6'E	WP2	0–100
N442	31.1.75	1000	43 13.9'	169 47.3'E	WP2	0–200
N443	31.1.75	1210	43 07.4'	169 41.8'E	WP2	0–200
N444	31.1.75	1420	43 00.5'	169 25'E	WP2	0–200
N445	1.2.75	1230	44 39.6'	167 54.7'E	WP2	0–176
N446	1.2.75	1350	44 37.2'	167 52.6'E	WP2	0–200
N447	1.2.75	1440	44 35.5'	167 48.9'E	WP2	0–120
N448	1.2.75	1600	44 31.9'	167 44.1'E	WP2	0–80
N449	1.2.75	1750	44 28.9'	167 38.6'E	WP2	0–200
N450	1.2.75	1945	44 22.8'	167 28.6'E	WP2	0–200
N451	2.2.75	0910	45 53.4'	166 42.6'E	WP2	0–40
N452	2.2.75	0955	45 56.8'	166 39.4'E	WP2	0–200
N453	2.2.75	1035	46 00.8'	166 36.4'E	WP2	0–200
N454	2.2.75	1110	46 04'	166 34.5'E	WP2	0–70
N456	3.2.75	1200	46 04.1'	166 17.2'E	WP2	0–170
N457	3.2.75	1405	46 03.8'	166 02.8'E	WP2	0–170
N458	3.2.75	1710	46 05.4'	165 49.8'E	WP2	0–200
N459	4.2.75	0335	46 41.4'	167 55.4'E	WP2	0–40
N460	4.2.75	0452	46 36.8'	167 58.8'E	WP2	0–40
N461	4.2.75	0622	46 32.0'	168 02.0'E	WP2	0–36
N462	4.2.75	0705	46 27.7'	168 04.2'E	WP2	0–25
N463	5.2.75	1250	48 16'	166 22.8'E	WP2	0–160
N464	5.2.75	1545	47 52.1'	166 43.4'E	WP2	0–160
N465	5.2.75	1717	47 40.7'	167 01.2'E	WP2	0–150
N466	5.2.75	1910	47 30.5'	167 15.7'E	WP2	0–150
N467	5.2.75	2045	41 18.7'	167 30.9'E	WP2	0–90
N468	6.2.75	0740	46 24.1'	169 55.8'E	WP2	0–25
N469	6.2.75	0820	46 25.1'	169 57.8'E	WP2	0–55
N470	6.2.75	0930	46 27.8'	170 02.5'E	WP2	0–100
N471	6.2.75	1050	46 30.9'	170 14.6'E	WP2	0–200
N472	6.2.75	2050	45 06.5'	171 09'E	WP2	0–25
N473	6.2.75	2140	45 08.8'	171 14.4'E	WP2	0–50
N474	7.2.75	0645	45 12.2'	171 22.6'E	WP2	0–100
N475	7.2.75	0825	45 15.7'	171 39.2'E	WP2	0–200
N476	8.2.75	0855	43 39.9'	172 54.1'E	WP2	0–7
N477	8.2.75	0920	43 37.7'	172 55.2'E	WP2	016
N478	8.2.75	1100	43 35.3'	173 08.3'E	WP2	0–24

Stn No.	Date	Time	Latitude (° S)	Longitude	Gear *	Depth of Haul (m)
N479	8.2.75	1215	43 35.2'	173 14.2'E	WP2	0–48
N480	8.2.75	1630	43 33.2'	173 48.7'E	WP2	0–100
N481	8.2.75	1820	43 33.8'	173 59.8'E	WP2	0–200
N482	8.2.75	2130	43 35.8'	174 21.6'	WP2	0–200
T944	30.7.88	0930–1413	43 00.1'	169 45.0'E	Pump	80
Auckland University Zoology Department Stations						
AUZ15	8.7.62	0932–0946	29 26'	169 49'E	1mC	Surface
AUZ46	14.7.62	0926–1026	32 40'	171 02'E	1mC	Surface
AUZ49	14.7.62	2124–2155	32 40'	171 02'E	1mC	Surface
AUZ51	15.7.62	0750–0823	33 59'	172 06'E	1mC	Surface
AUZ75	22.7.62	1938–2010	35 15'	176 15'E	1mC	0–200?
AUZ78	23.7.62	0537–0856	33 09'	176 06'E	1KMT	0–870
AUZ82	23.7.62	1903–1945	33 09'	176 06'E	1mC	0–100?
AUZ87	24.7.62	1630–1721	31 57'	177 38'E	1mC	0–100?
AUZ88	24.7.62	1828–1918	31 57'	177 38'E	1mC	0–100?
AUZ93	25.7.62	-	31 24'	179 00'E	1mC	0–100?
AUZ 99	26.7.62	-	30 11'	179 52'E	1mC	0–100?
AUZ108	29.7.62	0215–0705	30 14'	176 42'W	1KMT	0–823
AUZ111	30.7.62	0557–0656	30 26'	178 15'W	1mC	0–100?
AUZ123	2.8.62	0730–0823	33 13'	178 24'E	1mC	0–100?
A	15.5.63–21.5.65	100–1300	36 49'	174 50'E	0.5mC	0–18
B	1.3.64–24.4.65	100–1300	36 16'	174 54'E	CB	0–45
Victoria University of Wellington Zoology Department Stations						
VUZ93	24.8.57	1515–1815	41 53'	175 14'E	4m	0–1097
VUZ105	28.12.57	1130–1440	41 47'	175 01'E	4m	0–914
VUZ107	282.12.57	1850–2200	41 52'	175 06'E	4m	0–914
VUZ112	29.1.61	1143–1335	41 45'	174 55'E	4m	0–732
Portobello Marine Laboratory (Otago University) Stations						
Mu66/44	21.10.66	-	45 55'	171 05'E	CB	0–200
Mu66/46	21.10.66	-	45 55'	171 05'E	CB	0–200
Mu66/49A	21.10.66	-	45 55'	171 05'E	CB	0–200
Mu66/56B	2.11.66	-	45 47'	170 57'E	CB	0–80
Mu66/67A	13.11.66	0500	45 51'	171 15'E	CB	0–150
Mu66/68A	13.11.66	0900	45 50'	177 08'E	CB	0–150
Mu66/78	4.12.66	-	45 51'	171 16'E	CB	0–100
Mu67/6	29.1.67	-	45 48'	170 59'E	CB	0–100
Mu67/7	29.1.67	-	45 50'	171 10'E	CB	0–150
Mu67/8	29.1.67	1205	45 52'	171 17'E	CB	0–150
Mu67/43	24.2.67	Daylight	45 50'	171 07'E	CB	0–150
Mu67/44	24.2.67	Daylight	45 52'	171 16'E	CB	0–150
Mu67/45	22.3.67	0700	45 46'	170 47'E	CB	0–150

Stn No.	Date	Time	Latitude (° S)	Longitude	Gear *	Depth of Haul (m)
Mu67/46	22.3.67	-	45 48'	170 57'E	CB	0–150
Mu67/47	22.3.67	-	45 50'	171 06'E	CB	0–150
Mu67/48	22.3.67	1205	45 52'	171 18'E	CB	0–150
Mu67/48s	22.3.67	-	45 52'	171 18'E	S	0–1000
Mu67/49	14.4.67	-	45 46'	170 47'E	CB	0–25
Mu67/50	14.4.67	0830	45 49'	170 57'E	CB	0–150
Mu67/52	14.4.67	1400	45 52'	171 16'E	CB	0–50
Mu67/52s	14.4.67	-	45 55'	171 05'E	S	0–1000
Mu67/55	19.5.67	0920	45 49'	170 57'E	CB	0–80
Mu67/56	19.5.67	-	45 50'	170 48'E	CB	0–150
Mu67/57s	19.5.67	-	45 50'	170 48'E	S	0–1000
Mu67/57	19.5.67	-	45 52'	171 16'E	CB	0–150
Mu67/62s	19.6.67	-	45 50'	170 48'E	S	0–500
Mu67/77	19.6.67	daylight	45 50'	171 05'E	CB	0–150
Mu67/78	19.6.67	-	45 55'	171 16'E	CB	0–150
Mu67/88	14.7.67	-	45 50'	170 48'E	CB	0–150
Mu67/88s	14.7.67	-	45 50'	170 48'E	S	0–600
Mu67/94s	18.8.67	-	45 50'	170 48'E	S	0–1000
Mu67/104s	18.9.67	-	45 50'	170 48'E	S	0–823
Mu67/106s	18.9.67	-	45 50'	170 48'E	S	0–1000
Mu67/114	24.10.67	-	45 48'	170 57'E	CB	0–80
Mu67/116s	24.10.67	-	45 50'	170 48'E	S	0–1000
Mu67/147s	15.12.67	-	45 50'	170 48'E	S	0–1000
Leigh	23.5.64	daylight	36 18'	174 56'E	CB	0–45
Leigh	20.6.64	daylight	36 18'	174 56'E	CB	0–45
Leigh	25.7.64	daylight	36 18'	174 56'E	CB	0–45
Leigh	22.8.64	daylight	36 18'	174 56'E	CB	0–45
Leigh	19.9.64	daylight	36 18'	174 56'E	CB	0–45
Leigh	27.3.65	daylight	36 18'	174 56'E	CB	0–45
Leigh	24.4.65	daylight	36 18'	174 56'E	CB	0–45
LB(B)=Leigh	1.3.64	daylight	36 18'	174 56'E	CB	0–45
L(A&B)=Leigh	23.5.65	daylight	36 18'	174 56'E	CB	0–45
MAF Fisheries Stations (deposited at Museum of New Zealand, Wellington)						
Arr01/77	9.7.87	0634	38 48.7'	178 47.7'E	B	0–760
Arr01/84	11.7.87	1357	39 19.8'	178 27.2'E	B	0–1000
Arr01/86	11.7.87	1048	39 27'	178 25.9'E	B	0–764
Jco10/60	1.9.86	1246	38 32.4'	178 48.4'E	PN	0–630
Jco10/103	5.9.86	0933	39 27.4'	178 24.8'E	FMMT	0–849
Jco17/3	3.12.76	2020	35 07'	179 22'W	FMMT	0–774
Campbell Is	9.3.66	-	52 33'	169 08'E	0.6mC	Surface
Campbell Is	17.11.66	-	52 33'	169 08'E	0.6mC	Surface

SYSTEMATICS

SUPERFAMILY **CALANOIDEA**

Family **MEGACALANIDAE** Sewell, 1947

DEFINITION: Large strongly built copepods. Head and pedigerous segment 1 may be fused or separate, pedigerous segments 4 and 5 always separate.

Female: Urosome 4-segmented. Antenna 1 25-segmented, generally with segments 8 and 9 partially fused. Antenna 2 exopod 7-segmented with segment 2 bearing 2 setae and segments 1, 3–6 each bearing 1 seta. Mandible with well-developed teeth on the blade and the basal endopod segment with a prominent lobe. Maxilla 1 with varying setation. Maxilla 2, lobes 1–5, with 5–6, 3, 3, 3, and 3–4 setae, respectively. Maxilliped, 5 terminal segments with 4, 4, 3, 4 and 4 setae respectively except in *Bathycalanus* where the number of setae on the last 4 segments is reduced. Swimming legs 1–5 almost identical, with both rami 3-segmented. Exopods with 1 outer-edge spine on segments 1 and 2 (segments 1 and 2 of leg 1 may be naked); segment 3 of legs 1 and 5 with 2 outer-edge spines (1 subterminal) and 1 distal spine bordered by fine teeth and 4 inner setae; exopod segment 3 of legs 2–4 with 3 outer spines, 1 terminal spine bordered by fine teeth. Basipod segment 1 of swimming legs 1–4 with a plumose seta on its inner edge. Basipod segment 2 of swimming legs 2 and 3 with an articulated spine on the outer edge, on legs 4 and 5 this may be reduced to a small seta. Exopod segments with the following setation on their inner margins: segment 1 with 1 seta on legs 1–4, naked on leg 5; segment 2 with 1 seta on legs 1–5; segment 3 of legs 1 and 5 with 4 setae, of legs 2–4 with 5 setae. Endopod segments of legs 1–4 with 1 inner seta on segment 1; 2 inner setae on segment 2; outer margins of these segments naked. Endopod segment 3 of leg 1 with 1 outer, 1 terminal and 4 inner setae; legs 2 and 3 with 2 outer, 1 terminal and 5 inner setae; leg 4 with 2 outer, 1 terminal and 4 inner setae. Leg 5 endopod segments 1 and 2 with 1 inner seta, segment 3 with 2 outer, 1 terminal and 3 inner setae.

Male: Urosome 5-segmented. Cephalic dorsal hump present. Antenna 1 25-segmented, segments 7–9 may be fused, right antenna 1 may be modified as a grasping organ. Antenna 2, mandible, maxilla 1, maxilla 2 more or less as in female. Swimming legs 1–4 as in female. Leg 5 with rami 3-segmented similar to female leg 5 except endopod segment 1 and exopods without inner setae, left exopod segment 2 with inner distal projection.

(Sewell 1929, 1947; Farran & Vervoort 1951b; Nishida 1989)

An example of this family is *Megacalanus princeps* Wolfenden, 1904 (Figs 4, 5, 76).

REMARKS: There are three genera in this family: *Megacalanus* Wolfenden, 1904, *Bathycalanus* Sars, 1905, and *Bradycalanus* A. Scott, 1909. Sewell (1947) re-evaluated species in these genera and proposed this family. Subsequently two workers have described species of *Bathycalanus* and *Bradycalanus* (Johnson 1958; Björnberg 1968).

Members of the Megacalanidae are bathypelagic species. They are apparently carnivores (Arashkevich 1969).

Megacalanus Wolfenden, 1904

DEFINITION: As for the family. Head and pedigerous segment 1 and pedigerous segments 4 and 5 separate. Rostrum composed of two sharp, slightly tapering spines. Antenna 1 twice as long as the metasome. Maxilla 1 with the following arrangement of setae and spines: inner lobe 1 with 14 marginal spines and setae including 4 on the posterior surface and 1 on the anterior surface; inner lobes 2 and 3 with 4 and 4 setae respectively, basipod with 4 setae, endopod segments 1, 2, and 3 with 3, 4, and 7 setae respectively, exopod with 11 setae; outer lobe 2 with 1 seta; outer lobe 1 with 9 setae. Swimming leg 1 with exopod segments 1, 2, and 3 each with 1, 1, and 2 outer edge spines and a reflexed hook on each basipod 2 (absent in some varieties). Setae on maxilla 2 of moderate length, sparsely ciliated. Males have slight differences in rostrum and appendages up to swimming leg 4. Antenna 1 asymmetrical, similar to female on the left, but with larger aesthetascs, with segments 7–9 imperfectly separated; 24-segmented on the right, with segments 7–9, 12–13, and 17–18 fused, segments 17+18, 19, and 20 edge expanded slightly into a flange; segment 9 bearing a clavate seta. Male leg 5 is almost symmetrical, distinguished from those of the female only by the reduction in inner edge setae on exopod

segment 3 and in the hairy projection terminated in a fine whip on the inner edge of left exopod segment 2. (Sars 1924 as *M. longicornis*; Farran & Vervoort 1951b)

TYPE SPECIES: *Megacalanus princeps* Wolfenden, 1904

REMARKS: There has been considerable confusion as to the identity of this genus which has been cleared up by Farran (1939) and Sewell (1947). There is now only one species in this genus which has been taken in the Southwest Pacific:

Megacalanus princeps Wolfenden, 1904
(Figs 4, 5, 76)

DESCRIPTION Size: females 8.75–11.50 mm, males 7.90–10.10 mm.

Female: As in the generic description (Wolfenden 1904).

Male: As in the generic description (*see* Sars 1924, as *M. longicornis*).

REMARKS: A considerable amount of variability has been recorded in the reflex hook on leg 1 basipod 2 (*see* Gueredrat 1969b), ranging from complete absence, through atrophied, to well-developed. The present specimens seem to differ from the descriptions of other authors in some respects. The Southwest Pacific females do not have the head produced as far anteriorly as that figured by Sars (1924). The terminal spine on exopod segment three of at least legs 3 and 5 are long relative to the length of exopod segment 3 and compared with the figures of Sars (1924). The inner-edge seta on exopod segment 2 of male left leg 5 is short and very bulbous at its base unlike that figured by Sars (1924) and Wolfenden (1905b as *M. bradyi*). Sewell (1929) notes that the right male antenna 1 is modified as a grasping organ of 24 segments with joints 7–9 and 12 and 13 fused but does not mention the modification to joints 17+18, 19 and 20 each of which bears a keel-like extension to the outer border.

PREVIOUS SOUTHWEST PACIFIC RECORDS: None.

NEW RECORDS:

Station No.	Depth of Haul	Specimens
F745	1123–1440	1 female 9.09 mm, 1 male 9.00 mm
F946	200–500	copepodite V
VUZ93	0–1097	1 female 10.40 mm
VUZ105	0–914	2 females 10.00 mm, 1 male 10.2 mm
J10/60/86	0–630	1 female 9.32 mm
J10/103/86	0–839	2 females 9.85 mm, 9.70 mm
J17/3/76	0–774	3 females 9.55-9.95 mm, 1 male 10 mm (damaged)
Arr01/77	0–760	1 female 10.00 mm, 1 male 9.39 mm
Arr01/84	0–1000	2 females 9.55 mm, 9.70 mm
Arr01/86	0–764	3 copepodite V
Mu67/57s	0–1000	1 female
Mu67/62s	0–500	1 female
Mu67/94s	0-1000	1 female

DISTRIBUTION: This species has been taken in deep water in the Atlantic, Indian, Indo-Pacific Oceans and Indian Ocean sector of the Antarctic Ocean (Sewell 1947; Vervoort 1949, 1957; Gueredrat 1969a; Brodsky *et al.* 1983).

Bathycalanus Sars, 1905

DEFINITION: Rostrum composed of two stout sausage-shaped, not tapering processes, located on a conspicuously thickened base on the anterior head. Maxilla 1 with the following combination of spines and setae on various lobes: inner lobes 1, 2 and 3 with 11, 0, and 2 setae respectively; basipod with 2–3 setae; endopod segments 1, 2, and 3 with 1–2, 1, and 4–6 setae respectively; exopod with 11 setae; outer lobes 2 and 1 with 1 and 9 setae respectively. Setae on maxilla 2 very long, curved at the tips, each provided with a dense row of hairs on the inner margin forming a ribbon-like lamella. The 4 terminal segments of the maxilliped with reduced setation compared to the other 2 genera. Male leg 5 very similar to to that of *Megacalanus*.

(Farran and Vervoort 1951b; Björnberg 1968)

TYPE SPECIES: *Bathycalanus richardi* Sars, 1905

REMARKS: The following species are included in this genus: *B. bradyi* (Wolfenden, 1905b) (male see Wolfenden, 1911 as *B. maximus*); *B. eltaninae* Björnberg, 1968; *B. eximius* Markhaseva, 1983 in Brodsky *et al.* 1983 (male unknown); *B. inflatus* Björnberg, 1968 (male unknown); *B. princeps* (Brady, 1883) (male unknown); *B. richardi* Sars, 1905 (male *see*

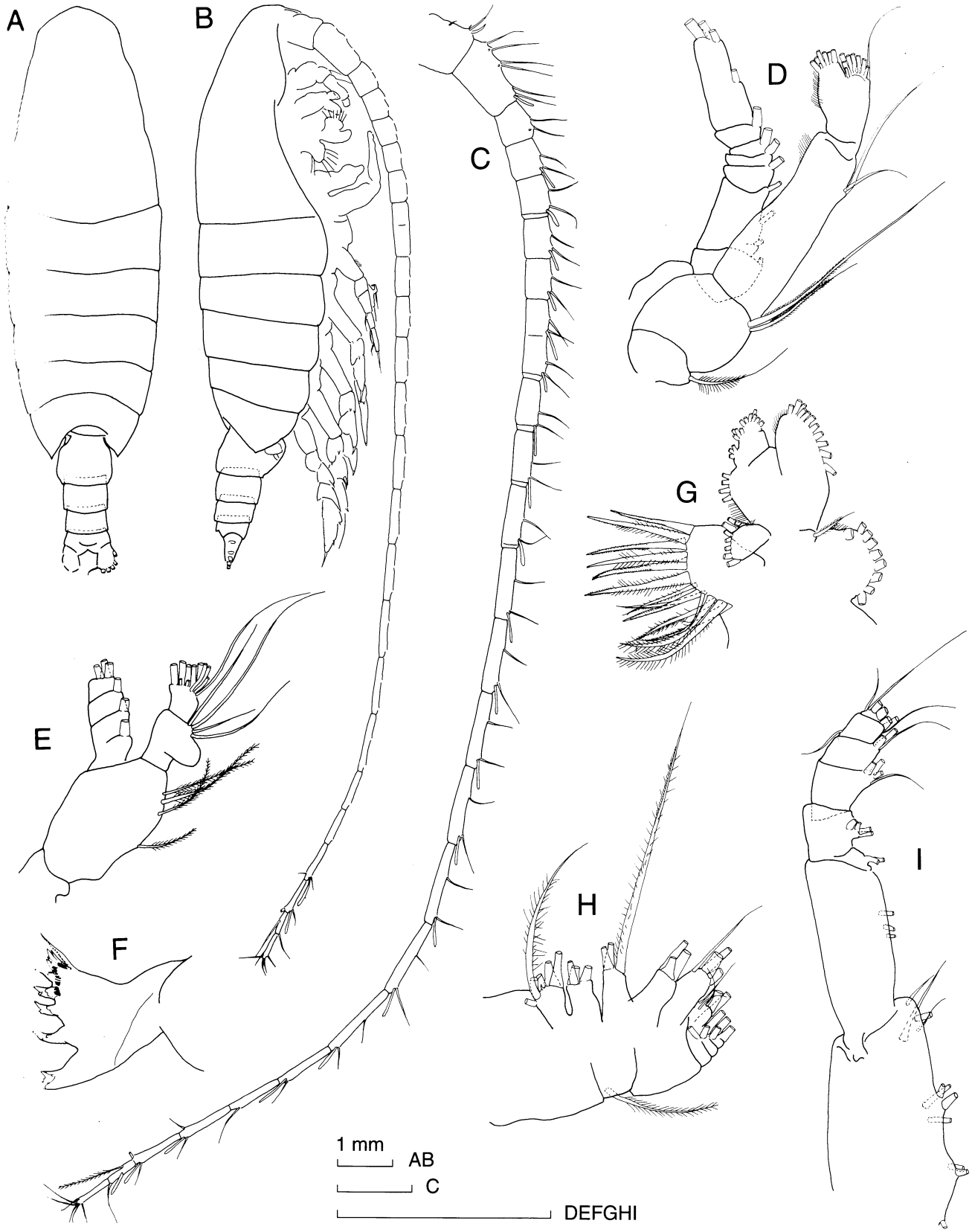
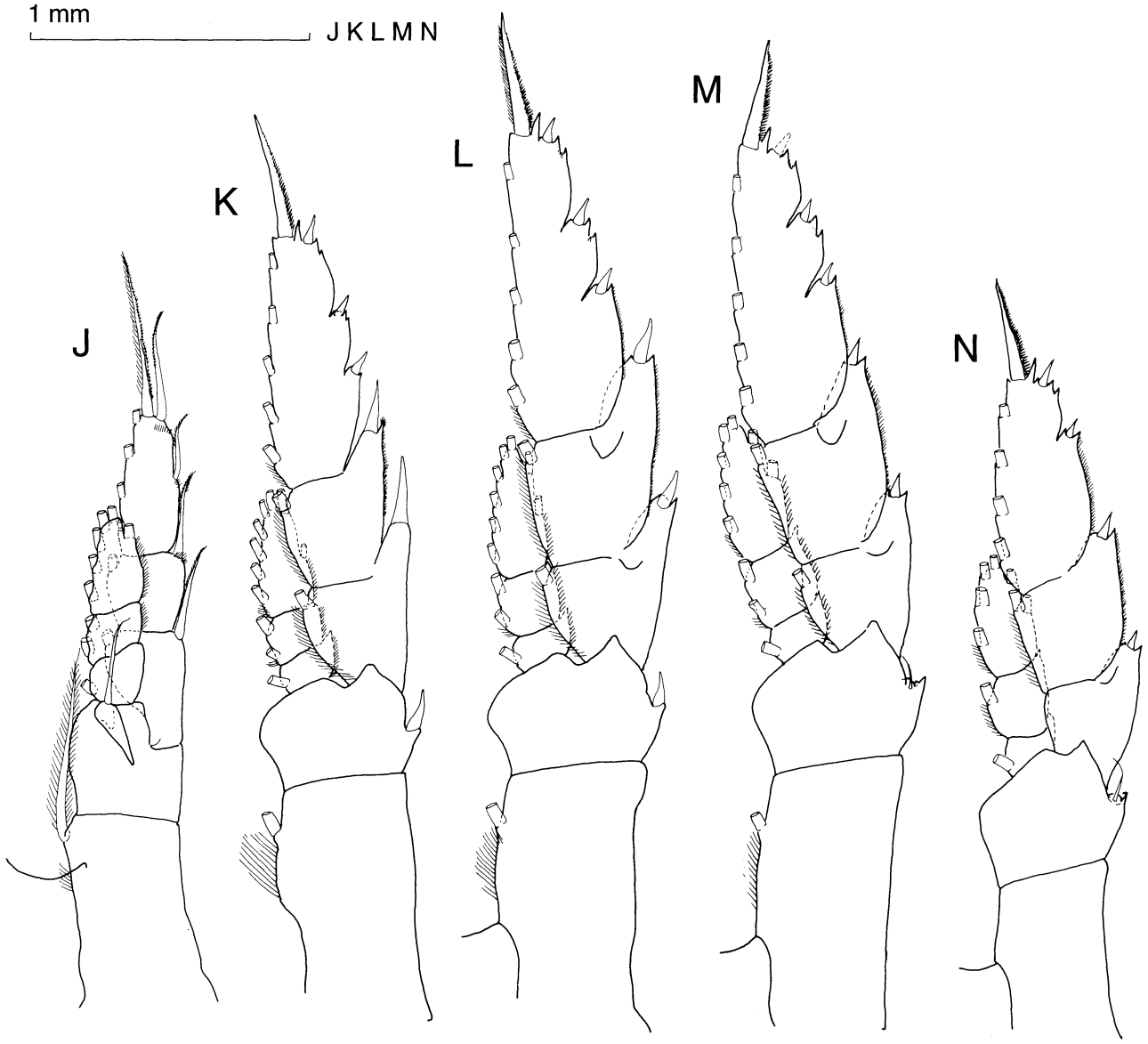


Fig. 4. (Above and overleaf). *Megacalanus princeps* female from VUZ Stn 105: A, dorsal view; B, lateral view; C, antenna 1; D, antenna 2; E, mandibular palp; F, mandibular blade; G, maxilla 1; H, maxilla 2; I, maxilliped; J, leg 1; K, leg 2; L, leg 3; M, leg 4; N, leg 5.



Sars, 1925); *B. sverdrupi* Johnson, 1958 (male unknown); *B. unicornis* Björnberg, 1968 (male unknown). None of these species has been taken in the Southwest Pacific.

Bradycalanus A. Scott, 1909

DESCRIPTION: This genus resembles *Megacalanus* but antenna 1 is apparently not modified for grasping in the male (*B. pseudotypicus enormis*), and the setae on the terminal parts of maxilla 2 are scythe-like and densely ciliated. Maxilla 1 with the following combination of spines and setae: inner lobes 1, 2, and 3 with 13, 4, and 2 setae respectively; basipod with 4 setae; endopod segments 1, 2, and 3 with 2, 1, and 5 setae respectively; exopod with 11 setae; outer lobes 2 and 1 with 1 and 9 setae respectively. Leg 1 basipod segment 2 without a hooked spine. Male left leg 5 exopod segment 2 has a simple spine without hairs on the inner border.

(Farran & Vervoort 1951b; Björnberg 1968)

TYPE SPECIES: *Bradycalanus typicus* A. Scott, 1909

REMARKS: The following species are included in this genus: *B. gigas* Sewell, 1947 (male unknown); *B. pseudotypicus* Björnberg, 1968 (male unknown); *B.*

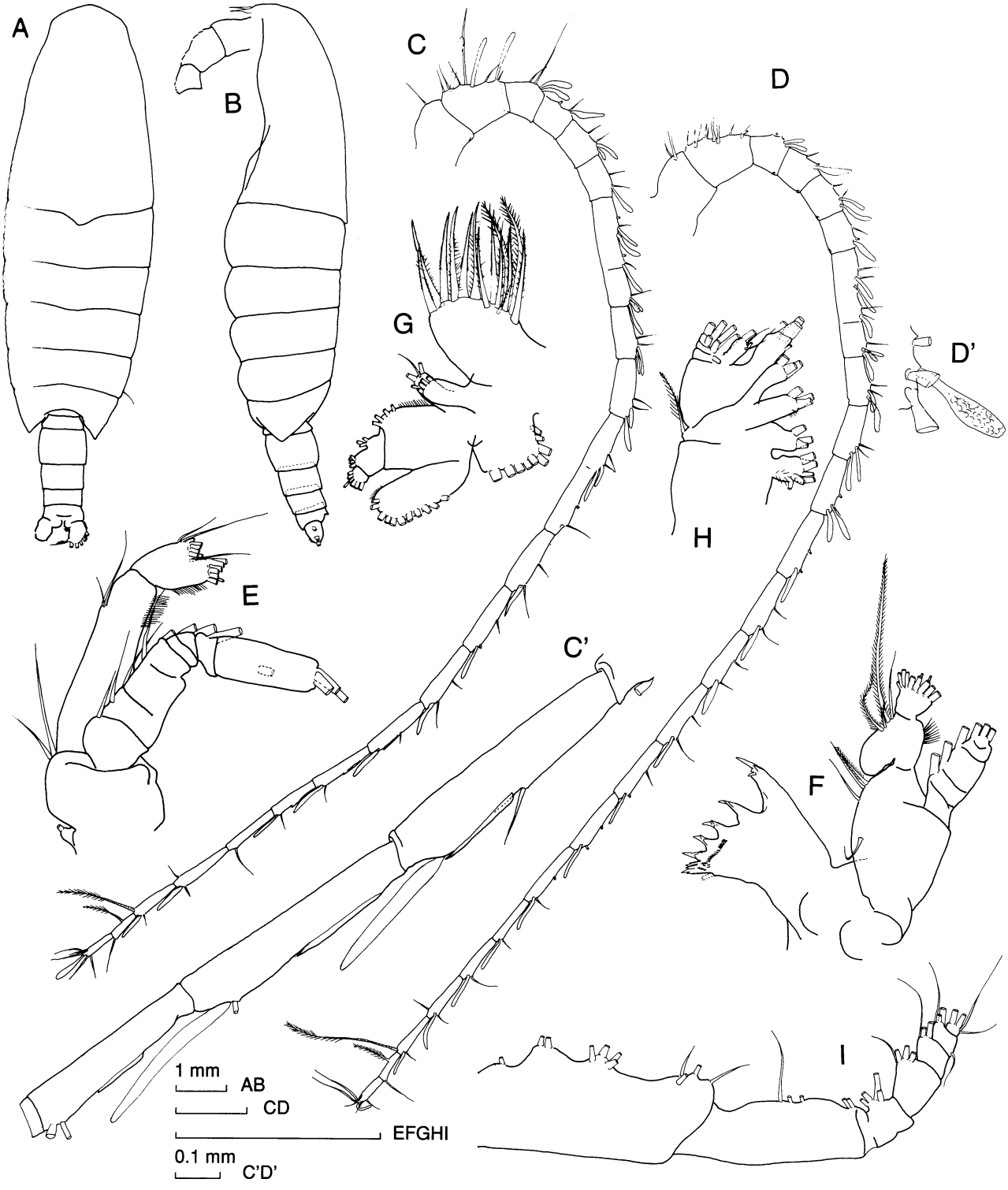
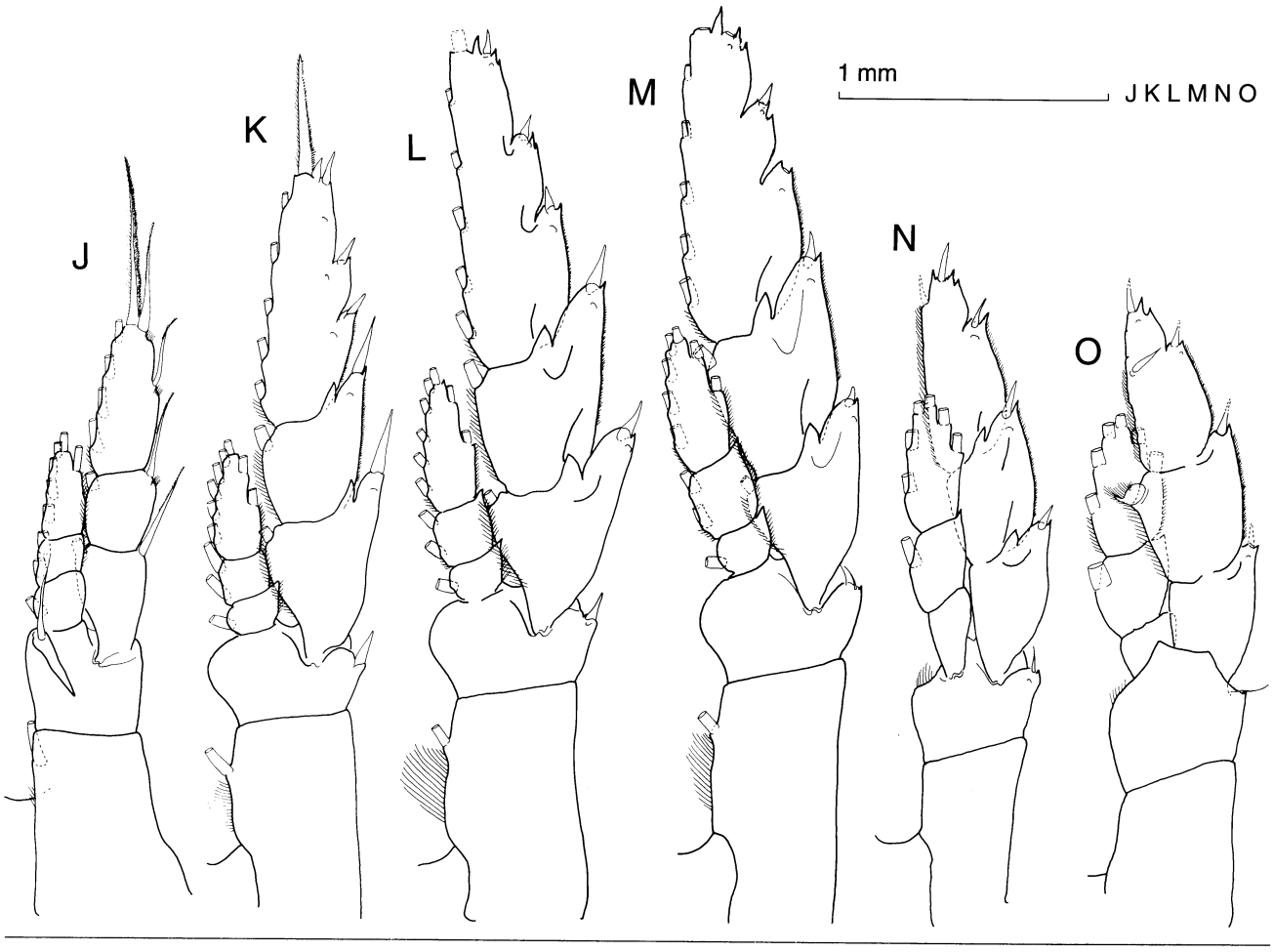


Fig. 5. (Above and overleaf). *Megacalanus princeps* male from VUZ Stn 105: A, dorsal view; B, lateral view; C, right antenna 1; D, left antenna 1; E, antenna 2; F, mandible; G, maxilla 1; H, maxilla 2; I, maxilliped; J, leg 1; K, leg 2; L, leg 3; M, leg 4; N, right leg 5; O, left leg 5.



pseudotypicus enormis Björnberg, 1968; *B. sarsi* (Farran, 1939) (male unknown); *B. typicus* A. Scott, 1909 (male unknown). None of these species has been taken in the Southwest Pacific.

Family **CALANIDAE** Dana, 1849

DEFINITION: Head and pedigerous segment 1 may be fused or separate, pedigerous segments 4 and 5 always separate. Rostrum with 2 filaments. Caudal rami with 4 subequal, terminal setae and 1 outer-edge seta.

Female: Urosome 4-segmented. Antenna 1 25-segmented, generally with segments 8 and 9 partially fused and with an elongate seta on each of segments 23 and 24. Antenna 2 exopods 7-segmented with segments 1 and 2 each bearing 2 setae and segments 3–6 each bearing 1 seta. Mandible usually with well developed teeth on the blade and the basal endopod segment with a prominent lobe. Maxilla 1 with the following arrangement of setae and spines: inner lobe 1 with 14 marginal spines and setae including 4 on the posterior surface and 1 on the anterior surface; inner lobes 2 and 3, basipod and endopod segments 1 and 2 with 4 setae each; endopod segment 3 with 7 setae, exopod with 11 setae; outer lobe 2 with 1 seta; outer lobe 1 with 9 setae. Maxilla 2, lobes 1–5, with 4–6, 3, 3, 3, and 4 setae, respectively. Maxilliped, 5 terminal segments with 4,4,3,4 and 4 setae respectively, basipod 2 with an inner distal row of fine spines. Swimming legs 1–5 almost identical with both rami 3-segmented. Exopods with 1 outer-edge spine on segments 1 and 2; segment 3 with 2 outer-edge spines (1 subterminal) and 1 distal spine with a smooth blade-like outer border. Basipod segment 1 of swimming legs 1–4 with a plumose seta on its inner edge. Basipod segment 2 of swimming legs 2 and 3 with an articulated spine on the outer edge, on legs 4 and 5 this may be

reduced to a small seta. Swimming leg 1 with a conical projection on the posterior surface of exopod segment 1. Exopod segments with the following setation in their inner margins: segment 1 with 1 seta on legs 1–4, naked on leg 5; segment 2 with 1 seta on legs 1–5; segment 3 of legs 1 and 5 with 4 setae, legs 2–4 with 5 setae. Endopod segments of legs 1–4 with 1 inner seta on segment 1; 2 inner setae on segment 2; outer margins of these segments naked. Endopod segment 3 of leg 1 with 1 outer, 1 terminal and 4 inner setae; legs 2 and 3 with 2 outer, 1 terminal and 5 inner setae; leg 4 with 2 outer, 1 terminal and 4 inner setae. Leg 5 endopod with variable setation.

(Bradford & Jillett 1974; Nishida 1989)

Male: Urosome 5-segmented. Cephalic dorsal hump present. Antenna 1 25-segmented with segments 1 and 2 always fused, segments 3–5, 7 and 8, 9 and 10, and 24 and 25 may also be fused. Antenna 2, mandible, maxilla 1, maxilla 2 — either exactly as in female, or reduced in size and setation as follows: antenna 2 with setae on exopod segments 1 and 2 small or absent; mandible blade sometimes reduced in size with teeth rudimentary or absent; maxilla 1 sometimes with small setae on inner lobe 1, or even modified to the extreme with inner lobes, basipod and endopod greatly reduced; maxilla 2 sometimes small with only small setae; maxilliped squat with reduced inner setae but enlarged outer setae on the terminal segments. Swimming legs 1–4 as in female. Leg 5 with both rami usually 3-segmented, right leg similar to other swimming legs, left leg variously modified. Leg 5 endopods sometimes reduced and devoid of segmentation on one or both sides. (Bradford & Jillett 1974; Nishida 1989)

An example of this family is *Calanus australis* (Figs 6, 7).

REMARKS: There are now eight genera in this family: *Calanoides, Calanus, Canthocalanus, Cosmocalanus, Mesocalanus, Nannocalanus, Neocalanus,* and *Undinula* (*see* Bradford 1988). For a key to the genera, apart from *Nannocalanus, see* Bradford & Jillett (1974).

Members of the family Calanidae are mainly medium-sized copepods. They are exclusively pelagic with an epipelagic to mesopelagic habit (Bradford 1988). Many species perform ontogenetic vertical migrations and are capable of overwintering at mesopelagic depths. Reproduction is usually coupled to euphotic-zone primary production except for a number of species of *Neocalanus* where mating and reproduction occur at mesopelagic depths in winter (*see* Bradford 1988). Members of this family have been classified as herbivores based on the morphology of their mouthparts (Itoh 1970), but are more likely to be omnivores (Arashkevich 1969; Arashkevich & Timonin 1970; Harding 1974; Landry 1981; Greene & Landry 1988). Chapman (1981) demonstrated that *Neocalanus plumchrus* is capable of taking up glucose from seawater; this supplemental nutrition may be important during periods of reduced primary productivity.

The following characters are those used principally to distinguish species in this family: both sexes: whether or not there are teeth on the inner border of basipod segment 1 of leg 5, whether or not exopod segment 1 of leg 2 has a recurved spine on the outer distal border, whether or not endopod segment 1 of leg 1 has an inner edge seta; female: the number of setae on the leg 5 endopod, and on lobe 1 of maxilla 2; male: whether or not the left leg 5 is prehensile, the number of setae on the endopods of leg 5, which segments of antenna 1 are fused, whether the mouthparts are reduced, and whether or not exopod segment 3 of the right leg 5 has inner-edge setae (Bradford 1988).

Calanoides Brady, 1883

DEFINITION: Head and pedigerous segment 1 partly fused, anterior head usually produced in lateral view. Antenna 1 like other calanids in female; in male segments 3–5 fused, though weak lines of separation are usually apparent. Maxilla 2, inner lobe 1 with 5 setae. Maxilliped with fewer setae than other calanids: terminal 5 segments with 4, 3, 2, 3, and 4 setae respectively. Male mouthparts reduced. Swimming legs without modification or ornamentation. Leg 5, basipod segment 1 with naked inner border in both sexes. Female leg 5 endopod with 6 setae. Male leg 5 endopods often reduced and unsegmented but never with more than 6 setae. (Bradford & Jillett 1974)

TYPE SPECIES: *Calanoides patagoniensis* Brady, 1883 by monotypy.

REMARKS: The following species have been described: *Calanoides acutus* (Giesbrecht, 1902); *C. carinatus* (Krøyer, 1849); *C. macrocarinatus* Brodsky, 1972 (male *see* Bradford 1970b as *C. carinatus*); *C. natalensis* Brady, 1914; *C. patagoniensis* Brady, 1883; *C. philippinensis* Kitou & Tanaka, 1969. *Calanoides natalensis* is imperfectly known (*see* Vervoort 1951).

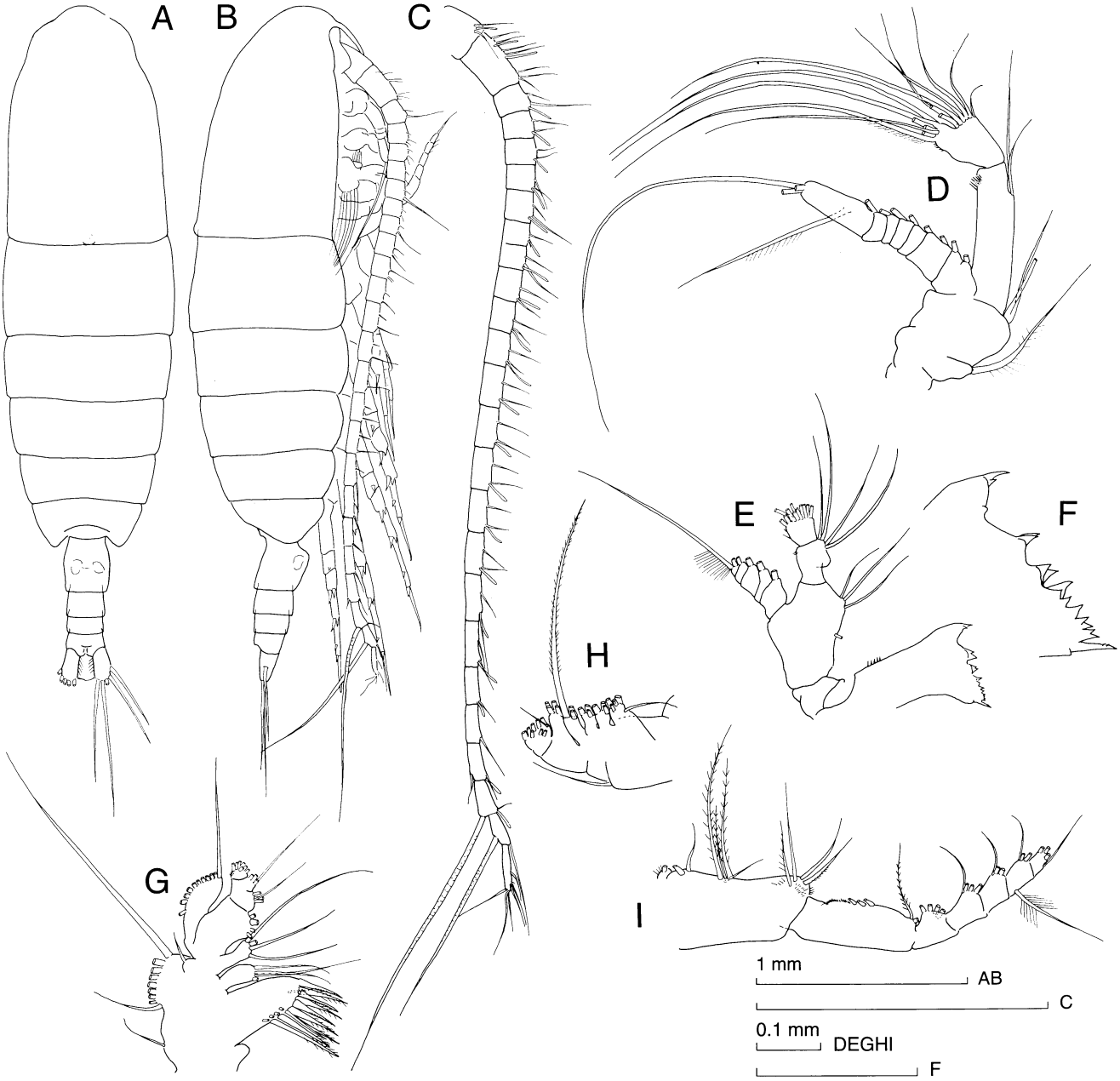


Fig. 6. (Above and opposite). *Calanus australis* female from NZOI Stn G142: A, dorsal view; B, lateral view; C, antenna 1; D, antenna 2; E, mandible; F, detail of cutting edge of mandibular blade; G, maxilla 1; H, maxilla 2; I, maxilliped; J, leg 1; K, leg 2; L, leg 3; M, leg 4; N, leg 5; O, inner edge of leg 5 basipod 1; P, disto-anterior border of basipod 2 of leg 4 anterior view; Q, disto-anterior border of basipod 2 of leg 5 anterior view.

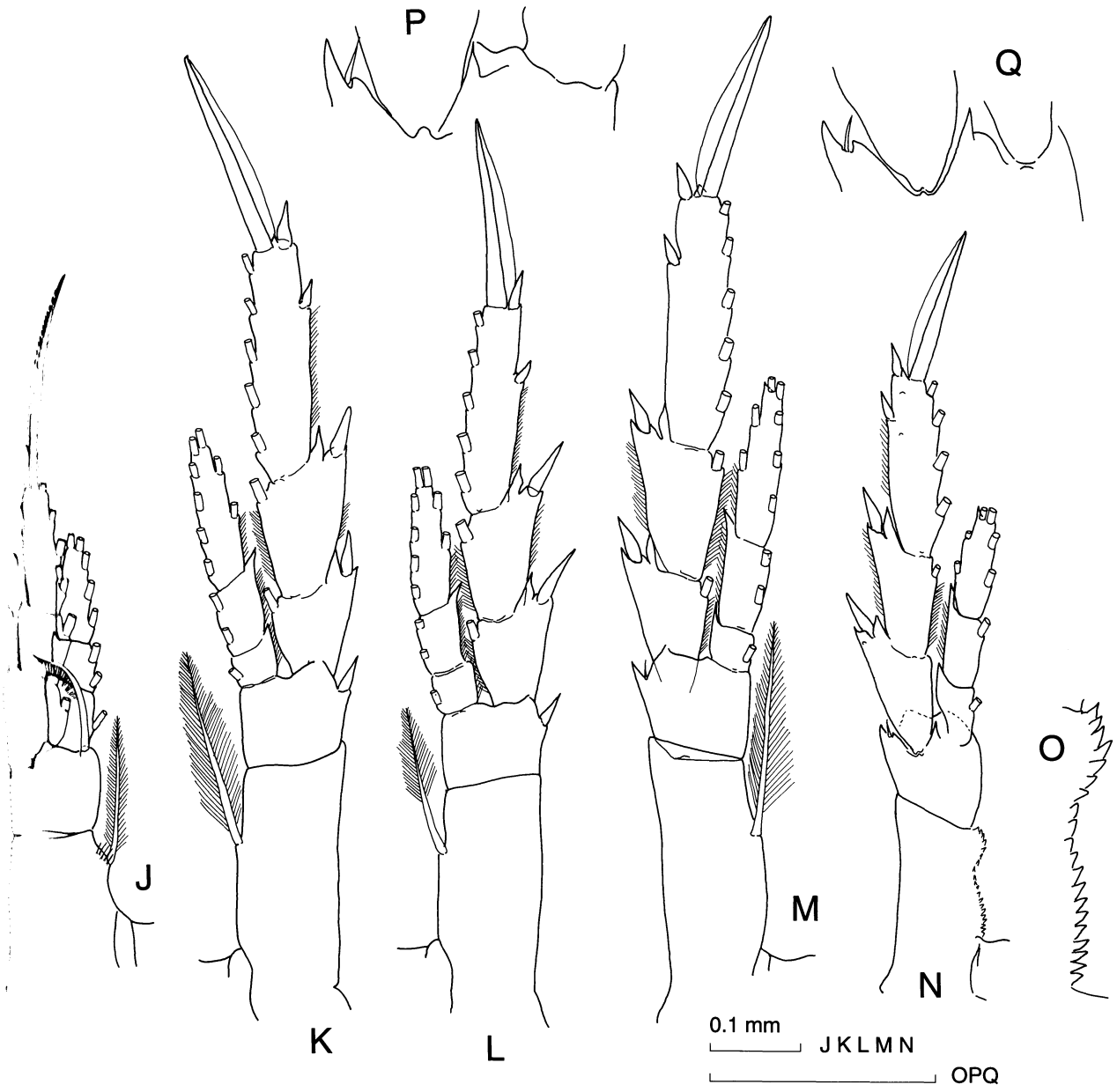
The following species have been taken in the Southwest Pacific.

Calanoides acutus (Giesbrecht, 1902) (Figs 8, 77)

DESCRIPTION: Size: females 3.50–5.70 mm, males 5.00–5.50 mm.

Female: As in the generic definition. This species is distinguished from others of the genus by its size and antenna 1 extends beyond the caudal rami.
(Vervoort 1951)

Male: As in the generic definition. Male leg 5 with relatively unreduced endopod setation and with exopods only slightly unequal in length
(Vervoort 1951)



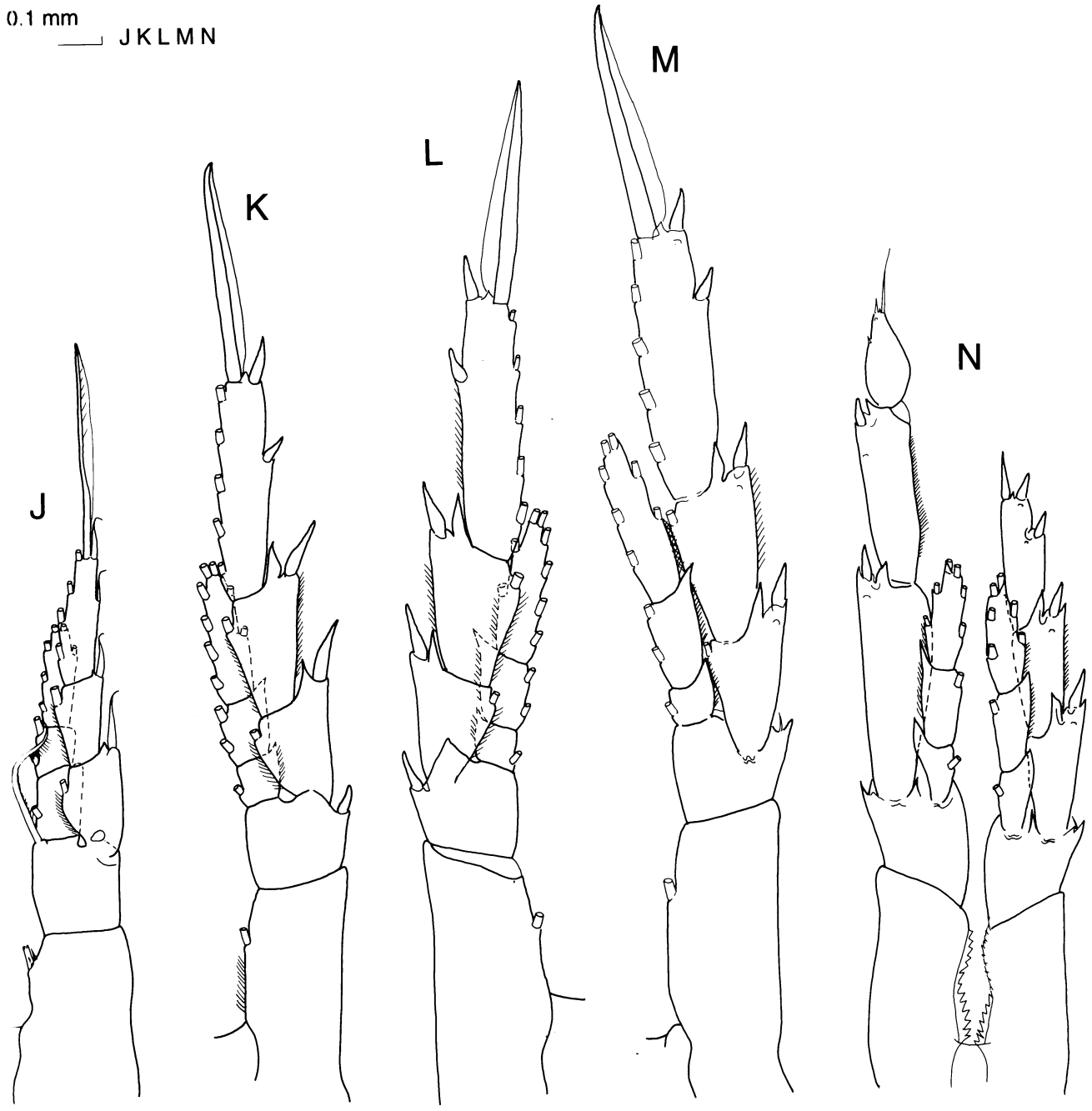
REMARKS: Vervoort (1951) established that Brady's briefly described genus *Calanoides* should be retained and that Giesbrecht's species should be placed in it.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Vervoort (1957).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B99	surface	1 female 3.5 mm
B108	0–500	5 copepodite V
B109	0–105	16 copepodite V
	0–500	2 copepodite V
B110	0–125	1 copepodite V
	0500	10 copepodite V
		1 copepodite IV

Fig. 7. (Above and opposite). *Calanus australis* male from NZOI Stn G142: A, dorsal view; B, lateral view; C, antenna 1; D, antenna 2; E, mandible; F, detail of cutting edge of mandibular blade; G, maxilla 1; H, maxilla 2; I, maxilliped; J, leg 1; K, leg 2; L, leg 3; M, leg 4; N, leg 5.



B111	0–500	3 females 4.0–4.6 mm 11 copepodite V
B112	0–125	1 female 4.2 mm, 9 copepodite V
B113	0–500	1 female 4.5 mm
B114	0–125	1 female, 1 copepodite V
B119	0–500	1 female 4.4 mm

DISTRIBUTION: This is an Antarctic species which is generally confined to south of the Antarctic Convergence, although developmental stages are carried north in the intermediate water layers of the subantarctic (Vervoort 1957). The present specimens were not in very good condition.

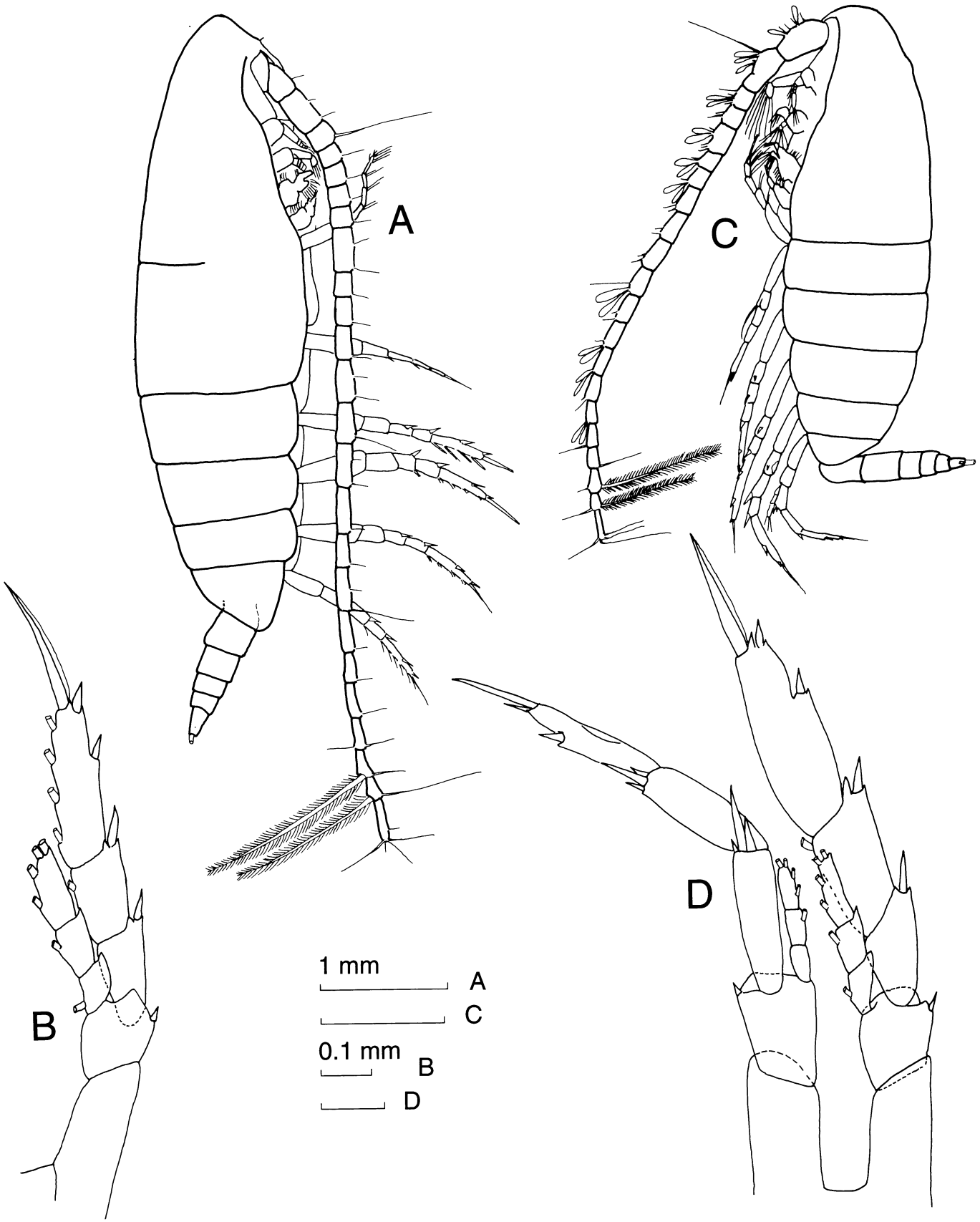


Fig. 8. *Calanoides acutus* (from Vervoort 1951). Female: A, lateral view; B, leg 5. Male: C, lateral view; D, leg 5.

Calanoides macrocarinatus Brodsky, 1972
(Figs 9, 77)

DESCRIPTION: Size: females 3.20–3.90 mm, males 2.90–3.90 mm.

Female: As in the generic definition. Antenna 1 does not extend to the caudal rami. This species is distinguished from *C. carinatus* mainly by the general body shape viewed laterally: the anterior head projects strongly and is larger than in *C. carinatus* and with a blunt triangular projection. On the genital segment the spermathecae in lateral view are inclined relative to the posterior border of this segment unlike *C. carinatus* where the spermathecae are parallel to this border. (Brodsky 1972)

Male: As in the generic definition. This species can be distinguished by the proportions and setation of leg 5. Right endopod segment 3 has 4 setae but the other 2 segments are naked, the distal border of exopod segment 3 extends about 0.75 of the way along the left exopod segment 2, and the terminal spine on the left exopod hardly extends beyond the distal border of left exopod segment 3. Left endopod 2-segmented with a hint of division on segment 2, terminal part of endopod bordered by hairs.
(Bradford 1970b)

REMARKS: The Southwest Pacific specimens examined here seem to fit Brodsky's brief description although the spermathecae are only very slightly inclined relative to the posterior border of the genital segment in lateral view. The species name *macro-carinatus* was published by Brodsky (1967) without a description; this was corrected later (Brodsky 1972). The developmental stages of this species may be identified from the work of Bradford *et al.* (1988).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929), Bradford (1970a, 1972), Nyan Taw (1978), Bradford *et al.* (1980), Bary (1951), Vervoort (1957), all as *C. carinatus*. Dakin & Colefax's (1940) specimens from off Sydney, identified as *C. brevicornis* do not appear to be referable to any of the presently described species. It is probable that the last word has yet to be written on the *Calanoides* of the Southwest Pacific.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	500–1000	1 female
		1 copepodite V
A295	400–1000	1 copepodite V
A302	500–1000	1 copepodite V
A303	450–1000	1 male 3.3 mm
F945	500–1000	2 copepodite V
F946	0–200	3 females 3.20–3.45 mm
		10 copepodite V
	200–500	6 females 3.30–3.70 mm
	0–1000	4 females 3.30–3.60 mm,
		4 copepodites
F947	0–200	8 females 3.30–3.70 mm
	0–500	4 females 3.30–3.50 mm
VUZ93	0–1097	3 females 3.35–3.45 mm
		1 male 3.9 mm
Mu67/114	0–80	7 females
		9 copepodites

Calanoides macrocarinatus was also present in hauls from 0–200 m or near the sea floor at the following stations: N333–N336, N364, N396, N404, N414, N415, N419–N421, N456, N458, N464–N467, N471, N473, N474, N480, N482.

DISTRIBUTION: This species was described from mid-latitudes in the Atlantic Ocean near southern Africa (Brodsky 1972). It apparently has a short-lived male as very few have been captured. Those specimens I have examined were taken in September (Bradford 1970a, b), July (Stn A303), and August (VUZ 93). *Calanoides macrocarinatus* appears to perform an ontogenetic vertical migration similar to *Neocalanus tonsus* as it disappeared at the same time from surface waters at the end of January off Kaikoura (Bradford 1972).

Calanus Leach, 1816

DEFINITION: Head and pedigerous segment 1 partly fused. Antenna 1 of male with segments 3–5 fused in some cases. Mouthparts the same in both sexes; maxilla 2 with 5 or 6 setae on inner lobe 1. Swimming legs without modification or ornamentation. Leg 5 with a toothed inner border on basipod 1 in both sexes. Female leg 5 endopod with 8 setae. Male leg 5 with both rami 3-segmented, both endopods with 8 setae.
(Bradford & Jillett 1974; Bradford 1988)

TYPE SPECIES: *Monoculus finmarchicus* Gunnerus, 1770

REMARKS: The following species have been described:

C. helgolandicus group: *Calanus agulhensis* De Decker, Kaczmaruk & Marska, 1991; *C. australis* Brodsky, 1959; *C. chilensis* Brodsky, 1959; *C. euxinus* Hulsemann, 1991; (= *C. ponticus*, see Fleminger & Hulsemann 1987); *C. helgolandicus* (Claus, 1863); *C.*

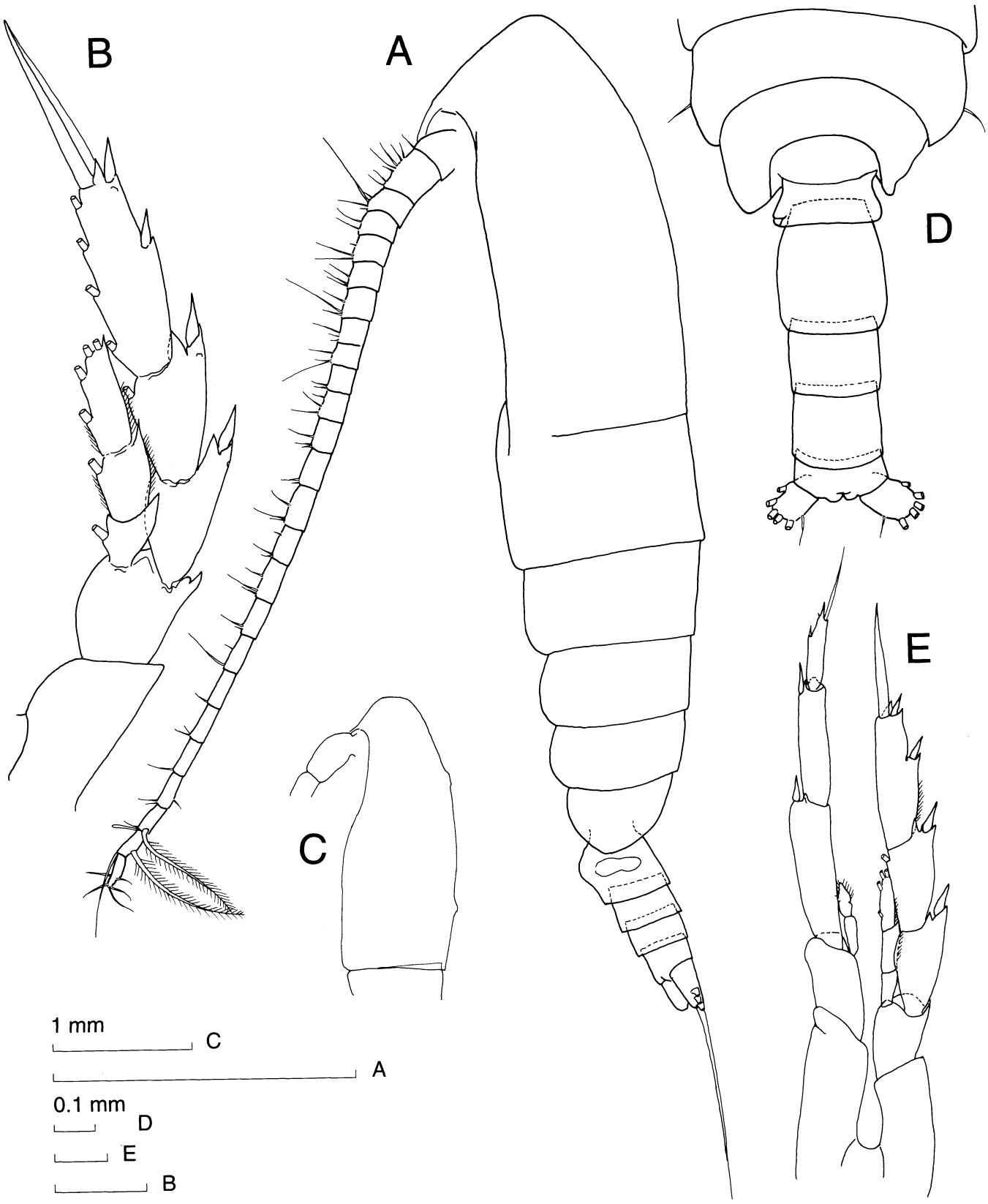


Fig. 9. *Calanoides macrocarinatus*. Female from VUZ Stn 93: A, lateral view; B, leg 5. Male (from Bradford 1970): C, lateral view of anterior body, D, dorsal view of posterior body; E, leg 5.

melitensis Pintar, 1988; *C. orientalis* Yashnov, 1975; *C. pacificus* Brodsky, 1948; *C. ragusensis* Pintar, 1988; *C. sinicus* Brodsky, 1965.

C. finmarchicus group: *C. finmarchicus* (Gunnerus, 1770); *C. glacialis* Yashnov, 1955; *C. marshallae* Frost, 1974.

C. hyperboreus Kroyer, 1838; *C. propinquus* Brady, 1883; *C. simillimus* Giesbrecht, 1902.

Species in the *C. helgolandicus* group are distinguished from species in the *C. finmarchicus* group by a characteristic of swimming leg 5 (both legs in the female and the right leg in the male): the outer distal corner of endopod segment 1 extends nearly to or beyond the inner distal corner of exopod segment 1 (Frost 1974). Species in the *C. finmarchicus* group have the outer distal corner of endopod segment 1 never extending close to the inner distal corner of exopod segment 1.

The following species have been taken in the Southwest Pacific.

Calanus australis Brodsky, 1959 (Figs 6, 7, 78)

DESCRIPTION: Size: females 2.60–3.59 mm, males 2.90–3.47 mm.

Female: As in the generic definition. Antenna 1 hardly extends beyond the caudal rami. Serrated edge of basipod 1 of leg 5 convex with a relatively small number of teeth (15–22) of triangular shape, especially distally. The outer distal projections of endopod segment 1 of leg 5 do not reach the border between exopod segments 1 and 2, the terminal spine of exopod segment 3 is shorter than its segment. (Brodsky 1961)

Male: As in the generic definition. Left leg 5 of "thin type": proportion of breadth to length of exopod segments 1 and 2 more than 1:3.0, usually 1:3.2, 1:3.5. Endopod of left leg 5 extends only slightly beyond exopod segment 1 of the same leg. Right exopod of leg 5 extends more than half way along left exopod segment 2. (Brodsky 1961)

REMARKS: There is still considerable uncertainty about the identity and distribution of species in the *helgolandicus* group. In the Southern Hemisphere the recent description of *C. agulhensis* from southern Africa suggests *C. australis* may yet prove to be distributed only in New Zealand and Australian waters rather than circumglobally in the Southern Hemisphere (see "Distribution" below). The developmental stages of this species may be identified from the work of Bradford *et al.* (1988).

PREVIOUS SOUTHWEST PACIFIC RECORDS: As *C. finmarchicus:* Brady (1883); Brady (1899); Farran (1929); Dakin & Colefax (1933); Vervoort (1957). As *C. helgolandicus:* Thomson & Anderton (1921); Bary (1951). As *C. australis:* Brodsky (1959); Deevey (1966); Jillett (1971, 1976); Roberts (1972); Bradford (1972, 1985); Nyan Taw (1978); Bradford *et al.* (1980).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B97	surface	2 stage V 2.15, 2.9 mm
B98	surface	3 females 2.8, 2.75, 2.9 mm
B120	0–150	1 female 3.2 mm
D614	0–100	1 female
G142	0–100	38 females 3.09–3.40 mm 3 males 2.9–3.4 mm
G142	100–250	89 females 2.77–3.44 mm 25 males 2.96–3.40 mm
	250–500	59 females 2.77–3.59 mm 133 males 2.90–3.47 mm
G144	100–250	9 males 3.15–3.28 mm
	250–500	15 males 3.15–3.4 mm
VUZ93	0–1097	4 females 2.5–3.1 mm 1 male 3.3 mm
VUZ105	0–914	1 female 2.6 mm
VUZ112	0–732	1 female 2.9 mm
Mu67/6	0–100	many females, 22 males, many copepodites

Calanus australis was present in hauls from 0–200 m or near the sea floor at the following stations: N333–N336, N338–N346, N349, N350, N356–N359, N361–N368, N370, N373–N375, N379, N380, N384, N385, N387–N389, N392, N395, N396–N408, N410–N423, N429, N430, N433–N436, N440, N441, N445–N475, N479-N482.

DISTRIBUTION: *Calanus australis* is an epipelagic species found at least in New Zealand waters, and south eastern Australian waters. Brodsky (1961) records this species as also occurring of the coast of Chile and Argentina.

Calanus propinquus Brady, 1883 (Figs 10, 78)

DESCRIPTION: Size: females 4.75–6.00 mm, males 4.75–4.95 mm.

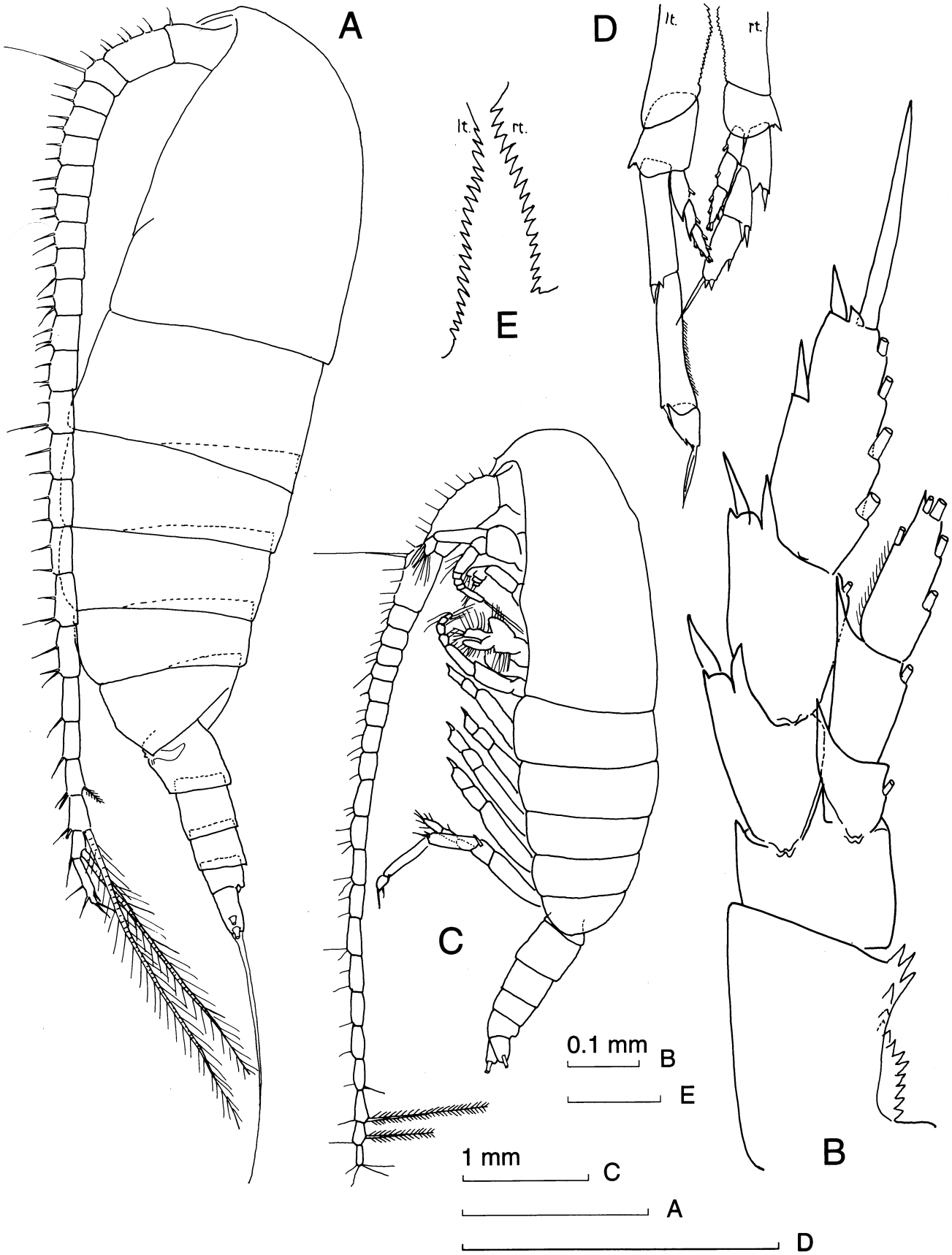


Fig. 10. *Calanus propinquus*. Female from NZOI Stn B109: A. lateral view; B, leg 5. Male (from Vervoort 1951): C, latera view; D, leg 5; E, inner borders of leg 5 basipod 1.

Female: As in the generic definition. This species can be distinguished from *C. simillimus* by its larger size and relatively long seta on segment 23 of antenna 1 which is longer than the last eight segments. (*see* Vervoort 1951)

Male: As in the generic defintion. This species can be distinguished from *C. simillimus* by its larger size and the proportions of leg 5: the right exopod extends beyond the distal border of left exopod segment 1. (*see* Vervoort 1951)

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Vervoort (1957).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B109	0–125	2 females 4.95, 5.10 mm

DISTRIBUTION: *Calanus propinquus* is a common Antarctic copepod usually found south of the Antarctic Convergence. Nevertheless this species may also be found occasionally north of this boundary (Vervoort 1951) as the present record attests.

Calanus simillimus Giesbrecht, 1902 (Figs 11, 78)

DISCRIPTION: Size: females 2.65–3.80 mm, males 2.62–3.42 mm.

Female: As in the generic definition. These may be distinguished from *C. australis*, by the pointed postero-lateral metasomal margins, and the shape of the teeth along the internal border of basipod 1 on leg 5. It may be distinguished from *C. propinquus* by the longer seta on segment 23 of antenna 1 which is shorter than the last 7 segments. (*see* Vervoort 1951)

Male: As in the generic definition. These may be distinguished by antenna 1 which does not extend beyond the caudal rami, leg 5 which extends beyond the caudal rami and its right exopod which does not extend as far as the distal border of the left exopod segment 1. (*see* Vervoort 1951)

REMARKS: It is clear that *Calanus* sp. (Bary 1951) was *C. simillimus*.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Bary (1951) (as *Calanus* sp.); Vervoort (1957); Jillett (1976).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B106	Surface	98 females 2.80–3.34 mm copepodites
B107	Surface	2 females 3.25, 3.30 mm 1 copepodite V
B109	0–125	6 females 2.85–3.04 mm 4 males 2.62–3.12 mm
B110	0–125	4 females 2.70–2.90 mm
	0–500	4 females 3.00–3.30 mm
B111	0–500	4 females 2.80–3.05 mm 1 copepodite V
B112	0–125	7 females 2.80–3.20 mm 1 copepodite V
B113	0–500	3 females 2.65-2.90 mm 5 copepodite V
B114	0–125	6 females; 8 copepodites 3 males 3.25–3.30 mm
	0–500	8 females 3.00–3.55 mm 6 copepodite V
B116	0–125	57 females 3.30–3.80 mm 8 copepodite V 12 males
B117	0–500	26 females 2.80–3.45 mm 1 copepodite V 4 males 3.10–3.35 mm 1 copepodite IV
B118	0–125	10 females 3.20–3.45 mm
	0–500	1 female; 1 copepodite V
B119	0–500	12 females; 4 males
Mu67/57s	0–1000	1 female, 5 copepodites
Mu67/94s	0–1000	1 female
Mu67/147s	0–1000	1 female

DISTRIBUTION: *Calanus simillimus* is a subantarctic species; south of the Antarctic Convergence it is found only in deep waters in small numbers against the Antarctic continent (Vervoort 1957). In the New Zealand region the present records are mainly south of the Subantarctic Front although Bary's (1951) and Jillett's (1976) records, as *Calanus* sp., are north of the front mainly in deep waters.

Canthocalanus A. Scott, (1909)

DEFINITION: Head and pedigerous segment 1 fused. Mouthparts similar in both sexes; maxilla 2 with 4 setae on inner lobe 1. Leg 1 basipod 1 anterior margin terminates in a well-defined projection; basipod 2 with a distal seta on the anterior surface modified into a proximally thickened spine. Legs 2-4 without modification or ornamentation. Leg 5

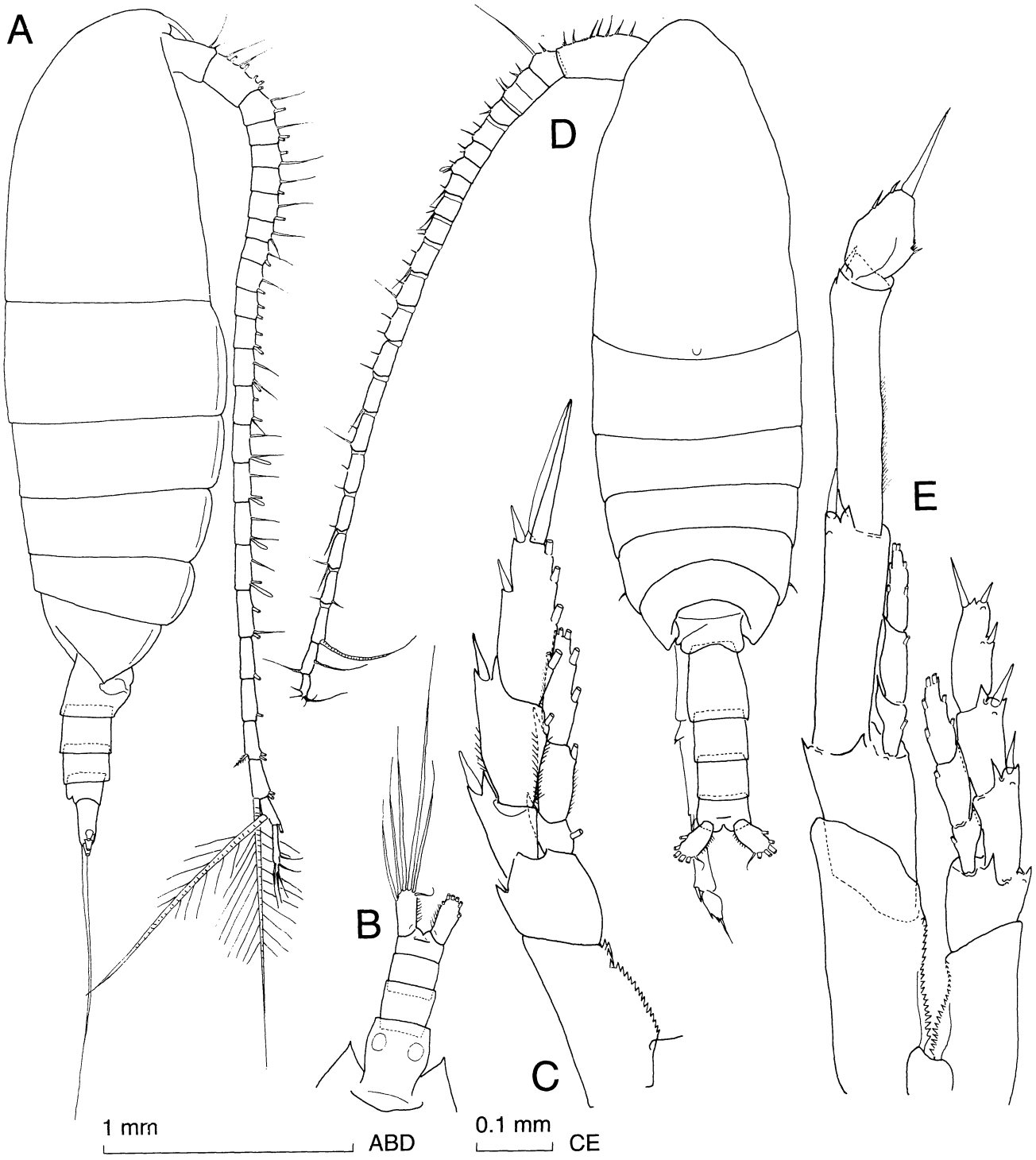


Fig. 11. *Calanus simillimus* from NZOI Stn B117. Female: A, lateral view; B, dorsal view of posterior body; C, leg 5. Male: D, dorsal view; E, leg 5.

with the inner border of basipod 1 naked in both sexes. Female leg 5 endopod with 7 setae. Male leg 5 with both rami 3-segmented, hardly modified on the right; left endopod with only 2 terminal setae. (Bradford & Jillett 1974)

TYPE SPECIES: *Calanus pauper* Giesbrecht, 1888

REMRKS: This genus is monotypic.

The sole species has been taken in the Southwest Pacific.

Canthocalanus pauper (Giesbrecht, 1888)
(Fig. 12)

DESCRIPTION: Size: females 1.30–1.60 mm, males 1.30–1.5 mm.

Female: As in the generic definition. General shape resembles that of *Nannocalanus minor* but the posterior metasomal corners are asymmetrical in dorsal view. Leg 1 basipod 2 with inner marginal seta thickened with a short extension at its base. (Mori 1937)

Male: As in the generic definition. Leg 5 right exopod without inner marginal setae, left endopod with 2 terminal setae, left exopod segments elongated with elongated outer distal setae on segments 2 and 3. (Mori 1937)

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Dakin & Colefax (1940); Chiba & Hirakawa (1972); Greenwood (1976).

NEW RECORDS: None.

DISTRIBUTION: This species is distributed in the Pacific Ocean between 15°N and 15°S according to Giesbrecht (1892). In Japanese waters it reaches 33°N (Mori 1937). Farran (1929) recorded 1 large male (2.04 mm) from about 33°S just north of New Zealand.

Cosmocalanus Bradford & Jillett, 1974

DEFINITION: Head and pedigerous segment 1 fused. Antenna 1 of the male with segments 3–5 and 24–25 fused. Postero-lateral corners of the metasome pointed in the female. Mouthparts similar in both sexes; inner lobe 1 of maxilla 2 with 5 setae. Basal segments of swimming legs ornamented with spines; these spines present on the anterior surface of basipod 1 of legs 1, 3–5 in the female; and of legs 1, 3 and 4 in the male; these spines are also present on the posterior surface of basipod segment 2 of legs 2 and 3. Leg 5 in both sexes with teeth on the inner borders of basipod segment 1. Female leg 5 endopods with 7 setae. Male leg 5 with 1-segmented, rudimentary left endopod; left exopod highly modified compared with the *Calanus* type: exopod segment 1 normal; exopod segment 2 external spine very elongate with an inner peg-like projection; exopod segment 3 elongate and complicated. Male right leg not modified. (Bradford & Jillett 1974)

TYPE SPECIES: *Undina darwinii* Lubbock, 1860

REMRKS: This genus contains two species *C. caroli* (Giesbrecht, 1888) and *C. darwinii* Lubbock, 1860. The separate status of *C. caroli* is in some doubt (Sewell 1929; Vervoort 1949).

The following species has been taken in the Southwest Pacific.

Cosmocalanus darwinii (Lubbock, 1860)
(Figs 13, 79)

DESCRIPTION: Size: females 1.60–2.40 mm, males 1.63–2.05 mm.

Female: As in the generic definition. Postero-lateral metasomal borders may take three forms (symmetrical = forma *symmetrica*, very asymmetrical with left border produced into a squared-off lappet = forma *typica*, and an intermediate form which is slightly asymmetrical = forma *intermedia*). Antenna 1 of forma *typica* and *symmetrica* have segments 6 and 7 with a transverse row of small spinules, and forma *intermedia* has segments 3 to 8 with a transverse row of small spines. Forma *typica* has the outer edge spine of leg 5 exopod segment 1 extending as far as the base of the outer edge-spine of the next segment, whereas in forma *intermedia* this spine is shorter. (Sewell 1929; Vervoort 1949)

Male: As in the generic description. Leg 5 is distinguised by the relatively elongate nature of the left exopod pincers relative to *C. caroli*, the detail of the structure of exopod segment 3 with a single prominent lappet extending towards the other part of the pincers, and the position of the lappet (almost at mid-length) on the modified extension of exopod segment 2 which serves as the other part of the pincers. (Giesbrecht 1892)

REMARKS: Both forma *typica* and forma *intermedia* females were present among the specimens exam-

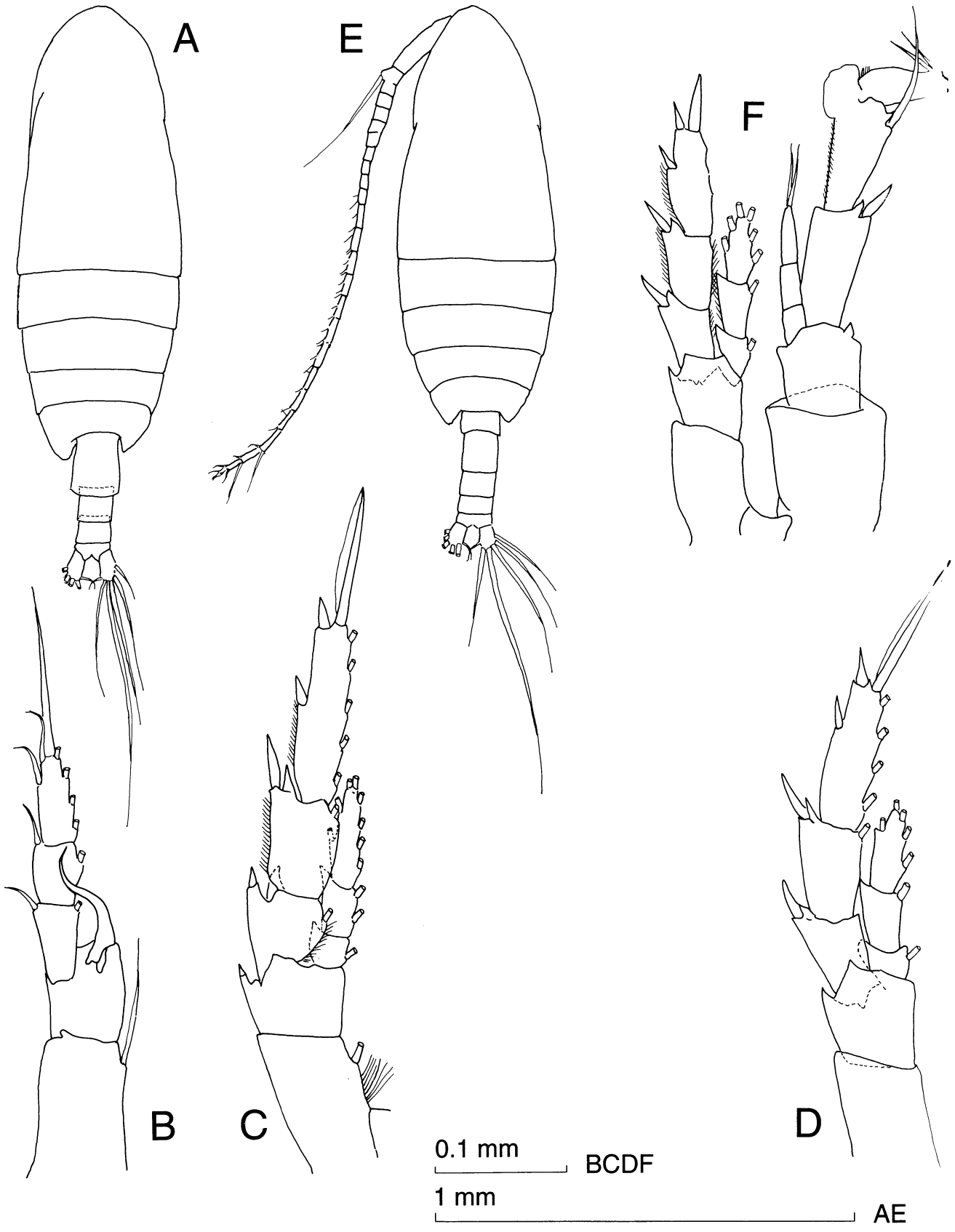


Fig. 12. *Canthocalanus pauper* (from Mori 1937). Female: A, dorsal view; B, leg 1; C, leg 2; D, leg 5. Male: E, dorsal view; F, leg 5.

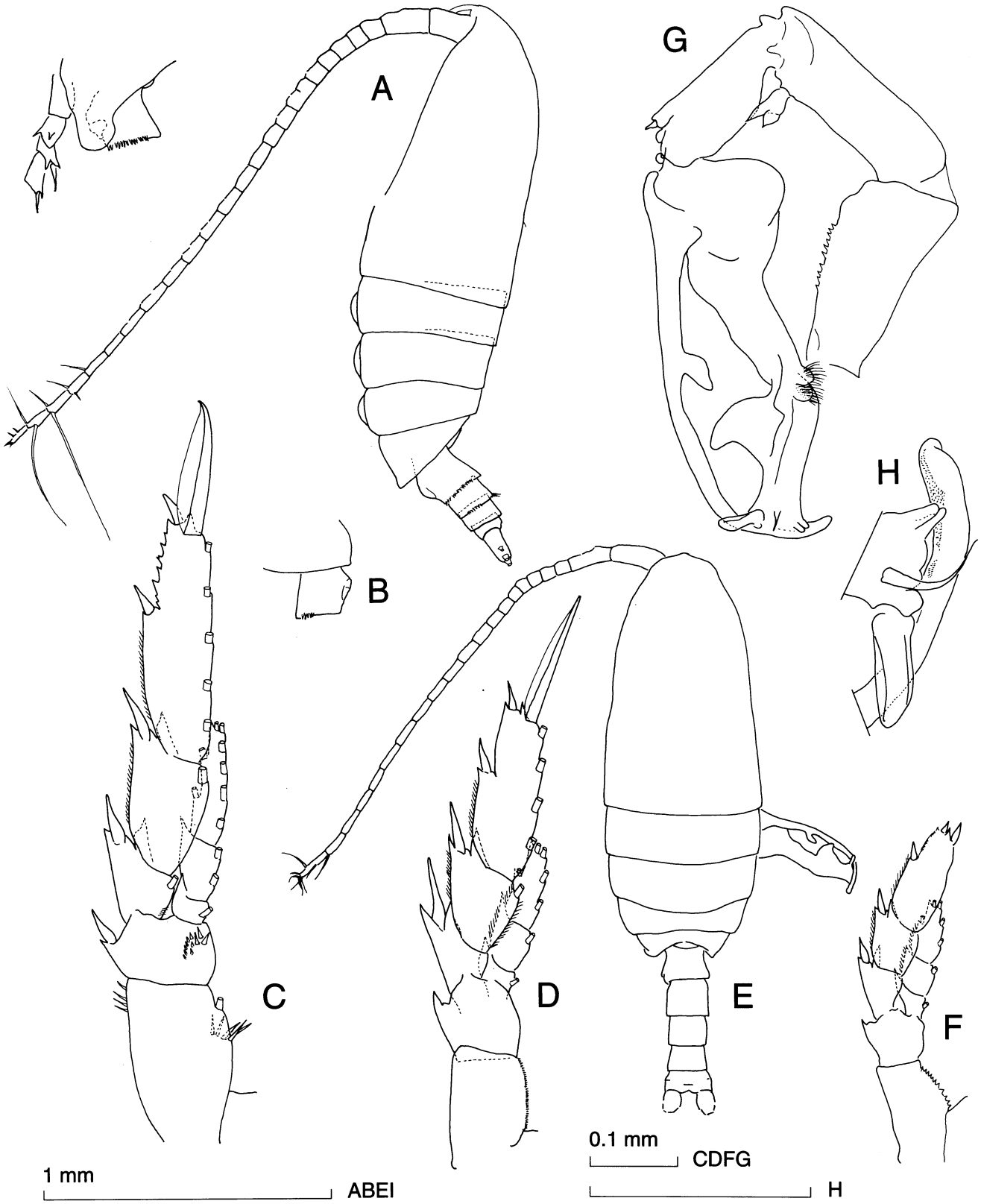


Fig. 13. *Cosmocalanus darwinii* from NZOI Stn A292. Female: A, lateral view, B, right side view of genital segment and pedigerous segment 5; C, leg 3; D, leg 5. Male: E, dorsal view; F, right leg 5; G, left leg 5; H, detail of the distal part of left leg 5. I, right side view of gential segment and pedigerous segment 5 of a female from NZOI Stn F945 0-200 m.

ined here. There did not seem to be a great difference in the lengths of the outer edge spine of leg 5 exopod segment 1; the apparent length appeared to depend on the attitude in which the following segments were held. It seems likely that *C. caroli* does represent the male of a separate species as the differences between the left legs seem quite distinct; this species has not yet been taken in the Southwest Pacific.

PREVIOUS SOUTHWEST PACIFIC RECORDS: As *Undina darwinii:* Hamilton (1896); Brady (1883). As *Undinula darwini:* Farran (1929); Dakin & Colefax (1940); Heinrich (1968) Chiba & Hirakawa (1972). As *Cosmocalanus darwini:* Greenwood (1976).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	surface	7 females, 2 males
A295	surface	4 females, 1 male
	0-500	1 female
A302	surface	1 male
	0–500	1 female
A303	0–10	2 females
C537B	0–250	1 female
C544	surface	3 females, 4 males
F945	0–200	3 females 2.30–2.40 mm
	0–500	1 male 2.05 mm
F946	200–500	2 males 2.30, 2.35 mm
AUZ51	surface	1 female

DISTRIBUTION: This species is found in tropical and subtropical waters usually restricted to surface layers (Vervoort 1949; Heinrich 1968).

Mesocalanus Bradford & Jillett,1974

DEFINITON: Head and pedigerous segment 1 separate. Antenna 1 with segments 8 and 9 fused in female; segments 3 to 5, 7 and 8, 9 and 10 fused in the male. Male mouth parts reduced. Maxilla 2 with 6 setae on inner lobe 1. Swimming legs 1–4 without modification or ornamentation. Leg 5 basipod 1 with a smooth inner border in both sexes. Female leg 5 endopod with 7 setae. Male leg 5 with both rami 3-segmented, endopods with 7 setae.
(Bradford & Jillett 1974).

TYPE SPECIES: *Calanus tenuicornis* Dana, 1849

REMARKS: This genus contains the following species: *Mesocalanus lighti* (Bowman, 1955) , and *M. tenuicornis* (Dana, 1849). Mullin (1969) records an intermediate form south of 40°S.

The following species has been taken in the Southwest Pacific.

Mesocalanus tenuicornis (Dana , 1849)
(Figs 14, 80)

DESCRIPTION: Size: females 1.80–2.40 mm, males 1.70–2.20 mm.

Female: Width of metasome relative to its length is about 0.30. In lateral view the posterior margin of the head not elevated. Length of urosome segment 2 relative to urosome segment 3 is about 1.25. (Bowman 1955; Mullin 1969)

Male: Left leg 5 exopod segment 3 terminal spine almost as long as its segment when measured along the outer border. (Giesbrecht 1892)

REMARKS: It appears that the present specimens are referable to *M. tenuicornis* because of the lack of an elevated postero-dorsal margin of the head, metasome width/length greater than or equal to 0.30, and the length of 2 relative to urosome segment 3 is not as great as 1.33. Male leg 5 exopod segment 3 terminal spine appears to be slightly longer than its segment measured along the outer border (in figure 14 this segment is drawn while it is not flat); in *M. lighti* this spine appears to be shorter than its segment (Bowman 1955). Although Mullin (1969) records an intermediate form from the southern hemisphere (which he says should be referred to *M. tenuicornis* until its taxonomic status is clearly established) the present specimens do not appear to have the characteristics of this form. This intermediate form might be designated *M. lighti* on morphometric grounds except that it lacks the dorsal hump, has the opaque appearance more characteristic of *M. tenuicornis*, and the male is larger relative to the female than is the case in either *M. lighti* or *M. tenuicornis* (Mullin 1969).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Dakin & Colefax (1940); Bary (1951); Heinrich (1968); Mullin (1969); Jillett (1971); Bradford (1970a, 1972) all as *Calanus tenuicornis.* Nyan Taw (1978); Bradford (1985) as *M. tenuicornis.*

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A295	0–500	2 females

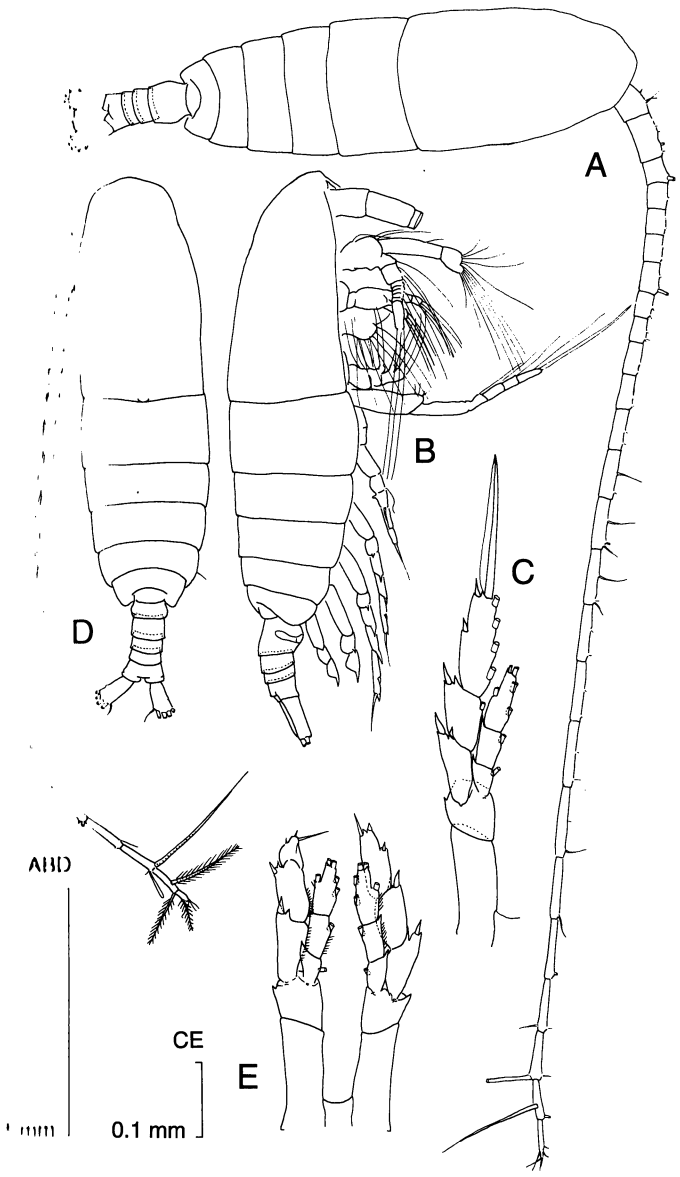


Fig. 14. *Mesocalanus tenuicornis* from NZOI Stn G142. Female: A, dorsal view; B, lateral view; C, leg 5. Male: D, dorsal view; E, leg 5.

A302	0–500	2 females
A313	0–914	1 female, 1 copepodite
A332	Surface	1 female 2.0 mm
A341	0–250	10 females, 2 males
B116	0–125	1 female 2.1 mm (damaged)
C537B	0–250	1 male
C544	Surface	1 female 3.4 mm
D614B	100–250	1 female
F946	200–500	2 males 1.7, 1.8 mm
	0–1000	1 male 1.8 mm
F947	0–200	1 females 2.15 mm, 1 copepodite V
	0–500	2 females 2.0, 2.1 mm 1 male 1.9 mm

Mesocalanus tenuicornis was present in hauls from 0–200 m or near the sea floor at the following stations: N333, N336–N338, N340–N346, N350, N351, N353, N357, N358, N364–N366, N369–N371, N374, N376, N379–N381, N384–N386, N397, N398, N400, N410–N415, N419–N423, N429–N432, N434, N436, N438, N441–N450, N452, N453, N456–N458, N464–N467, N469–N471, N473, N474, N482.

DISTRIBUTION: Widespread in tropical and subtropical oceans (Heinrich 1968; Mullin 1969). *Mesocalanus lighti* is found in the South Pacific Ocean just north of the region treated here (Heinrich 1968; Mullin 1969) and the intermediate form is found in subantarctic water south of 40°S (Mullin 1969).

Nannocalanus Sars, 1925

DEFINITION: Head and pedigerous segment 1 fused in the male and female. Otherwise very similar to *Calanus*. Right and left spermathecae fused on female genital segment. Male antenna 1 segments 1–2, 3–5, 24–25 fused. Male right leg 5 like other swimming legs, i.e., with setae on the inner border of the exopod, left endopod without setae, left exopod with outer edge spines greatly elongated.
(Giesbrecht 1892; Bradford 1988)

TYPE SPECIES: *Calanus minor* Claus, 1863

REMARKS: This monotypic genus contains the following species: *Nannocalanus minor* (Claus), which has been taken in the Southwest Pacific.

Nannocalanus minor (Claus, 1863) (Figs 15, 81)

DESCRIPTION: Size: females 1.80–2.25 mm, males 1.20–1.80 mm.

Female: As in the generic definition.
(Giesbrecht 1892)

Male: As in the generic definition. Caudal rami divergent in dorsal view. On leg 5 the longest of the inner edge setae on the right endopod segment 3 extends to the distal border of right exopod segment 3. (Giesbrecht 1892)

REMARKS: Male right leg 5 with the longest terminal

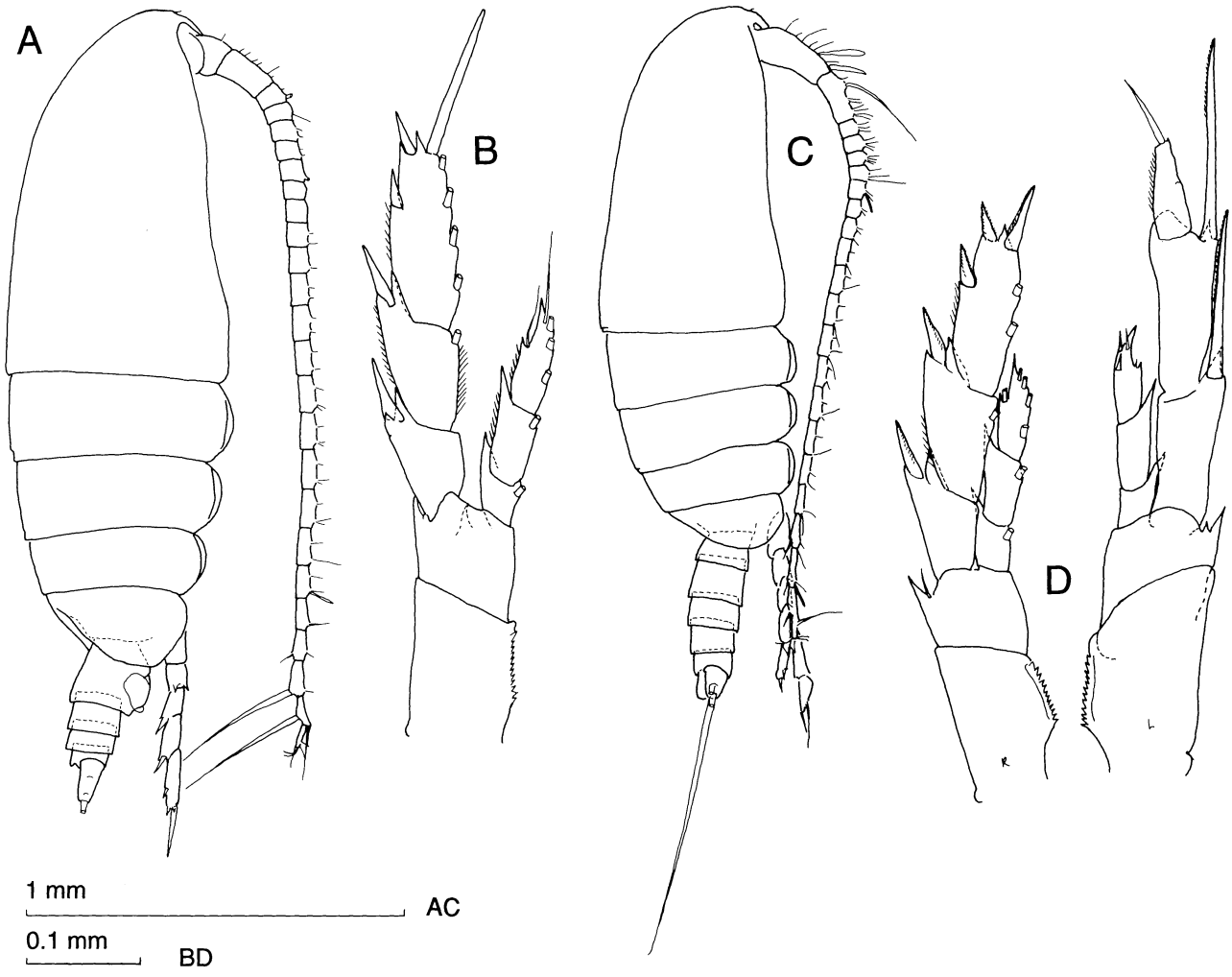


Fig. 15. *Nannocalanus minor* from NZOI Stn F946. Female: A, lateral view; B, leg 5. Male: C, lateral view; D, leg 5.

endopod setae extending beyond the distal border of right exopod segment 3. It is noted that Mori's (1937) figure of this limb indicates that these setae are much shorter.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Dakin & Colefax (1940); Heinrich (1968); Jillett (1971); Chiba & Hirakawa (1972); Greenwood (1976); Nyan Taw (1978). As *C. valgus:* Brady (1883).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	surface	2 females
A295	surface	4 females
A302	surface	7 females, 2 males
A302	0–500	4 females
A303	0–10	3 females
A332	surface	8 females 1.80–1.90 mm 2 males 1.7 mm
C526	0–250	2 females 1.88 mm
C537	surface	3 females 1.70 mm 6 copepodites
C537B	0–250	25 females 1.55–1.80 mm 2 males 1.40 mm 5 copepodites
C544	surface	many females, 14 males
F945	0–200	8 females 1.70–2.00 mm
	0–500	12 females 1.80–2.00 mm 1 male 1.20 mm
	500–1000	1 female (dead)
F946	0–200	13 females 2.00–2.25 mm
	200–500	8 females 1.90–2.10 mm

1946	0–1000	19 females 1.90–2.15 mm 7 males 1.7–1.85 mm
1947	0–200	7 females 1.95–2.10 mm
	0–500	8 females 1.90–2.10 mm

Nannocalanus minor was present in hauls from 0–200 m near the sea floor at the following stations: N335–N337, N340–N342, N344, N346, N350–N352, N356–N360, N364–N367, N370–N377, N379, N399, N401, N408, N414, N436.

DISTRIBUTION: *Nannocalanus minor* is a common inhabitant of all tropical and subtropical oceans (*see* Giesbrecht 1892). In New Zealand waters, off the east coast, it extends in offshore waters as far south as Kaikoura and on the west coast to about 38°S with an occasional specimen recorded in western Cook Strait and off Cape Foulwind.

Neocalanus Sars, 1925

DEFINITION: Head and pedigerous segment 1 fused or separate. Male antenna 1 may have segments 24 and 25 fused. Male, sometimes female, mouthparts reduced. Maxilla 2 with 6 setae on inner lobe 1. Swimming leg 2 in both sexes, with a recurved spine at the outer distal border of exopod segment 1. Basipod segment 1 of leg 5 with inner border naked in both sexes. Male leg 5 with both rami 3-segmented; left leg modified, endopod usually with 8 setae; right leg unmodified, or with inner edge setae of exopod absent. (Bradford & Jillett 1974)

TYPE SPECIES: *Calanus gracilis* Dana, 1849

REMARKS: The following species are in this genus: *N. cristatus* (Krøyer, 1848) *N. flemingeri* Miller, 1988; *N. gracilis* (Dana, 1849); *N. plumchrus* (Marukawa, 1921); *N. robustior* (Giesbrecht, 1888); and *N. tonsus* (Brady, 1883). Some workers consider that a separate genus should be established to take *cristatus, flemingeri, plumchrus,* and *tonsus.* (*see* Bradford 1988).

The following species have been taken in the Southwest Pacific.

Neocalanus gracilis Dana, 1849 (Figs 16, 83)

DESCRIPTION: Size: females 2.43–4.00 mm, males 2.30–3.10 mm.

Female: As in the generic definition. Head and pedigerous segment 1 fused. Leg 1 terminal exopod seta with a proximally truncate external blade, basipod segment 2 with a large spine at the base of the inner seta. (Giesbrecht 1892)

Male: As in the generic definition. Head and pedigerous segment 1 fused. Antenna 1 with segment 25 very small and fused to segment 24. Legs 2–4 distal exopod segments with dentate outer margins. Right leg 5 distal exopod segment with setae on the inner border. (Giesbrecht 1892)

REMARKS: The Southwest Pacific specimens of this species were not very plentiful, nor were the males in good condition so Giesbrecht's figures of the male have been reproduced here.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Brady (1883); Farran (1929); Dakin & Colefax (1940); Bary (1951); Vervoort (1957); Heinrich (1968); Bradford (1970a, 1972); Chiba & Hirakawa (1972); Nyan Taw (1978) as *N. robustior.*

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	0–500	3 copepodite V
A303	450–1000	1 female 2.80 mm
A307	surface	1 female 3.80 mm
A313	0–914	1 damaged
A332	surface	1 female 2.90 mm
C526	0–250	1 copepodite
C537	0–250	1 female 3.1 mm
C587	surface	1 male 2.88 mm
D614B	100–250	6 females 3.50–3.70 mm 16 copepodites
E774	0–1165	1 female
E788	0–1193	1 female
E892	0–1224	3 females
E901	0–1248	3 females
E904	0–1243	1 female
F874	0–1357	2 females
F879	0–1267	1 female
F911	0–1697	1 female 3.40 mm
F945	0–200	1 female 3.25 mm
	0–500	1 female, 1 male 2.70 mm
	500–1000	1 male 3.10 mm
F946	200–500	1 female 2.90 mm
F947	0–200	2 copepodite V
AUZ111	0–100?	1 female, 1 copepodite
VUZ105	0–914	1 female 4.00 mm
VUZ107	0–914	2 females 3.90, 3.85 mm
Mu67/88s	0–600	1 male 3.40 mm 1 copepodite

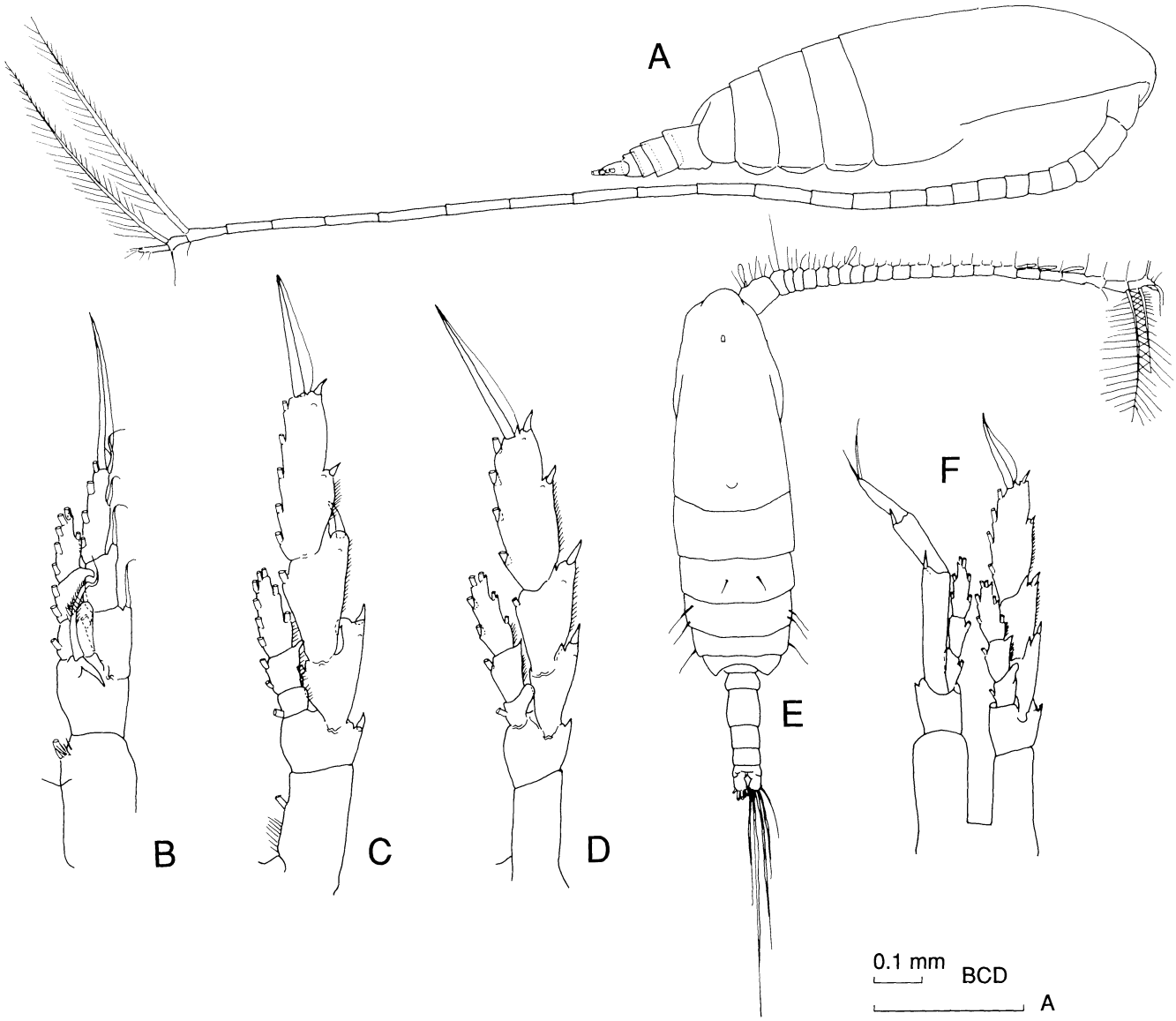


Fig. 16. *Neocalanus gracilis*. Female from NZOI Stn G142: A, lateral view; B, leg 1; C, leg 2; D, leg 5. Male (from Giesbrecht 1892): E, dorsal view; F, leg 5.

Mu67/116s	0–1000	1 female 3.75 mm
		1 male 3.70 mm
Mu67/147s	0–1000	1 female, 1 copepodite

Neocalanus gracilis was present in hauls from 0–200m or near the sea floor at the following stations: N335–N337, N341, N342, N345, N346, N352, N353, N357, N358, N364, N370, N374, N376, N381, N386, N407, N408, N414, N415, N436, N439, N444, N448, N456, N458, N459, N464, N465, and N471.

DISTRIBUTION: This species is widespread in tropical, subtropical and temperate oceans (*see* Vervoort 1957). In New Zealand waters it is found in offshore water around the whole country (Fig. 83).

Neocalanus tonsus (Brady, 1883) (Figs 17, 82)

DESCRIPTION: Size: females 3.40–4.10 mm, males 3.3–4.40 mm.

Female: As in the generic definition. Head and pedigerous segment 1 separate but not as distinctly as the joints between the other pedigerous segments. Genital segment bulbous at mid-length in dorsal view. Mouthparts well-developed. Basipod segment 2 of legs 2–5 with conspicuous, posterior surface spines on inner distal border of segment. (Vervoort 1957)

Male: As in the generic definition. Head and pedigerous segment 1 separate. Antenna 1 25-segmented extending just beyond the caudal rami.

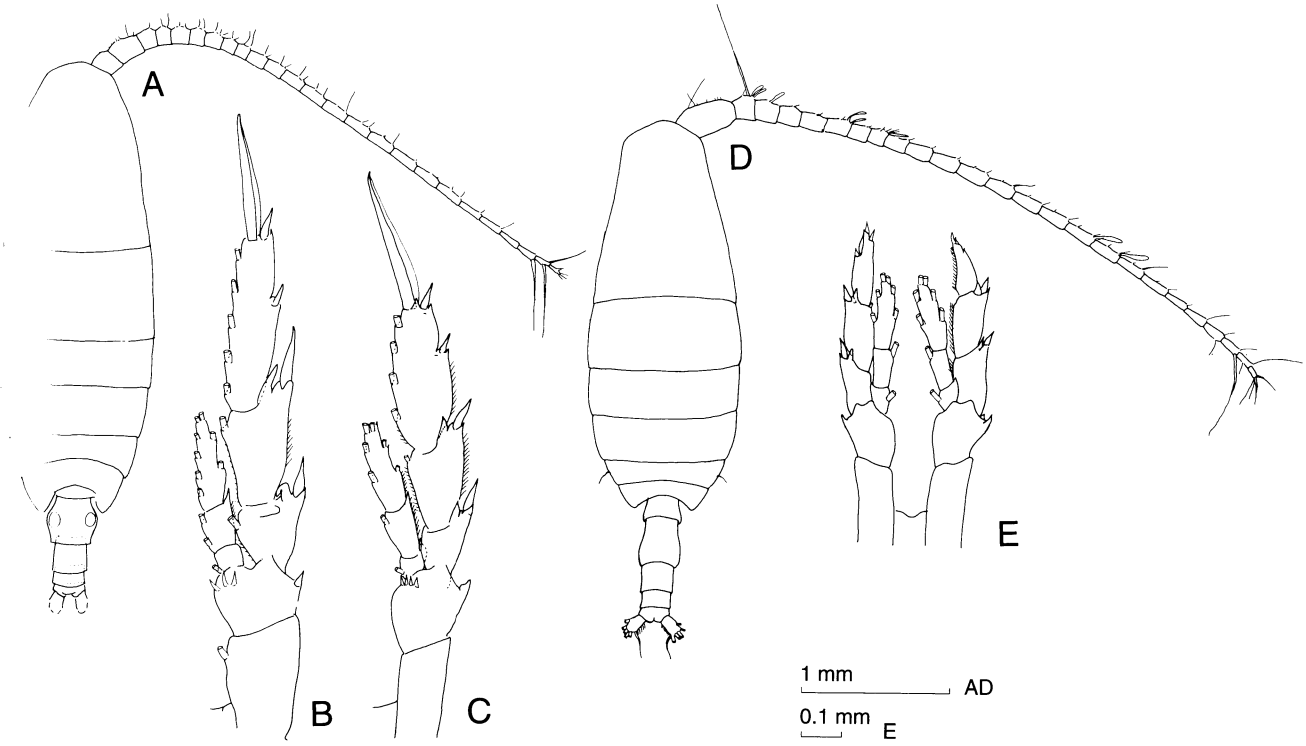


Fig. 17. *Neocalanus tonsus*. Female from NZOI Stn G142: A, dorsal view; B, leg 2; C, leg 5. Male (from Jillett 1968): D, dorsal view; E, leg 5.

Mouthparts typical of male calanids which do not have reduced mouthparts. Swimming legs 2–4 similar to female; leg 5 only slightly asymmetrical, with endopods as in female, exopods without inner edge setae. (Jillett 1968)

REMARKS: The developmental stages of this species may be identified from the work of Bradford *et al.* (1988).

PREVIOUS SOUTHWEST PACIFIC RECORDS: As *Calanus tonsus*: Brady (1883); Farran (1929); Vervoort (1957); Jillett (1968); Bradford (1970a,1972); Nyan Taw (1978). As *N. tonsus:* Bary (1951); Jillett (1976).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	500–1000	3 copepodite V
A295	400–1000	10 copepodite V
A302	500–1000	8 copepodite V
		1 males 3.3 mm
A303	450–1000	1 copepodite V
A313	0–914	86 females 3.5–4.0 mm
B97	surface	1 copepodite V
B112	0–500	2 females 3.40, 3.80 mm
B114	0–500	1 female 3.8 mm
B116	0–125	46 females,
		4 copepodite V
B117	0–500	5 females, 2 copepodite V
B118	0125	2 females
	0–500	4 females, 2 copepodite V
B119	0–500	14 females,
		1 copepodite V
B120	0–150	2 females
	0–400	5 females,
		68 copepodite V
E774	0–1165	1 copepodite V
E788	0–1193	3 copepodite V
F753	0–790	1 female
F946	0–200	7 copepodite V
	200–500	4 copepodite V
	0–1000	6 copepodite V,
	0–1000	1 copepodite IV
F947	0–200	1 copepodite V
	0–500	6 copepodite V
VUZ93	0–1097	9 females 3.30–3.80 mm
		2 males 3.30, 3.90 mm
VUZ105	0–914	2 females 3.40, 3.50 mm,
		4 copepodite V
VUZ107	0–914	2 females 3.40, 3.6 mm
VUZ112	0–732	1 female 3.90 mm,
		1 copepodite V

Neocalanus tonsus was present in hauls between 0–200 m or near the sea floor at the following stations: N334, N335, N371, N380, N395, N396, N401, N408, N411–N415, N418, N421, N466, N467, N470, N471–N475, and N480–N482.

DISTRIBUTION: Widespread in the subantarctic province of the world ocean although it may be occasionally taken north of the subtropical convergence in deep water (*see* Jillett 1968; Ohman *et al.* 1989). This species performs ontogenetic vertical migrations (Jillett 1968; Ohman *et al.* 1989).

Undinula A. Scott, 1909

DEFINITION: Head and pedigerous segment 1 fused. Posterior corners of pedigerous segment 5 extend into 1 or 2 points. Mouthparts similar in both sexes: maxilla 2 inner lobe 1 with 6 setae. Swimming leg 2 exopod segment 2 with an invaginate outer proximal border in both sexes. Leg 5 basipod segment 2 with the inner border naked in both sexes. Female leg 5 endopod with 7 setae; those on segments 1 and 2 spine-like. Male left leg 5 highly modified; outer edge spines of exopod segments 1 and 2 very elongate and segment 3 very modified; endopod absent. Male right leg 5 with both rami 3-segmented, endopod with reduced setation, exopod segment 2 with outer distal border elongate extending as far as the first outer spine of segment 3.

(Bradford & Jillett 1974)

TYPE SPECIES: *Undina vulgaris* Dana, 1849

REMARKS: This genus is monotypic (*see* Bradford & Jillett 1974).

The sole species has been taken in the Southwest Pacific.

Undinula vulgaris (Dana, 1849) (Figs 18, 79)

DESCRIPTION: Size: females 2.25–3.25 mm, males 2.04–2.50 mm.

Female: As for the generic description. Forma *typica* has symmetrical metasomal corners which are prolonged posteroventrally into a claw-like spine.

(Vervoort 1949)

Male: As for the generic description.

REMARKS: Three forms are recognised on the basis of the form of the postero-lateral corners of the metasome (*see* Vervoort 1949). Only one specimen of the typical form was taken.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Brady (1883); Dakin & Colefax (1940); Greenwood (1976).

NEW RECORD:

Station No.	Depth of Haul (m)	Specimens
F946	0–200	1 female 2.95 mm

DISTRIBUTION: This is a neritic tropical species (*see* Heinrich 1968).

Family **PARACALANIDAE** Giesbrecht, 1892

DEFINITION: Head and pedigerous segment 1 usually fused, pedigerous segments 4 and 5 fused or separate.

Female: Urosome 2- to 4-segmented, anal segment usually much longer than any segment between it and the genital segment. Antenna 1 25-segmented, generally with segments 1 and 2, also 8 and 9, partially fused and with elongate setae on each of segments 23 and 24. Antenna 2 exopod 7-segmented with segments 1 and 2 each bearing 2 setae and segments 3–6 each bearing 1 seta, segment 7 elongate as in the Calanidae. Mandible with well-developed teeth on the blade and palp similar to that of the Calanidae but without a prominent lobe on the basal endopod segment. Maxilla 1 with the following arrangement of setae and spines: inner lobe 1 with 14 marginal spines and setae including 4 on the posterior surface and 1 on the anterior surface; inner lobes 2 and 3 each with 3 setae, basipod and endopod segments 1 and 2 with 3, 3 and 4 setae respectively; endopod segment 3 with 6 setae, exopod with 11 setae; outer lobe 2 with 1 reduced seta; outer lobe 1 with 7 setae. Maxilla 2, lobes 1–5, with 6, 3, 3, 3, and 3, setae respectively. Maxilliped, 5 terminal segments with 3, 4, 3, 4, and 4 setae respectively, basipod 2 with inner proximal row of stiff hairs or a serrated plate. Swimming legs 1–4 with 3-segmented exopods, endopod of leg 1 usually 2-segmented, endopods of legs 2–4 3-segmented, posterior surfaces of some segments ornamented with spines. Exopods of legs 2–4 with 1 outer-edge spine on segments 1 and 2, segment 3 with 2 outer-edge spines (1 subterminal) and 1 distal spine with a smooth blade-like border. Exopod segments with the following setation on their inner margins: segment 1 usually with 1 seta on legs 2–4; segment 2 with 1 seta on legs 1–4; segment 3 of leg 1 with 4 setae, legs

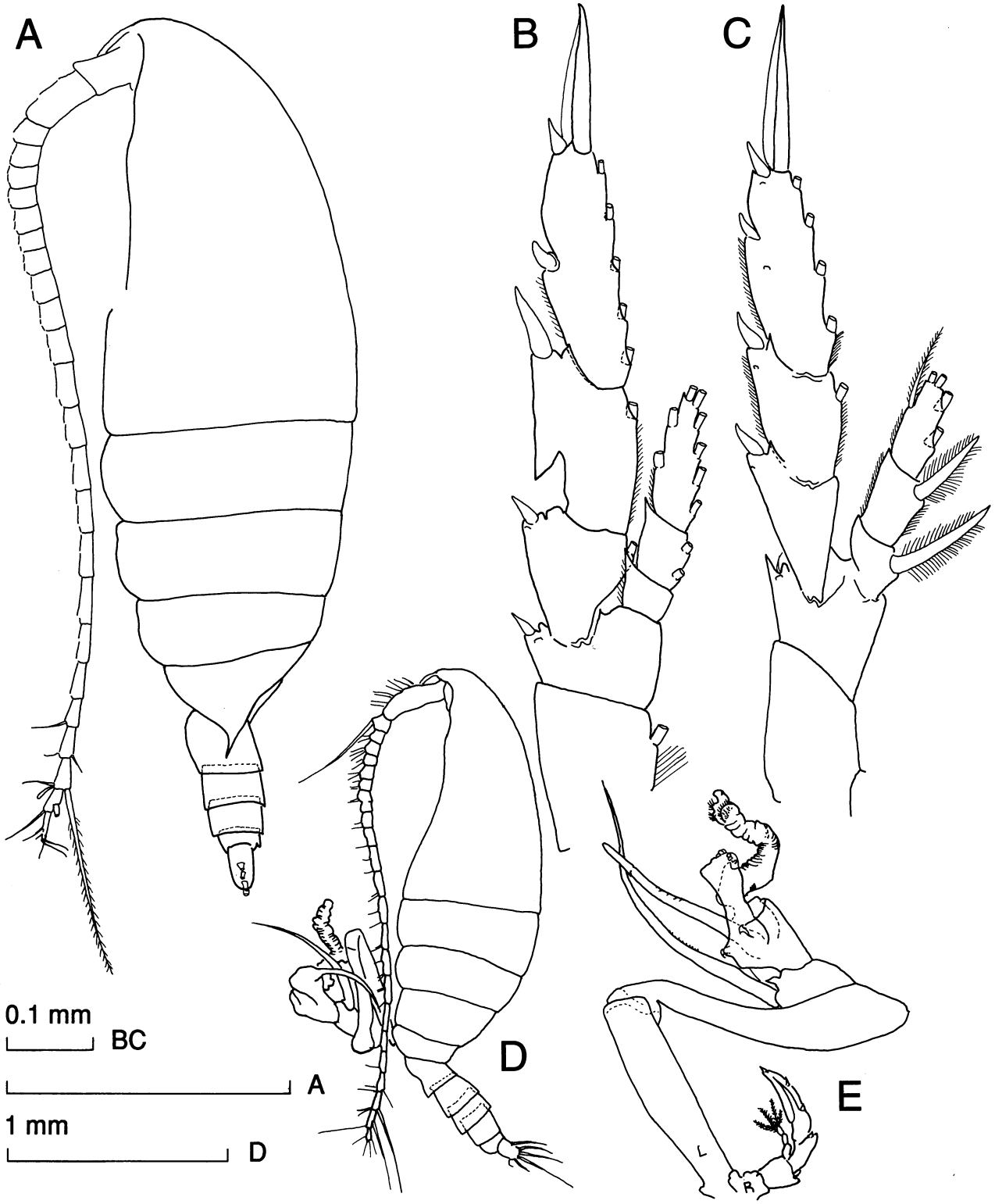


Fig. 18. *Undulina vulgaris*. Female from NZOI Stn F946: A, lateral view; B, leg 2; C, leg 5. Male: D, lateral view (from Mori 1937); E, leg 5 (from Dakin & Colefax 1940).

of 2–4 with 5 setae. Endopod segment 1 of legs 2–4 usually with 1 inner seta; segment 2 of legs 2–4 with 2 inner setae; outer margins of these segments naked. Endopod segment 3 of legs 2–4 with 2 outer, 2 terminal and 3 inner setae. Leg 5 uniramous, symmetrical and composed of a common basal segment and 1–3 additional segments terminated by seta(e) and often also spines.

(Giesbrecht 1892; Andronov 1970, 1972a, b, c)

Male. Urosome 5-segmented. Cephalic hump usually present. Antenna 1 25-segmented with some or all of segments 1–6 fused and swollen, segments 9 and 10 may also be fused. Antenna 2 exopod with elongate segment 2, segment 7 very short; segments 1 and 2 without setae, terminal segment without the 3 terminal setae present in the female. Other mouthparts reduced especially maxillae 1 and 2. Swimming legs 1–4 as in female. Leg 5 uniramous and symmetrical.

(Giesbrecht 1892; Andronov 1970, 1972a, b, c)

An example of this family is *Paracalanus indicus* (Figs 19, 21).

REMARKS: The history of this family has been confused because Bernard (1958) decided to erect a new family for *Calocalanus* and two new genera, without a justification that withstands close examination. Andronov (1970) disagreed with Bernard's conclusion citing the males, without going into details, as being evidence that *Paracalanus* and *Calocalanus* are very close. I agree with Androvov (1970). Giesbrecht's (1892) inclusion of *Calocalanus* in the Paracalanidae is well founded. A key characteristic of the Paracalanidae is the form of the male exopod of antenna 2. Although he did not figure antenna 2, Giesbrecht (1892) described this part: "On antenna 2 the basal segments, endopod segment 1, and also exopod segments 1 and 2 in *C. pavo*, seem to be devoid of setae. The exopod appears to be indistinctly segmented; in *C. pavo* its proximal segments are extended at the expense of the distal segments; there are 5 plumose setae on the exopod which are twice as long as the antenna itself, each seta arising from segments 3–7 (in *C. styliremis* the seta on exopod segment 7 is inserted terminally)." This form of male antenna 2 is characteristic of the Paracalanidae alone and is figured here (e.g., Figs 20D, 28K, 29J). Björnberg's (1972) analysis of the developmental stages of members of this family reveals there are some differences between *Calocalanus* and *Paracalanus*; she recognises differences in the morphology and swimming behaviour.

There are now six genera in this family: *Acrocalanus, Bestiolina, Calocalanus* (= *Leptocalanus, Ischnocalanus), Delius, Paracalanus, Parvocalanus.*

Members of the family Paracalanidae are mainly small- to minute-sized copepods. They are exclusively pelagic with an epipelagic habit. They appear to be mainly herbivorous (Arashkevich 1969; Itoh 1970; Paffenhöfer 1984).

Acrocalanus Giesbrecht, 1888

DEFINITION: As for the family with the following additional characters. Rostrum with long slender filaments. Pedigerous segments 4 and 5 incompletely separated. Antenna 1 long. Basipod 2 of swimming leg 1 with an inner-edge seta. Well-developed ornamentation on the posterior surfaces of the swimming legs, all or some of the outer edges of the exopods of legs 2–4 are serrated, distal outer margin of the endopods end in a small spine. Female leg 5 absent or rudimentary, male leg 5 present only on the left. (Tanaka 1956b)

TYPE SPECIES: *Acrocalanus longicornis* Giesbrecht, 1888

REMARKS: This genus contains the following species: *A. andersoni* Bowman, 1958 (male *see* Vervoort 1963); *A. gibber* Giesbrecht, 1888 (= *A. pediger* Claus) (male *see* Tanaka 1956b); *A. gracilis* Giesbrecht, 1888 (male *see* Tanaka 1956b); *A. longicornis* Giesbrecht, 1888 (male = *A. gardineri, see* also Tanaka 1956b); *A. monachus* Giesbrecht, 1888 (? male unknown).

The following species have been taken in the Southwest Pacific.

Acrocalanus gibber Giesbrecht, 1888 (Fig. 20)

DESCRIPTION: Size: females 0.93–1.13 mm, males 0.94–1.24 mm.

Female: As in the generic description with the following additional points. The outline of the head is inflated in lateral view and the line of separation of the head from pedigerous segment 1 is apparent; antenna 1 exceeds the end of the caudal rami by the 2 terminal segments, segments 19–22 are each no longer than segment 25; the distal toothed outer border of exopod 3 of swimming leg 4 is about 60% of the length of the proximal part of the toothed border.

(Giesbrecht 1892; Tanaka 1956b)

Male: Proportions of exopod segments 2 and 3 and the terminal spine to one another are:

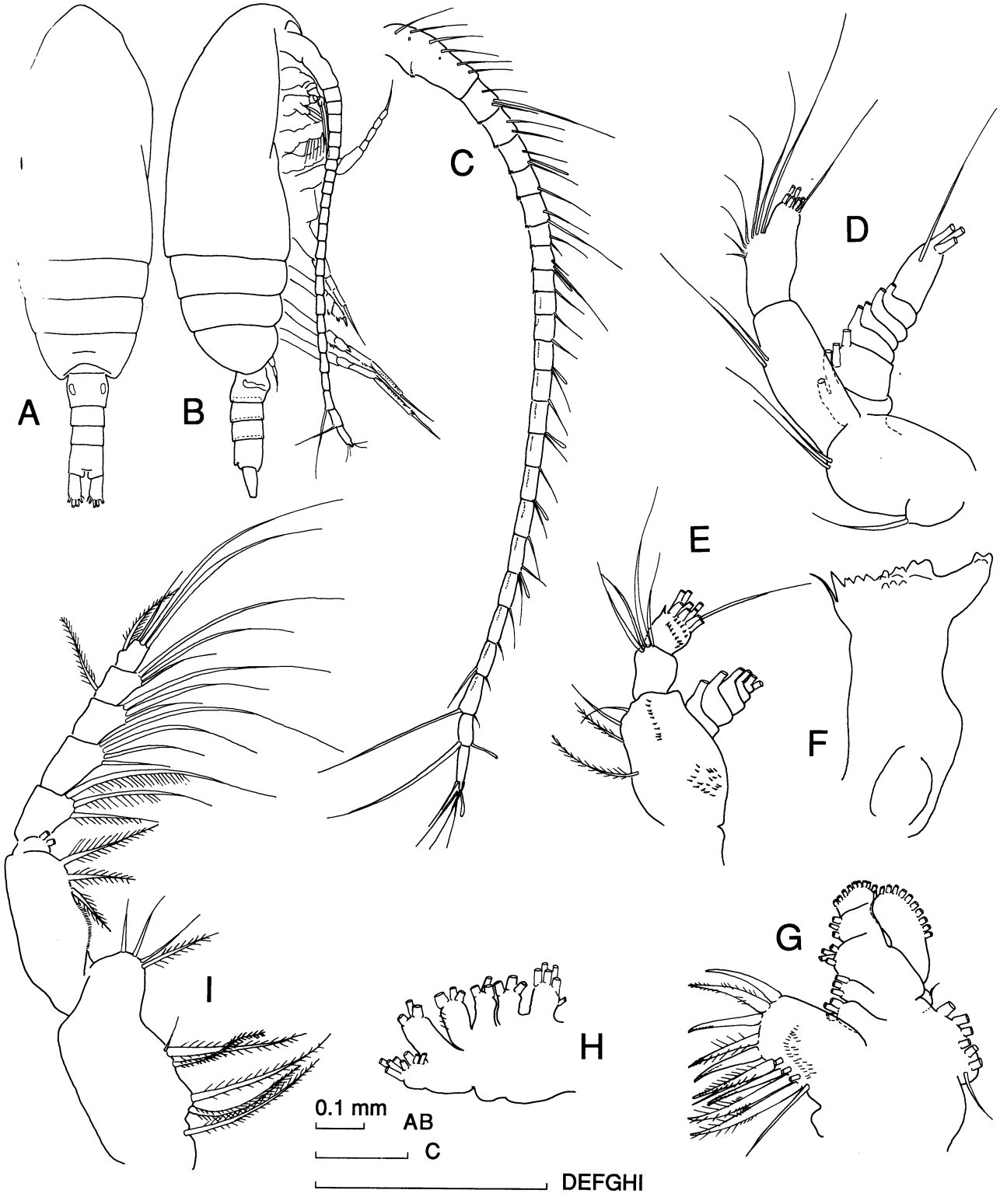


Fig. 19. (Above and overleaf). *Paracalanus indicus* female from NZOI Stn N767: A, dorsal view; B, lateral view; C, antenna 1; D, antenna 2; E, mandibular palp; F, mandibular blade; G, maxilla 1; H, maxilla 2; I, maxilliped; J, leg 1; K, leg 2; L, leg 3; M, leg 4; N, leg 5.

	Leg 2	Leg 3	Leg 4
Exopod 2	24	26	27
Exopod 3 proximal	20	21	23
Exopod 3 distal	18	29	18
End-spine	38	33	32
Total	100	100	100

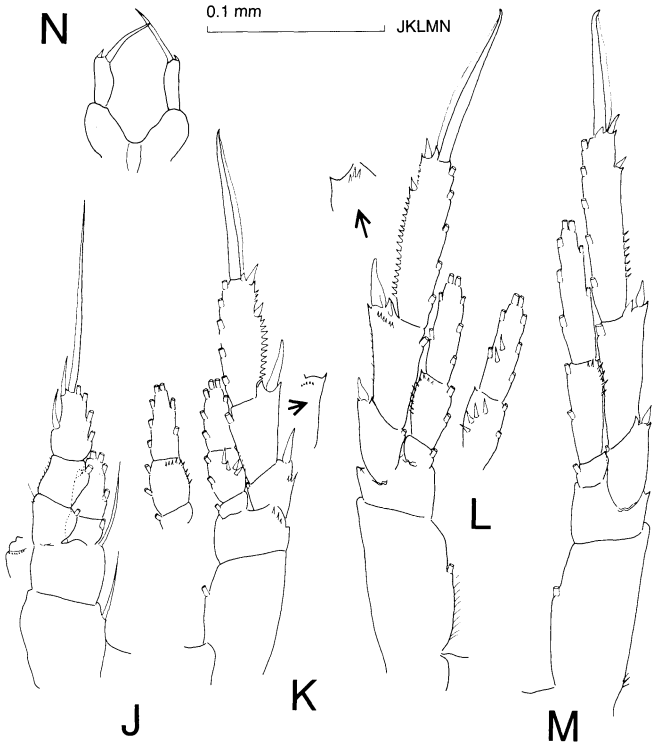
The number of outer-edge spines on exopod segments are as follows:

	Leg 2	Leg 3	Leg 4
Exopod 2	11	13	20–22
Exopod 3 proximal	10	15	25
Exopod 3 distal	7–8	14–15	10–121

Leg 5 extends to the end of urosome segment 3 or the middle of urosome segment 4 when this leg is fully extended. The proportional lengths of the various segments from the base are: 26:12:25:22:15 = 100. (Sewell 1929)

REMARKS: Males are very difficult to tell apart. Tanaka (1956b) summarises data on proportions of the body from Sewell (1929) and gives his opinion on the identity of the specimens off Japan.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Dakin & Colefax (1940), Greenwood (1976).



NEW RECORDS: Nil.

DISTRIBUTION: Recorded from tropical parts of all oceans (Dakin & Colefax 1940).

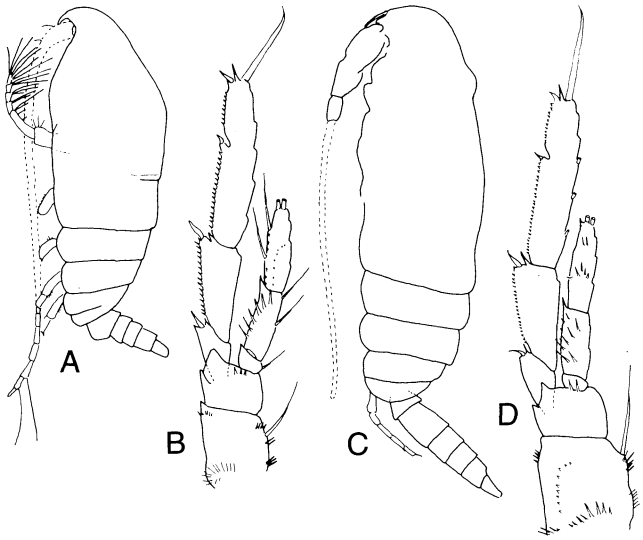


Fig. 20. *Acrocalanus gibber* (from Sewell 1929). Female: A, lateral view; B, leg 4. Male: C, lateral view; D, leg 4.

Acrocalanus gracilis Giesbrecht, 1888 (Fig. 22)

DESCRIPTION: Size: females 1.20–1.32 mm, males 0.88–1.00 mm.

Female: As in the generic description with the following additional points. The head is evenly round in lateral view and the line of separation of the head from pedigerous segment 1 is very slight; antenna 1 exceeds the end of the caudal rami by the 3 or 4 terminal segments, segments 19–22 are each no longer than segment 25; the distal toothed outer border of exopod 3 of swimming leg 4 is about 80% of the length of the proximal part of the toothed border. (Giesbrecht 1892; Tanaka 1956b)

Male: Proportions of exopod segments 2 and 3 and the terminal spine to one another are:

	Leg 2	Leg 3	Leg 4
Exopod 2	22	25	25
Exopod 3 proximal	20	22	28
Exopod 3 distal	19	20	17
End-spine	39	33	30
Total	100	100	100

The number of outer-edge spines on exopod segments are as follows:

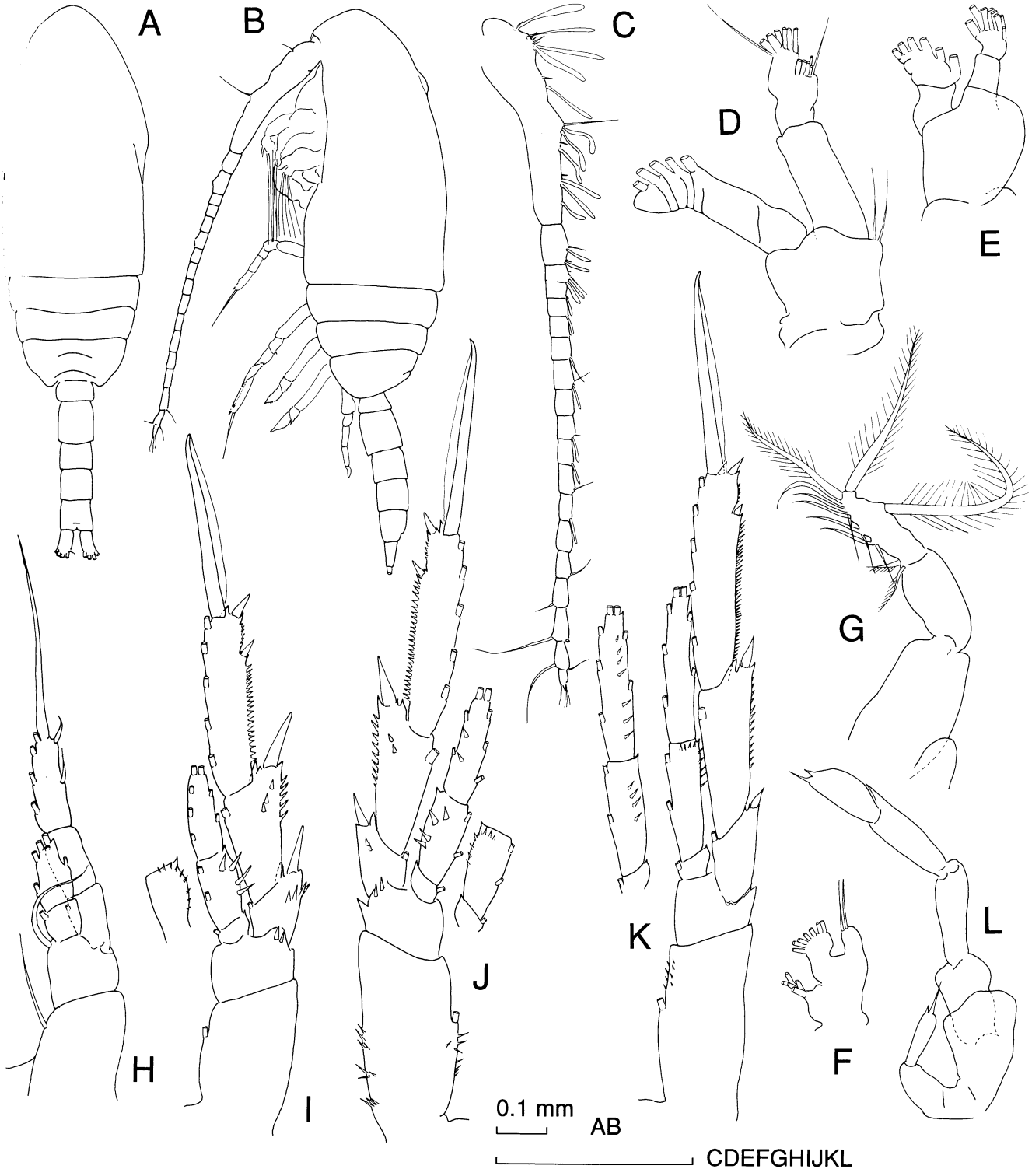


Fig. 21. *Paracalanus indicus* male from NZOI Stn N767: A, dorsal view; B, lateral view; C, antenna 1; D, antenna 2; E, mandibular palp; F, maxilla 1; G, maxilla 2 and maxilliped; H, leg 1; I, leg 2; J, leg 3; K, leg 4; L, leg 5.

	Leg 2	Leg 3	Leg 4
Exopod 2	10–11	11–12	17
Exopod 3 proximal	11	15	22
Exopod 3 distal	8	14	17

Leg 5 extends to the end of urosome segment 2 when this leg is fully extended. The proportional lengths of the various segments from the base are: 25:13:24:20:18 = 100. (Sewell 1929)

REMARKS: Males are very difficult to tell apart. Tanaka (1956b) summarises data on proportions of the body from Sewell (1929) and gives his opinion on the identity of the specimens off Japan.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Dakin & Colefax (1940); Chiba & Hirakawa (1972); Greenwood (1976).

NEW RECORDS: Nil.

DISTRIBUTION: Recorded from tropical parts of all oceans (Dakin & Colefax 1940).

Acrocalanus longicornis Giesbrecht, 1888
(Figs 23, 86)

DESCRIPTION: Size: females 1.00–11.26 mm, males 0.95–1.25 mm.

Female: As in the generic description with the following additional characters. Dorsal surface of the body moderately strongly arched, anterior head rounded. Antenna 1 extends beyond the caudal rami by its last 5 segments. Outer distal boder of exopod segment 3 of leg 4 with very small numerous teeth. (Giesbrecht 1892)

Male: As in the family and generic descriptions with the following additional characters. Exopod segment 3 of swimming leg 4 similar to that of the female. Leg 5 5-segmented on the left.
(Wolfenden 1905a)

REMARKS: Sewell (1947) believes that *Acrocalanus gardineri* Wolfenden, 1905 is the male of *A. longicornis* (*see* also Sewell 1929).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Greenwood (1976).

NEW RECORD:

Station No.	Depth of Haul (m)	Specimens
C544	Surface	1 female 1.25 mm

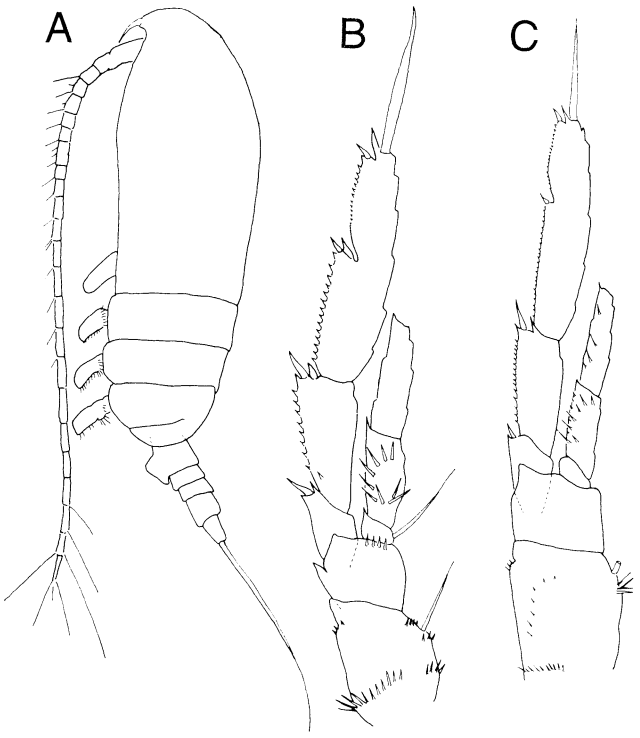


Fig. 22. *Acrocalanus gracilis* (from Sewell 1929). Female: A, lateral view; B, leg 4. Male: C, leg 4.

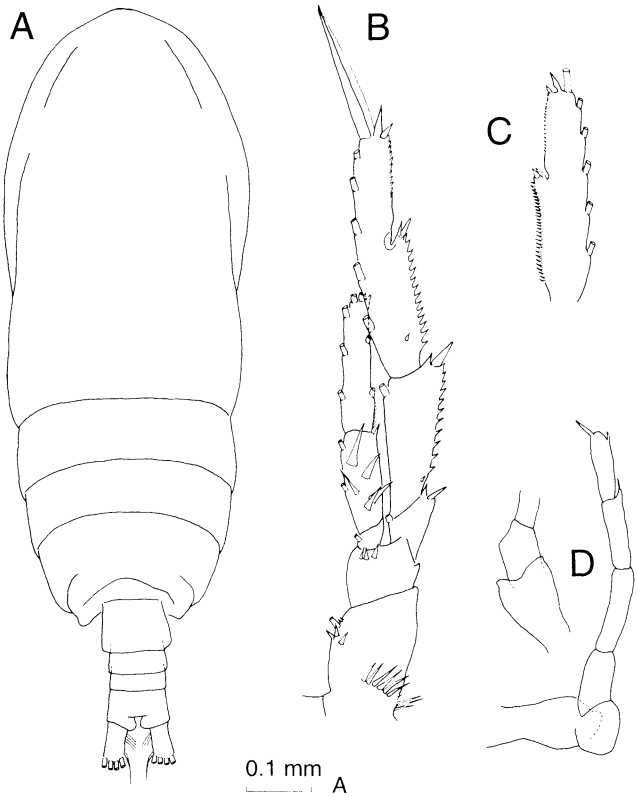


Fig. 23. *Acrocalanus longicornis*. Female from NZOI Stn C544: A, dorsal view; B, leg 4. Male (from Wolfenden 1905, as *A. gardineri*): C, exopod segment 3 of leg 4; D, leg 5.

DISTRIBUTION: Tropical and subtropical parts of all oceans (Greenwood 1976).

Acrocalanus monachus Giesbrecht, 1888 (Fig. 24)

DESCRIPTION: Size: females 0.90–1.05 mm, males unknown.

Female: Dorsal surface of the body not inflated, with a shallow arch; anterior head prolonged, in lateral view almost square in outline. Antenna 1 extends beyond the caudal rami by its last 3 segments. Outer distal border of exopod segment 3 of leg 4 with about 12 large teeth. (Giesbrecht 1892)

Male: Unknown

REMARKS: The square appearance in lateral view readily distinguishes this species from others in the genus (Giesbrecht 1892).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Heinrich (1968), Greenwood (1976).

NEW RECORDS: Nil.

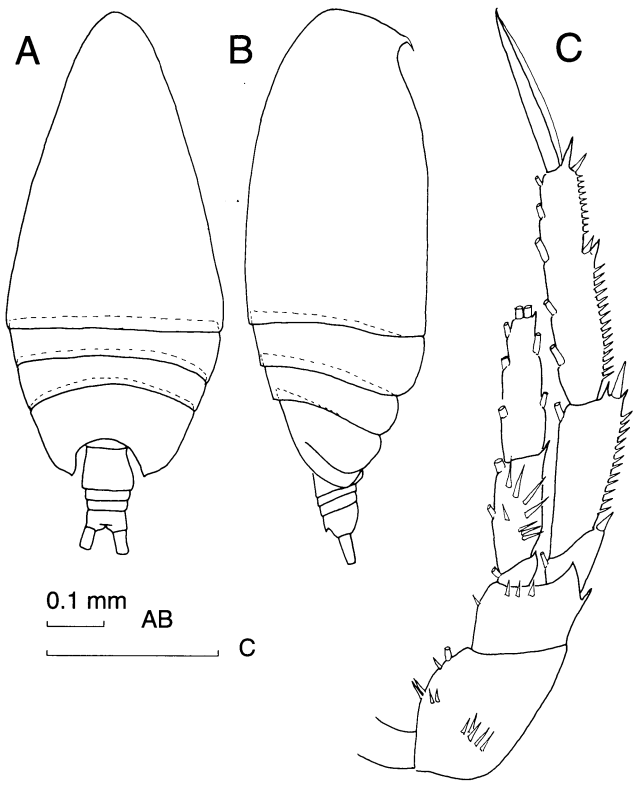


Fig. 24 *Acrocalanus monachus* female (from Grice 1961): A, dorsal view; B, lateral view; C, leg 4.

DISTRIBUTION: Recorded from the Pacific and Indian Oceans and from the Red Sea (Mori 1937; Heinrich 1968; Greenwood 1976).

Bestiolina Andronov, 1991

DEFINITION: As for the family but with the following additional characters. Rostrum shortened in males and females. Male with dorsal cephalic hump. Basipod 2 of swimming leg 1 with an inner edge seta. Endopod segment 3 of swimming legs 3 and 4 with 6 setae. Leg 5 is rudimentary and knob-like in the females, in males it is elongated on the left and a rudimentary knob on the right. The outer edges of exopod segments 2 and 3 of legs 2–4 are devoid of teeth and there are only 6 setae on endopod 3 of legs 3 and 4. (Andronov 1972a, 1973a)

TYPE SPECIES: *Bestiola zeylonica* Andronov, 1972

REMARKS: Andronov (1991) changed the name of this genus to *Bestiolina* as *Bestiola* was pre-occupied by an insect genus. This genus as now defined contains the following species: *Bestiolina inermis* (Sewell, 1912); *B. similis* (Sewell, 1914); *B. sinicus* (Shen & Lee, 1966) all as *Acrocalanus; B. zeylonica* (Andronov, 1972a).

The following species of this genus has been taken in the Southwest Pacific.

Bestiolina similis (Sewell, 1914) (Fig. 25)

DESCRIPTION: Size: females 0.72–0.81 mm, males 0.8 mm.

Female: As in the generic description with the following additional characters. Rostral filaments long and slender. Pedigerous segment 5 without spinules. Antenna 1 extends as far as the caudal rami, terminal segment elongate, no transverse row of spinules on segments 1–7. Posterior surfaces of exopod segment 2 on legs 2–4 without spines. (Sewell 1914)

Male: As in the generic description with the following additional characters. Swimming legs as in the female. Leg 5 consists of a swollen basal segment and 4 free segments; the terminal segment with 2 unequal spines and the penultimate segment with a laterodistal spine. (Sewell 1914)

REMARKS: Vervoort (1946) suggested that *B. similis* is a junior synonym of *B. inermis*. Nevertheless

both Wellershaus (1969) and Greenwood (1976) have recorded specimens, exhibiting little variability, which they believe can be referred to *B. similis.*

PREVIOUS SOUTHWEST PACIFIC RECORDS: Greenwood (1976).

NEW RECORDS: Nil.

DISTRIBUTION: Tropical, neritic parts of the Indo-West Pacific (Sewell 1914; Wellershaus 1969; Greenwood 1976).

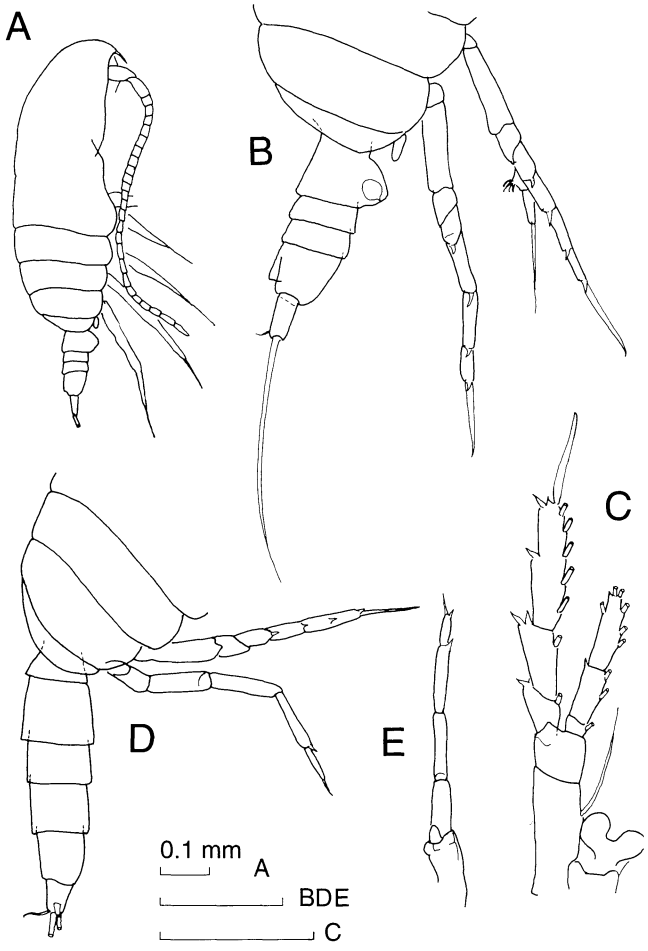


Fig. 25. *Bestiolina similis* (from Wellershaus 1969 as *Bestiola*). Female: A, lateral view; B, lateral view of posterior body; C, leg 4 and leg 5. Male: D, lateral view of posterior body; E, leg 5.

Calocalanus Giesbrecht, 1888

Ischnocalanus Bernard, 1963
Leptocalanus Bernard, 1958

DEFINITION: As for the family but with the following additional characters. Very small copepods with the head and pedigerous segment 1, and pedigerous segments 4 and 5 fused or separated. Female urosome relatively short with 2–4 segments, often 2 setae on the caudal rami much thicker than the others, caudal rami sometimes asymmetrical. Female antenna 1 often much longer than the body and segment 25 is usually long, being at least twice as long as the preceeding segment. Male antenna 1 with segments 1–2, 3–6, and 24–25 fused. Basipod 2 of maxilliped with an inner proximal row of conspicuous spines or teeth. Basipod 2 of leg 1 without a seta, there may be fusion between exopod and endopod segments so that in a few species these rami may be both 1-segmented, endopod 2 usually with 4 setae. The outer borders of the distal exopod segments not toothed. Female leg 5 symmetrical, uniramous, of 3 or 4 segments; male leg 5 asymmetrical, uniramous, of 4 segments on the right and 5 segments on the left. (Giesbrecht 1892)

TYPE SPECIES: *Calanus pavo* Dana, 1849, 1852

REMARKS: Bernard (1958) separated *C. plumulosus* and *L. equalicauda* into a separate genus *Leptocalanus* (later renamed *Ischnocalanus* Bernard, 1963 because the name *Leptocalanus* was not available). Andronov (1970) is not convinced this separation is valid, a conclusion I agree with, because subsequently described species of *Calocalanus* indicate there are no features characteristic of *Ischnocalanus* alone. Nevertheless there are a large range of combinations of characteristics within *Calocalanus sensu lato.* A number of features of males and females have not been thoroughly described, presumably because of their small size and the fact that it is difficult to obtain undamaged specimens. Future workers using different methods for capturing these copepods and examining their morphology may find a system for breaking up what is now a long list of described species with a wide variety of combinations of characteristics.

The following species have been described in this genus: *Calocalanus aculeatus* Shmeleva, 1987b (male unknown); *C. adriaticus* Shmeleva, 1965; *C. africanus* Shmeleva, 1979; *C. alboranus* Shmeleva, 1979; *C. antarcticus* Shmeleva, 1978; *C. atlanticus* Shmeleva, 1975a; *C. beklemishevi* Shmeleva, 1987a (male unknown); *C. contractus* Farran, 1926 (male *see* Corral 1972b); *C. dellacrocei* Shmeleva, 1987a (male unknown); *C. elegans* Shmeleva, 1965; *C. elongatus* Shmeleva, 1968; *C. equalicauda* (Bernard, 1958) (as *Leptocalanus*); *C. fiolenti* Shmeleva, 1978; *C. fusiformis*

Shmeleva, 1978 (male unknown); *C. gracilis* Tanaka, 1956 (male unknown); *C. gresei* Shmeleva, 1973; *C. indicus* Shmeleva, 1974; *C. kristalli* Shmeleva, 1968 (male unknown) (= *C. curtus* Andronov, 1973; *see* Andronov 1991); *C. latus* Shmeleva, 1968 (male unknown); *C. lomonosovi* Shmeleva, 1975a; *C. longifurca* Shmeleva, 1975 (male unknown); *C. longisetosus* Shmeleva, 1965 (male *see* Shmeleva 1973); *C. longispinus* Shmeleva, 1978; *C. minor* Shmeleva, 1975a; *C. minutus* Andronov, 1973 (male described here); *C. monospinus* Chen & Zhang, 1974; *C. namibiensis* Andronov, 1973 (male described here); *C. nanus* Shmeleva, 1987b (male unknown); *C. neptunus* Shmeleva, 1965; *C. omaniensis* Shmeleva, 1975; *C. ovalis* Shmeleva, 1965 (male *see* Shmeleva 1973); *C. paracontractus* Shmeleva, 1974 (male unknown); *C. parelongatus* Shmeleva, 1979; *C. pavo* Dana, 1849 (male *see* Giesbrecht 1892); *C. pavoninus* Farran, 1936 (male unknown); *C. plumatus* Shmeleva, 1965 Shmeleva 1965 (male unknown); *C. plumulosus* (Claus, 1863) (male *see* Tanaka 1956b); *C. pseudocontractus* Bernard, 1958 (male unknown); *C. pubes* Andronov, 1973 (male unknown); *C. pyriformis* Shmeleva, 1975 (male unknown); *C. regini* Shmeleva, 1987b (male unknown); *C. sayademalja* Shmeleva, 1987a (male unknown); *C. spinosus* Shmeleva, 1987 (male unknown); *C. styliremis* Giesbrecht, 1888 (male *see* Giesbrecht 1892); *C. tenuiculus* Andronov, 1973 (male unknown); *C. tenuis* Farran, 1926 (male unknown); *C. vinogradovi* Shmeleva, 1987a (male unknown); *C. vitjazi* Shmeleva, 1974 (male unknown); *C. vivesei* Shmeleva, 1979. The world *Calocalanus* fauna needs revising from specimens in good condition and knowledge of the geographical distribution of described species needs to be improved.

The following species have been taken in the Southwest Pacific. This list is provisional as all specimens are in poor condition with antenna 1 and very few of the swimming legs intact. Also it is clear that males and very small species are absent from most Southwest Pacific samples because the 200 µm mesh nets used were too coarse to retain them.

Calocalanus contractus Farran, 1926 (Fig. 26)

DESCRIPTION: Size: females 0.68–0.76 mm, males 0.49 mm.

Female: Head and pedigerous segment 1, and pedigerous segments 4 and 5 fused. Cephalothorax just more than three times as long as wide. Urosome 3-segmented, genital segment broad, anal segment twice as wide as long. Caudal rami spread at 75° and a little longer than wide, with 4 terminal setae, 2 outer most much more slender than inner most. Antenna 1 with terminal segment twice as long as the penultimate segment. Leg 5 3-segmented with terminal segment bearing 2 setae longer than the segment and 1 or 2 subterminal spinules. (Farran 1926)

Male: Head and pedigerous segment 1 fused and pedigerous segments 4 and 5 incompletely fused. The left leg 5 is just over 2 times the length of the right leg; the terminal segment of the right leg is terminated by 2 spines and some spinules. (Corral 1972b)

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nyan Taw (1978).

NEW RECORDS: Nil.

DISTRIBUTION: *Calocalanus contractus* is an epiplanktonic, oceanic species found in the warmer parts of the Atlantic and Pacific Oceans (Corral 1972b).

Calocalanus longispinus Shmeleva, 1978 (Figs 27, 85)

DESCRIPTION: Size: females 0.62–0.79 mm, male 0.57 mm.

Female: Head and pedigerous segment 1 fused, pedigerous segments 4 and 5 separate. Urosome 3-segmented, caudal rami as wide as long, width of the genital segment about half the width of the prosome at its widest part. Swimming leg endopod 2-segmented; leg 5 with 3 free segments in addition to the common basal segment, terminated by a group of spinules and a long spine which is longer than the whole leg. (Shmeleva 1978)

Male: Head and pedigerous segment 1 fused, pedigerous segments 4 and 5 separate. The left leg 5 is 2.5 times the length of the right leg. (Shmeleva 1978)

REMARKS: The Southwest Pacific specimens reported here are assigned to this species provisionally. The present specimens appear to have a more bulbous-shaped genital segment and there appears to be some variability in the state of separation of the head and pedigerous segment 1 and pedigerous segments 4 and 5. Also the terminal 2 segments on leg 5 are not completely separated and the terminal seta is not as long as that figured by Shmeleva (1978).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Bradford (1972) as *C. styliremis*.

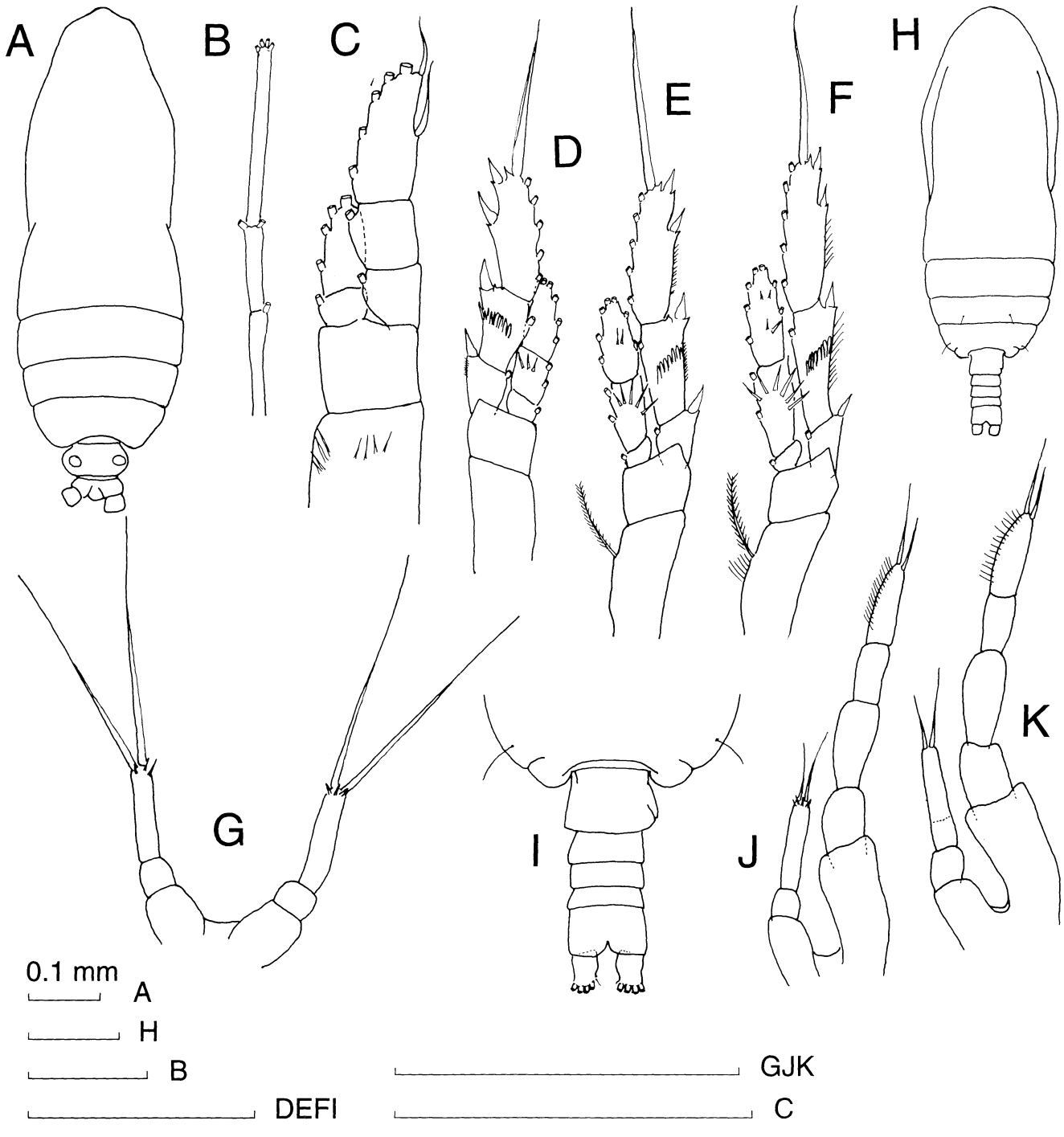


Fig. 26. *Calocalanus contractus* (from Corral 1972b). Female: A, dorsal view; B, terminal part of antenna 1; C, leg 1; D, leg 2; E, leg 3; F, leg 4; G, leg 5. Male: H, dorsal view; I, dorsal view of urosome; J, leg 5; K, leg 5 of another specimen.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
D559	0–100	4 females 0.70–0.79 mm
D614	250–500	2 females 0.62, 0.67 mm

DISTRIBUTION: Indian sector of the Antarctic Ocean (Shmeleva 1978).

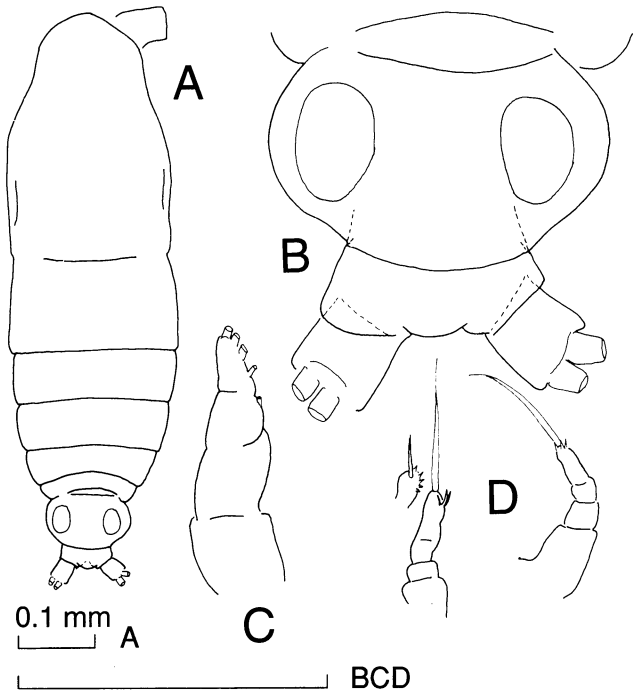


Fig. 27. *Calocalanus longispinus* female from NZOI Stn D599: A, dorsal view; B, dorsal view of urosome; C, lateral view of leg 1 endopod; D, various views of leg 5.

Calocalanus minutus Andronov, 1973
(Figs 28, 85)

DESCRIPTION: Size: females 0.50–0.57 mm, males 0.42-0.44 mm.

Female: Head and pedigerous segment 1 and pedigerous segments 4 and 5 fused. Urosome 3-segmented, genital segment of a distinctive shape with the widest part anterior to its midlength; caudal rami longer than wide. Antenna 1 extends beyond the caudal rami by 2 segments. Swimming leg 1 with a 1-segmented endopod and a 2-segmented exopod; endopods of legs 3 and 4 2-segmented; leg 5 with 2 free segments in addition to a common basal segment, leg terminated by 1 seta but without spinules. (Andronov 1973a)

Male: Head and pedigerous segment 1 separated by a constriction, pedigerous segments 4 and 5 fused. Urosome 5-segmented, genital aperture on the right, caudal rami slightly longer than wide terminated by 3 setae of equal size. Antenna 1 not entire, segments 1 and 2 also 4 and 5 appear to be fused. Antenna 2 as in the family description with a short terminal segment on the endopod which is devoid of the terminal setae evident in the female. Maxilla 1 is very reduced but with a remnant of inner lobe 1. Maxilla 2 is a very small knob. Leg 5 extends well beyond the caudal rami; left leg not extending beyond the first segment of the right leg; both legs terminated by a spine.

REMARKS: Few of the swimming legs and antenna 1 were intact. The Southwest Pacific specimens have been checked by Dr V. Andronov (Museum of the World Oceans, Kaliningrad, Russia) who agrees they fit within the description of specimens of *C. minutus* from the Atlantic Ocean. Small males were taken off New Zealand which appeared to agree with the females in size and are described above. The female maxilliped has a proximal row of long stiff spines on the inner border.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORD:

Station No.	Depth of Haul (m)	Specimens
T944	80	8 females 0.54–0.57 mm, 3 males 0.42–0.43 mm

DISTRIBUTION: Off the south-west coast of Africa at 20°S (Andronov 1973a) and from the southern boundary of subtropical water off New Zealand (present record).

Calocalanus namibiensis Andronov, 1973
(Figs 29, 85)

DESCRIPTION: Size: females 0.66–0.70 mm, males 0.50–0.52 mm

Female: Head and pedigerous segment 1 fused, as are pedigerous segments 4 and 5. Urosome 3-segmented; genital segment bulbous with its width less than half the width of the prosome at its widest part; segment 2 almost hidden inside the genital

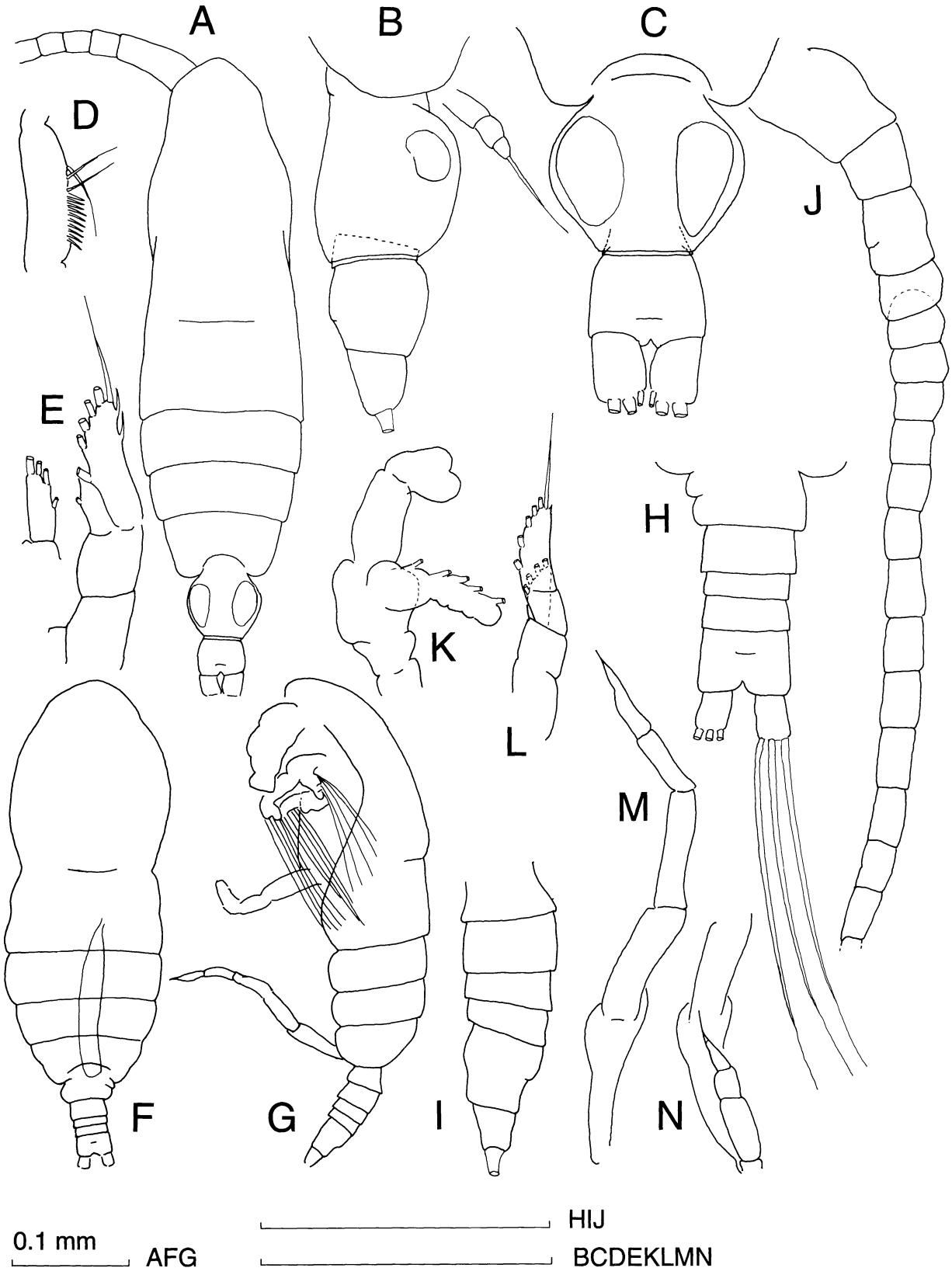


Fig. 28. *Calocalanus minutus* from NZOI Stn T944. Female: A, dorsal view; B, lateral view of urosome; C, dorsal view of urosome; D, basipod 2 of maxilliped; E, leg 1. Male: F, dorsal view; G, lateral view; H, dorsal view of urosome; I, lateral view of urosome; J, antenna 1; K, antenna 2; L, leg 1; M, right leg 5; N, left leg 5.

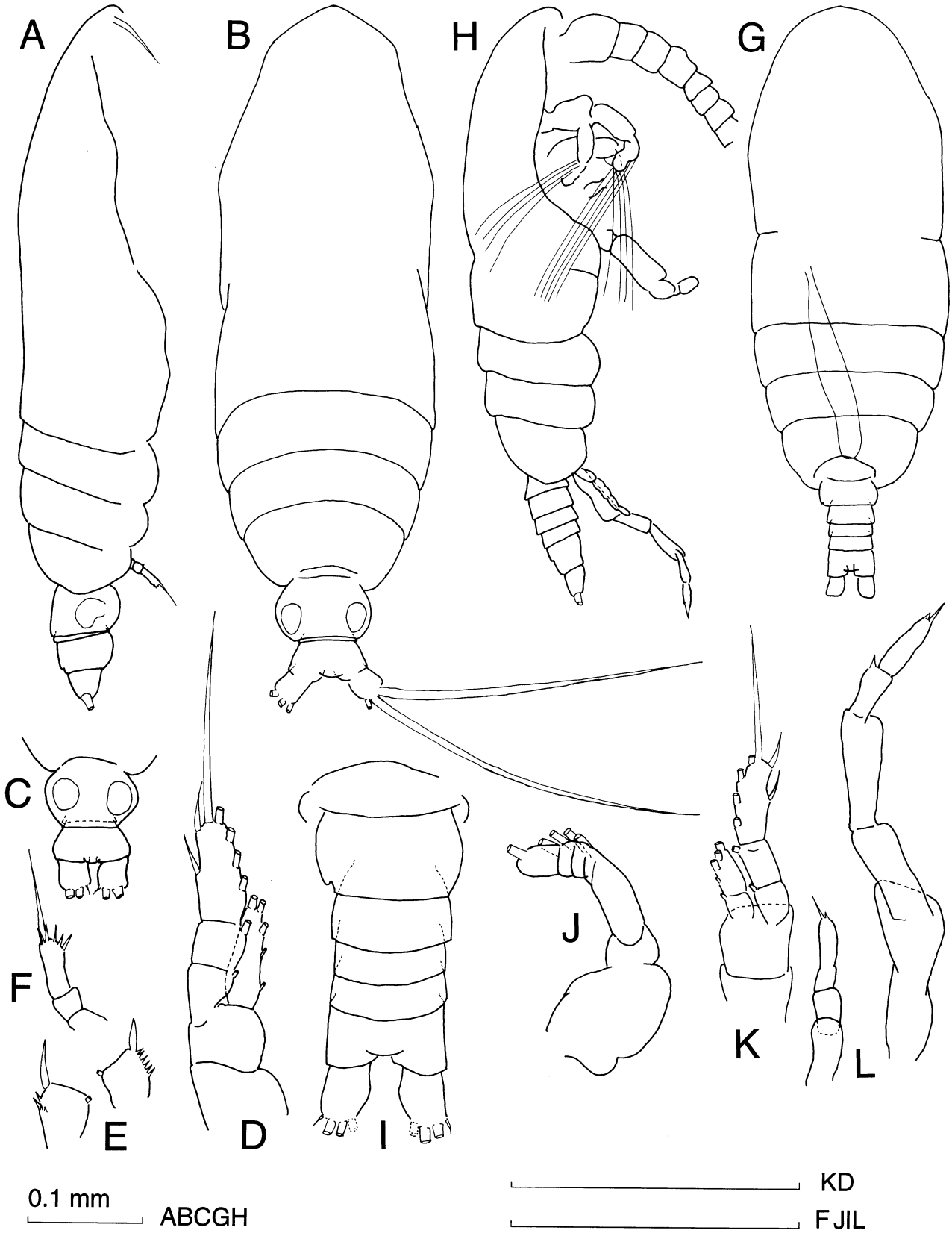


Fig. 29. *Calocalanus namibiensis* from NZOI Stn T944. Female: A, lateral view; B, dorsal view; C, dorsal view of urosome of another specimen; D, leg 1; E, right and left exopod 1 of leg 2; F, leg 5. Male: G, dorsal view; H, lateral view; I, dorsal view of urosome; J, exopod of antenna 2; K, leg 1; L, leg 5.

segment; anal segment with its lateral borders diverging posteriorly; caudal rami as long as wide, extending directly posteriorly. Antenna 1 extending beyond the caudal rami by at least 3 segments. Swimming leg 1 endopod 1-segmented. Leg 5 with 3 segments in addition to a common basal segment, terminated by spinules and a single seta which is shorter than this leg. (Andronov 1973a)

Male: Head and pedigerous segment 1 demarcated by a constriction, pedigerous segments 4 and 5 fused. Urosome 5-segmented, genital opening on the left, anal segment with parallel lateral borders, caudal rami slightly longer than wide. Antenna 1 not entire. Antenna 2 and other mouth parts as in the family description. Swimming leg 1 endopod with a division between segments 1 and 2 apparent. Leg 5 extends slightly beyond the caudal rami; 3-segmented on the right (terminal segment with the remnants of a division into 2 segments evident), apparently terminated by 2 small unequal spines; 5-segmented on the left, terminated by 2 small unequal spines, segment 4 with a distal spine.

REMARKS: Medium-sized males were taken off New Zealand which appeared to agree with the females in size and are described above. Although few of the swimming legs and antenna one were intact, I am fairly certain the Southwest Pacific specimens agree with Andronov's (1973a) description of specimens from the Atlantic ocean. The spermathecae are bulbous in lateral view. The female leg 5 did not appear to have the terminal segment divided as figured by Andronov.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	0-500	2 females 0.74, 0.76 mm
T944	80	7 females 0.59–0.62 mm, 2 males 0.50, 0.52 mm
Mu67/7	0–150	3 females 0.72–0.76 mm
Mu67/47	0–150	15 females 0.66–0.76 mm
Mu67/52	0–1000	4 females 0.67–0.78 mm, 2 juveniles

DISTRIBUTION: Southwest coast of Africa at 17° and 24°S.

Calocalanus neptunus Shmeleva, 1965

(Figs 30, 85)

DESCRIPTION: Size: females 0.84–0.91 mm, males 0.81–0.84 mm.

Female: Head and pedigerous segment 1 separate, pedigerous segments 4 and 5 fused. Urosome 3-segmented; genital segment oval with well developed spherical spermathecae; caudal rami short, about 0.33 times the length of the anal segment, 4 strong setae on each side. Antenna 1 extends slightly beyond the caudal rami, the last segment 2.5 times the length of the penultimate segment. Swimming leg 1 with 2-segmented endopod. Leg 5 3-segmented in addition to the common basal segment, the last segment is 2.5 times longer than the preceding segment, terminated by a row of small spinules and two terminal subequal spines. (Shmeleva 1965)

Male: Similar to the female with the head and pedigerous segments fused but pedigerous segments 4 and 5 separate. Urosome 5-segmented, caudal rami apparently immovable, slightly asymmetrical, equal to the length of the anal segment, each terminated in 4 strong setae and 1 fine inner seta. Both leg 5 are armed with small subequal terminal spines; the left leg extends about 0.25 of the way along the second free segment of the right leg. (Shmeleva 1965; Corral 1972b)

REMARKS: The Southwest Pacific females appear to be similar to the Adriatic specimens in size, short caudal rami, and form of the legs 5 but differ in that the head and pedigerous segment 1 appear to be fused and there is an indication, in the midline, of fusion between pedigerous segments 4 and 5. Corral (1972b) has described specimens from the Canary Islands which he attributes to this species. He figures the spermathecae in lateral view as being elongate in the ventro-dorsal direction, as in the Southwest Pacific specimens.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	0–500	3 females 0.85–0.88 mm
F945	0–500	1 female 0.84 mm

DISTRIBUTION: Previously known from the Adriatic Sea (Shmeleva 1965) and in the region of the Canary Islands in the Atlantic Ocean (Corral 1972b).

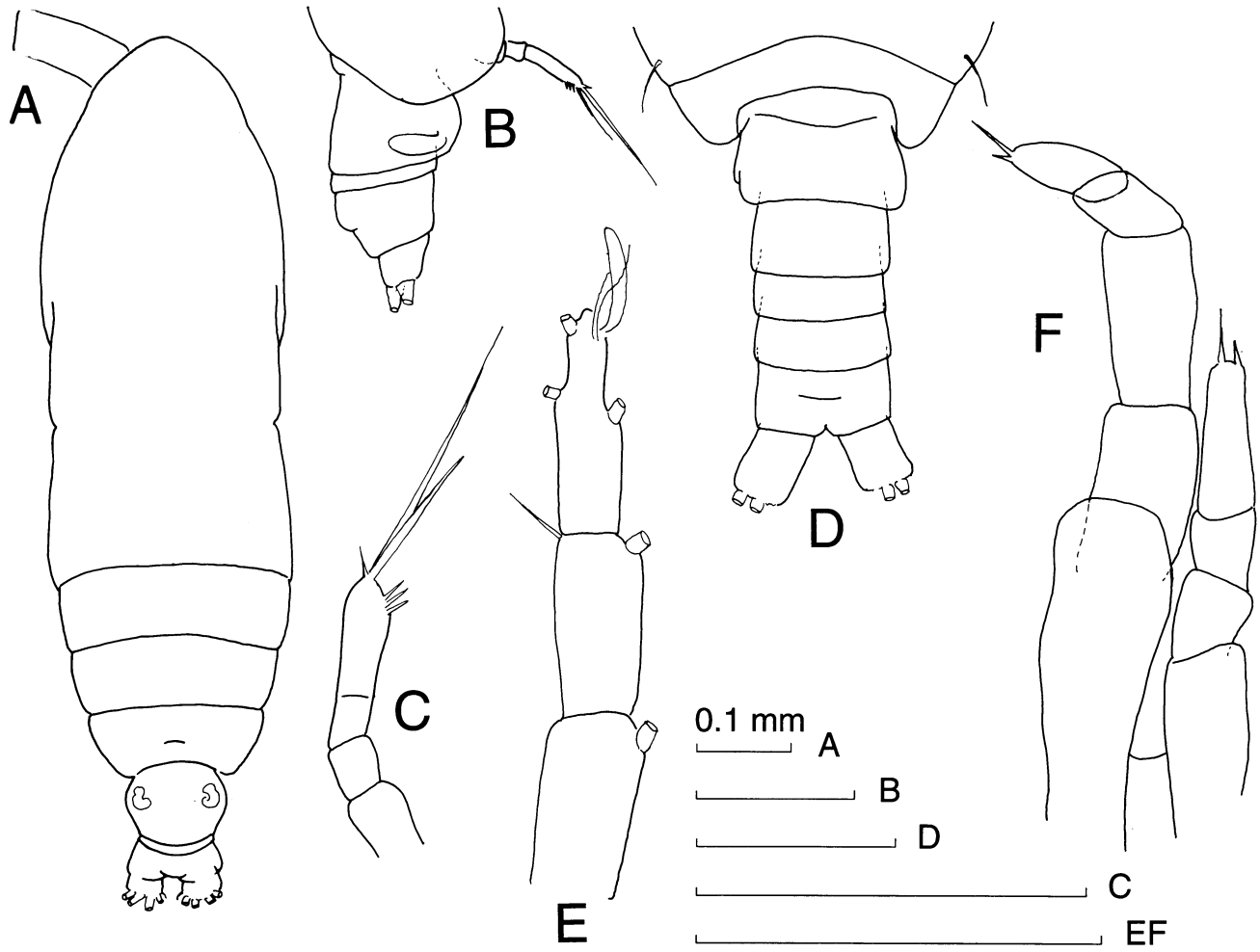


Fig. 30. *Calocalanus neptunus*. Female from NZOI Stn A302: A, dorsal view; B, lateral view of urosome; C, leg 5. Male (from Corral 1972): D, dorsal view of urosome; E, distal part of antenna 1; F, leg 5.

Calocalanus pavo (Dana, 1849) (Figs 31, 86)

DESCRIPTION: Size: females 0.88–1.20 mm, males 1.04 mm.

Female: Head and pedigerous segments 1 and 2 fused, pedigerous segments 4 and 5 separated. Urosome 2-segmented, genital segment onion-shaped, caudal rami symmetrical, elongate and held almost at right angles to the urosome. Basipod 1 of leg 1 with an inner edge seta, endopod segment 3 of legs 3 and 4 with 1 group of spines, the proximal, external border of leg 4 twice the length of the distal border. Leg 5 as long as the basipods of leg 4; its terminal segment has 5 plumose setae, 1 spine on the outer distal border and 2 rows of fine spinules.

(Giesbrecht 1892)

Male: Body form quite different from the female. Head and pedigerous segment 1 separate, pedigerous segments 4 and 5 fused and extending laterally into almost square corners. Urosome 5-segmented, caudal rami longer than wide. Swimming legs as in the female. Both leg 5 terminated by 2 small subequal spines; right leg does not extend as far as the distal border of the first free segment.

(Giesbrecht 1892; Corral 1972b)

REMARKS: The male specimen figured by Corral (1972b) appears to have the head and the first pedigerous segment fused.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Heinrich (1968); Chiba & Hirakawa (1972); Nyan Taw (1978).

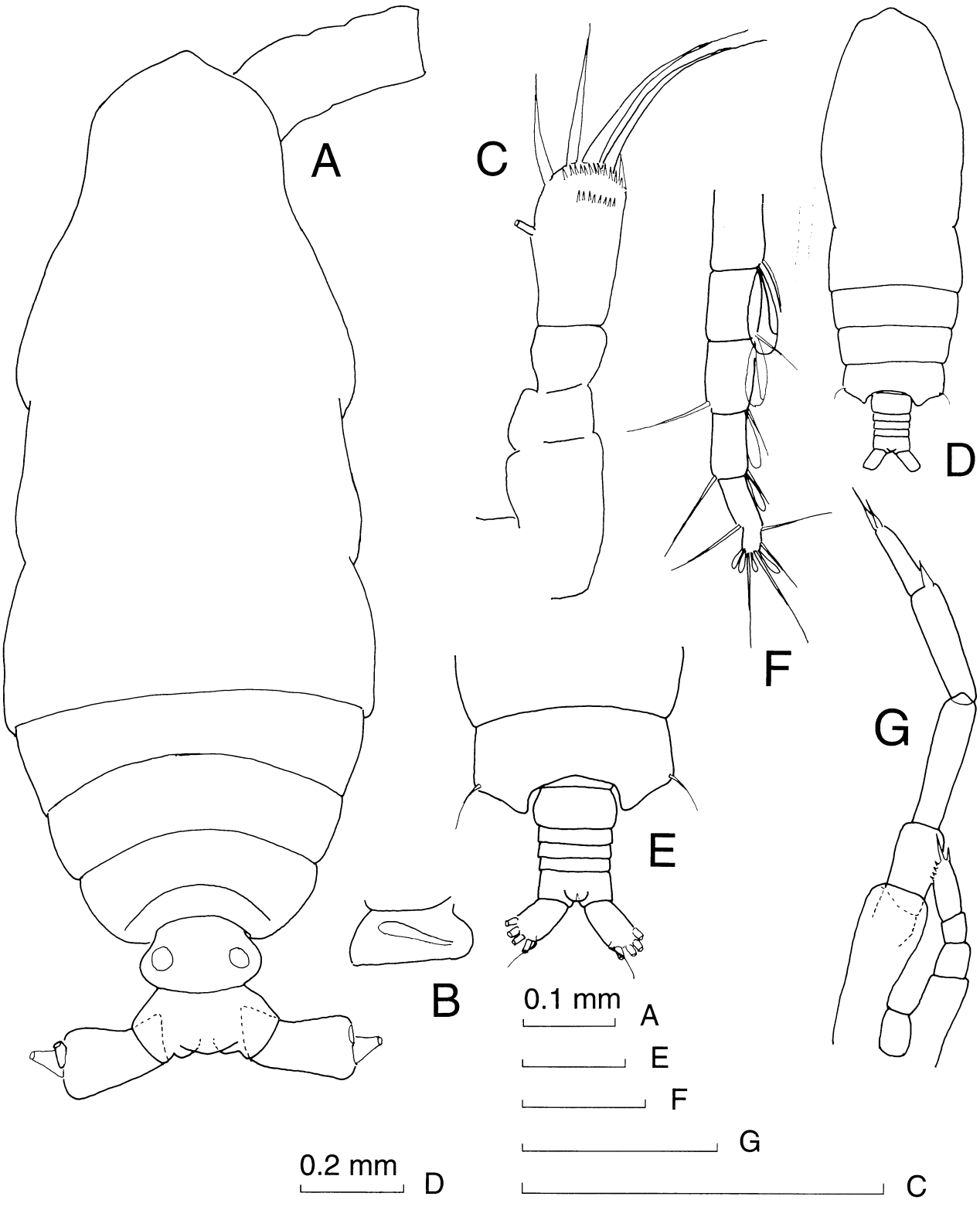


Fig. 31. *Calocalanus pavo*. Female from NZOI Stn A302: A, dorsal view; B, lateral view of genital segment; C, leg 5. Male (from Corral 1972): D, dorsal view; E, dorsal view of ursome; F, distal part of antenna 1; G, leg 5.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	0–500	1 female 1.14 mm
C537	0–250	3 females 1.04–1.15 mm 1 copepodite
F946	0–200	2 females 1.10 mm, 1 copepodite
	0–1000	3 females 1.10 mm
F947	0–200	1 female 0.90 mm

DISTRIBUTION: Widespread in tropical, subtropical and temperate parts of all oceans (Vervoort 1946).

Calocalanus pavoninus Farran, 1936 (Figs 32, 86)

DESCRIPTION: Size: females 0.63–0.71 mm, males 0.48 mm.

Female: Head and pedigerous segment 1 and pedigerous segment 4 and 5 fused, dorsal outline of head indented opposite the mandible. Urosome 2-segmented, genital segment slightly wider than long in dorsal view, anal segment about twice as wide as long, caudal rami as long as wide and slightly shorter than the anal segment. Antenna 1 twice as long as the whole animal, segments 13 to 20 each with a longitudinal row of very fine spinules along the upper margin. Leg 1 with 1-segmented endopod Leg 5 is long and slender reaching almost to the end of the anal segment, 3-segmented with the second segment as long as wide, fourth segment 4 times longer than wide terminated by a strong seta with 2–3 fine spinules at its base. (Farran 1936)

Male: Head and pedigerous segment 1 fused, pedigerous segments 4 and 5 fused but the fusion line evident. Antenna 1 25-segmented with segments 1–2, 3–6 fused, 7–8 incompletely fused, and 24-25 fused. Urosome 5-segmented, caudal rami divergent with 4 setae, the outer seta the finest. Swimming leg 1 with 1-segmented endopod, swimming legs 2–4 with an inner-edge seta on basipod 1 and no inner edge seta on exopod segment 1. Swimming leg 4 elongate. The second free segment on the left leg 5 with 5 long spinules, third segment with 1 outer distal spine, and the last segment terminated by 1 long and 1 short spine; free segments of the right leg do not extend as far as the distal border of the basal segment of the left leg.

(Corral 1972b)

REMARKS: The single specimen taken in the Southwest Pacific appears to agree with the above description but the fact that the specimen was permanently mounted on a slide meant that some details could not be checked, e.g., the exact form of leg 5 when lying flat.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORD:

Station No.	Depth of Haul (m)	Specimens
C537	surface	1 female 0.63 mm

DISTRIBUTION: This species has been recorded from the warmer parts of the Atlantic and Pacific oceans (Corral 1972a).

Calocalanus plumulosus (Claus, 1863) (Figs 33, 86)

DESCRIPTION: Size: females 0.93–1.2 mm, males 0.83–0.90 mm.

Female: Head and pedigerous segment 1 fused, pedigerous segments 4 and 5 with fusion line evident in the midline. Urosome 3-segmented, genital segment with almost straight sides, posterior border of genital segment and urosome segment 2 lined with fine spinules, caudal rami and their setae asymmetrical, one being very long and plumose on the left. Terminal segment of antenna 1 twice the length of the penultimate segment. Basipod 1 of swimming leg 1 with an inner-edge seta, endopod segment 3 of leg 3 with 2 groups of spines, and endopod segment of leg 4 with 1 group of spines. The proximal external border of exopod segment 3, 4 times the length of the distal border. Leg 5 with 3 free segments in addition to a common basal segment, the terminal segment with 1 plumose seta between 2 styliform setae, 1 external spine and a horizontal row of fine spinules, the last 2 segments of leg 5 are decorated with hairs.

(Giesbrecht 1892)

Male: Head and pedigerous segment 1 and pedigerous segments 4 and 5 separated. Antenna 1 21-segmented, exceeding the caudal rami by the distal 5 segments. Swimming leg 1 with an inner-edge seta on basipod 1. Swimming leg 3 has 3 groups of spinules on the posterior surface of endopod segment 3; exopod segment 3 has a row of leaf-like spines on the outer margin, and also on the inner margin of the proximal third of the segment. Swimming leg 4 has a group of spinules on the posterior surface of the endopod segment 3. Leg 5

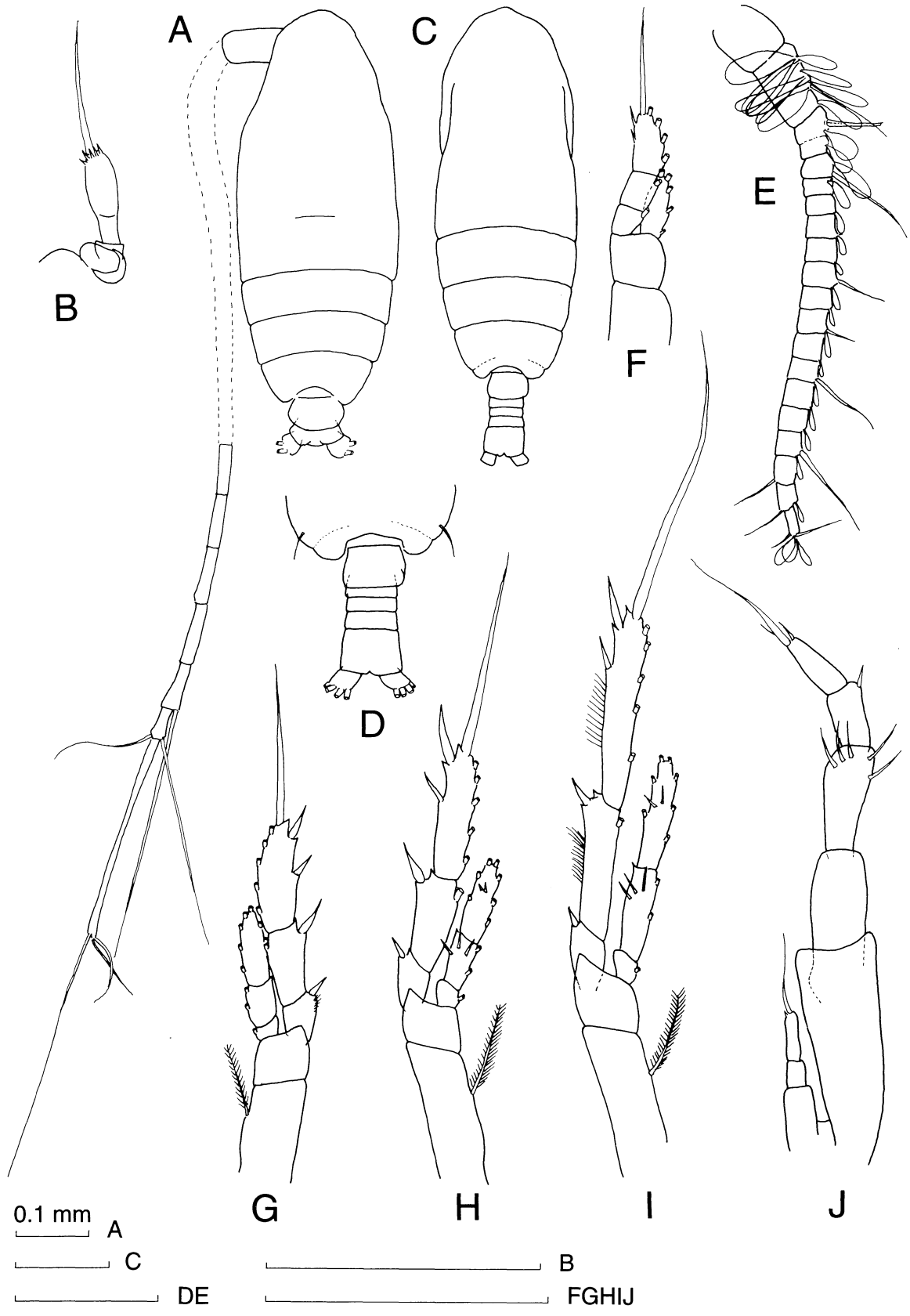


Fig. 32. *Calocalanus pavoninus*. Female from NZOI Stn C537: A, dorsal view; B, leg 5. Male (from Corral 1972b): C, dorsal view; D, dorsal view of urosome; E, antenna 1; F, leg 1; G, leg 2; H, leg 3; I, leg 4; J, leg 5.

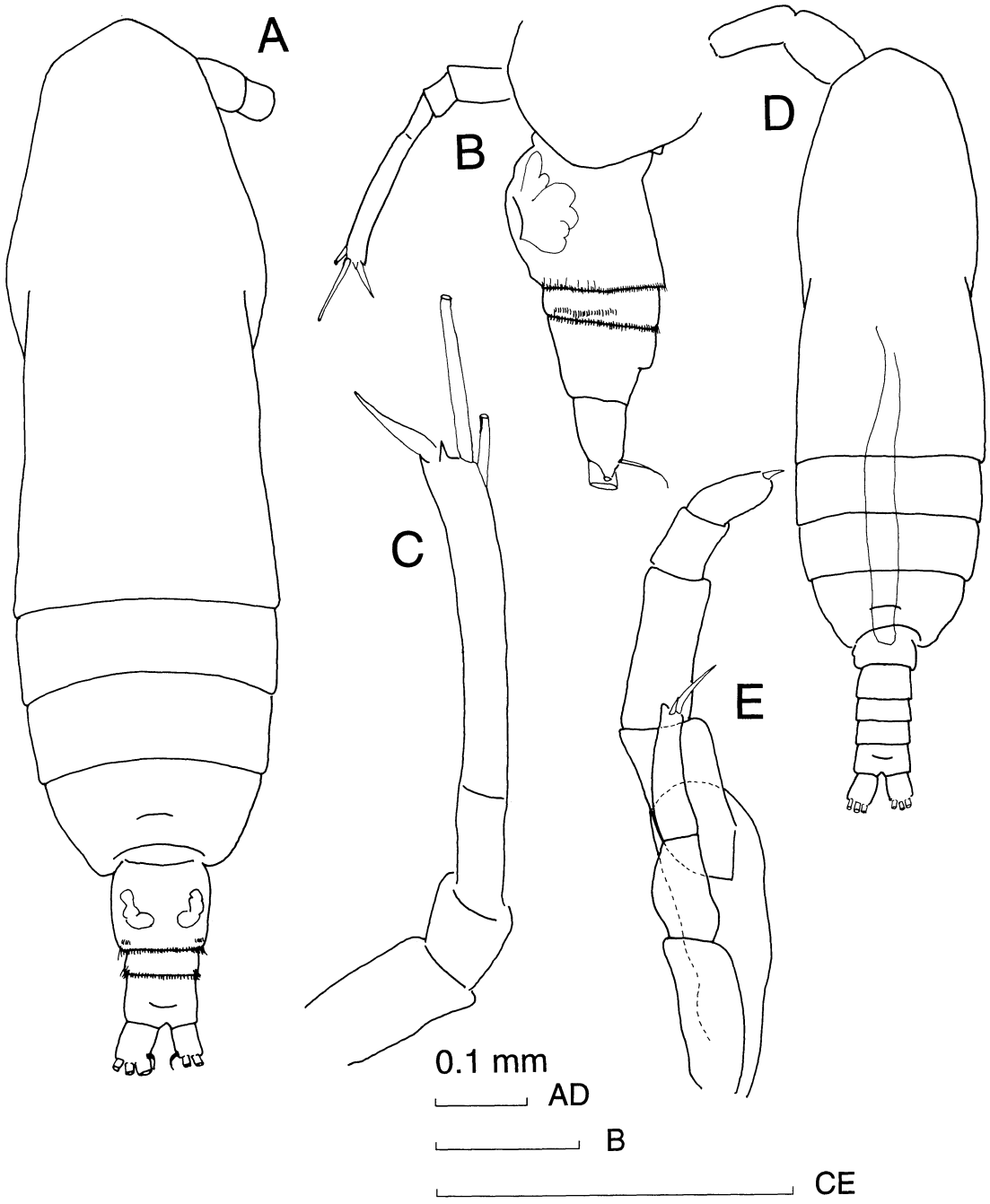


Fig. 33. *Calocalanus plumulosus* from NZOI Stn A302. Female: A, dorsal view; B, lateral view of urosome; C, leg 5. Male: D, dorsal view; E, leg 5.

similar to that of *C. pavo* except the right leg extends beyond the first free segment of the left leg and the segments generally appear to be wider than in *C. pavo*. (Tanaka 1956b)

REMARKS: The present specimens seem to agree with the above descriptions although the details (e.g., hairs on the distal segments of the female leg 5) were not always clear.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran 1929, Dakin & Colefax 1933, Nyan Taw (1978 as *Leptocalanus*).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	surface	2 females 0.99, 1.14 mm
		1 male 0.83 mm
A303	0–10	1 female
F946	0–200	1 female 1.2 mm
	0–1000	1 female 1.2 mm

DISTRIBUTION: Found in the tropical, subtropical and temperate parts of all the major oceans and the Mediterranean (Corral 1972a).

Calocalanus styliremis Giesbrecht, 1888 (Figs 34, 86)

DESCRIPTION: Size: females 0.59–0.72 mm, males 0.55 mm.

Female: Prosome very wide, head and pedigerous segment 1 fused, pedigerous segments 4 and 5 with fusion line evident. Urosome 3-segmented, genital segment onion-shaped, caudal rami symmetrical. Terminal segment of antenna 1 twice the length of the preceding segment. Swimming leg 1 without a seta on basipod segment 1. Exopod segment 3 of legs 3 and 4 with 2 groups of spines. Proximal outer border of exopod segment 3 of leg 4, 3 times the length of the distal border. Leg 5 equal to half the length of the basipods of leg 4, the terminal segment with a single seta and a row of spinules. (Giesbrecht 1892)

Male: Body form quite different, head and pedigerous segment 1 separate, pedigerous segments 4 and 5 fused. Urosome 5-segmented, caudal rami longer than wide with 4 terminal setae. Antenna 1 with segments 1–2 fused, segments 3–6 and 7–9 are fused but the boundaries between the segments detectable. Antenna 2 as in the family definition. Swimming legs as in the female. Leg 5 may be 3- or 4-segmented, right leg extends varying distances along the second segment of the left leg. (Giesbrecht 1892; Corral 1972b)

REMARKS: In Southwest Pacific samples there were several varieties of *Calocalanus* which appeared to be very similar to *C. styliremis* except that their bodies were different widths relative to the width of their genital segments. Here these specimens have been assigned to different species (e.g., *C. longispinus, C. namibiensis*). The males described by Corral (1972a) which have varying types of leg 5 may be the males of similarly related females. For the reason that there appear to be several closely related species, the record of Jillett (1976) is queried as it was not accompanied by figures which could be checked.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	0–500	3 females 0.59–0.62 mm
D614	100–250	1 CV copepodite
T944	80	2 females 0.68 mm
		1 male 0.83 mm

DISTRIBUTION: Previous records of this species appear to be an amalgam of specimens with different body widths (*see* e.g., Farran 1929). Altogether these forms are widely distributed over the Atlantic and Indo-Pacific Oceans (Vervoort 1963).

Calocalanus tenuis Farran, 1926 (Figs 35, 85)

DESCRIPTION: Size: females 1.18–1.31 mm, male unknown.

Female: Head and pedigerous segment 1 fused, pedigerous segments 4 and 5 fused. Urosome 3-segmented, genital segment about as broad as long, slightly longer than the anal segment, caudal rami as broad as long. Antenna 1 with segments 8 and 9 fused. Swimming leg 1 with 2-segmented endopod, the separation between exopod segments 2 and 3 not as definite as that between segments 1 and 2. Leg 5 with 3 segments in addition to common basal segments, the terminal segment 2.5 times as long as the preceding segments, and bears a small distal outer-edge tooth, a terminal spine about as long as the segment, and 2 distal inner-edge setae a little longer than the segment; at the base of these setae are about 3 minute spines. (Farran 1926)

Male: Unknown.

REMARKS: The present specimens appear to agree in most respects with Farran's (1926) description. There appears to be some indication of the fusion-line on the mid-dorsal surface between the head and pedigerous segment 1 and pedigerous segments 4 and 5 in the Southwest Pacific specimens.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Bradford (1972); Nyan Taw (1978).

NEW RECORDS: See page 66.

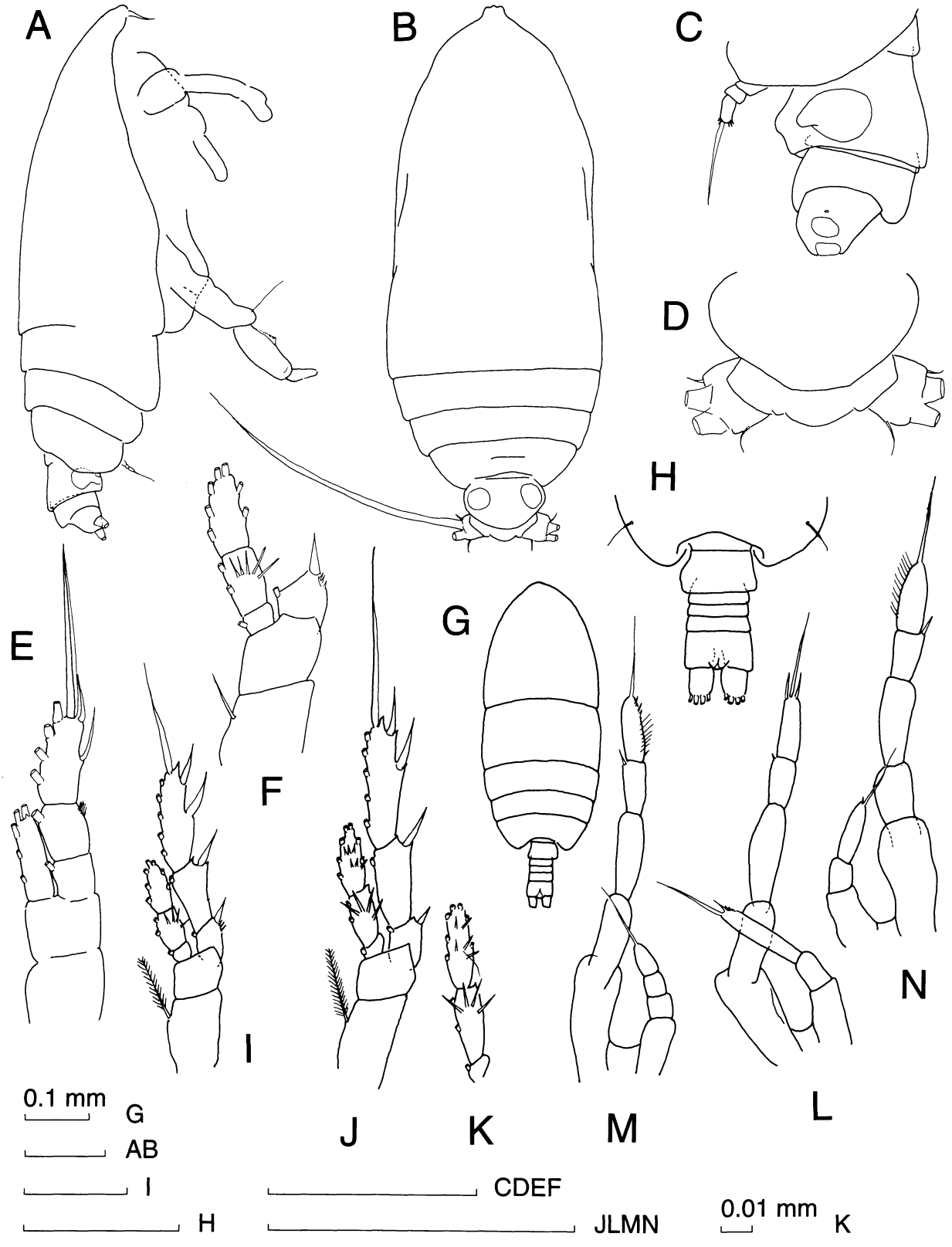


Fig. 34. *Calocalanus styliremis*. Female: A, lateral view; B, dorsal view; C. lateral view of urosome; D, dorsal view of urosome; E, leg 1; F, leg 2. Male (from Corral 1972): G, dorsal view; H, dorsal view of urosome; I, leg 2, J, leg 3; K, endopod of leg 4; L, M, N, various leg 5.

Station No.	Depth of Haul (m)	Specimens
A307	surface	1 female 1.07 mm
D614	100–250	5 CV copepodites
F946	0–1000	1 female
Mu67/7	0–150	5 females 1.22–1.31 mm
Mu67/44	0–150	1 female
Mu67/45	0–150	1 female 1.18 mm
Mu67/47	0–150	3 females 1.18–1.26 mm 1 copepodite

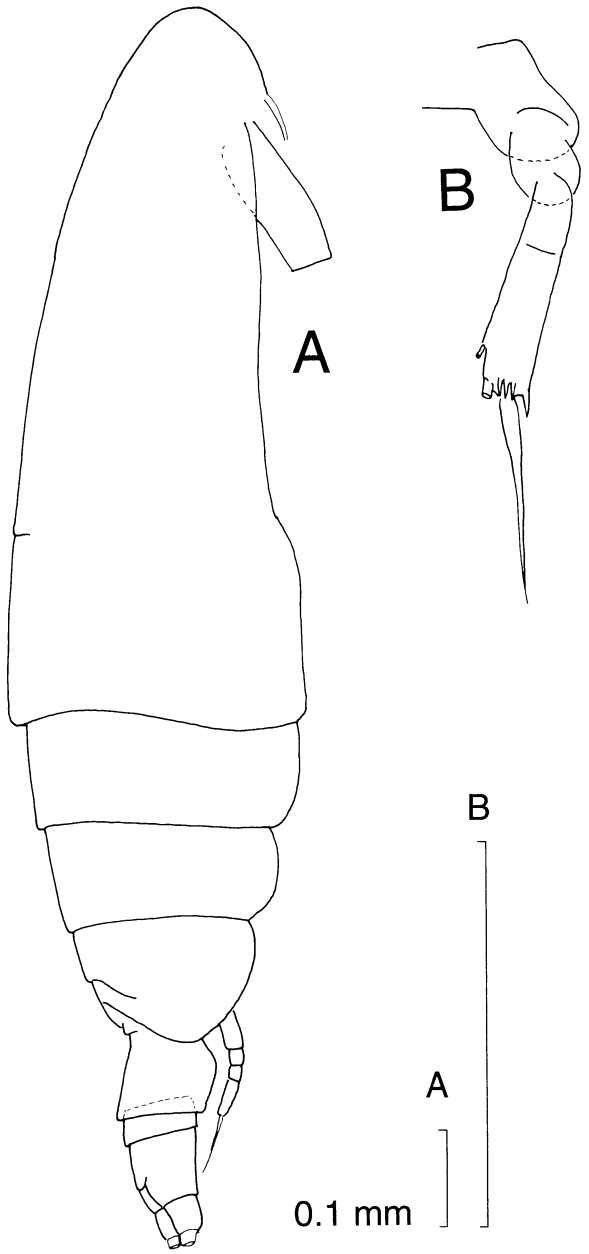


Fig. 35. *Calocalanus tenuis* female from OU Stn Mu67/47: A, lateral view; B, leg 5.

DISTRIBUTION: Atlantic, Indian and Pacific Oceans (Corral 1972b).

Delius Andronov, 1972

DEFINITION: Very small copepods less than 1 mm. Head and pedigerous segment 1 and pedigerous segments 4 and 5 fused. Rostrum bifurcate, with its branches short and rather wide and not filiform. Cephalic dorsal hump absent in the male. Female urosome 4-segmented, male urosome 5-segmented. Antenna 1 extends to the posterior border of the mesosome. Mouthparts as for the family. Basipod 2 of swimming leg 1 with an inner-edge seta. The outer edge of segments 2 and 3 of exopods of swimming legs 2–4 is smooth. Leg 5 is reduced being present only on the left; of 2 segments in the female and 5 segments in the male.

(Andronov 1972c)

TYPE SPECIES: *Paracalanus nudus* Sewell, 1929

REMARKS: This genus contains two species: *Delius nudus* (Sewell, 1929) and *D. sewelli* Bjornberg, 1980 neither of which has been taken in the Southwest Pacific.

Paracalanus Boeck, 1864

DEFINITION: As in the family definition with the following additional points. Head and pedigerous segment 1 and pedigerous segments 4 and 5 separate or fused. Rostrum with fine filaments. Urosome 4-segmented in female, 5-segmented in male, genital segment and caudal rami symmetrical without outer-edge seta. Antenna 1 25-segmented in the female, strongly swollen at its base in the male with segments 1–6, 7–8 fused, and the terminal segment small but free; sensory organs well-developed and numerous in the male. Antenna 2 endopod shorter than the endopod. Mandible with a large blade. Maxilla 1 endopod with indistinct segmentation, outer lobe 2 with a very reduced seta. Maxilliped basipod 2 with a proximal row of very fine spinules along its inner border. Male mouth parts very reduced: antenna 2 with proximal segments elongated at the expense of the terminal segment, the 3 terminal setae present in the female are absent in the male; maxilla 1 very reduced with inner lobes atrophied and only a few setae on the remains of the outer parts of this limb; maxilla 2 represented by a knob; maxilliped terminal part hardly segmented with 3 enlarged plumose outer setae and atrophied inner

setae. Swimming leg 1 basipods 1 and 2 with an inner-edge setae, endopod 2-segmented. External border of swimming leg 4 exopod segment 3 divided by a spine into 2 parts of which the distal part is less than half the proximal part. External border of exopod segment 2 not toothed; external border of exopod segment 3 of some or all of legs 2–4 toothed. Endopod segment 3 of leg 1 with 5 setae, endopod segment 3 of leg 2 with 7 setae. Leg 5 short, uniramous, symmetrical and of 2 segments in the female; in the male it is uniramous, asymmetrical, with 5 segments on the left and 2 on the right.
(Giesbrecht 1892)

TYPE SPECIES: *Calanus parvus* Claus, 1863

REMARKS: This species now contains the following species: *P. aculeatus* Giesbrecht, 1892; *P. campaneri* Bjornberg, 1980 (male unknown); *P. indicus* Wolfenden, 1905; *P. intermedius* Shen & Bai, 1956; *P. nanus* Sars, 1907; *P. parvus* (Claus, 1863); *P. pygmaeus* (Claus, 1863) (= *P. denudatus* Sewell, 1929; *see* Andronov 1977); *P. quasimodo* Bowman, 1971; *P. serrulus* Shen & Lee, 1963; *P. tropicus* Andronov, 1977.

The following species have been taken in the Southwest Pacific.

Paracalanus aculeatus Giesbrecht, 1892
(Fig. 36)

Description: Size: females 0.80–1.360 mm, males 0.92–1.36 mm.

Female: As in the generic description, with the following additional characters. The fusion line between pedigerous segments 4 and 5 evident laterally, posterior borders fringed with a number of long delicate hairs. The inner seta on the caudal rami scarcely half the length of the other setae. Antenna 1 extends beyond the caudal rami, segments 1–2, and 8–9, fused. Endopod segment 1 of maxilla 1 with 3 setae. Lobe 3 of basipod 1 of the maxilliped with 3 setae. Inner edge of basipod 1 of swimming leg 4 terminated by a ledge; the posterior surface of exopod segment 2 of leg 2, exopod segments 1 and 2 of leg 3, and endopod segments 2 and 3 of leg 4 ornamented with spines. Leg 5 uniramous, the distal segment cylindrical, with the terminal spine longer than its joint, the outer distal spine elongated to almost half the length of the terminal segment.
(Giesbrecht 1892)

Male: As for the generic and female description with the following additional characters. Caudal rami about as long as wide, anal segment shorter than urosome segment 4. Antenna 1 extends almost as far as the caudal rami. Leg 5 extends beyond the posterior border of urosome segment 3, right leg extends well beyond the distal border of left leg segment 2. (Vervoort 1963)

REMARKS: This species is often found in two size classes. *See* Vervoort (1949) for a summmary.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Dakin & Colefax (1940); Vervoort (1957); Jillett (1971); Chiba & Hirakawa (1972); Greenwood (1976).

NEW RECORDS: Nil.

DISTRIBUTION: Common in tropical and subtropical regions of the Atlantic, Indian and Pacific Oceans (Vervoort 1949).

Paracalanus indicus Wolfenden, 1905
(Figs 19, 21, 84)

DESCRIPTION: Size: females 0.85–0.95 mm, males 0.85–1.02 mm.

Female: As in the generic description with the following additional characters. The fusion line between pedigerous segments 4 and 5 evident dorsally. Genital segment widest anteriorly in dorsal view; caudal rami twice as long as wide with its inner seta short. Antenna 1 extends just beyond the anal segment, all segments separate. Endopod segment 1 of maxilla 1 with 3 setae. Lobe 3 of basipod 1 of the maxilliped with 3 setae. Swimming leg 1 basipod 1 without inner seta, outer border of exopod segments 1 and 2 bearing hairs. Inner distal edge of basipod 1 of swimming leg 4 smooth. The posterior surface of exopod segment 2 of leg 2, exopod segments 1 and 2 of leg 3, and endopod segments 2 and 3 of leg 4 naked. Distal margin of exopod segment 3 of legs 2 and 3 serrate, of leg 4 naked. Legs 2–4 basipod segment 1 with variable ornamentation from almost naked to several short rows of spines. Leg 5 uniramous, distal segment cylindrical, with the terminal spine longer than its joint, outer distal spine small, almost a quarter the length of the terminal segment. (Bradford 1978)

Male: As for the generic and female description with the following additional characters. Caudal rami twice as long as wide, anal segment longer than urosome segment 4. Antenna 1 extends to about the distal border of urosome segment 2.

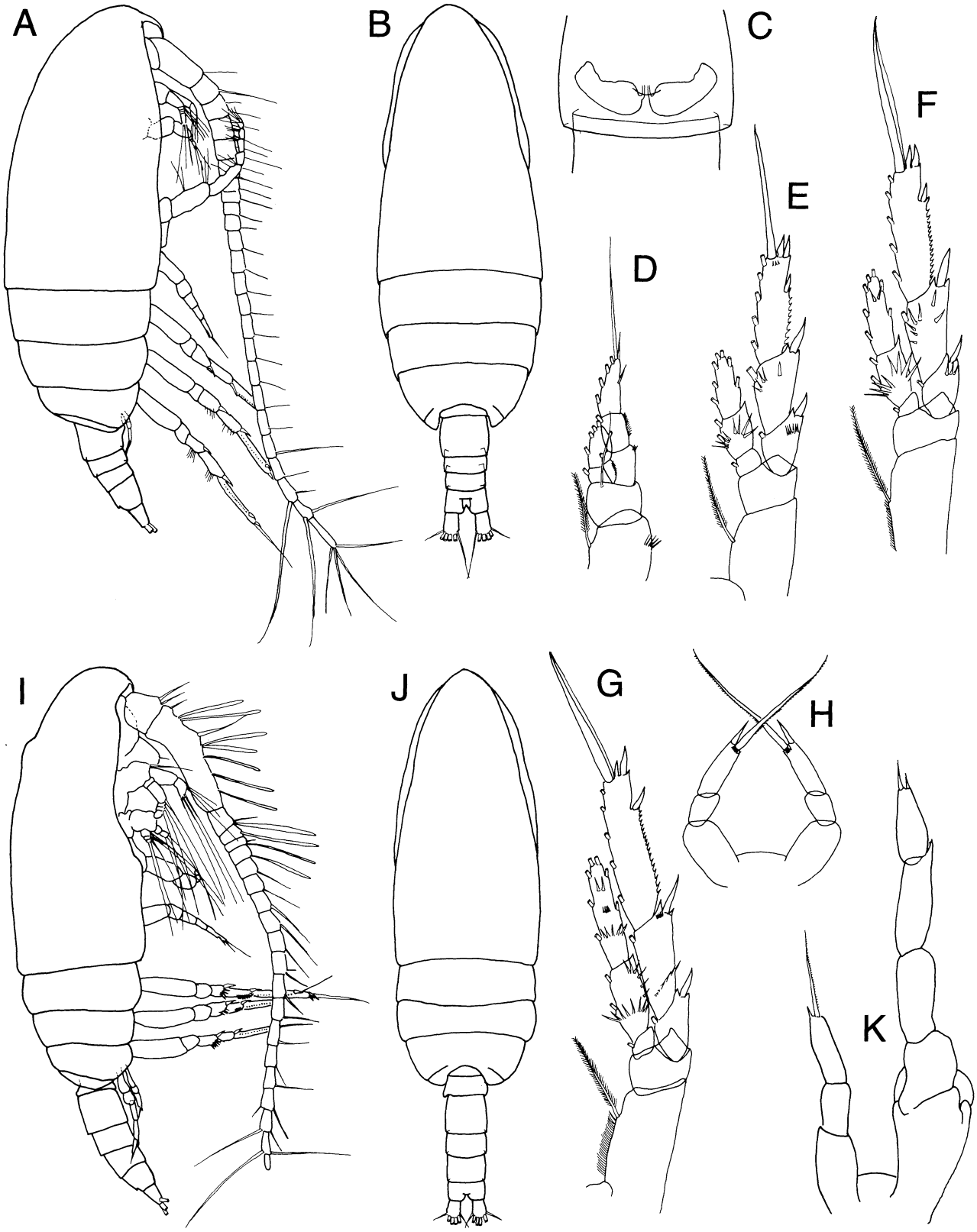


Fig. 36. *Paracalanus aculeatus* (from Vervoort 1963). Female: A, lateral view; B, dorsal view; C, ventral view of genital segment; D, leg 1, E, leg 2; F, leg 3; G, leg 4; H, leg 5. Male: I, lateral view; J, dorsal view; K, leg 5.

Swimming legs differ from those of the female in the following respects: leg 1 exopod segment 1 without outer-edge hairs, exopod segment 2 with short hairs on the outer distal corner. Segments of legs 2-4 with slightly more ornamentation than in female: exopod segment 2 outer edge serrate, exopod segment 3 of leg 4 with distal border serrate, basipod 1 of leg 2 sometimes with small latero-proximal spinules, endopod segment 3 of leg 3 with more posterior surface spines, endopod segments 2 and 3 of leg 4 with posterior surface spines. Leg 5 extends beyond the posterior border of urosome segment 3, right leg extends well beyond the distal border of left leg segment 2. (Bradford 1978)

REMARKS: There is some doubt that New Zealand specimens and those considered by Bowman (1971) to be *P. indicus* are conspecific. The female genital segment of New Zealand specimens, unlike Bowman's description, appear to be without postero-lateral spinules and there is a tendency to have fewer spinules on the surfaces of legs 2–4 (Bradford 1978).

PREVIOUS SOUTHWEST PACIFIC RECORDS: As *C. parvus*: Krämer (1894); Thomson & Anderton (1921); Farran (1929); Dakin & Colefax (1940); Bary (1951); Vervoort (1957); Cassie (1959a, b, 1960, 1963); Jillett (1971); Bradford (1972); Nyan Taw (1978). As *C. indicus:* Bradford (1978, 1985); Bradford *et al.* (1980).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	500–1000	1 female
F945	0–500	1 female 0.88 mm, 2 males 0.90, 0.93 mm
F946	0–200	10 females 0.84–1.09 mm
	0–1000	1 male 1.03 mm
F947	0–200	2 females 0.97, 1.01 mm 3 males 1.04–1.39 mm

DISTRIBUTION: This species is common and ubiquitous throughout New Zealand coastal waters. The Southwest Pacific may be part of a widespread distribution of this species in tropical, subtropical, and temperate waters (Bowman 1971). Around New Zealand this species is mainly found in coastal waters although records from the mid-Tasman Sea (Fig. 84) indicate that it is easily transported across expanses of ocean.

Parvocalanus Andronov, 1970

DEFINITION: As in the family definition but with the following additional characters. The fusion line between pedigerous segments 4 and 5 usually conspicuous. Rostrum bifurcated, short and solid. Cephalic dorsal hump absent in the male. Female urosome 4-segmented. Antenna 1 25-segmented. Basipod 2 of swimming leg 1 without inner-edge seta, endopod of leg 1 1- or 2-segmented. The posterior and lateral surfaces of swimming legs 2–4 may be ornamented with spines. Leg 5 2-segmented, symmetrical in the female with short terminal spines; asymmetrical in the male: left leg 5-segmented, right leg 2- or 3-segmented. (Andronov 1970)

TYPE SPECIES: *Paracalanus crassirostris* Dahl, 1894

REMARKS: This genus contains the following species: *P. crassirostris* (Dahl, 1894); *P. dubia* (Sewell, 1912) (male unknown); *P. elegans* Andronov, 1972; *P. latus* Andronov, 1972 (male unknown); *P. scotti* (Früchtl, 1923) (male unknown); *P. serratipes* (Sewell, 1912).

The following species has been recorded from the Southwest Pacific.

Parvocalanus crassirostris (Dahl, 1894) (Fig. 37)

DESCRIPTION: Size: females 0.47–0.55 mm, males 0.35–0.39 mm.

Female: As in the family and generic description with the following additional characters. Innermost caudal seta more than twice as long as the caudal ramus. Antenna 1 nearly as long as the body. Lobe 3 of basipod 1 of the maxilliped with 2 setae. Swimming leg 1 with 2-segmented endopod. Outer distal border of exopod segment 3 and the outer border of exopod segment 2 of swimming legs 2–4 smooth, posterior surfaces of these legs sparingly decorated with spinules, no surface spinules on basipods 1 and 2. Leg 5 terminal segment just under 0.5 times as wide as long with 2 subequal strong terminal spines. (González & Bowman 1965)

Male: As in the family and generic description with the following additional characters. Antenna 1 17-segmented, hardly extending to the posterior border of the cephalothorax. Swimming legs as in the female. Leg 5 on the right does not extend as far as the distal border of segment 1 on the left, terminal setae short and stout. (González & Bowman 1965)

REMARKS: A number of different forms of this species

have been described which may yet prove to be separate species (*see* Greenwood 1976).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Greenwood (1976) as *Paracalanus*.

NEW RECORDS: Nil.

DISTRIBUTION: The distribution of the typical form includes coastal waters of the western Atlantic and Indo-Malaysian and northeastern Australian waters, probably mainly in brackish water (González & Bowman 1965; Greenwood 1976).

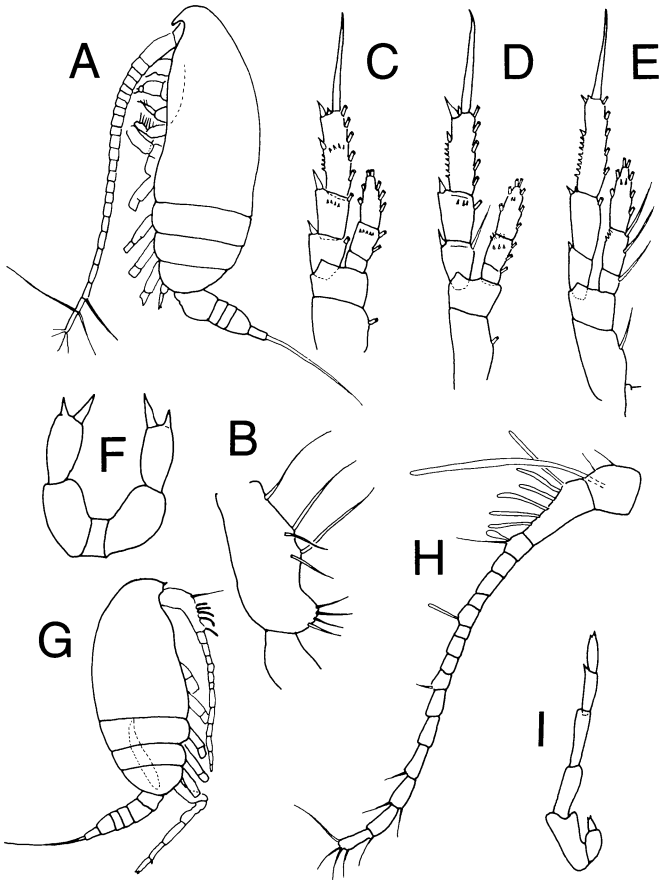


Fig. 37. *Parvocalanus crassirostris* (from González & Bowman 1965). Female: A, lateral view; B, basipod 1 of maxilliped; C, leg 2; D, leg 3; E, leg 4; F, leg 5. Male: G, lateral view; H. antenna 1; I, leg 5.

Family **MECYNOCERIDAE** Andronov, 1973

Mecynocera Thompson, 1888

DEFINITION: Small copepods with head and pedigerous segment 1 and pedigerous segments 4 and 5 separate, rostrum with two long filaments.

Female: Urosome 3-segmented with articulated caudal rami. Antenna 1 very long, 23-segmented, with segments 1–2, and 8–9 fused; carrying elongate setae on segments 7, 14, 16, 18, 21, 23, 24. Antenna 2 exopods are shorter than the endopod, segments 1 and 2 each bearing 2 setae, terminal segment short. Mandible with well-developed teeth on the blade, the endopod is small relative to the rest of the palp. Maxilla 1 inner lobe 1 with 12 marginal spines and setae including 4 on the posterior surface; inner lobes 2 and 3 with 3 setae each; basipod 2 with 4 setae; endopod segments 1–3 with 4, 4, 6 setae respectively; exopod with 11 setae; outer lobe 1 without setae, outer lobe 2 with 9 setae. Maxilla 2, lobes 1–5, with 5, 3, 3, 3, and 4 setae, respectively. Maxilliped, 5 terminal segments with 4, 4, 3, 4 and 4 setae respectively, basipod 2 with a longitudinal row of long spinules proximally. Swimming leg 1 with 3-segmented exopod and 1-segmented endopod; outer borders of exopod segments with a group of distal spinules on segment 1, naked on segment 2, and with 1 distal spine on segment 3. Swimming legs 2–4 almost identical with both rami 3-segmented; posterior surfaces naked; exopods with 1 outer-edge spine on segments 1 and 2; segment 3 with 2 outer-edge spines (1 subterminal) and 1 distal spine with a smooth blade-like outer border. Basipod segment 1 of swimming legs 2–4 naked, basipod 2 of swimming leg 1 with a seta on its inner edge. Exopod segments with the following setation in their inner margins: segment 1 with 1 seta on legs 1–4; segment 2 with 1 seta on legs 1–4; segment 3 with leg 1 with 4 setae, legs 2–4 with 5 setae. Endopod segments of legs 2–4 with 1 inner seta on segment 1; 1 inner seta on segment 2; outer margins of these segments naked. Endopod segment 3 of legs 2–4 with 1 outer, 2 terminal and 2 inner setae; leg 1 endopod with 1 inner seta and 2 terminal setae. Leg 5 uniramous, 5-segmented, symmetrical. (Giesbrecht 1892; Corral 1972b)

Male. Urosome 5-segmented, with articulated caudal rami; genital pore on the right side. Dorsal cephalic hump present. Antenna 1 shorter than in the female, 25-segmented with segments 1–2, and 3–6 fused making 21 free segements. Mouthparts have not been described in detail. Swimming legs 1–4 as in female except basipod 1 of legs 2–4 have an inner-edge seta, the inner edge of exopod segment 1 has no seta, and the outer border of endopod segment 2 convex and well supplied with hairs. Leg 5 uniramous, 5-segmented, asymmetrical, longer on the right.

(Andronov 1970, 1973c; Corral 1972b)

This is a monotypic family containing *Mecynocera clausi* Thompson, 1888 (Figs 38, 39).

REMARKS: This family was created by Andronov (1973c) for *Mecynocera*. In the past this genus was placed in the Eucalanidae, then in the Calocalanidae by Bernard (1958). *Mecynocera* cannot be accommodated in the Eucalanidae because females have the second basipod of the maxilliped with a proximal row of long teeth (these are absent in the Eucalanidae), exopod segment three of the second to fourth legs have only two outer-edge spines (three in the Eucalanidae), and the male has a dorsal cephalic hump (absent in the Eucalanidae) (Andronov 1973c); Andronov also believes that segments eight and nine are separate in *Mecynocera*, unlike the Eucalanidae, but my observation is that these two segments are fused. *Mecynocera* cannot be accommodated in the Paracalanidae (the senior synonym of Calocalanidae — *see* the previous section) because the terminal segment of the second antenna is short (this segment is long in female Paracalanidae), the second endopod segment of the second to fourth swimming legs have only one seta (two in Paracalanidae), and the third endopod segment of the third and fourth swimming legs have only five setae (seven in Paracalanidae). None of the male mouthparts has been described in detail either by Andronov (1970) or Corral (1972b) except that Andronov (1970) states that the mouthparts are reduced and that the mandible was not evident. A detailed description of the male mandibular palp would settle the position of *Mecynocera* with respect to the Paracalanidae; also the form of the paracalanid male exopod of the second antenna is a very characteristic and consistent feature (*see* Fig. 20D).

Mecynocera clausi Thompson, 1888
(Figs 38, 39, 87)

DESCRIPTION: Size: females 0.92–1.21 mm, males 0.94–1.12 mm.

Female: As in the family definition. Antenna 1 twice as long as the whole body. Leg 5 segment 4 with 1 inner seta, segment 5 with 3 inner and 2 terminal setae. (Giesbrecht 1892)

Male: As in the family definition. Antenna 1 extends beyond the caudal rami by 1–2 segments. Right leg 5 inner border hairy, terminal segments on both sides with a stout terminal spine and a small disto-lateral spinule, distal border of left segment 5 does not extend quite as far as the distal border of segment 4 of the right leg. (Andronov 1970, 1973c; Corral 1972b)

REMARKS: No males were detected in the Southwest Pacific samples examined and all females had most of their swimming legs damaged.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Dakin & Colefax (1940); Bary (1951); Vervoort (1957); Heinrich (1968); Jillett (1971); Chiba & Hirakawa (1972); Bradford (1972, 1985); Greenwood (1977); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	500–1000	1 female
A295	surface	2 females, 1 CV male
	0–500	1 female
A302	surface	1 female
	0–500	7 females
A303	0–10	12 females
	450–1000	6 females
A341	surface	2 females
C526	surface	3 females
C537	surface	10 females
	0–250	5 females
D614	0–100	1 female
	100–250	1 female
F945	0–200	1 female 0.90 mm
	0–500	2 females 1.05, 10.5 mm
	500–1000	1 female 1.1 mm
F946	0–200	2 females
Mu67/7	0–150	3 females
Mu67/44	0–150	21 females
Mu67/47	0–150	1 female
Mu67/50		3 females
Mu67/51		4 females

DISTRIBUTION: This species is a widespread epipelagic inhabitant of all the world's tropical, subtropical, and temperate oceans (Vervoort 1957).

Superfamily EUCALANOIDEA

Family EUCALANIDAE Giesbrecht, 1892

DEFINITION: Body elongate, especially anterior to antenna 2, more or less transparent, often with a triangular head. Head and pedigerous segment 1 fused, pedigerous segments 4 and 5 partially fused, rostrum with two long filaments.

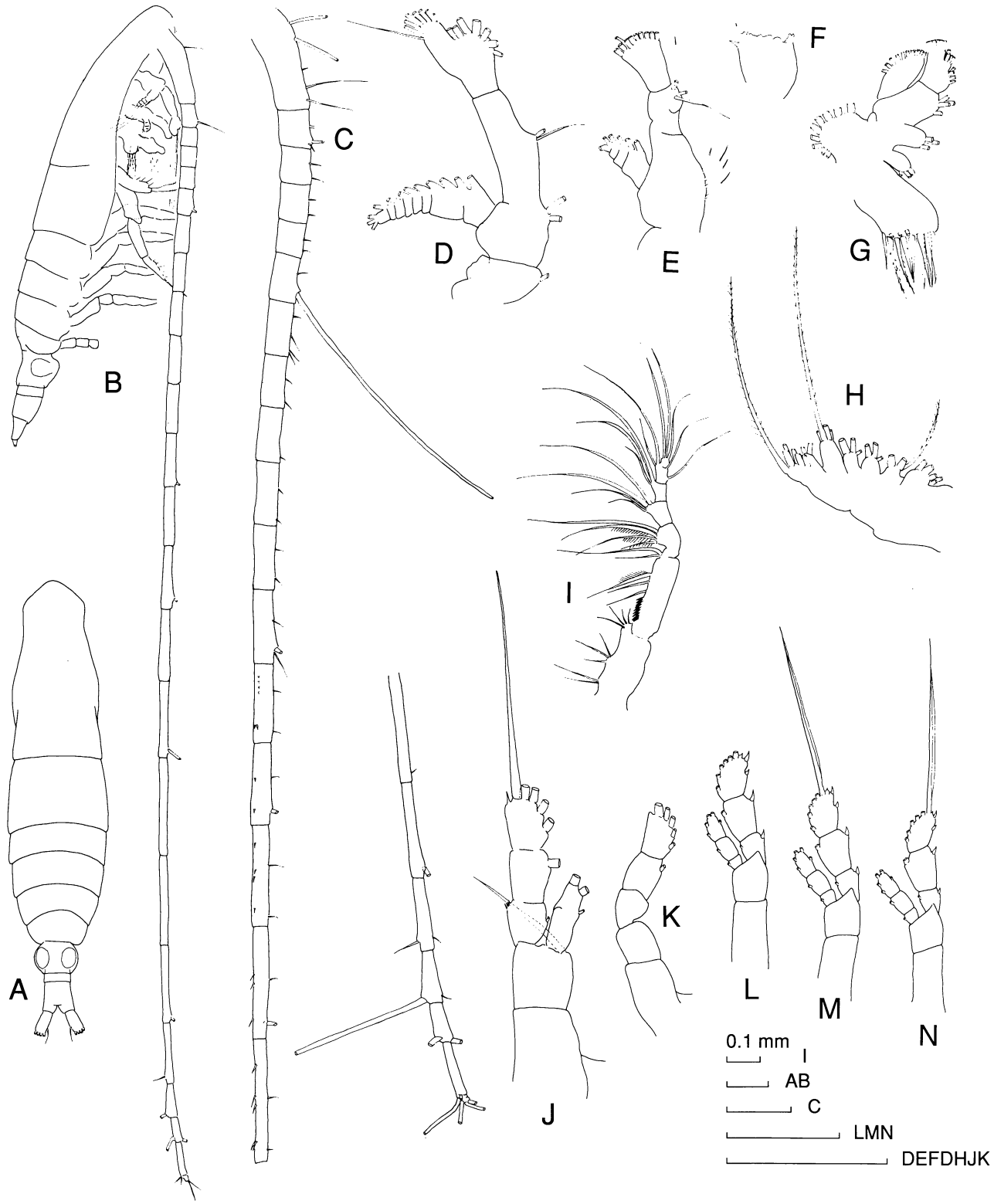


Fig. 38. *Mecynocera clausi*. Female from NZOI Stn T944: A, dorsal view; B, lateral view. Female from NZOI Stn F945: C, antenna 1, D, antenna 2, E, mandibular palp; F, mandibular blade; G, maxilla 1; H, maxilla 2; I, maxilliped; J, leg 1; K, leg 5. Female (from Corral 1972): L, leg 2; M, leg 3; N, leg 4.

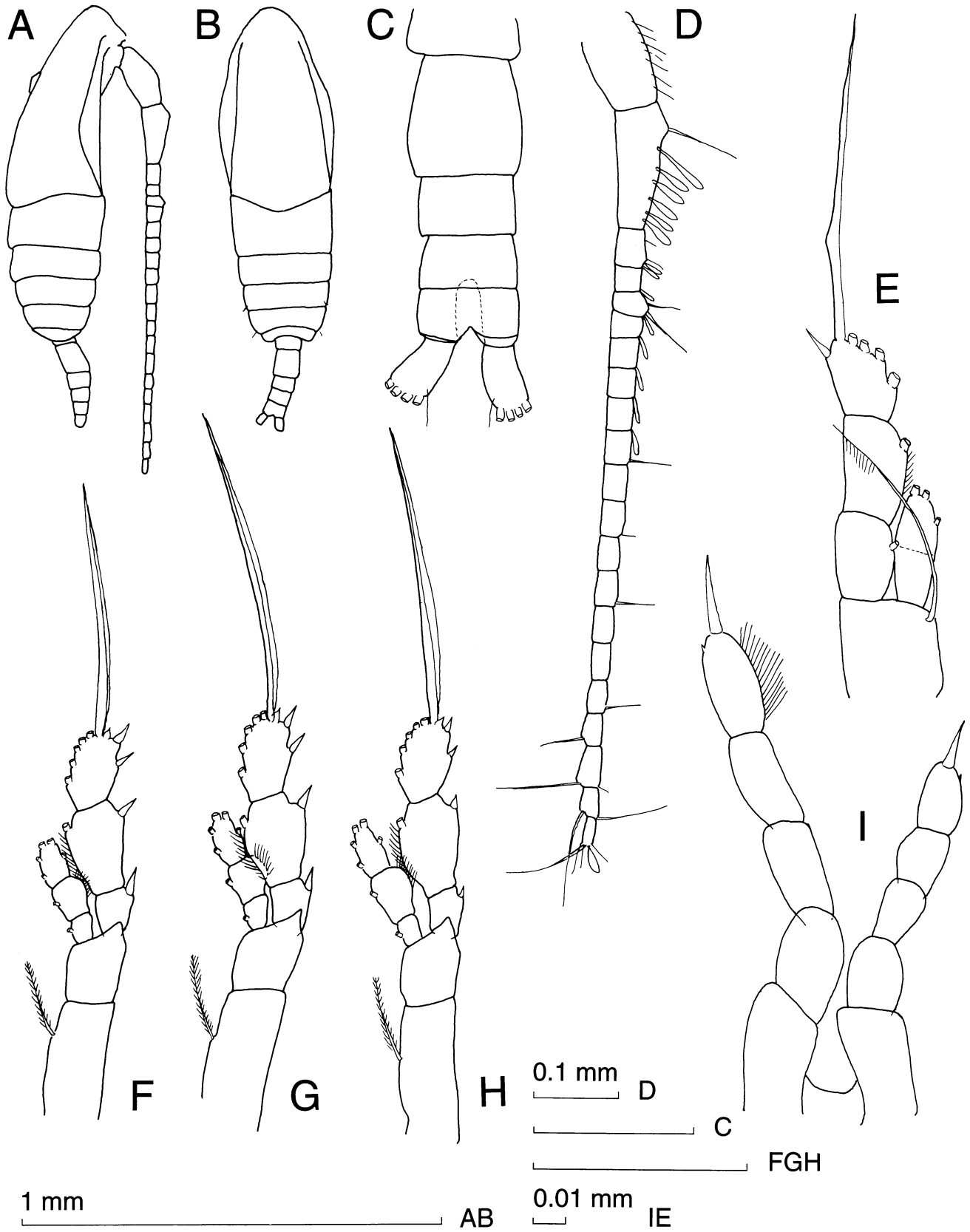


Fig. 39. *Mecynocera clausi* male (from Corral 1972): A, lateral view; B, dorsal view; C, dorsal view of urosome; D, antenna 1; E, leg 1; G, leg 2; G, leg 3; H, leg 4; I, leg 5.

Female: Urosome 3 or 4-segmented with caudal rami usually completely fused to the anal segment. Antenna 1 23-segmented, generally with segments 8–9 fused; carrying an elongate seta on some segments. Antenna 2 exopod shorter than the endopod, segments 1 and 2 each bearing 2 setae and either fused or separate. Mandible with well-developed teeth on the blade, the endopod reduced and basipod 2 and the exopod elongate except in *Rhincalanus*. Maxilla 1 inner lobe 1 with 14 marginal spines and setae including 4 on the posterior surface and 1 on the anterior surface; inner lobe 2 may be absent or without setae, basipod 2 and endopod elongate; exopod with a reduced number of setae; outer lobe 2 with 1 seta; outer lobe 1 with 9 setae. Maxilla 2, lobes 1–5, with 6, 3, 3, 3, and 3 or 4 setae, respectively. Maxilliped, 5 terminal segments with 3, 4, 3, 4 and 4 setae respectively, basipod 2 without a row of longitudinal spinules. Swimming leg 1 with 2- or 3-segmented exopods and 2-segmented endopods. Swimming legs 2–4 almost identical with both rami 3-segmented. Exopods with 1 outer-edge spine on segments 1 and 2; segment 3 with 3 outer-edge spines (1 subterminal) and 1 distal spine with a smooth blade-like outer border. Basipod segment 1 of swimming legs 2–4 and basipod 2 of swimming leg 1 with a plumose seta on its inner edge. Exopod segments with the following setation on their inner margins: segment 1 with 1 seta on legs 1–4; segment 2 with 1 seta on legs 1–4; segment 3 of leg 1 with 4 setae, of legs 2–4 with 5 setae, of leg 1 segment 1 with 1 inner seta, of segment 2 with 2 inner and 2 terminal setae. Endopod segments of legs 2–4 with 1 inner seta on segment 1; 1 inner setae on segment 2; outer margins of these segments naked. Endopod segment 3 of leg 2 with 1 outer, 2 terminal and 2 inner setae. Leg 5 absent or uniramous.

Male: Urosome 5-segmented, with caudal rami usually completely fused to the anal segment. Antenna 1 24-segmented. Antenna 2, mandible, maxilla 1, maxilla 2 more or less as in female, but antenna 2 with proximal setae on the exopod reduced, endopod not as elongate; mandibular palp not as elongate; maxilliped squat with enlarged outer and inner setae on the terminal segments. Swimming legs 1–4 as in the female. Leg 5 uniramous on both sides, or absent on one side or uniramous on the left and biramous on the right.

An example of this family is *Subeucalanus longiceps* (Matthews,1925) (Figs 40, 41).

REMARKS: The classification of species in the Eucalanidae has been confused because of the lack of distinctive sexually modified appendages and rigorous estimates of variability (Fleminger 1973). On the basis of integumental organs, Fleminger (1973) has clarified relationships between species with the result that four groups (*elongatus* group, *attenuatus* group, *subtenuis* group, and *pileatus* group) have been identified. Later Geletin (1976) further clarified relationships between *Eucalanus senso lato* species and *Rhincalanus* based on the development of the abdomen. He identified four groups, characterised by *E. hyalinus*, *E. attenuatus*, *E. subtenuis*, and *R. nasutus* respectively.

Group I of Geletin (1976), *Eucalanus* Dana, 1852, corresponds to Fleminger's (1973) *elongatus* group; group II of Geletin, *Pareucalanus* Geletin, 1976, corresponds to Fleminger's (1973) *attenuatus* group; and group III of Geletin, *Subeucalanus* Geletin, 1976, corresponds to the combined *subtenuis* and *pileatus* groups of Fleminger (1973). The *subtenuis* and *pileatus* groups of Fleminger (1973) have smaller differences between them than between themselves and the *elongatus* and *attenuatus* groups. I have therefore accepted Geletin's 1976 arrangement of the species into genera. I have concentrated on characters which are easy to see.

The following characters are those principally used to distinguish species in this family: the shape of the head, degree of fusion between abdominal segments, ornamentation of the urosome and metasome, the patterns of distribution of integumental organs, the presence and form of the fifth swimming leg, form and setation of the second antenna, the mandibular palp, first maxilla, and first swimming leg.

It appears that the Eucalanidae feed chiefly on micro-algae (Arashkevich 1969; Arashkevich & Timonin 1970; Itoh 1970; Samyshev 1970) although Mullin and Brooks (1967) showed an increasing preference for large animal particles as they matured.

Eucalanus Dana, 1852

DEFINITION: As in the family definition. Additional distinguishing features are female urosome 4-segmented, and the posterior borders of pedigerous segments 2–4 and urosome segment 1 without spines. Integumental organs located at the maxilla 1 and 2 sites vary from 8–18 in number and are not arranged in a rectangular pattern, posterior sets more lateral than the anterior sets; maxilliped sites are in 4 or more pairs; pedigerous segments 2 and 3 with 1 or 2 lateral sites; pedigerous segment 4 lacking paired sites lying outside the dorsal quadrangle of hair sensilla, abdominal segment 1–2 with at least 2

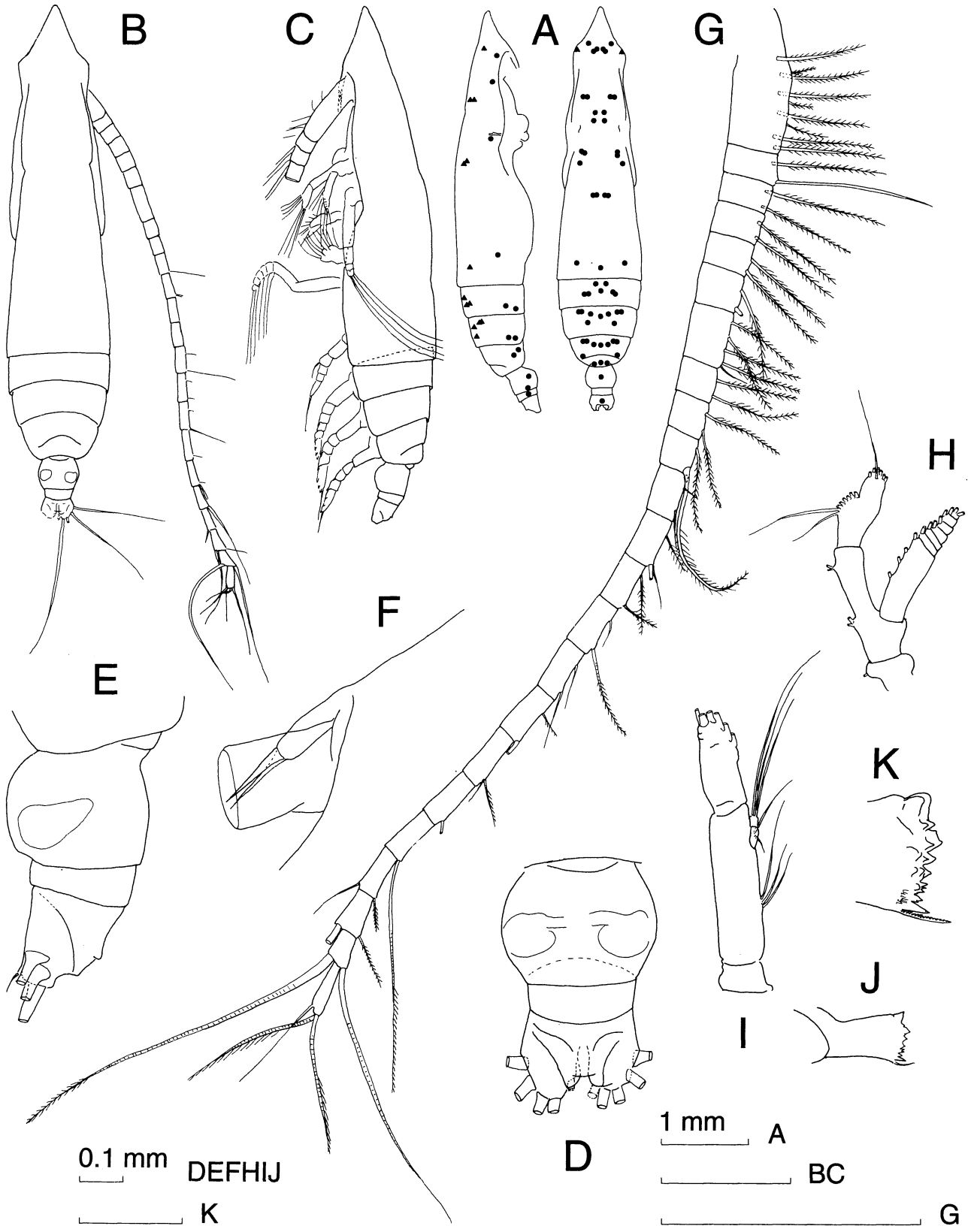
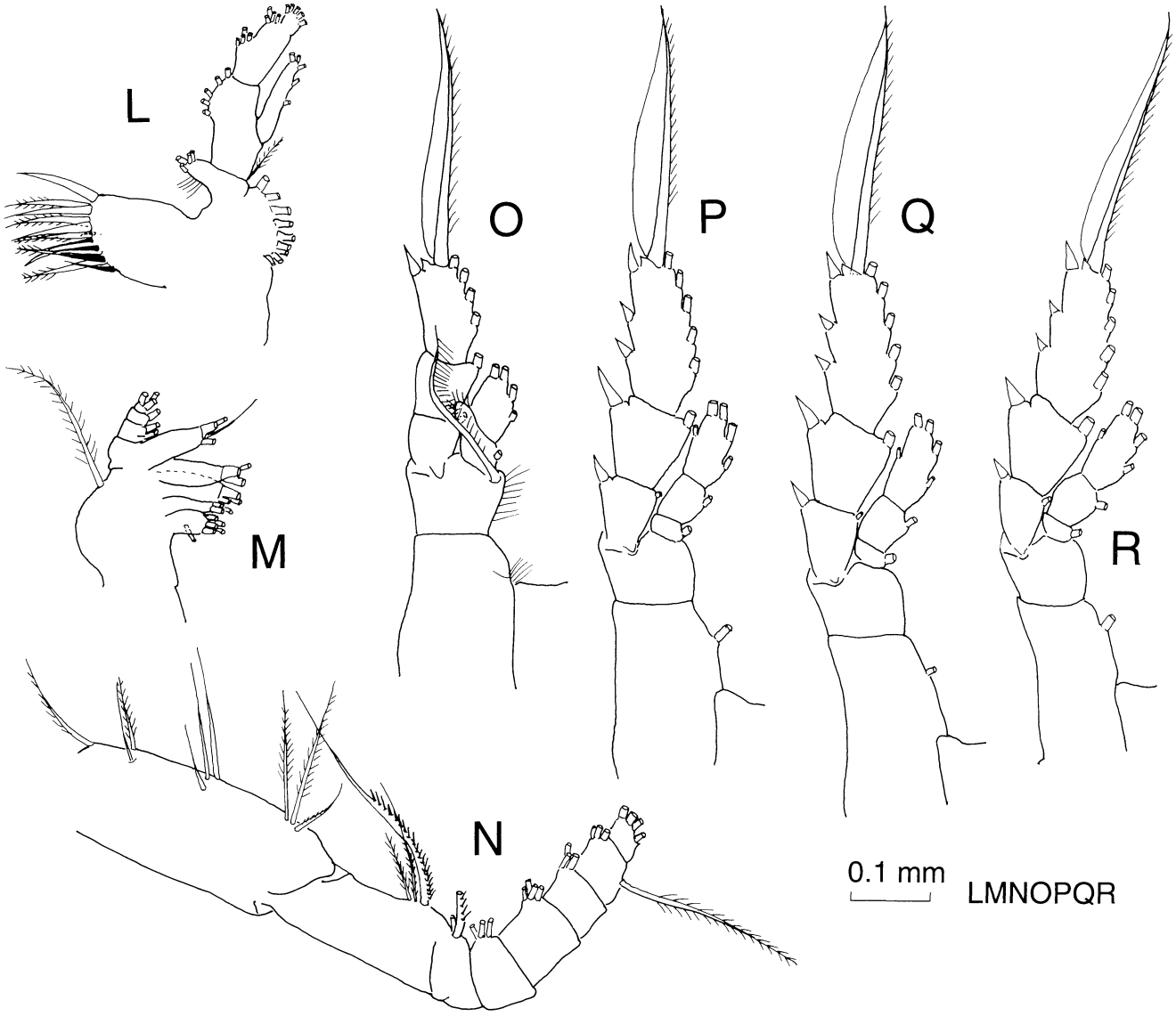


Fig. 40. (Above and overleaf). *Subeucalanus longiceps*. Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female from NZOI Stn G144: B, dorsal view; C, lateral view; D, genital segment dorsal view; E, genital segment lateral view; F, rostrum in lateral view; G, antenna 1; H, antenna 2; I, mandibular palp; J, mandibular blade; K, distal part of mandibular blade; L, maxilla 1; M, maxilla 2; N, maxilliped; O, leg 1, P, leg 2; Q, leg 3; R, leg 4.



dorsal perforations. Antenna 2 endopod elongate, exopod segments 1 and 2 separate. Mandibular palp basipod 2 and exopod elongate; endopod small, inserted just beyond midlength on basipod 2 which also bears 1 or 3 setae. Maxilla 1 with 3 inner lobes bearing setae. Swimming leg 1 with a 2-segmented endopod and 3-segmented exopod. Leg 5 absent in female, uniramous on both sides in male.

(Fleminger 1973; Geletin 1976)

TYPE SPECIES: *Calanus elongatus* Dana, 1849

REMARKS: This genus as now defined contains the following species: *Eucalanus bungii* Giesbrecht, 1892 (males *see* Johnson 1938); *E. californicus* Johnson, 1938; *E. elongatus* (Dana, 1849) (= *E. giesbrechti* Mori, 1937, *see* Vervoort 1957; =? *E. muticus* Wilson, 1950 Wilson 1950; =? *E. atlanticus* Wolfenden, 1904); *E. hyalinus* (Claus, 1866) (males *see* Giesbrecht, 1892 as *E. elongatus*); *E. inermis* Giesbrecht, 1892 males unknown?).

The following species has been taken in the Southwest Pacific:

Eucalanus hyalinus (Claus, 1866) (Figs 42, 88)

DESCRIPTION: Size: females 5.10–7.1 mm, males 4.70–6.25 mm.

Female: As in the family and generic descriptions. This species is easily distinguished from other species

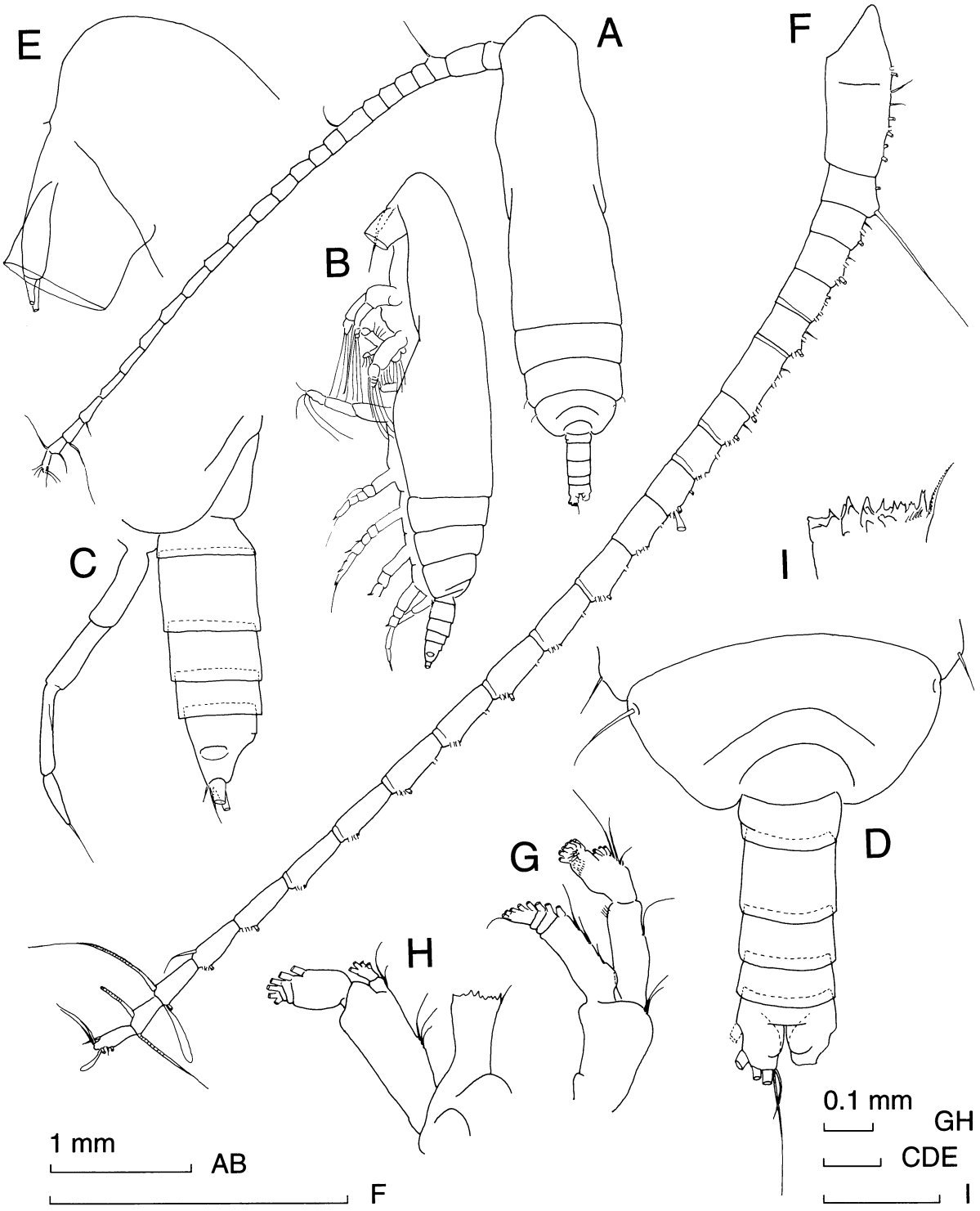
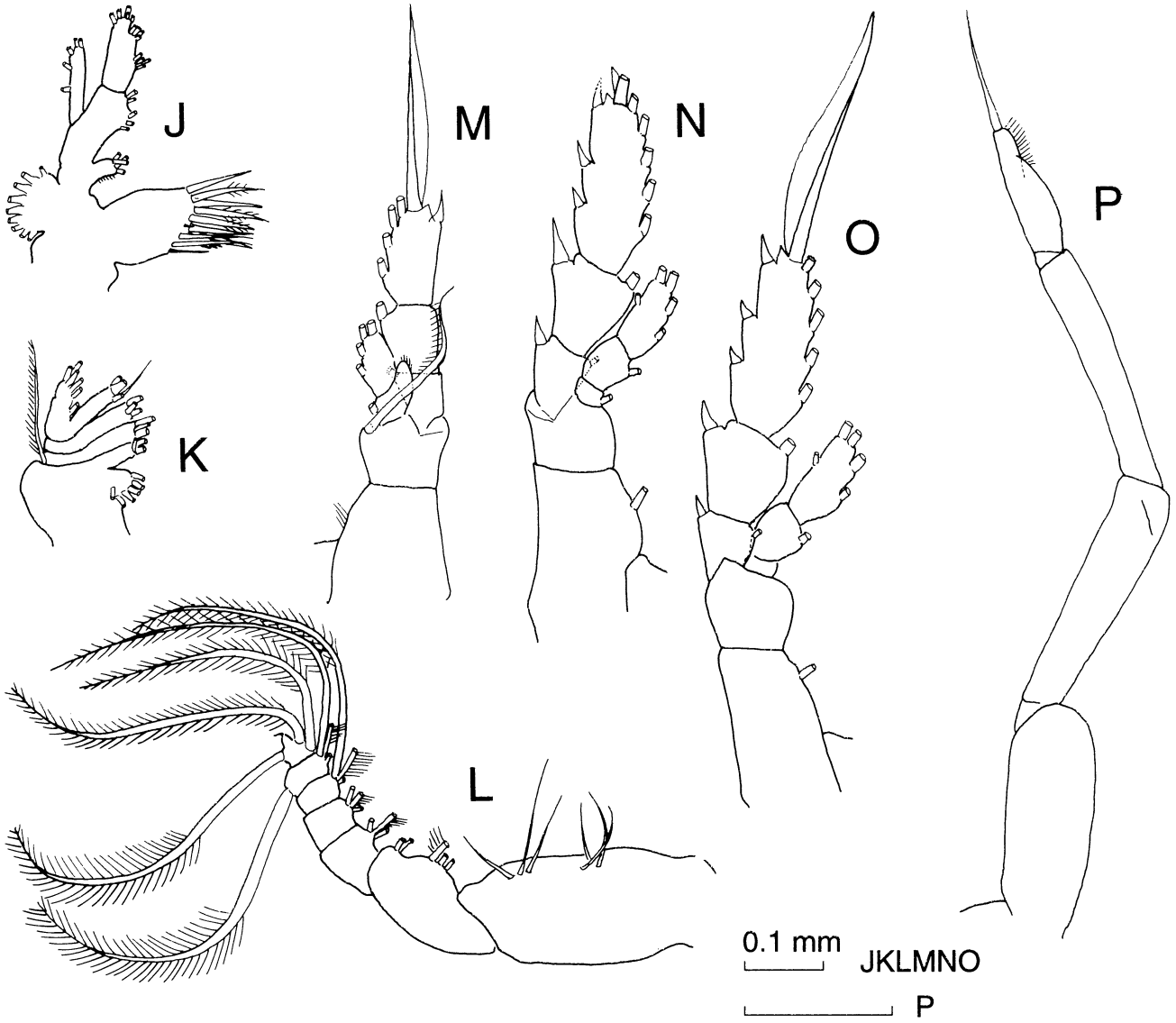


Fig. 41. (Above and overleaf). *Subeucalanus longiceps*. Male from NZOI Stn G142: A, dorsal view; B, lateral view; C, lateral view of urosome; D, dorsal view of urosome; E, rostrum in lateral view; F, antenna 1; G, antenna 2; H, mandible; I, terminal part of mandibular blade; J, maxilla 1; K, maxilla 2; L, maxilliped; M, leg 1; N, leg 2; O, leg 4; P, leg 5.



in this genus by the pointed extensions on the posterolateral corners of pedigerous segment 5. Integumental organs placed as follows. Pedigerous segments 2 and 3 with a pair of sites anterolateral to the arc formed by the dorsal sites, each with 7 dorsal sites; maxilla 1 and 2 with at least 16 sites; abdominal segments 1–2 with 3 dorsal sites.

(Fleminger 1973)

Male: As in the family and generic descriptions. The posterolateral corners of pedigerous segment 5 extend into a blunt tooth. Leg 5 with distal border of right segment 4 level with the distal border of left segment 2. (Giesbrecht 1892, as *E. elongatus*)

REMARKS: One male specimen from the south-west Pacific appeared to have a longer right leg. The few males examined did not appear to have a distal spine on segment 3 of the left leg which is figured by Giesbrecht (1892).

PREVIOUS SOUTHWEST PACIFIC RECORDS: As *E. elongatus*: Farran (1929); Dakin and Colefax (1940); Vervoort (1957); Bary (1951, 1959); Heinrich (1968); Bradford (1970b, 1972); Chiba & Hirakawa (1972); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	500–1000	2 females
A295	400–1000	3 females
A302	500–1000	1 female
A303	450–1000	2 females
C537	0–250	2 females

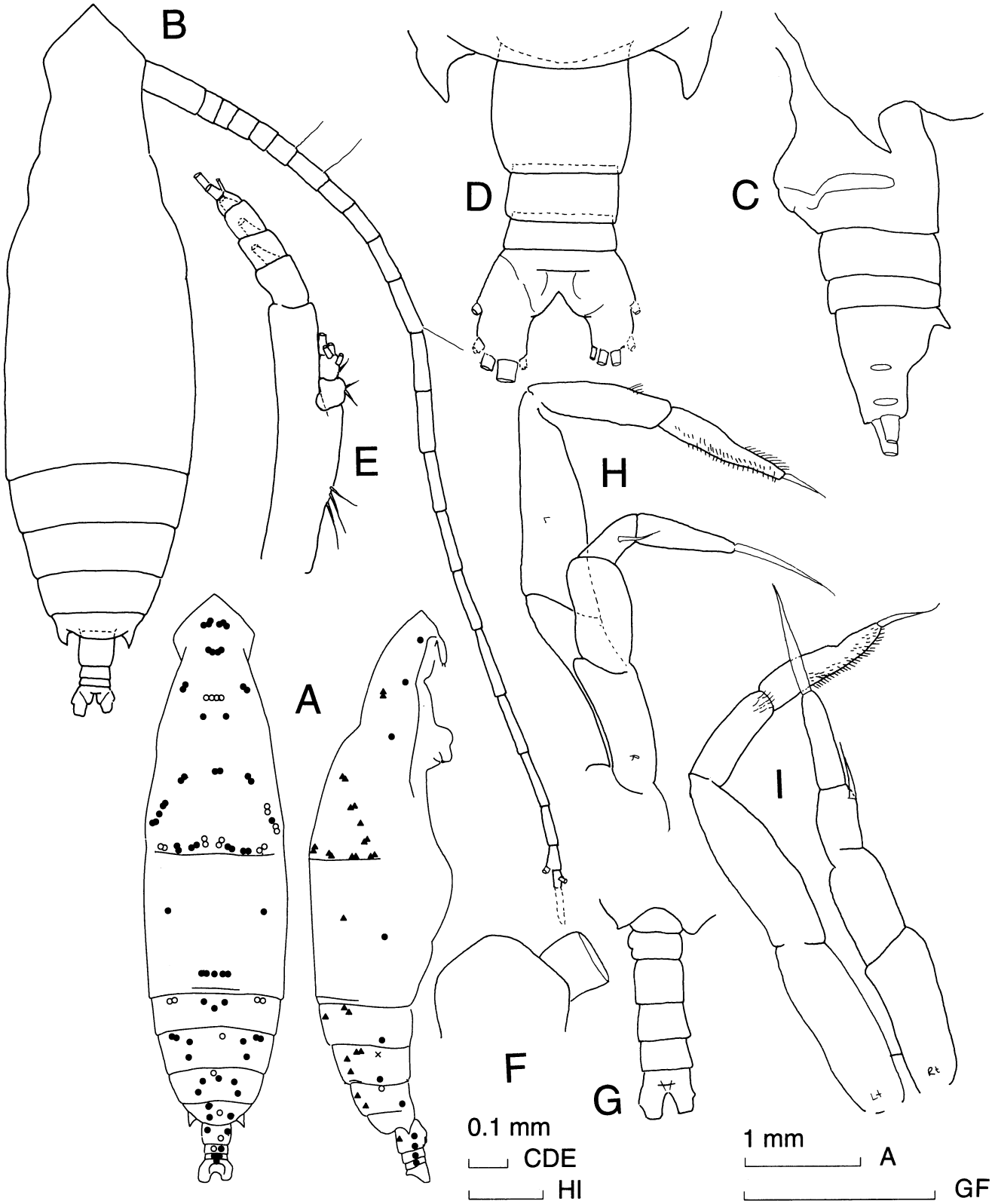


Fig. 42. *Eucalanus hyalinus*. Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female from VUZ Stn G112: B, dorsal view; C, lateral view of urosome; D, dorsal view of urosome; E, mandibular palp. Male from NZOI Stn E774: F, anterior head; G, dorsal view of urosome; H, leg 5 in lateral view; I, leg 5 in posterior view.

E774	0–1165	11 females, 3 males 4.70 mm 2 male copepodites
E788	0–1193	11 females
E800	0–700	7 females, 1 male copepodite
E882	0–1212	2 females
E892	0–1224	5 females
E901	0–1248	1 female
E904	0–1243	1 female
F874	0–1357	2 females
F881	0–1260	1 female
F910	0–1397	2 females
F911	0–1697	3 females
F945	0–200	2 females 6.5, 6.3 mm
	0–500	3 females 6.0, 5.5, 5.1 mm
	500–1000	1 female 6.6 mm
F946	0–200	2 females 6.2, 6.8 mm
	200–500	3 females 6.7, 6.8, 6.9 mm
	0–1000	15 females 6.0–7.0 mm
F947	0–500	2 females 6.5, 6.5 mm
AUZ51	surface	1 female
AUZ75	0–200?	1 female
AUZ87	0–100?	3 females, 1 copepodite
AUZ88	0–100?	5 females, 1 copepodite
AUZ99	0–100?	15 females
AUZ111	0–100?	30 females
AUZ123	0–100?	1 male
VUZ93	0–1097	4 females 7.1, 6.7, 7.0, 7.0 mm
VUZ105	0–914	3 females 6.5, 6.1, 6.3 mm
VUZ107	0–914	1 female 6.1 mm
VUZ112	0–732	21 females 5.8–7.1 mm
Mu67/57	0–150	3 females
Mu67/104s	0–823	1 female
Mu67/116s	0–1000	9 females, 1 male 27 copepodites
Mu67/147s	0–1000	2 females

Eucalanus hyalinus was present in hauls from 0–200 m or near the sea floor at the following stations: N384, N385, N398, N407, N408, N414, N415, N420, N423, N430, N436, N438, N447–N450, N456–N458, N464–N466, N471, N473, N481.

DISTRIBUTION: Tropical-subtropical, circumglobal especially in eutrophic, oxygenated waters adjacent to boundary currents; in deep epipelagic to upper mesopelagic depths (Fleminger 1973).

Pareucalanus Geletin, 1976

DEFINITION: As in the family definition. Additional distinguishing features are female urosome 3-segmented, and the posterior borders of pedigerous segments 2–4 and urosome segment 1 without spines. Integumental organs located at the maxilla 1 and 2 somites with a total of 10 sites forming a rectangle and arranged anterior to posterior in 2 bilateral sets of 1 pair, 1 single and 1 pair of sites; maxilliped site has 6 pairs; pedigerous segments 2 and 3 in lateral view with 3 sites; pedigerous segment 4 lacking paired sites lying outside of the dorsal quadrangle of hair sensilla, urosome segment 4–5 with at least 3 dorsal sites. Antenna 2 endopod elongate, exopod segments 1 and 2 separate. Mandibular palp basipod 2 and exopod elongate; endopod small, inserted just at midlength on basipod 2 which also bears 2 or 4 setae. Maxilla 1 with 3 inner lobes bearing setae. Swimming leg 1 with a 2-segmented endopod and 3-segmented exopod. Leg 5 absent in female, uniramous on both sides in male with right leg not extending beyond the distal part of left leg segment 2. (Fleminger 1973; Geletin 1976)

TYPE SPECIES: *Paracalanus attenuatus* Dana, 1849.

REMARKS: This genus as now defined contains the following species: *Pareucalanus attenuatus* (Dana, 1849) (= *E. pseudattenuatus* Sewell, 1947) (male *see* Fleminger 1973); *P. parki* (Fleminger, 1973) (= *E. quadrisetosa* Geletin, 1973); *P. peruanus* (Volkov, 1971); *P. langae* (Fleminger, 1973); *P. sewelli* (Fleminger, 1973).

The following species have been taken in the Southwest Pacific.

Pareucalanus langae (Fleminger, 1973)

(Figs 43, 89)

DESCRIPTION: Size: females 5.61–7.22 mm, males 6.12–6.59 mm.

Female: As in the family and generic definition with the following additional characters. Basipod 2 of the mandibular palp with 4 setae. This species can only be distinguished from *P. parki* by the arrangement of integumental organs on the urosome: abdominal segment 3 with dorsal sites, urosome segments 1–2 usually with 2 sites, urosome segments 4–5 with at least 4 dorsal and 3 lateral sites. (Fleminger 1973)

Male: Terminal part of right leg 5 apparently hardly extends beyond the distal border of left leg segment 1. (Fleminger 1973)

REMARKS: Geletin (1976) does not think there is

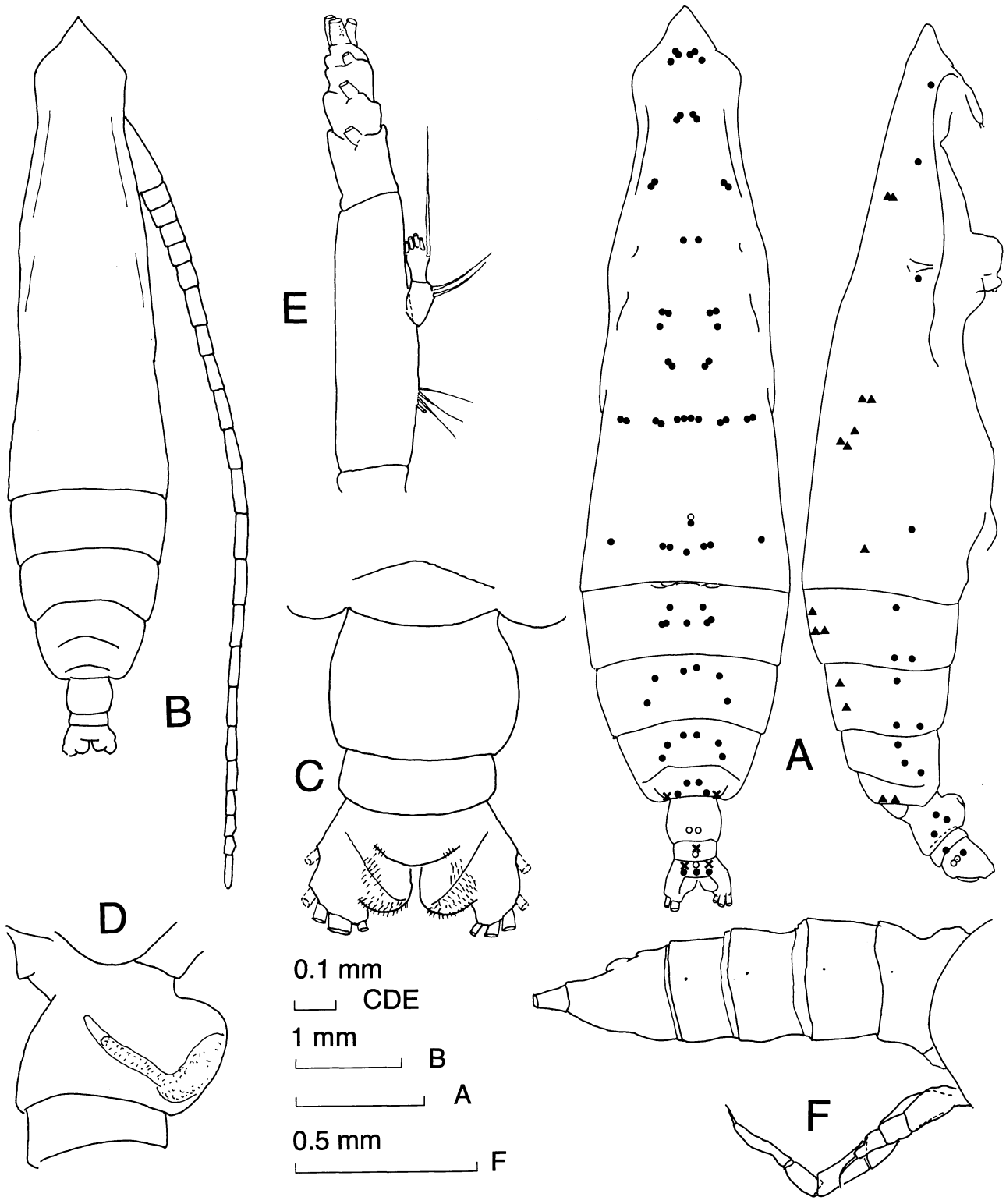


Fig. 43. *Pareucalanus langae.* Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female from VUZ Stn G144: B, dorsal view; C, dorsal view of urosome; D, lateral view of genital segment; E, mandibular palp. Male (from Fleminger 1973): F, urosome and leg 5 in lateral view.

sufficient difference between *P. parki* and *P. langae* to consider them different species. The Southwest Pacific specimens have urosome segments 4–5 ornamented with hairs. Fleminger (1973) did not mention this characteristic so it is not possible to tell if hairy distal urosome segments are peculiar to *P. langae.*

PREVIOUS SOUTHWEST PACIFIC RECORDS: As *E. attenuatus:* Bary (1951, 1959); Bradford (1970b); Chiba & Hirakawa (1972); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	500–1000	2 CV females, 2 CV males
A303	450–1000	1 CV female 5.5 mm 1 CIV female 4.9 mm 2 CV males 5.6, 5.3 mm 3 CIV males 5.45–5.91 mm
A313	0–914	2 CV females 6.1, 6.5 mm
E788	0–1193	1 female, 1 female copepodite 1 male copepodite
E882	0–1212	2 male copepodites
E892	0–1224	3 female copepodites 5 male copepodites
E901	0–1248	1 female
E904	0–1243	2 CV females, 2 CV males
F874	0–1357	1 CV female
F879	0–1267	2 male copepodites
F881	0–1260	3 CV males
F892	0–1260	2 females
F897	0–1269	1 female, 3 CV males
F910	0–1397	2 CV females 5.6 mm 3 other copepodites
F911	0–1697	3 CV females, 2 CV males 5.75 mm
F945	0–200	3 CV females 5.26–6.1 mm, 6 CV males 5.1–6.1 mm
	0–500	6 CV females 5.85–6.2 mm. 2 CV males 5.7, 6.0 mm 1 CIV male 4.6 mm
	500–1000	4 CV females 5.7–6.1 mm 3 CV males 5.9–6.35 mm
F946	0-200	4 CV females 6.3–6.9 mm 8 CIV females 5.8–6.1 mm 6 CV males 5.8–6.2 mm 1 CV male 4.70 mm
	200–500	4 CV males 5.9–6.2 mm
	0–1000	2 CV females 6.0, 6.4 mm 4 CV males 5.7–6.1 mm
F947	0–200	2 males 5.7, 6.1 mm,
F947	0–200 0-500	1 CV male 4.85 mm 1 CV male 5.9 mm
AUZ88	0–100?	17 females 5.91–7.05 mm 2 female copepodites
AUZ93	0–100?	22 females 5.9–6.9 mm 7 copepodites
AUZ99	0–100?	14 females 4.7–6.7 mm
AUZ111	0–100?	27 females 5.61–6.51 mm 9 female copepodites, 1 male copepodite
AUZ123	0–100?	20 females, 2 copepodites
VUZ93	0–1097	2 females 7.1, 6.5 mm
VUZ112	0–732	1 CV female 6.3 mm 1 CV male 6.2 mm
Mu67/116s	0–1000	1 copepodite

Pareucalanus langae was present in hauls from 0–200 m or near the sea floor at the following stations: N411, N415, and N438.

DISTRIBUTION: This species is distributed in the circumglobal transition zone in the Southern Hemisphere (Fleminger 1973).

Pareucalanus sewelli (Fleminger, 1973)
(Figs 44, 89)

DESCRIPTION: Size: females 3.89–6.10 mm, males 2.89–4.58 mm.

Female: As in the family and generic definition with the following additional characters. Basipod 2 of mandibular palp with 2 setae. This species can be distinguished from *P. attenuatus* by the arrangement of integumental organs on the urosome and prosome: pedigerous segments 3 and 4 each lack the 2 pairs of dorsal sites enclosed by the outer arc of 6 dorsal sites; genital segment lacking integumental organs; urosome segment 3 without dorsal sites; urosome segments 4–5 usually with 5 dorsal and no lateral sites. (Fleminger 1973)

Male: Dorsal integumental pore sites on pedigerous segments 3 and 4 as in female, abdominal segment 2 lacking dorsal sites. Basipod 2 of mandible with 2 setae. Terminal part of right leg 5 apparently hardly extends beyond the distal border of left leg segment 1. (Fleminger 1973)

REMARKS: Geletin (1976) thinks that Fleminger (1973) is not justified in considering *E. pseudattenuatus* (Sewell, 1947) a synonym of *E. attenuatus.* The identity of Sewell's (1947) *E. pseudattenuatus* is thoroughly muddled as he describes small females (3.32–4.25 mm) but refers to a large female in text-fig. 7 compared with the figure labelled *E. attenuatus.*

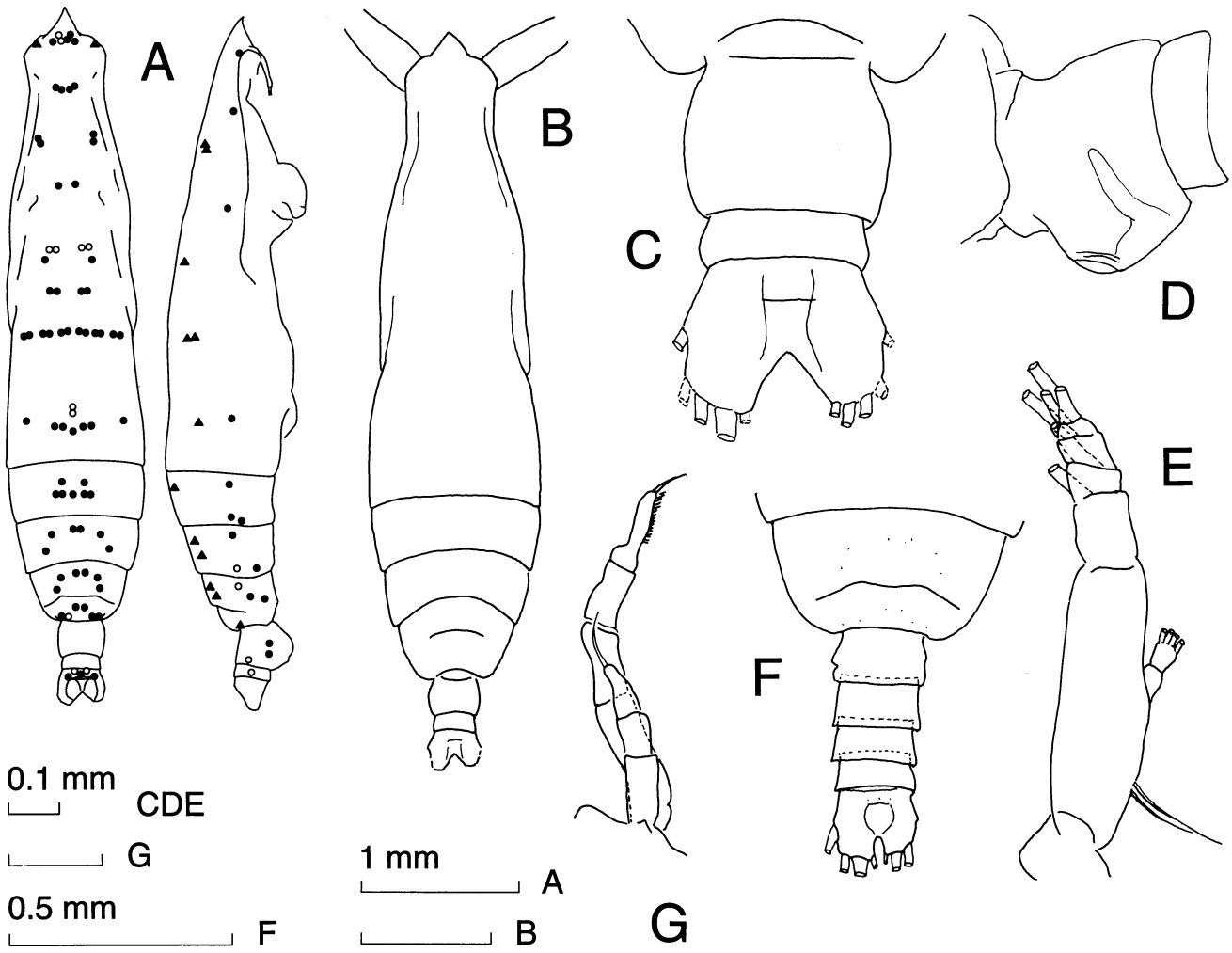


Fig. 44. *Pareucalanus sewelli.* Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female from AUZ Stn 88: B, dorsal view; C, dorsal view of urosome; D, lateral view of genital segment; E, mandibular palp. Male (from Fleminger 1973): F, dorsal view of urosome; G, leg 5.

Fleminger could recognise only the pore patterns as the rest of the description could be of either *E. attenuatus senso stricto* or its closely related relatives. Fleminger did the only thing he could in considering *E. pseudattenuatus* as a synonym of *E. attenuatus* on the basis of the integumental pores which leaves Sewell's (1947) *E. attenuatus* without a name. Therefore, unlike Geletin (1976) I agree with Fleminger's (1973) conclusion. The Southwest Pacific specimens do not have hairs on the distal part of the urosome.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
F946	0–200	1 male 3.6 mm
	200–500	2 CV females 5.5, 5.5 mm
AUZ51	surface	9 females 4.06–5.63 mm
AUZ75	0–200?	2 females 5.75, 5.90 mm
AUZ88	0–100?	1 female 5.38 mm
AUZ111	0–100?	1 female 5.76 mm

DISTRIBUTION: This species appears to be distributed circumglobally in eutrophic tropical and subtropical waters extending to the Subtropical Convergences (Fleminger 1973).

Rhincalanus Dana, 1852

DEFINITION: As in the family definition. Additional distinguishing features are female urosome 3-segmented, and the posterior borders of some or all of pedigerous segments 2–4 and urosome segment 1 with dorsal spines. Antenna 2 endopod squat, exopod segments 1 and 2 separate. Mandibular palp basipod 2 and exopod squat; endopod normal, inserted terminally on basipod 2 which also bears 4 setae. Maxilla 1 with 2 inner lobes bearing setae, inner lobe 2 present but without setae. Swimming leg 1 with a 2-segmented endopod and exopod. Leg 5 present in female and uniramous on both sides; uniramous on the right and biramous on the left in the male. (Fleminger 1973; Geletin 1976)

TYPE SPECIES: *Rhincalanus cornutus* Dana, 1849.

REMARKS: This genus contains the following species: *Rhincalanus cornutus* Dana, 1849; *R. gigas* Brady, 1883; *R. nasutus* Giesbrecht, 1888; *R. rostrifrons* Dana 1852.

The following species have been taken in the Southwest Pacific.

Rhincalanus gigas Brady, 1883 (Figs 45, 90)

DESCRIPTION: Size: females 6.46–9.30 mm, males 6.90–7.20 mm.

Female: As in the family and generic description with the following additional characters. A spine is present on the posterolateral borders of pedigerous segment 5 and sometimes 3, dorsal spines are absent from pedigerous segments 3 and 4. (Vervoort 1951)

Male: Right leg 5 with terminal exopod spine extending almost as far as the distal end of the endopod, both rami well supplied with spinules; left leg terminal spine extends almost as far as the right leg, segment 2 with an inner border of spinules, segment 2 with outer distal spines. (Schmaus & Lehnhofer 1927)

REMARKS: Very few males were found in good condition, but it appears that leg 5 is very like some males ascribed to *R. nasutus* except for the presence of inner edge spines on segment 2 of the left leg.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Vervoort (1957).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B99	surface	2 copepodites
B106	surface	3 copepodites
B107	surface	2 females 6.46, 7.30 mm
B109	0–125	2 females 7.2, 7.5 mm, 7 copepodites
	0–500	1 female 7.05 mm
B110	0–125	5 copepodites
	0–500	6 females, 15 copepodites
B111	0–500	6 females 6.67–7.58 mm, 30 copepodites
B112	0–125	4 females 6.6–7.4 mm, 5 copepodites
	0–500	5 copepodites
B113	0–500	5 females, 2 males, 7 copepodites
B114	0–125	1 female 7.65 mm, 11 copepodites
	0–500	2 females 7.3, 7.6 mm, 13 copepodites
B116	0–125	3 females 7.2–7.9 mm, 19 copepodites
B117	0–500	1 female 6.2mm, 22 copepodites

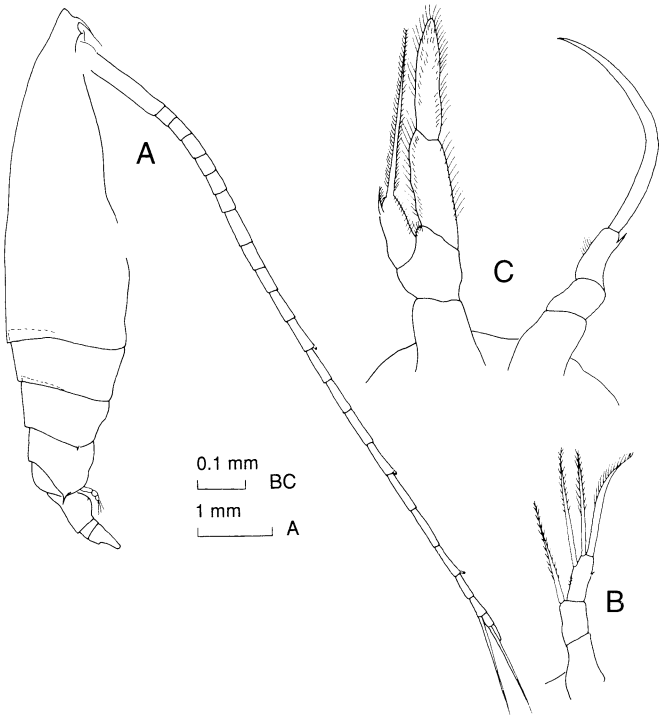


Fig. 45. *Rhincalanus gigas*. Female from NZOI Stn B109: A, lateral view; B, leg 5. Male (from Schmaus & Lehnhofer 1927): C, leg 5.

B118	0–125	2 copepodites
	0–500	1 female 7.6 mm
B119	0–500	5 copepodites
VUZ93	0–1097	3 copepodites
VUZ105	0–914	7 females 6.6–7.9 mm
Mu67/57	0–150	4 females 6.9–8.4 mm copepodites
Mu67/94S	0–1000	13 females many copepodites
Mu67/104S	0–823	1 female 7.2 mm copepodites
Mu67/116s	0–1000	2 females 7.4, 7.5 mm

DISTRIBUTION: This species is characteristic of Antarctic waters but is found at deeper depths north of about 50°S and appears to be carried north in Antarctic Intermediate Water (Schmaus & Lehnhofer 1927).

Rhincalanus nasutus Giesbrecht, 1888

(Figs 46, 90)

DESCRIPTION: Size: females 3.9–5.3 mm, males 2.7–88.8 mm.

Female: As in the family and generic desription with the following additional characters. A spine is present on the posterolateral borders of pedigerous segments 2, 3, and 4–5, dorsal spines are present on pedigerous segments 3 and 4. A pair of dorsal spines is present on the genital segment.

(Giesbrecht 1892)

Male: As in the family and generic description with the following additional characters. Spines decorate the pedigerous segments in the same way as the female. Leg 5 on the right with terminal exopod spine not extending as far as the endopod, both rami well supplied with spinules; left leg terminal spine does not extend as far as the right leg endopod, segment 2 without an inner border of spinules, segment 2 with an outer distal spine.

(Giesbrecht 1892)

REMARKS: There appear to be some differences between Giesbrecht's (1892) figures and the Southwest Pacific specimens. The outer edge spine on segment 2 of the left leg 5 is placed proximally in the Southwest Pacific males and distally in Giesbrecht's figure of *R. nasutus*, the exopod spines are longer and more like those of *R. gigas*, and the right endopod does not have a terminal spine in the Southwest Pacific specimens. There is also a small pair of dorsal spines on pedigerous segment 2, a characteristic also noticed by Tanaka (1956a). There is a possibility that a complex of species exists within *R. nasutus* auctt. but global comparisons would have to be made between specimens to settle this question.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Dakin & Colefax (1940); Vervoort (1957); Bary (1951, 1959); Bradford (1970b, 1972); Chiba & Hirakawa (1972); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	500–1000	3 females, 1 copepodite
A295	400–1000	3 females, 3 copepodites
A302	0–500	1 female 4.3 mm
	500–1000	4 females, 2 copepodites
A303	450–1000	6 females 3.9–4.9 mm, 2 copepodites
E774	0–1165	5 females, 2 males
E788	0–1193	2 females, 1 copepodite
E882	0–1212	5 females, 1 male
E892	0–1224	10 females
E901	0–1248	1 male
E904	0–1243	1 female
F874	0–1357	7 females
F879	0–1267	1 female
F881	0–1260	1 female
F892	0–1260	1 copepodite
F897	0–1269	5 females, 3 males
F910	0–1397	3 females
F911	0–1697	3 females, 4 males
F945	0–200	4 females 4.2–4.5 mm , 2 males 3.5, 3.6 mm
	0–500	8 females 4.1–4.8 mm
	500–1000	4 females 4.2–4.5 mm
F946	200–500	13 females 3.7–4.6 mm
	0–1000	17 females 4.3–4.8 mm
F947	0–200	1 male 3.7 mm 1 copepodite
	0–500	1 female 3.9 mm, 1 male 3.6 mm
AUZ111	0–100?	38 females
VUZ105	0–914	15 females 4.2–5.0 mm
VUZ107	0–914	3 females 4.75–5.30 mm
VUZ112	0–732	11 females 4.6–5.2 mm
Mu67/88s	0–600	1 female 5.22 mm 1 copepodite
Mu67/116s	0–1000	4 females 4.7–5.4 mm
Mu67/147s	0–1000	1 female 5.0 mm 5 copepodites

Rhincalanus nasutus was present in hauls from 0–200 m or near the bottom at the following stations: N384–N386, N396, N398, N401, N402, N407, N408, N411, N412, N414–N416, N419–N421, N430, N436, N438, N449, N456–N458, and N464–N466.

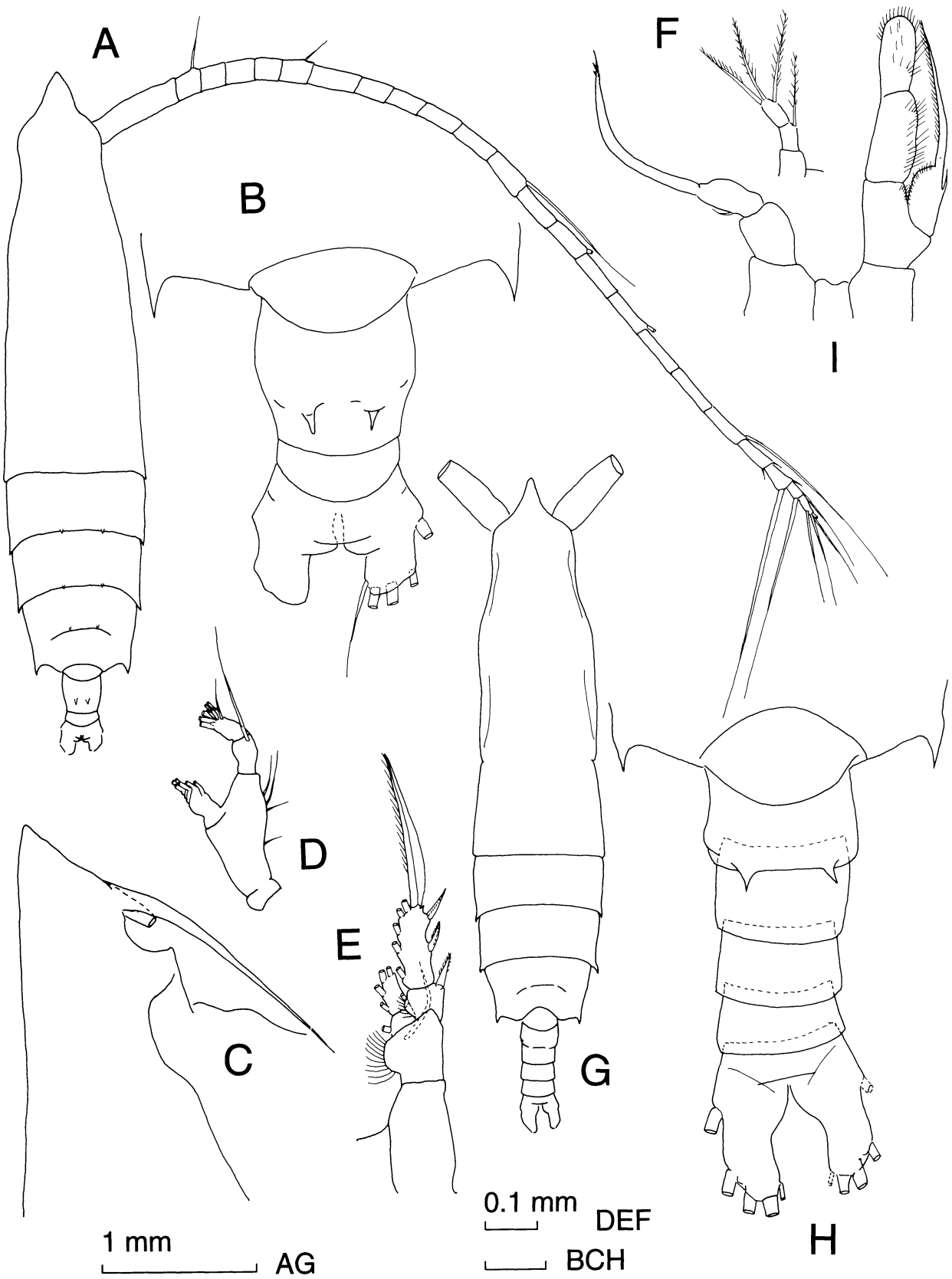


Fig. 46. *Rhincalanus nasutus.* Female from NZOI Stn F945: A, dorsal view; B, dorsal view of urosome; C, lateral view of anterior head and rostrum; D, mandibular palp; E, leg 1; F, leg 5. Male from NZOI Stn G142: G, dorsal view; H, dorsal view of urosome; I, leg 5.

DISTRIBUTION: This species is widespread in both hemispheres and all oceans. It appears at the surface in subtropical and subantarctic waters and at deeper depths (>1000 m) extending towards the equator (Schmaus & Lehnhofer 1927)

Rhincalanus rostrifrons (Dana, 1852) (Fig. 47)

DESCRIPTION: Size: females 3.00–3.80 mm, males 2.41–2.86 mm.

Female: As in the family and generic descriptions with the following additional characters. Anterior head narrow, very extended, rostral filaments visible in dorsal view. Antenna 1 1.5 times as long as the body. Leg 5 3-segmented without setae on segment 2 and with 1 strong toothed spine on segment 3 which is extended into a point.

(Giesbrecht 1892; Bowman 1971)

Male: As in the family and generic descriptions with the following additional characters. Body shape similar to the female especially the anterior head. Leg 5 3-segmented on the right with terminal segment in the form of a stout spine; left leg biramous, exopod elongate with a terminal spine just more than half the length of its segment, endopod 2-segmented with segment 1 twice the length of segment 2. (Mori 1937)

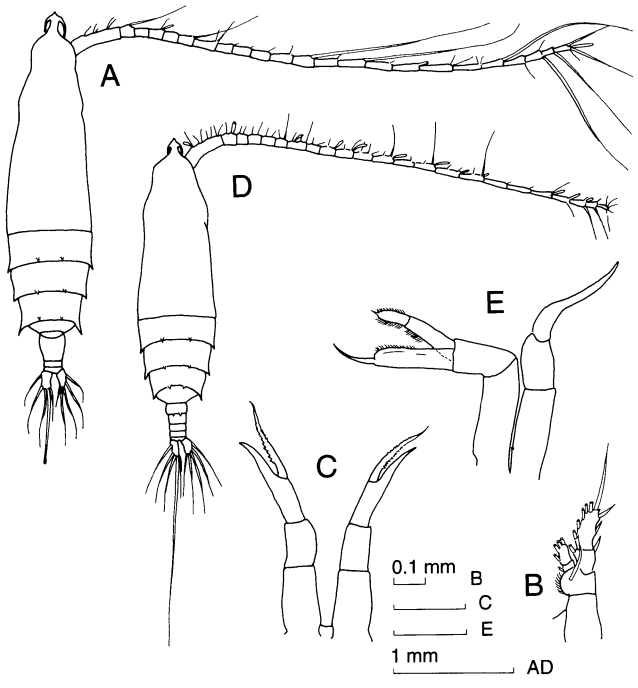


Fig. 47. *Rhincalanus rostrifrons* (from Mori 1937). Female: A, dorsal view; B, leg 1; C, leg 5. Male: D, dorsal view; E, leg 5.

REMARKS: Bowman (1971) clarified the identity of *R. rostrifrons* (the Indo-Pacific species) which has antenna 1 1.5 times as long as the body (1.3 times as long in the Atlantic species *R. cornutus*). He also shows that *R. cornutus typicus* Schmaus and Lehnhofer, 1927 is a synonym of *R. rostrifrons*. It is not clear from the literature how male *R. rostrifrons* differ from *R. cornutus*.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Dakin & Colefax (1940); ?Jillett (1971 as *R. cornutus*); Greenwood (1976).

NEW RECORDS: Nil.

DISTRIBUTION: This species is distributed in tropical waters of the Indo-Pacific region (Bowman 1971) to 25°S with adults being found mainly below 400 m depth (Schmaus & Lehnhofer 1927).

Subeucalanus Geletin, 1976

DEFINITION: As in the generic definition. Additional distinguishing features are female urosome 3-segmented, and the posterior borders of pedigerous segments 2–4 and urosome segment 1 without spines. Integumental organs located at the maxilliped site are in 2 pairs; pedigerous segments 3 and 4 with a single mid-dorsal site lying between the anterior 2 hair sensilla; pedigerous segment 4 with 1 pair of sites lateral to the quadrangle formed by 4 hair sensilla. Antenna 2 endopod elongate, exopod segments 1 and 2 fused. Mandibular palp basipod 2 and exopod elongate; endopod small, inserted on the terminal one third or quarter of basipod 2 which also bears 2 or 3 setae. Maxilla 1 with 2 inner lobes bearing setae i.e. 1 lobe is absent. Swimming leg 1 with a 2-segmented endopod and 3-segmented exopod. Leg 5 absent in female, uniramous in male with right leg absent.

(Fleminger 1973; Geletin 1976)

TYPE SPECIES: *Eucalanus subtenuis* Giesbrecht, 1888

REMARKS: This genus contains two groups, the *subtenuis* and *pileatus* groups of Fleminger 1973. There are smaller differences between these two groups than between *Subeucalanus* and *Eucalanus* and *Subeucalanus* and *Pareucalanus*. This genus as now defined contains the following species: *Subeucalanus crassus* (Giesbrecht, 1888) (= *E. oculanus* Marukawa, 1921; ?*E. setiger* Brady,1883); *S. dentatus* (Scott, 1909) (male unknown?); *S. longiceps* (Mat-

thews, 1925) (= *E. acus* Farran, 1929); *S. monachus* (Giesbrecht, 1888) (*see* Matthews 1968 for discussion of differences from *S. pileatus*); *S. mucronatus* (Giesbrecht, 1888); *S. pileatus* (Giesbrecht, 1888); *S. subcrassus* (Giesbrecht, 1888); *S. subtenuis* (Giesbrecht, 1888).

The following species have been taken in the Southwest Pacifi.:

Subeucalanus crassus (Giesbrecht, 1888)
(Figs 48, 91)

DESCRIPTION: Size: females 2.8–8.7 mm, males 2.9–3.1 mm.

Female: As for the family and generic description with the following additional characters. Anterior head rounded and short, genital segment is wider than long and shaped like an onion. Integumental organs on mandibular somite with 6 sites; maxilla 2 somite lacking sites; pedigerous segment 1 with 3 sites; pedigerous segments 2 and 3 with 2 lateral sites and lacking sites within the dorsal arc of hair sensilla; pedigerous segments 3 and 4 with 1 medial site in the dorsal arc formed by the dorsal sites; urosome segments 1–2 lacking dorsal sites; urosome segments 4–5 with 1 dorsal site. Caudal rami slightly asymmetrical. Antenna 2 endopod segment 1 shorter than endopod segment 2 and about 2 times as long as wide. Basipod 2 of the mandibular palp with 3 setae, endopod reaches the distal border of basipod 2, endopod segment 1 with 2 setae, endopod segment 2 with 4 setae. Maxilla 1 inner lobe 3 with 4 setae and basipod 2 with 5 setae. Maxilliped endopod segments 1 and 2 with 3 setae each. (Giesbrecht 1892; Fleminger 1973)

Male: As for the family and generic description. Secondary sexual characters are not distinct.
(Giesbrecht 1892)

REMARKS: The body of the Southwest Pacific specimens were covered with very small spinules although Farran (1929) noted that his specimens had a smooth integument.

PREVIOUS SOUTHWEST PACIFIC RECORDS: As *Eucalanus:* Farran (1929); Dakin & Colefax (1940); Bary (1951); Greenwood (1976); Chiba & Hirakawa (1972); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
F874	0–1357	1 female 3.3 mm
F945	0–200	1 female 3.4 mm
	0–500	1 female 3.05 mm
		1 copepodite
F946	0–200	6 females 3.2–8.9 mm
	200–500	5 copepodites
	0–1000	6 copepodites

DISTRIBUTION: This species has an epiplanktonic, tropical-subtropical distribution circumglobally in eutrophic, broadly neritic waters (Fleminger 1973).

Subeucalanus longiceps (Matthews, 1925)
(Figs 40, 41, 91)

DESCRIPTION: Size: females 4.2–4.9 mm, males 3.2–8.8 mm.

Female: As for the family and generic description with the following additional characters. Anterior head triangular and elongated, genital segment is slightly wider than long. Integumental organs on mandibular somite with 4 sites; maxilla 2 somite lacking sites; pedigerous segment 1 with 3 sites; pedigerous segments 2 and 3 with 2 lateral sites and lacking sites within the dorsal arc of hair sensilla; pedigerous segments 3 and 4 with 1 medial site in the dorsal arc formed by the dorsal sites; urosome segments 1–2 with 1 dorsal site, urosome segments 4–5 with 1 dorsal site. Caudal rami slightly asymmetrical. Antenna 2 endopod segment 1 shorter than endopod segment 2 and about 2 times as long as wide. Basipod 2 of the mandibular palp with 3 setae, endopod does not reach the distal border of basipod 2, endopod segment 1 with 2 setae, endopod segment 2 with 3 setae. Maxilla 1 inner lobe 3 with 4 setae and basipod 2 with 5 setae. Maxilliped endopod segments 1 and 2 with 3 and 4 setae respectively.
(Fleminger 1973)

Male: As for the family and generic description. Anterior head rounded. Left leg 3 extends to the posterior border of the urosome, terminal seta about the same length as the terminal segment.

REMARKS: On the basis of size it is presumed that Bary (1959) erroneously ascribed the male of this species to *S. crassus*. Bradford (1972) figured an immature specimen of *S. longiceps*. In his survey Bary took female *E. longiceps* (as *E. acus*) quite commonly but no males, and records males of *S. crassus* (as *E. crassus*) but no females (Bary 1951).

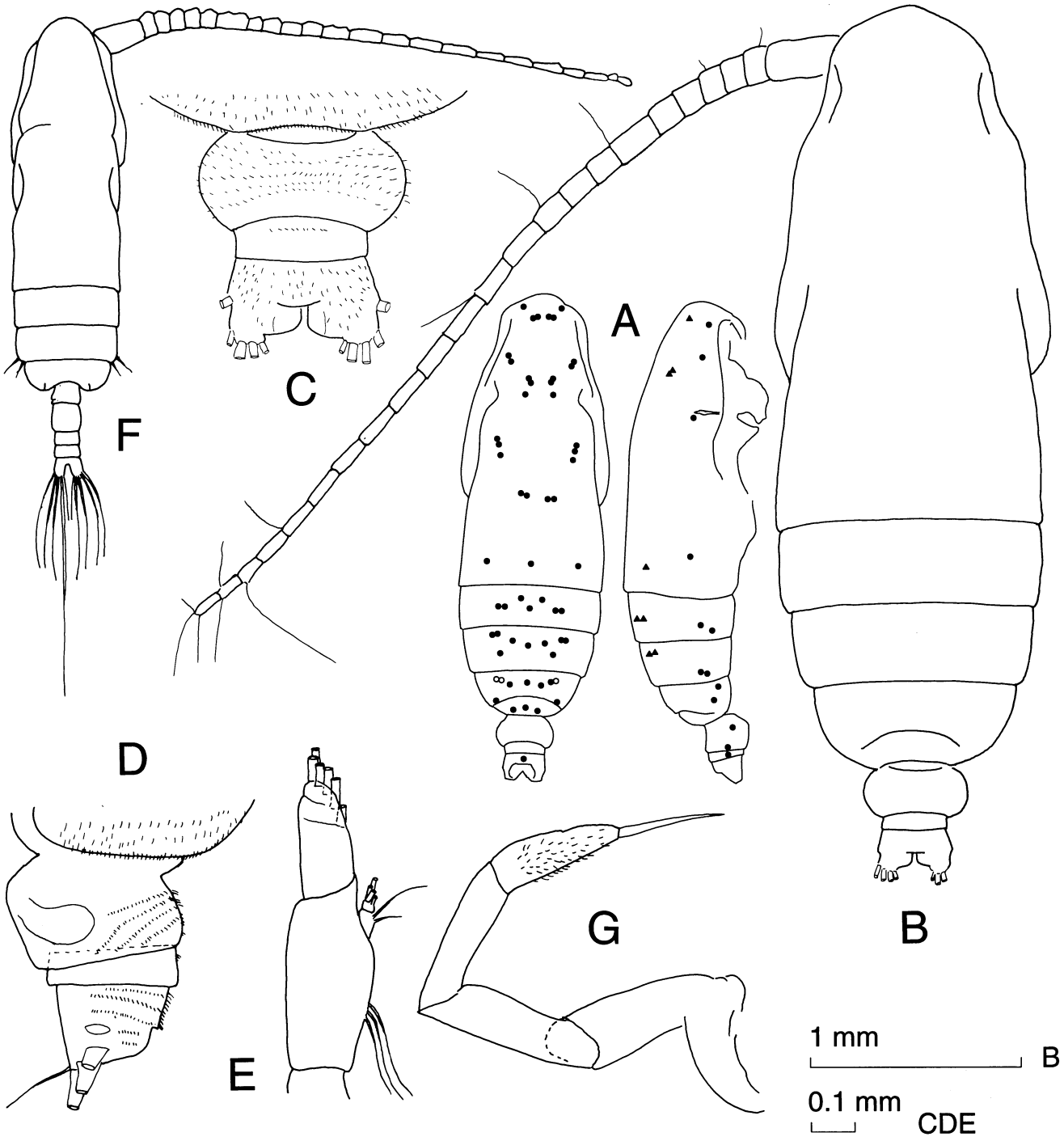


Fig. 48. *Subeucalanus crassus.* Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female from NZOI Stn F946: B, dorsal view; C, dorsal view of urosome; D, lateral view of urosome; E, mandibular palp. Male (from Fleminger 1973): F, dorsal view; G, leg 5.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Vervoort (1957); Bary (1951, 1959); Bradford (1970b, 1972); Roberts (1972); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B110	0–125	1 female 4.6 mm
B111	0–500	1 female 4.2 mm
B112	0–125	1 female 4.3 mm
B114	0–125	1 female
	0–500	1 female 4.3 mm
B116	0–125	2 females 4.6, 4.7 mm
B117	0–500	5 females
B118	0–125	1 female
B119	0–500	1 female, 1 male 3.33 mm 2 copepodites
B120	0–150	copepodites
	0–400	copepodites
VUZ93	0–1097	1 female 4.2 mm
VUZ105	0–914	4 copepodites
VUZ112	0–732	4 females 4.2–4.9 mm
Mu67/88s	0–600	many copepodites
Mu67/94s	0–1000	many copepodites
Mu67/104s	0–823	many copepodites
Mu67/116s	0–1000	29 females, 2 males 3.50, 3.63 mm, many copepodites
Mu67/147s	0–1000	1 female

Subeucalanus longiceps was present in hauls from 0–200 m or near the sea floor at the following stations: N407–N409, N411–N415, N417, N458, N464–N466, N471, N480, and N481.

DISTRIBUTION: This species has a boreal-temperate, circumglobal, southern hemisphere West Wind Drift system distribution, mostly in epipelagic waters (Fleminger 1973).

Subeucalanus mucronatus (Giesbrecht, 1888)
(Fig. 49)

DESCRIPTION: Size: females 3.0–3.2 mm, males 2.7–2.9 mm.

Female: As for the family and generic description with the following additional characters. Anterior of head triangular and sharply pointed. Genital segment longer than wide. Caudal rami asymmetrical. Integumental organs on antenna 1 somite with 6 dorsal sites; mandibular somite with 4 to 6 sites; maxilla 1 somite lacking 4 medial sites; maxilla 2 somite with 2 or more pairs of sites; pedigerous segment 1 with 7 sites sites; pedigerous segments 2 and 3 with 2 lateral sites and with 1 asymmetrical site within the arc of hair sensilla on the left of the midline; pedigerous segments 3 and 4 with 1 medial site in the dorsal arc formed by the dorsal sites; urosome segments 1–2 with 2 sites; urosome segments 4–5 with 1 dorsal site. Endopod segment 1 of antenna 2 longer than endopod segment 2, and is

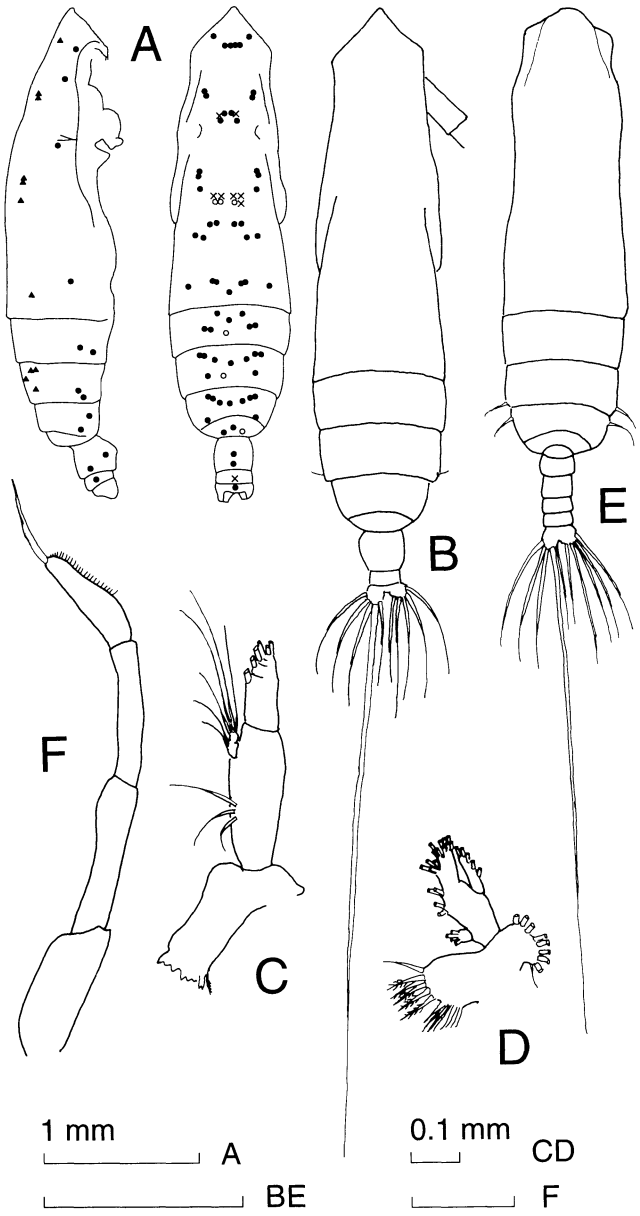


Fig. 49. *Subeucalanus mucronatus*. Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female (from Mori 1937): B, dorsal view; C, mandible; D, maxilla 1. Male (from Mori 1937): E, dorsal view; F, leg 5.

is just over 3 times as long as wide. Mandibular palp with 3 setae on basipod 2, endopod segment 1 with 2 setae, endopod segment 2 with 4 setae. Maxilla 1 inner lobe 3 with 4 setae, basipod 2 with 4 setae respectively. Endopod segments 1 and 2 of the maxilliped with 4 setae each.

(Giesbrecht 1892; Mori 1937; Fleminger 1973)

Male: As for the family and generic description. Anterior head rounded. Terminal seta on left leg 5 shorter than the terminal segment. (Mori 1937)

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Vervoort (1957); Chiba & Hirakawa (1972); Greenwood (1976).

NEW RECORDS: Nil.

DISTRIBUTION: This species has an epiplanktonic, tropical Indo-West Pacific distribution (Fleminger 1973).

Subeucalanus pileatus (Giesbrecht, 1888)

(Fig. 50)

DESCRIPTION: Size: females 1.95–2.50 mm, males 1.80–2.25 mm.

Female: As for the family and generic description with the following additional characters. Anterior of head triangular overall, but rounded anteriorly. Genital segment with widest part in dorsal view at midlength, as long as wide. Integumental organs on pedigerous segments 2 and 3 at 1 pair of lateral sites; pedigerous segments 3 and 4 with 2 medial sites in the arc formed by the dorsal sites. Maxilla 2 somite lacking dorsal sites. Urosome segments 1–2 (genital) usually with 1 site. Urosome segment 3 lacking dorsal sites. Caudal rami asymmetrical. Antenna 2 endopod segment 1 shorter than endopod segment 2 and hardly 2.5 times as long as wide. Basipod 2 of mandibular palp with 3 setae, endopod reaches the distal border of basipod 2, endopod segment 1 with 2 setae, endopod segment 2 with 4 setae. Maxilla 1 inner lobe 3 with 4 setae, basipod 2 with 5 setae. Maxilliped endopod segments 1 and 2 with 4 setae each.

(Giesbrecht 1892; Fleminger 1973)

Male: As for the family and generic description. This male is very similar to *S. crassus* but much smaller. The terminal seta on the left fifth leg is shorter than the terminal segment.

(Vervoort 1963)

REMARKS: There is apparently considerable variation in the shape of the head in the female. Vervoort

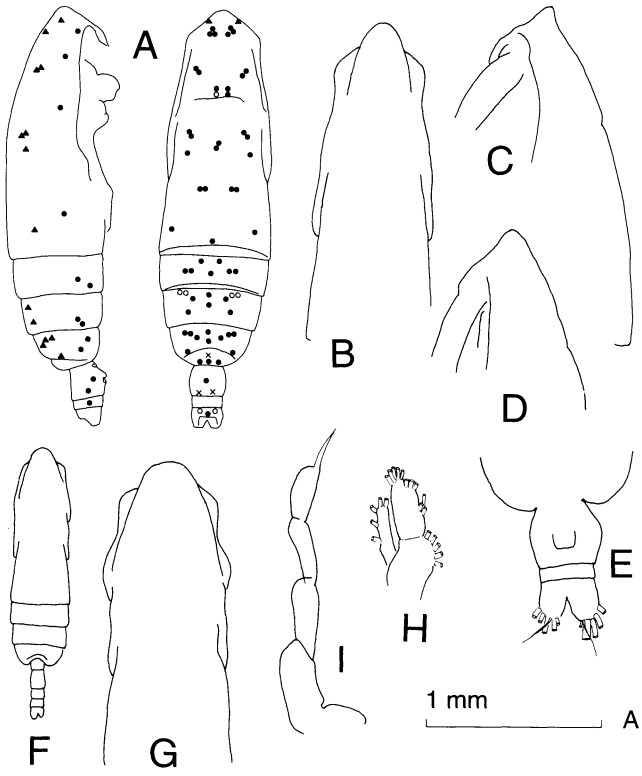


Fig. 50. *Subeucalanus pileatus*. Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female (from Giesbrecht 1892): B, dorsal view of anterior body; C, lateral view of anterior body; D, lateral view of anterior body of another specimen; E, ventral view of urosome. Male (from Giesbrecht 1892): F, dorsal view; G, dorsal view of anterior body; H, leg maxilla 1; I, leg 5.

(1963) noted the presence of specimens with helmet-shaped heads and with evenly rounded heads as well as numerous intermediates; in all other respects females seemed identical. He also noted males with a hairy terminal segment on the fifth leg. Fleminger (1973) settled the relationships between this species and the closely related species *S. subcrassus* and *S. monachus*.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Dakin & Colefax (1940 as *E. monachus, see* Vervoort 1963); Greenwood (1976).

NEW RECORDS: Nil.

DISTRIBUTION: Tropical-subtropical, circumglobal, coastal-neritic, epiplanktonic species (Fleminger 1973).

Subeucalanus subcrassus (Giesbrecht, 1888)
(Fig. 51)

DESCRIPTION: Size: females 2.35–2.68 mm, males 2.4 mm.

Female: As for the family and generic description with the following additional characters. Anterior of head rounded anteriorly. Genital segment broader than long with widest part in dorsal view on the posterior half of the segment. Integumental organs on pedigerous segments 2 and 3 at 2 pairs of lateral sites; pedigerous segments 3 and 4 with 2 medial sites in the arc formed by the dorsal sites. Maxilla 2 somite with 2 pairs of dorsal sites. Urosome segments 1–2 (genital) with 3 sites. Urosome segment 3 with 2 sites. Urosome segment 4–5 (anal) with 1 site. Maxilla 1 somite with 2 pairs of sites adjacent to the midline. Caudal rami asymmetrical. Antenna 2 endopod segment 1 shorter than endopod segment 2 and less than 3 times as long as wide. Basipod 2 of mandibular palp with 3 setae, endopod reaches the distal border of basipod 2, endopod segment 1 with 2 setae, endopod segment 2 with 4 setae. Maxilla 1 inner lobe 3 with 4 setae, basipod 2 with 5 setae. Maxilliped endopod segments 1 and 2 with 4 setae each. (Giesbrecht 1892; Fleminger 1973)

Male: As for the family and generic description. Terminal seta on left leg 5 longer than the terminal segment. (Giesbrecht 1892)

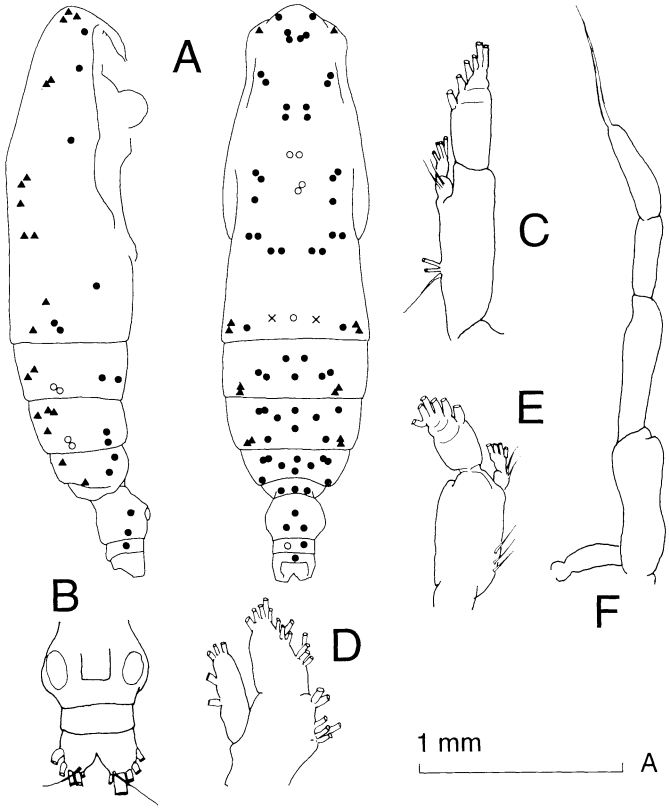


Fig. 51. *Subeucalanus subcrassus*. Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female (from Giesbrecht 1892): B, ventral view of urosome; C, mandibular palp; D, part of maxilla 1. Male (from Giesbrecht 1892): E, mandibular palp; F, leg 5.

REMARKS: This species has often been confused with *S. pileatus* and *S. monachus*. Fleminger (1973) has demonstrated that these species are separate and how to distinguish them by the integumental organ pattern.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Greenwood 1976.

NEW RECORDS: Nil.

DISTRIBUTION: Fleminger (1973) has confirmed that this species has at least a tropical, Indo-Pacific, broadly neritic, epiplanktonic distribution.

Subeucalanus subtenuis (Giesbrecht, 1888)
(Fig. 52)

DESCRIPTION: Size: females 2.65–3.1 mm, males 2.75 mm.

Female: As for the family and generic description with the following additional characters. Anterior of head triangular and pointed. Integumental organs on antenna 1 somite with 10 sites including a posterior set of 4; mandibular somite with 8 sites; maxilla 1 somite with 10 sites including a medial set of 4; maxilla 2 somite with 2 or more pairs of sites; pedigerous segment 1 with 15; pedigerous segments 2 and 3 with 1 asymmetrical site within the arc of hair sensilla on left of midline; urosome segments 1–2 with 2 sites. Caudal rami asymmetrical. Antenna 2 endopod segment 1 longer than endopod segment 2 and more than 3 times as long as wide. Basipod 2 of the mandibular palp with 2 setae, endopod does not extend as far as the distal border of basipod 2, endopod segment 1 with 2 setae, endopod segment 2 with 4 setae. Maxilla 1 inner lobe 3 with 4 setae and basipod 2 with 4 setae. Maxilliped endopod segments 1 and 2 with 4 setae each. (Giesbrecht 1892; Fleminger 1973)

Male: As for the family and generic description. Anterior of head rounded. Terminal seta on left leg

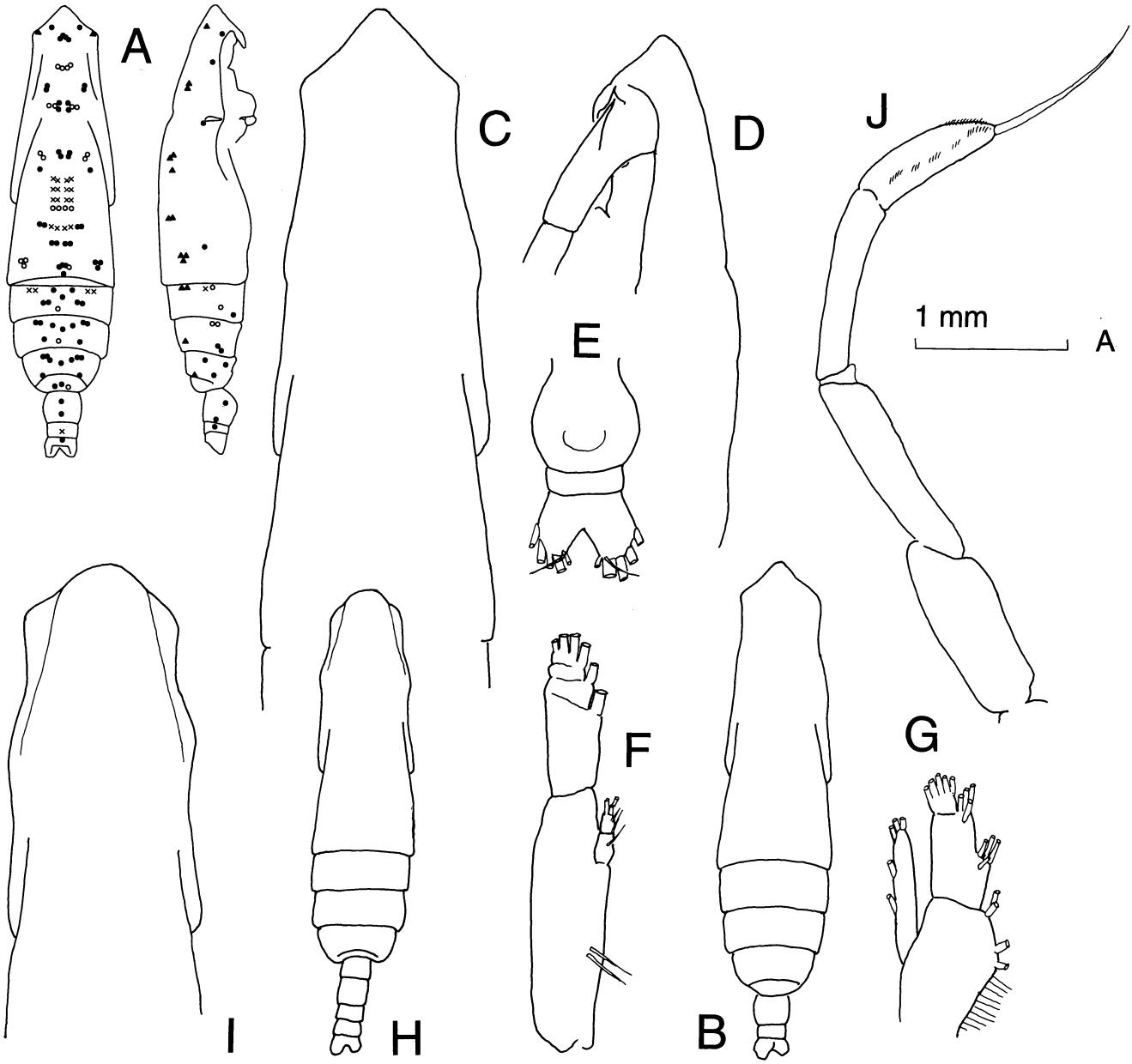


Fig. 52. *Subeucalanus subtenuis*. Female (from Fleminger 1973): A, dorsal and lateral pattern of integumental organs (• = sites occurring at 100% frequency, o = sites occurring at 80–99% frequency, x = sites occurring at 10–79% frequency, ▲ are sites which are also visible in lateral view but which are assigned to dorsal sets). Female (from Giesbrecht 1892): B,dorsal view; C, dorsal view of anterior body; D, lateral view of anterior body; E, ventral view of urosome; F, mandibular palp; G, part of maxilla 1. Male (from Giesbrecht 1892): H, dorsal view; I, dorsal view of anterior head; J, leg 5.

5 longer than the terminal segment.
(Giesbrecht 1892)

PREVIOUS SOUTHWEST PACIFIC RECORDS: Greenwood (1976).

NEW RECORDS: Nil.

DISTRIBUTION: This species has an epiplanktonic, tropical Indo-West Pacific distribution (Fleminger 1973).

Superfamily **RYOCALANOIDEA**

Family **RYOCALANIDAE** Andronov, 1974

Ryocalanus Tanaka, 1956

DEFINITION: Body elongate, head separate from pedigerous segment 1, pedigerous segments 4 and 5 separate. Rostrum stout, 1-pointed, may be bifurcate at the tip. Urosome 4-segmented in the female, 5-segmented in the male. Antenna 1 24-segmented, segments 8 and 9 fused, male right antenna transformed into a grasping organ with segments 23 and 24 fused and the hinge between joints 22 and 23, also the terminal part bends out and backwards Mouthparts and swimming legs generally similar in both sexes. Antenna 2 with 3 setae on the inner margin of exopod segment 2. Mandible with a relatively slender palp, endopod 2-segmented and shorter than the exopod. Maxilla 1 exopod, basipod 2, and inner lobes 2 and 3 relatively slender. Swimming legs as in *Spinocalanus* except that exopod segment 3 of leg 1 has 2 outer-edge spines. Female leg 4 basipod 1 with very large spines as well as small spinules. Male leg 5 uniramous or with very reduced endopods, asymmetrical, longest on the left. (Tanaka 1956b, Andronov 1992)

TYPE SPECIES: *Ryocalanus infelix* Tanaka, 1956

REMARKS: A new family and superfamily was created for this genus by Andronov (1974b). A further species, *R. mirabilis* Andronov, 1992 was described, including both the male and female. Andronov (1992) points out that the form of the male geniculate antenna 1 indicates that the grasping antenna must have arisen independently and convergently in this family. Unlike all other calanoids the elbow joint is between the 22nd and 23rd segments (not 18th and 19th) and the terminal part bends backwards, not forwards as in all other calanoids. No specimens of this genus have been discovered in the Southwest Pacific.

Superfamily **SPINOCALANOIDEA**

Family **SPINOCALANIDAE** Vervoort, 1951

DEFINITION: Head and pedigerous segment 1 separate, pedigerous segments 4 and 5 partly fused or separate. Caudal rami with 4 terminal well-developed but very fragile setae; inner caudal seta small, directed ventrally; outer seta small, minute, or, usually absent. The anterior and especially the posterior surface of some of the joints of the swimming legs are usually spinulose.

Female: Urosome 4-segmented, genital segment longest protruding ventrally by 0.25–0.50 the depth of the rest of the urosome, anal segment length 0.66–1.0 times the caudal ramus, caudal ramus length 1.0–2.5 times its width (sometimes longer and wider on one side). Rostrum of 2 symmetrical or asymmetrical long strong points, a single long blunt cone, or this absent. Antenna 1 extends to the anal segment or beyond, segments 8 and 9 usually fused, segments 24 and 25 always separate. Antenna 2 basipod 2 with proximal hairs or setules and 1 long plumose distal seta; basipod 2 with 2 subequal setae; exopod of equal or greater length than the endopod. Exopod 7-segmented; exopod segment 1 with 0–2 setae; exopod segments 2 and 3 separate, partly fused, or competely fused; exopod segment 2 with 0 or 2 setae; exopod segments 3–6 each with one seta; exopod segment 7 with one seta at about midlength and 3 terminal setae. Endopod 2-segmented; endopod segment 1 twice the length of endopod segment 2; endopod segment 1 with 2 unequal setae; endopod segment 2 with 2 lobes, inner lobe with 9 setae, outer lobe with 7 setae and a cluster of hairs along the outer edge. Mandible basipod 2 length about 1.33 times its width; exopod 5-segmented, about the same length as the endopod; endopod segment 1 without a sac-like appendage on the inner edge, usually with 4 setae; endopod segment 2 with 10 or 11 setae. Maxilla 1 with the following arrangement of spines and setae: inner lobe 1 with 9 strong, thick, short, spinulose marginal setae, 0, 3, or 4 proximal posterior surface setae, 1 mid-marginal anterior surface seta, and with or without 1 small distal anterior surface seta, distal posterior surface with spinules and denticles; inner lobe 2 with 4–6 setae, inner lobe 3 with 4 setae, margins of the lobe with spinules or stiff hairs; basipod with 5 setae; endopod segments 1 and 2 setation varies with genus, segment 3 with 7 setae; exopod with 11 setae and hairs on the inner margin; outer lobe 2 usually absent, or small, nude or with a minute seta; outer lobe 1 with 9 setae. Maxilla 2 lobes 1–5 with 6, 3, 3, 3, 4 setae respectively, lobe 1 also with a terminal mid-marginal hook; outer seta present or absent. Maxilliped 5 terminal segments with 4, 4, 2–3, 4, 4 setae respectively; basipod 2 with 5 setae and longitudinal row of stiff hairs, spinules or denticles. Swimming leg 1 basipod 1 without an inner-edge seta, basipod 2 usually with a minute seta near the outer distal edge and a long anterior seta near the base of the endopod; exopod 3-segmented, exopod segment 1 with or without a distal outer spine, without an inner-edge seta; exopod segment 2 with or without 1 outer distal spine and with 1 inner seta; exopod segment 3 with 1 outer distal spine, 4 inner setae, and 1 blade-like terminal seta with the outer edge

lightly serrate and inner edge plumose; endopod 1-segmented with outer lobe-like process near the end, 2 terminal setae, and 1-3 inner setae. Basipod 1 of swimming legs 2–4 usually with an inner seta; surfaces and margins of basipod 2 nude. Endopod of leg 2, 2-segmented; endopod segment 1 without surface decoration, with 1 inner seta; endopod segment 2 with 2 inner, 2 terminal, and 0–1 outer-edge setae. Endopod of legs 3 and 4, 3-segmented; endopod segment 1 without surface decoration, with 1 inner seta; endopod segment 2 outer distal corner spiniform, 1 inner-edge seta; endopod segment 3 with 2 inner, 2 terminal, and 0–2 outer-edge setae. Exopods of swimming legs 2–4, 3-segmented; exopod segment 1 without posterior surface decoration, with 1 outer spine and 1 inner seta; exopod segment 2 with 1 outer spine and 1 inner seta; exopod segment 3 without serrate margins, with 3 outer-edge spines, 5 inner-edge setae, and 1 serrate blade-like terminal seta. Leg 5 absent. (Damkaer 1975)

Male: Head and pedigerous segment 1 partly fused or separate, pedigerous segments 4 and 5 separate. Rostrum a reduced knob, long cone, or absent. Urosome 5-segmented; anal segment short; even reduced. Antenna 1 with segments 8 and 9 fused, segment 10 separate from or fused partly or completely with segment 9; segment 20 merging with segment 21, with noticeably wrinkled margins, on the right side in species with a left-handed leg 5 and on the left in species with a right-handed leg 5; segments 24 and 25 separate, segment 25 may be reduced. Antenna 2 segmentation and setation as in the female although several setae are reduced, proximal hairs or setules on basipod 1 and hairs on endopod segment 2 longer than in the female, the exopod about 2 times the length of the endopod because of the short endopod segment 1. Mandible basipod 2 swollen, length equalling its width; the blade reduced as are the size and number of setae on basipod 2 and endopod segment 1, endopod surface setules sometimes longer. Maxilla 1 inner lobe 1 and other inner-edge processes much reduced and fragile; outer processes similar to the female. Maxilla 2 lobes and reduced. Maxilliped segmentation and inner setation usually as in the female; basipods 1 and 2 narrow, without transverse spine-combs; endopod segment 4 and 5 outer setae usually reduced or absent. Swimming legs generally similar to those of the female, although the surface armature may vary slightly; basipod 1 of swimming leg 4 with or without an inner seta. Leg 5 simple, basipod 2 uneven, usually longer on the left (left-handed); uniramous or biramous. (Damkaer 1975)

An example of this family is *Spinocalanus longicornis* (Figs 53, 54).

REMARKS: This family has been largely reviewed by Damkaer (1975) and Schulz (1989) and now contains the genera *Damkaeria, Isaacsicalanus, Mimocalanus, Monacilla, Spinocalanus,* and *Teneriforma.* A typical member of the family is *Spinocalanus longicornis* (Figs 53, 54).

This family comprises mainly bathypelagic genera which are apparently omnivores (Harding 1974; Gowing & Wishner 1986).

Damkaeria Fosshagen, 1983

DEFINITION: As for the family with the following additional characters. Small copepods with all pedigerous segments separate, pedigerous segment 5 rounded posteriorly. Rostrum pointed, single and directed backwards. Caudal rami slightly longer than the anal segment. Antenna 1 in the female extends a little beyond the genital segment, 23-segmented, segments 8–9 and 24–25 fused; male antenna 1, 22-segmented on the right, 23-segmented on the left; on the right, segments 20–21 are fused. Antenna 2 exopod longer and stronger than the endopod. Mandible with 3 setae on the inner margin of basipod 2; mandibular blade with sharp teeth, the most ventral of which is set apart from the others. Maxilla 1 of the female with some reduction in inner lobe 3, the basipod, and endopod, where the size and number of setae have been reduced; inner lobes 2 and 3 with 3 and 4 setae respectively. Maxilla 1 of the male shows further reduction, particularly in inner lobe 2 which is smaller and has 2 small setae; inner lobe 1, the exopod, and outer lobe 1 are similar to that of the female. Maxilla 2 bears a strong modified claw-like spine on lobe 4; distally this spine is strongly armed. Maxilliped of the female with basipod 1 and 2 about the same length; there is a longitudinal row of spinules on basipod 2; endopod segments 1 and 2 are of about equal length. The male maxilliped is reduced in size and has a reduced number of setae compared with the female. Swimming leg 1 basipod 2 without minute outer distal seta; exopod segments 1 and 2 with an outer-edge spine; endopod with 2 terminal and 3 inner edge setae; male exopod outer-edge spines shorter and weaker than in the female. There are weak surface spinules on the basipods of legs 2-4 which are particularly dense on the posterior surface of basipod 1 of leg 4; the surfaces of the

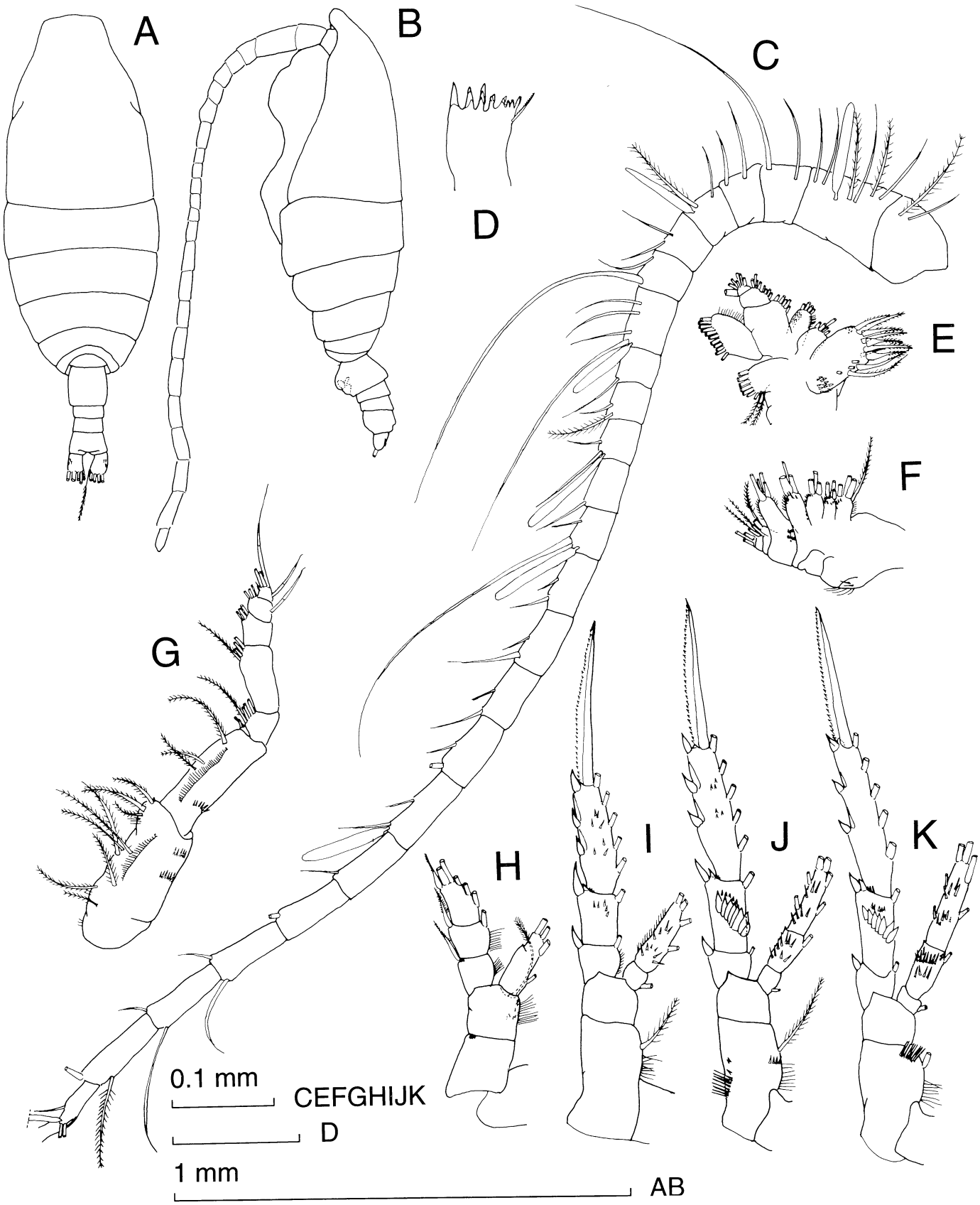


Fig. 53. *Spinocalanus longicornis* (from Damkaer 1975). Female: A, dorsal view; B, lateral view; C, antenna 1; D, mandibular blade; E, maxilla 1, F, maxilla 2; G, maxilliped; H, leg 1, I, leg 2, J, leg 3; K, leg 4.

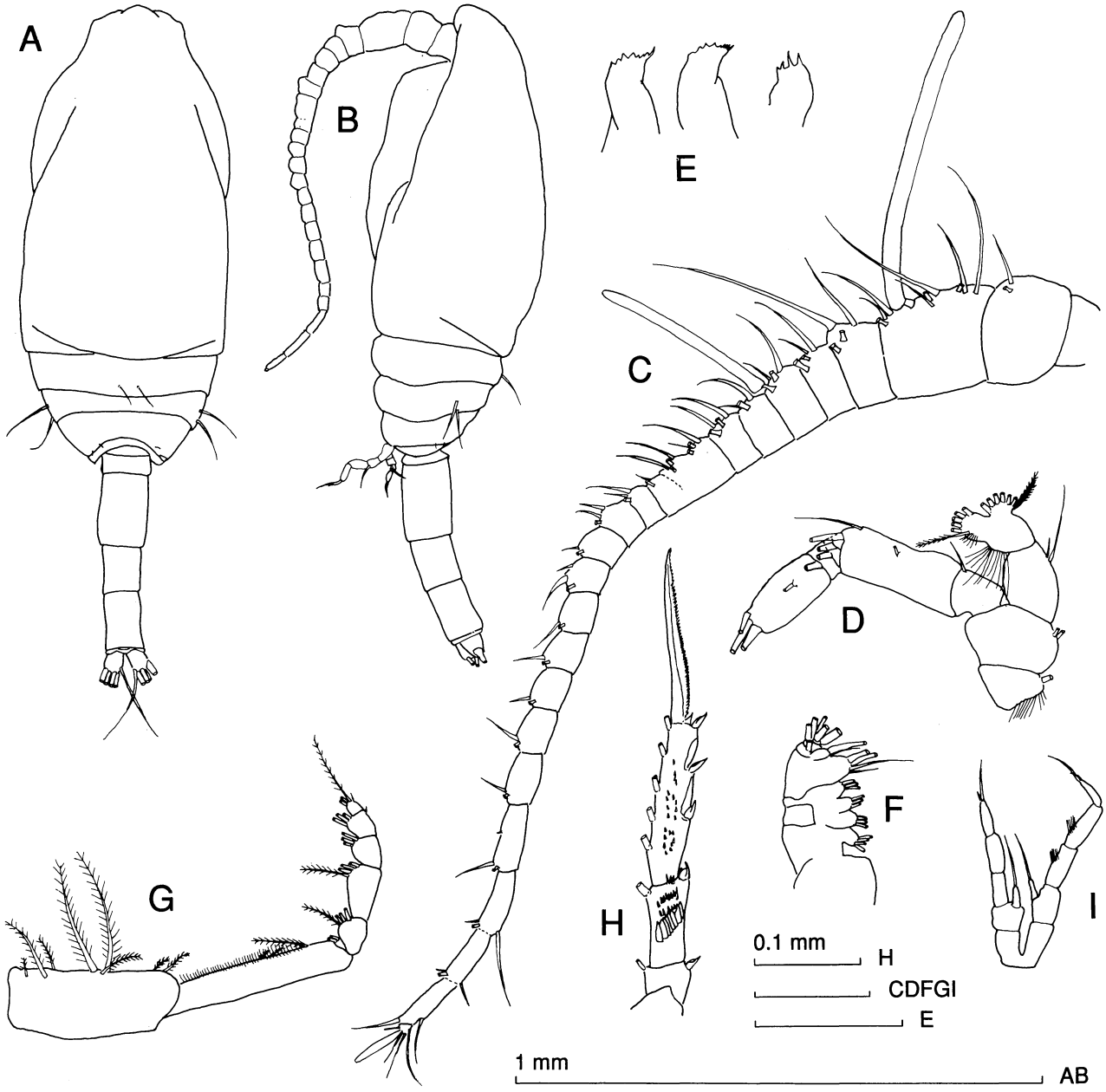


Fig. 54. *Spinocalanus longicornis* (from Damkaer 1975). Male: A, dorsal view; B, lateral view; C, antenna 1; D, antenna 2; E, mandibular blades; F, maxilla 2; G, maxilliped; H, exopod of leg 4; I, leg 5.

exopods and endopods of legs 2–4 without ornamentation. Endopod segment 2 of leg 2 with 1 outer-edge seta, endopod segment 3 of legs 3 and 4 with 2 outer-edge setae, endopod segment 1 of legs 3 and 4 apparently with outer distal corner rounded. Female leg 5 absent. Male leg 5 present on the right side only as a uniramous, 4-segmented, long appendage which is twice the length of the urosome when extended; the first segment is broad with a proximal thickening, the other segments are slender, and the distal segment has a longitudinal row of stiff spinules which increase in length distally.

(Fosshagen 1983)

TYPE SPECIES: *Damkaeria falcifera* Fosshagen, 1983.

REMARKS: There is only one species in this genus which has not been taken in the Southwest Pacific.

Schulz (1989) examined the taxonomic position of *Damkaeria*, formerly referred to the Bathypontiidae, and tentatively placed it in the Spinocalanidae because of the high number of similarities among the appendages. The highly asymmetrical right-handed male leg 5 differs from most other spinocalanids and is cited as the reason for Schulz's reservation about the position of this genus.

Isaacsicalanus Fleminger, 1983

DEFINITION: As for the family with the following additional characters. Robust copepods with pedigerous segments 4 and 5 partly fused. Caudal rami asymmetrical because of the differing position of the inner-edge setae; the left inner seta is located on the ventral surface and projects ventrally, the right inner seta is located on the dorsal surface, is inserted more distally than the left seta, and is directed dorsally. Rostrum short, lobate, without bifurcation. Female antenna 1 short, 23-segmented with segments 8–9, 24–25 fused. Antenna 2 exopod 1 without setae, exopod segments 2 and 3 not fused, exopod segment 2 with 1 seta. Maxilla 1 with basipod 2 fused to the endopod and bearing 8 setae; inner lobe 2 with 1 seta, inner lobe 3 without setae. Maxilla 2 and maxillliped with distal setae unarmed except for very fine setules on the proximal side. Maxilliped basipod 1 with 2 setae, basipod 2 with a short row of stiff hairs proximal to the medial setae. Swimming leg 1 exopod segment 1 and 2 without an outer-edge spine; endopod with 5 setae and a prominent lateral swelling at the segment's midlength which bears spinules concentrated at its apex. The outer distal spine on exopod segment 3 of swimming legs 2–4 about twice as long as the two proximal spines. Posterior surfaces of swimming legs 2–4 without spines. Female leg 5 absent.

(Fleminger 1983; Schulz 1989)

TYPE SPECIES: *Isaacsicalanus paucisetus* Fleminger, 1983

REMARKS: There is only one species in this genus which has not been taken in the Southwest Pacific. *Isaacsicalanus paucisetus* was collected adjacent to the sea floor of the East Pacific Rise off the mouth of the Gulf of California. It was captured swimming among concentrations of macrobenthic invertebrates typical of known hydrothermal vent communities. Fleminger (1983), based on phylogenetic analysis, believes that this genus occupies a highly derived position within the Spinocalanidae. Schulz 1989, who adds some details to the description of *I. paucisetus*, highlights the similarities between *Isaacsicalanus* and *Teneriforma*.

Mimocalanus Farran, 1908

DEFINITION: As for the family with the following additional characters. Male anal segment not reduced. Caudal rami symmetrical, caudal setae usually incomplete on specimens examined: no trace of outer (6th) seta, outer and inner terminal setae usually completely detached, middle 2 setae usually broken at bases, inner seta directed ventrally, small or reduced. Rostrum absent. Female antenna 1 with segments 8–9 partly or completely fused, limb narrowing between segments 9 and 11. Male antenna 1 with segment 9 partly fused with segment 10, right segment 20 merging with segment 21, as in other left-handed species, limb narrowing between segments 8–10, segment 25 not reduced. Antenna 2 exopod exceeding the length on the endopod by 20%, exopod segment 1 without setae, exopod segments 2 and 3 separate, exopod segment 2 without setae. Mandible basipod 2 with 2 or 3 inner setae, surface nude, endopod segment 1 surface nude. Maxilla 1 inner lobe 1 proximal surface without spinules, distal anterior seta present; inner lobe 2 with 4 setae, inner lobes 2 and 3 relatively large; proximal part of the endopod with 3 or 7 proximal and 3 or 7 distal setae; small nude outer lobe 2 sometimes present. Maxilla 2 length is twice its width, without a proximal hump; lobe 5 with 3 strong and 1 reduced setae, posterior surface of its base without spines; lobe 6 reduced, apparently with only 1 seta; endopod segments reduced. Maxilla 2 outer seta apparently absent. Maxilliped basipods 1 and 2 without a transverse spine-comb, basipod 1 with a proximal group of 2 setae, midlength group of 3 setae, and distal group of 3 or 4 setae, basipod 2 with longitudinal row of reduced spinules or denticles, 3 setae about midlength, and 2 distal setae, endopod segments 4 and 5 with outer setae usually moderately long, with very long plumes on each side, endopod segment 5 inner edge without spinules. Swimming leg 1 exopod segment 1 without an outer distal spine; exopod segment 1 and 2 together longer than exopod segment 3; the endopod with 1–2 inner-edge setae. Swimming legs 2–4 exopod terminal seta with finely serrate outer edge (48–90 teeth), outer flange wide. Swimming leg 1 endopod with 1–2 inner setae, leg 2 endopod segment 2 with 0–1 outer setae. Swimming legs 3–4 endopod segment 3 with 0–1 outer-edge setae. The

surfaces of the swimming-leg segments without spines, except basipod 1 of female swimming leg 4 which usually has a transverse row of thin setules on the posterior surface proximal to the inner seta; males of some species have an inner seta on basipod 1 of swimming leg 4. Male leg 5 uniramous, left-handed, variably asymmetrical; exopod essentially 3-segmented, exopod segments 1 and 2 may be partly fused. (Damkaer 1975)

TYPE SPECIES: *Mimocalanus cultrifer* Farran, 1908

REMARKS: This genus was reviewed by Damkaer (1975) and now contains the following species although there is some difference of opinion between Damkaer and Brodsky *et al.* (1983) as to the identity of some species: *Mimocalanus crassus* Park, 1970; *M. cultrifer* Farran, 1908 (male undescribed); *M. damkaeri* Brodsky *et al.* 1983; *M. distinctocephalus* Brodsky, 1950 (male unknown); *M. heronae* Damkaer, 1975 (male unknown); *M. inflatus* Davis, 1949 (male unknown); *M. major* Sars, 1920 (male unknown); *M. ovalis* (Grice & Hulsemann, 1965) (male unknown); *M. nudus* Farran, 1908 (male *see* Grice & Hulsemann 1965); *M. sulcifrons* Wheeler, 1970 (female unknown? *see* Damkaer 1975 and Brodsky *et al.* 1983). Only one species has been recorded from the Southwest Pacific.

Mimocalanus cultrifer Farran, 1908 (Fig. 55)

DESCRIPTION: Size: females 1.0–1.70 mm, males 1.14, 1.20 mm.

Female: Prosome in dorsal view fairly robust and ovoid; head rounded, with a slight bulge and with a fairly abrupt forward slope in lateral view. Pedigerous segments 4 and 5 separate. Prosome length 4 times that of the urosome. Genital segment slightly wider than long, protruding ventrally 0.33 of the depth of the rest of the urosome. Caudal rami slightly longer than wide. Inner caudal setae reduced. Antenna 1 exceeds the caudal rami by 3–4 segments. Mandible basipod 2 with 2 inner setae. Maxilla 1 inner lobe 1 apparently without posterior setae. Swimming leg 1 basipod 2 and exopod segment 1 distal border with 3–4 small teeth, endopod with 2 inner setae. Swimming leg 2 endopod segment 2 with no outer seta. Endopod segment 3 of swimming legs 3 and 4 with 1 outer seta.

Male: Undescribed, although recorded by Grice and Hulsemann (1965) and Roe (1972).

REMARKS: This species may have been confused with *M. heronae* in the past (*see* Damkaer 1975).

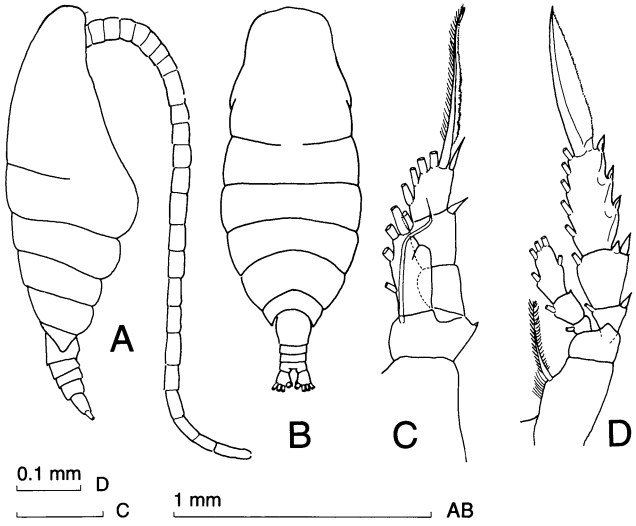


Fig. 55. *Mimocalanus cultrifer* female (from Vervoort 1957): A, dorsal view; B, lateral view; C, leg 1, D, leg 3.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Vervoort (1957).

NEW RECORDS: Nil.

DISTRIBUTION: This species appears to be widespread in the deep waters of most oceans (Vervoort 1957; Damkaer 1975).

Monacilla Sars, 1905

Oxycalanus Farran, 1908
Hypsicalanus Wolfenden, 1911

DEFINITION: As for the family with the following additional characters. Prosome in dorsal view slender to robust ovoid, head rounded or with a prominent crest. Rostrum 2-pointed, sometimes asymmetrical. Pedigerous segment 5 with lateral corners prolonged, pedigerous segments 1–4 without lateral spinules. Prosome length 3.0–3.5 times the length of the urosome. Genital segment sometimes asymmetrical, protruding ventrally 0.5 times the depth of the rest of the urosome. Anal segment reduced in the male. Caudal rami and setae symmetrical. Female antenna 1 with segments 8–9 fused. Male antenna 1 with 9–10 fused, right segment 20 merging with segment 21, segment 25 reduced. Antenna 2 exopod length exceeding the endopod by 20%, exopod segment 2 probably with 2 setae and at least partly fused with segment 3. Mandible basipod 2 with 4 setae. Maxilla 1 inner lobe 1 as in *Spinocalanus* as the distal anterior seta is apparently absent; inner

lobe 2 with 5 setae, outer lobe 2 small with 1 short seta. Maxilla 2 length 1.5 times its width with proximal outer lump nude and the outer seta apparently absent, lobe 5 with 4 strong setae and the posterior surface of its base without spines, lobe 6 small with 2 setae, endopod segments not reduced. Maxilliped basipod 1 with or, apparently without a transverse spine-comb at midlength on the outer anterior and posterior edge, basipod 2 without a spine-comb; basipod 1 with the proximal and midlength group of 3 setae each, distal group apparently with 4-6 setae; basipod 2 with a longitudinal row of stiff hairs, 2 setae at about midlength, 1 seta more distal, and 2 distal setae; endopod segments 4 and 5 outer setae relatively short and thin, probably lightly plumose; endopod segment 5 inner edge without spinules. Male maxilla 1 and maxilliped setae reduced in size. Swimming leg 1 exopod segment 1 with outer distal spine, reduced in the male, and male with the distal outer spine on exopod segment 2 forming a sharply curved hook; exopod segments 1 and 2 together longer than exopod segment 3 which is apparently without posterior surface spines; endopod with 3 inner setae. Swimming leg 2 endopod segment 2 with 1 outer seta. Swimming legs 3 and 4 endopod segment 3 with 2 outer-edge setae. Posterior surface of certain segments of the swimming legs with rows of spines. Male leg 5 biramous, asymmetrical, subequal, endopods 1-segmented, sometimes filiform, exopods well built and 2- or 3- segmented. (Damkaer 1975)

Type species: *Monacilla typica* Sars, 1905

REMARKS: This genus was reviewed by Damkaer and now contains the following species, none of which has been taken in the Southwest Pacific: *Monacilla gracilis* (Wolfenden, 1911) (male unknown); *M. tenera* Sars, 1907 (male unknown); *M. typica* Sars, 1905; *Monacilla* sp. Wheeler, 1970 (*see* Damkaer 1975) (female unknown).

Spinocalanus Giesbrecht, 1888

DEFINITION: As for the family with the following additional characters. Rostrum absent. Female prosome in dorsal view slender to robust ovoid, lateral corners of pedigerous segment 5 sometimes prolonged; pedigerous segments 1–4 sometimes with lateral spinules, sometimes left and right sides with variable numbers. Male prosome in dorsal view usually not ovoid, anterior part irregular or rounded, with a central knob-like protrusion, posterior part usually somewhat rectangular, head usually expanded dorsally to nearly cover pedigerous segment 1, head and pedigerous segment 1 separate or partly fused. Male anal segment usually reduced. Female caudal rami and caudal setae sometimes asymmetrical. Female antenna 1 with segments 8–9 fused. Male antenna 1 with segment 9 partly fused with segment 10, segment 25 usually reduced. Antenna 2 exopod length exceeds the endopod by 20%, exopod segment 1 with 0–2 setae, exopod segments 2 and 3 fused, exopod segment 2 with 2 setae. Mandible basipod 2 with 4 inner setae, and usually with a distal row of long setules on the anterior surface, endopod segment 1 also with a row of long setules. Maxilla 1 inner lobe 1 posterior surface with proximal clusters of spinules and denticles, proximal posterior surface with 3 or 4 setae, distal anterior seta present or absent, inner lobe 2 with 6 setae, proximal part of the endopod with 4 proximal and 5 distal setae, outer lobe 2 absent. Maxilla 2 length 1.5–1.75 times its width with a small to strong proximal outer hump usually armed with hairs, setules, and/or spinules; lobe 5 with 4 strong setae and its posterior surface may have spines; lobe 6 small with 2 setae (1 seta small); endopod segments not reduced; maxilla 2 outer seta present or, apparently, absent. Maxilliped basipod 1 sometimes with a transverse spine-comb at midlength on the outer and posterior edge; basipod 2 sometimes also with a transverse spine-comb at about 0.33 of its length on the anterior and posterior surfaces; basipod 1 with 3 groups of 3 setae each; basipod 2 with a longitudinal row of stiff hairs or stiff setules, 2 setae at about midlength, 1 seta more distal, and 2 distal setae; the form of the outer setae on endopod segments 4 and 5 varying with species. Swimming leg 1 exopod segment 1 with an outer distal spine, exopod segments 1 and 2 together longer than exopod segment 3 which sometimes has posterior surface spines, endopod with 1–3 inner setae. Swimming leg 2 endopod segment 2 with 0–1 outer seta. Swimming legs 3 and 4 endopod segment 3 usually with 2 outer setae. Posterior surface of certain segments of the swimming legs with rows of spines. Swimming legs 2–4 exopod segment 2 distal anterior surface with 1 row of spinules; leg 2 exopod segment 2 posterior surface usually with 1 row of spines; legs 3 and 4 exopod segment 2 posterior surface with 1–2 rows of spines. Legs 2 and 3 exopod segment 3 posterior surface usually with 1–3 rows of spines; leg 4 exopod segment 3 with or without posterior surface spines or spinules. Terminal exopod seta of legs 2–4 with a moderately coarse serrate outer edge (20–50 pri-

mary teeth), the outer flange narrow. Endopod segment 2 of legs 2–4 with posterior surface with 2 rows of spines, 1 row sometimes reduced to small spinules on a few species. Endopod segment 3 of leg 3 with the posterior surface usually with 2 rows of spines, but at least 1 row of spines or denticles; endopod segment 3 of leg 4 posterior surface with 2 rows of spines. Basipod 1 of leg 4 usually with a transverse row of setules on the posterior surface near the inner seta. Male swimming legs generally similar to those of the female with variable armature, rows of spines on the posterior surface of some segments in the female are sometimes in circular clusters in the male, basipod 1 of leg 4 without inner transverse row of setules or spinules on the posterior surface, with or without a seta. Male leg 5 biramous with styliform endopods; or very asymmetrical uniramous, usually left-handed; exopods usually 3-segmented. (Damkaer 1975)

TYPE SPECIES: *Spinocalanus abyssalis* Giesbrecht, 1888

REMARKS: Damkaer (1975) reviewed this genus and created a key. He divided the species into three groups as follows: Group A which has the first leg endopod with two inner setae, second leg endopod segment two with zero or one seta, third and fourth leg third endopod segment with two outer setae, and second antenna exopod segment one with one or two setae; Group B which has the first leg endopod with three inner setae, second leg endopod segment two with one outer seta, third and fourth leg endopod segment three with two outer setae, and second antenna exopod segment one without setae; and Group C with the first leg endopod with one inner seta, second leg endopod segment two with no outer seta, third and fourth leg endopod segment three with one outer seta, and second antenna exopod segment one with one seta.

Brodsky *et al.* (1983) reconfirmed the separate taxonomic status of species previously described by Brodsky but whose separate status Damkaer (1975) doubted. This genus now appears to contain the following species: *Spinocalanus abruptus* Grice & Hulsemann, 1965 (male unknown); *S. abyssalis* Giesbrecht, 1888 (male = *S. parabyssalis* Park, 1970, *see* Damkaer 1975); *S. angusticeps* Sars, 1920 (male *see* Damkaer 1975 = *Spinocalanus* sp. Wheeler, 1970, = *S. longipes* Tanaka, 1956); *S. antarcticus* Wolfenden, 1906; *S. aspinosus* Park, 1970 (male unknown); *S. brevicaudatus* Brodsky, 1950 (= female *S. pseudospinipes* Brodsky, 1950 *see* Damkaer 1975); *S. dispar* Schulz, 1989 (male unknown); *S. dorsispinosus* Brodsky, 1950 (female unknown); *S. elongatus* Brodsky, 1950; *S. hirtus* Sars, 1907 (male unknown); *S. hoplites* Park, 1970 (male unknown); *S. horridus* Wolfenden, 1911 (male *see* Damkaer 1975); *S. longicornis* Sars, 1900 (male *see* Damkaer 1975); *S. macrocephalon* Brodsky *et al.*, 1983 (female unknown); *S. magnus* Wolfenden, 1904 (male *see* Damkaer 1975); *S. oligospinus* Park, 1970 (male unknown); *S. profundalis* Brodsky, 1955 (male unknown); *S. polaris* Brodsky, 1950 (male *see S. elongatus* Brodsky, 1950; *see* Brodsky *et al.* 1983); *S. pseudospinipes* Brodsky, 1950 (female unknown, see *S. brevicaudatus*); *S. similis* Brodsky, 1950; *S. spinipes* Brodsky, 1950; *S. spinosus* Farran, 1908 (male *see* Schulz 1989); *S. stellatus* Brodsky, 1950; *S. terranovae* Damkaer, 1975 (male *see* Damkaer 1975, Bradford 1971, fig. 26); *S. usitatus* Park, 1970 (= *S. pteronus* Park, 1970 see Damkaer 1975, male unknown); *S. validus* Sars, 1920 (male *see* Grice & Hulsemann 1967); *Spinocalanus* sp. Grice & Hulsemann 1967, and Roe 1975; *Spinocalanus* sp. A Roe 1975; *Spinocalanus* sp. B Roe 1975.

The following species have been taken in the Southwest Pacific:

Spinocalanus angusticeps Sars, 1920 (Fig. 56)

DESCRIPTION: Size: females 1.98–2.23 mm; males 1.59–1.76 mm.

Female: Prosome in dorsal view a long, slender ovoid, anteriorly tapering towards a slightly truncate head. Pedigerous segments 4 and 5 separate, segments 1–4 without lateral spinules, posterolateral corners of pedigerous segment 5 protruding about 0.33 times the length of the genital segment. Genital segment as long as wide, protruding ventrally 0.33 times the depth of the rest of the urosome, caudal rami slightly longer than wide, caudal setae symmetrical. Antenna 1 length not known. Antenna 2 exopod segment 1 without seta. Maxilliped basipods 1 and 2 without transverse spine combs, endopod segments 4 and 5 with outer 2 setae lightly plumose, moderately fragile, thin, and relatively short, endopod segment 5 inner edge without spinules. Swimming leg 1 endopod with 3 inner setae. Leg 2 endopod segment 2 with 1 outer seta; exopod segment 1 outer spine forming a strongly bent hook, exopod segments 2 and 3 posterior surface nude. Legs 3–4 endopod segment 3 with 2 outer setae, leg 4 exopod segment 3 posterior surface with many small spinules. (Damkaer 1975)

Male: Head not expanded. Anal segment not reduced. Antenna 1 segment 25 not reduced. Maxilliped endopod segments 4 and 5 outer 2 setae

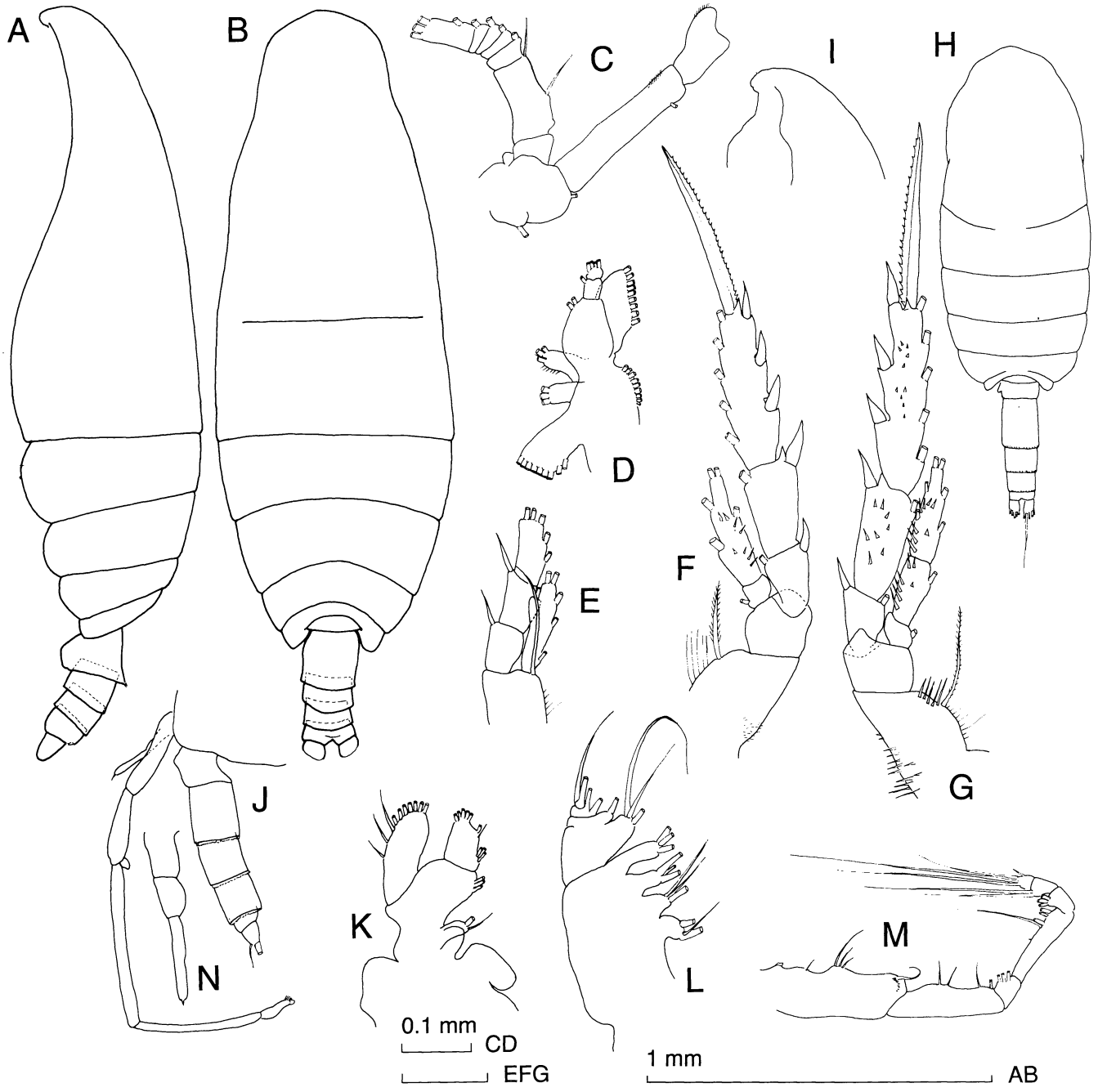


Fig. 56. *Spinocalanus angusticeps.* Female from NZOI Stn F945: A, lateral view; B, dorsal view; C, antenna 2; D, maxilla 1; E, leg 1; F, leg 2; G, leg 3. Male (from Tanaka 1956 as *S. longipes* — see Damkaer 1975): H, dorsal view; I, lateral view of head; J, lateral view of urosome and leg 5; K, maxilla 1; L, maxilla 2; M, maxilliped; N, right leg 5.

reduced, inner setae of endopod segments 2–5 not inflated, endopod segment 5 inner edge without spinules. Swimming leg 4 basipod 1 without an inner seta. Leg 5 left-handed, essentially uniramous (with rudimentary left endopod), very asymmetrical. (Damkaer 1975)

REMARKS: Two specimens were taken at stations NZOI F945 (500–1000 m) and F946 (0–1000 m) (recorded by Damkaer 1975).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Damkaer (1975).

NEW RECORDS: Nil.

DISTRIBUTION: In the deep waters of the Pacific, Indian and Atlantic Oceans (Damkaer 1975).

Spinocalanus antarcticus Wolfenden, 1906
(Fig. 57)

DESCRIPTION: Size: females 2.25–3.00 mm, males 1.70–2.32 mm.

Female: Prosome in dorsal view a robust ovoid, length 4.25 times the urosome. Pedigerous segments 4 and 5 separate, segments 1–4 without lateral spinules, posterolateral corners of pedigerous segment 5 protruding about 0.33 times the length of the genital segment. Antenna 1 extending beyond the anal segment. Antenna 2 exopod segment 1 without seta. Maxilliped basipods 1 and 2 without transverse spine combs, endopod segments 4 and 5 with outer 2 setae asymmetrically plumose, and as large and strong as other terminal setae, endopod segment 5 inner edge without spinules. Swimming leg 1 endopod with 3 inner setae. Leg 2 endopod segment 2 with 1 outer seta, exopod segments 2 and 3 posterior surface with a row of spines. Legs 3-4 endopod segment 3 with 2 outer setae, leg 4 exopod segment 3 posterior surface nude. (Damkaer 1975)

Male: Head not expanded. Anal segment not reduced. Antenna 1 segment 25 not reduced. Maxilliped endopod segments 4 and 5 outer 2 setae reduced, inner setae of endopod segments 2–5 not inflated, endopod segment 5 inner edge without spinules. Swimming leg 4 basipod 1 with an inner seta. Leg 5 left-handed, uniramous, very asymmetrical. (Damkaer 1975)

REMARKS: This species has not been recorded in the Southwest Pacific but as *S. magnus* and *S. antarcticus* have been confused and co-occur in many locations (Damkaer 1975) its description has been included here.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORDS: Nil.

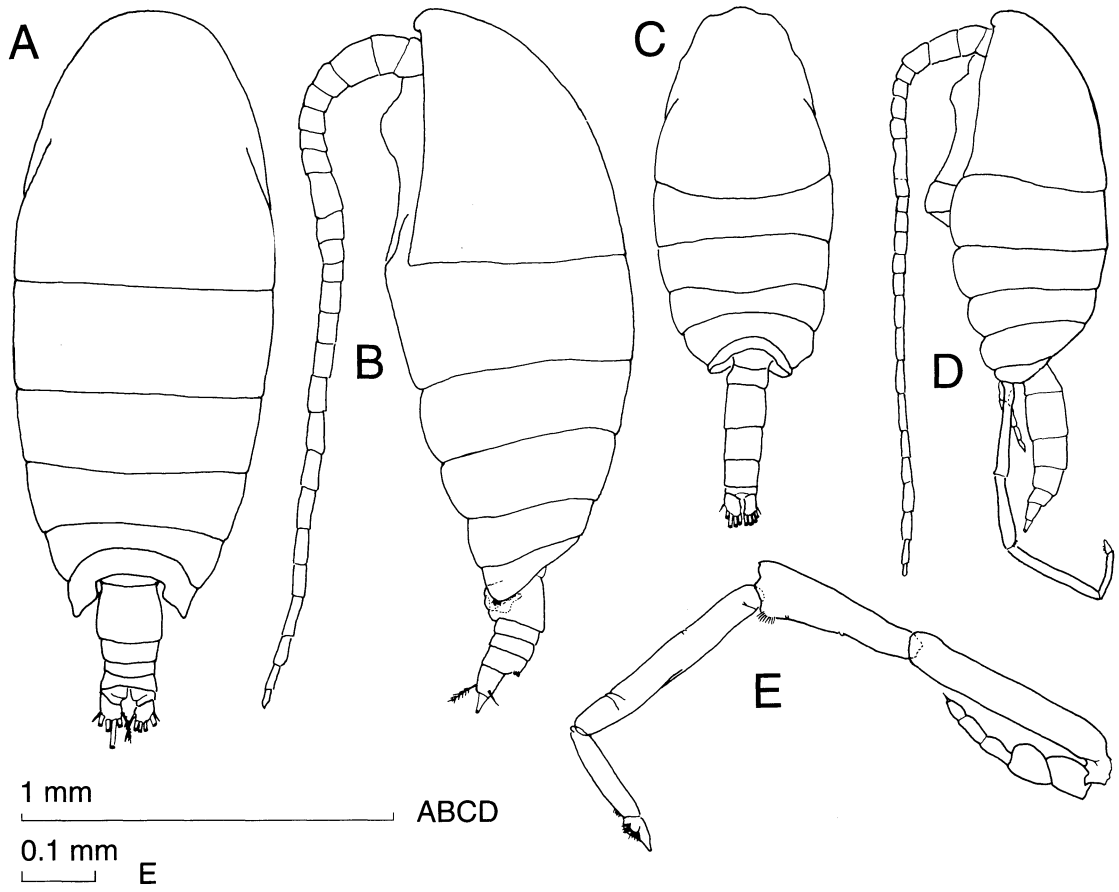


Fig. 57. *Spinocalanus antarcticus* (from Damkaer 1975). Female: A, dorsal view; B, lateral view. Male: C, dorsal view; D, lateral view; E, leg 5.

DISTRIBUTION: Known from Arctic and Antarctic waters 0–2500 m. Damkaer (1975) urged that the possibility of a continuous distribution at deeper depths should not be overlooked.

Spinocalanus longicornis Sars, 1900
(Figs 53, 54, 92)

Description: Size: Females 0.88–1.30 mm, males 1.00–1.40 mm.

Female: Prosome in dorsal view somewhat robust to ovoid, prosome length less than 2.4 times its width, head slightly truncate in dorsal view. Pedigerous segments 4 and 4 usually separate, sometimes partly fused. Posterolateral corners of prosome rounded, not prolonged. Pedigerous segments 1-4 without lateral spinules. Genital segment slightly wider than long, protruding ventrally 0.5 times the depth of the rest of the urosome, caudal rami length 1.5 times its width, symmetrical with a cluster of spinules on the outer distal surface. Caudal setae symmetrical, inner seta moderately long. Supra-anal plate without fringe of hairs. Antenna 1 exceeds caudal rami by nearly 4 segments. Antenna 2 exopod segment 1 with 1 seta. Maxilliped basipod segment 1 without spine-comb, basipod 2 with or without a transverse spine comb, endopod segments 4 and 5 outer 2 setae fragile, blade-like, nude and tapered toward their ends, endopod segment 5 inner edge with spinules. Swimming leg 1 endopod segment 1 with 2 inner setae. Leg 2 endopod segment 2 without an outer seta, exopod segments 2 of legs 3 and 4 with proximal posterior surface spines broad and leaflike, and endopod segment 3 with 2 outer setae. (Damkaer 1975)

Male: Prosome anteriorly irregular in dorsal view, posteriorly somewhat rounded. Head and pedigerous segment 1 partly fused. Prosome length 2 times the urosome, anal segment reduced, length of the caudal rami slightly more than their width, symmetrical, caudal setae as in female. Antenna 1 reaching about the end of pedigerous segment 4, segment 25 small. Maxilliped endopod segments 4 and 5 outer 2 setae reduced, inner setae of endopod segments 2–5 not inflated, endopod segment 5 inner edge with spinules. Swimming leg 1 similar to that of the female except exopod outer spines wider, shorter and smoother. Legs 2 and 4 with slight differences from the female. Leg 5 biramous reach-ing the end of urosome segment 2, biramous, left-handed; left basipod 1 reaching the middle of right basipod 2; left basipod 2 reaching 0.66 along the length of the right exopod segment 1; left leg longest, left exopod including terminal blade, longest; right endopod not much longer than the left endopod; left endopod reaching 1/3 the length of left exopod segment 2, right endopod reaching to right exopod segment 3; each exopod with 1 small and 1 moderate blade-like terminal seta. (Damkaer 1975)

REMARKS: All the Southwest Pacific specimens were damaged so the drawings have been taken from the first reviser, Damkaer (1975) who untangled the confused identity of this species and *S. abyssalis.*

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	500–1000	4 females 0.90–10.00 mm
B109	0–125	3 females 1.05–1.15 mm
B111	0–500	1 female 1.10 mm

DISTRIBUTION: Arctic, Pacific, and Atlantic Oceans (Damkaer 1975). These records appear to be the first for the Southwest Pacific.

Spinocalanus magnus Wolfenden, 1904 (Fig. 58)

DESCRIPTION: Size: females 1.87–3.1 mm, males 1.80–2.43 mm.

Female: Prosome in dorsal view a long, slender ovoid, length 3.25 times the urosome. Pedigerous segments 4 and 5 separate, segments 1-4 without lateral spinules, posterolateral corners of pedigerous segment 5 protruding about 0.33 times the length of the genital segment. Antenna 1 extending beyond the anal segment. Antenna 2 exopod segment 1 without seta. Maxilliped basipods 1 and 2 without transverse spine combs, endopods segments 4 and 5 with outer 2 setae asymmetrically plumose, and as large and strong as other terminal setae, endopod segment 5 inner edge without spinules. Swimming leg 1 endopod with 3 inner setae. Leg 2 endopod segment 2 with 1 outer seta, exopod segments 2 and 3 posterior surface with a row of spines. Legs 3–4 endopod segment 3 with 2 outer setae, leg 4 exopod segment 3 posterior surface nude. (Damkaer 1975)

Male: Head slightly expanded dorsolaterally. Anal segment not reduced. Antenna 1 segment 25 not reduced. Maxilliped endopod segments 4 and 5 outer 2 setae reduced, inner setae of endopod segments 2–5 not inflated, endopod segment 5 inner

edge without spinules. Swimming leg 4 basipod 1 with an inner seta. Leg 5 left-handed, biramous.
(Damkaer 1975)

REMARKS: This species was recorded from the southwest Pacific by Vervoort (1957) but this is one of the records that Damkaer (1975) did not check. There is a possibility that this species has been confused with *S. antarcticus* (*see* Damkaer 1975).

PREVIOUS SOUTHWEST PACIFIC RECORDS: ?Vervoort (1957).

NEW RECORDS: Nil.

DISTRIBUTION: *Spinocalanus magnus* is very widespread horizontally and vertically (0–4000 m) over the Pacific, Indian, Atlantic, Mediterranean and Antarctic Oceans (Damkaer 1975).

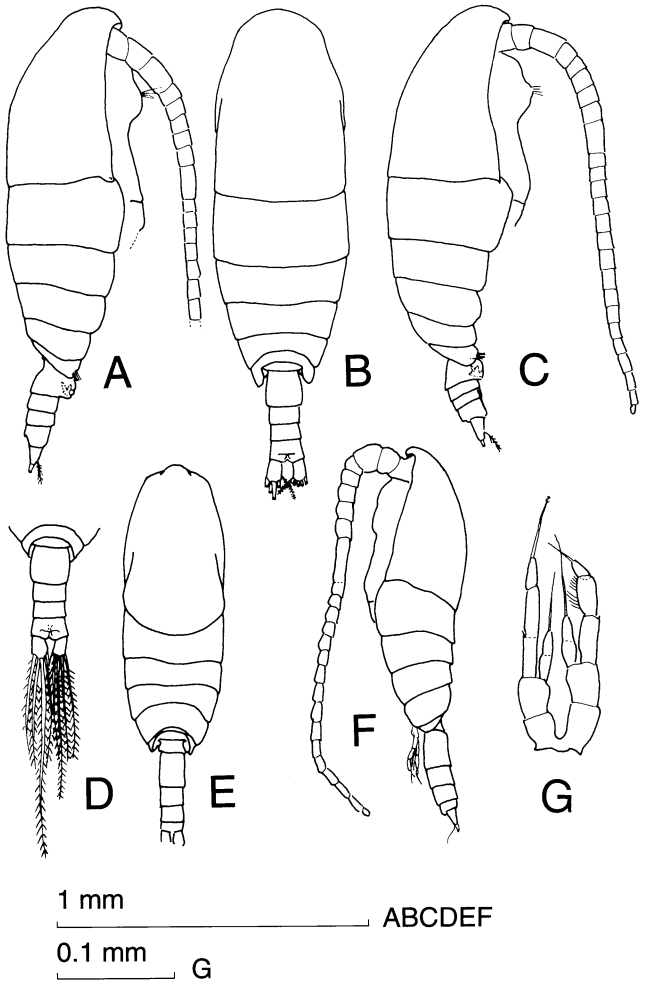


Fig. 58. *Spinocalanus magnus* (from Damkaer 1975). Female: A, dorsal view; B, lateral view; C, lateral view of another specimen; D, dorsal view of urosome of specimen "C". Male: E, dorsal view; F, lateral view; G, leg 5.

Spinocalanus spinosus Farran, 1908 (Figs 59, 92)

DESCRIPTION: Size: females 1.67–2.00 mm, male unknown.

Female: Prosome in dorsal view somewhat robust ovoid, head slightly truncate. The lateral corners of pedigerous segment 5 rounded, at least 1 segment of pedigerous segments 1–4 on the right and/or left sides with ventrolateral spinules. Antenna 2 exopod segment 1 with 2 setae. Maxilliped basipod 1 without transverse spine combs, basipod 2 with a strong transverse spine comb, endopod segments 4 and 5 outer 2 setae fragile, blade-like, nude, tapered toward each end, endopod segment 5 inner edge with spinules. Swimming leg 1 endopod with 2 inner setae. Leg 2 endopod segment 2 with 1 outer seta. Legs 3–4 endopod segment 3 with 2 outer setae.
(Damkaer 1975)

Male: Unknown.

REMARKS: A very damaged specimen was taken in the Southwest Pacific which seemed to be referable to *S. spinosus.*

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORD:

Station No.	Depth of Haul (m)	Specimens
A302	500–1000	1 female 0.64 mm

DISTRIBUTION: Sparingly recorded 0–1000 m from the Atlantic and Pacific Oceans (Damkaer 1975).

Teneriforma Grice & Hulsemann, 1967

Tanyrhinus Farran, 1936

DEFINITION: As for the family, with the following additional characters. Small copepods with all pedigerous segments separate, pedigerous segment 5 prolonged, extending 0.33 times the length of the genital segment. Rostrum is a single, long, blunt cone directed backwards. Caudal rami symmetrical, length 2.0–2.5 times their width, longer than or equal to the anal segment. Male anal segment not reduced. Antenna 1 in the female extends to the anal segment, 24-segmented, segments 8–9 are fused; male antenna 1 reaching the end of the caudal rami, 24-segmented, segments 8–9 fused, on the left segments 20 and 21 are distinct, segment 25 not reduced. Antenna 2 exopod equals the endopod,

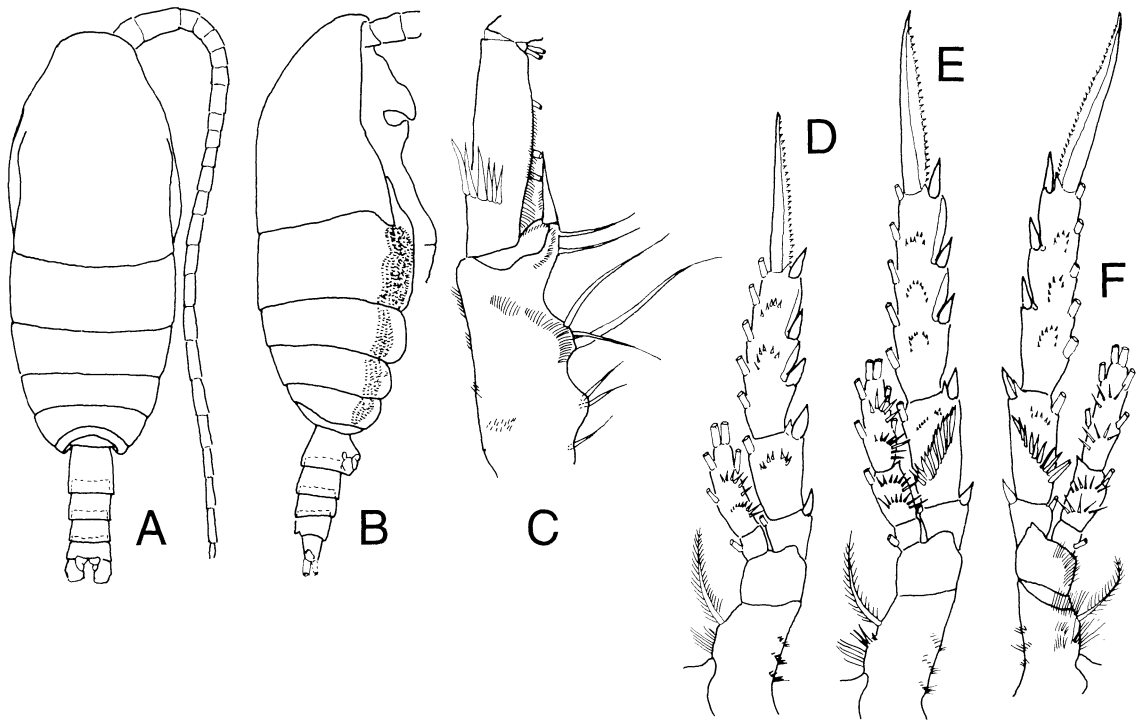


Fig. 59. *Spinocalanus spinosus* female (from Park 1970): A, dorsal fiew, B, lateral view; C, basipods 1 and 2 of maxilliped; D, leg 2, E, leg 3, F, leg 4.

exopod segment 1 with 1 seta, exopod segments 2 and 3 fused, exopod segment 2 with 2 setae. Mandible with 3 setae on the inner margin of basipod 2. Maxilla 1 of the female with some reduction in inner lobe 3, the basipod, and the endopod, where the size and number of setae are reduced; inner lobes 2 and 3 with 4 and 2 setae respectively. Swimming leg 1 basipod 2 without minute outer distal seta, with inner distal seta; exopod segment 1 without an outer distal spine, exopod segment 2 with an outer-edge spine; endopod with 2 terminal and 2–3 inner-edge setae. Surfaces of the swimming legs without spinules. Endopod segment 2 of leg 2 with 1 outer-edge seta, endopod segment 3 of legs 3 and 4 with 2 outer-edge setae. Female leg 5 absent. Male leg 5 very asymmetrical present on the left side as a uniramous, 5-segmented appendage, right basipod 2 reduced to a small knob.

(Damkaer 1975; Schulz 1989)

TYPE SPECIES: *Tanyrhinus naso* Farran, 1936

REMARKS: There are now three species in this genus: *T. meteorae* Schulz, 1989; *T. naso* (Farran, 1936); *T. pentatrichodes* Schulz, 1989 none of which has been taken in the Southwest Pacific. The genus name *Tanyrhinus* was pre-occupied by *Tanyrhinus* Mannerheim, 1852.

Superfamily **CLAUSOCALANOIDEA**

The following families are not a complete list of families in the Clausocalanoidea. The remaining families have been dealt with in previous volumes on the copepod fauna of the Southwest Pacific: Aetideidae (Bradford & Jillett 1980), and Euchaetidae, Phaennidae, Scolecithricidae, Diaixidae, and Tharybidae (Bradford *et al.* 1983).

Family **CLAUSOCALANIDAE** Giesbrecht, 1892

DEFINITION: Head and pedigerous segment 1 fused, pedigerous segments 4 and 5 usually fused. Caudal rami with 4 subequal terminal setae, outer border without setae.

Female: Urosome 4-segmented. Rostrum usually with 2 filaments. Antenna 1 generally with segments 8–9 fused and sometimes with segments 1–2 and

24–25 fused. Antenna 2 exopods usually 7-segmented with segments 1 and 2 each bearing 2 setae and segments 3–6 each bearing 1 seta; segment 7 elongate. Mandible with well-developed teeth on the blade. Maxilla 1 with the following arrangement of setae and spines: inner lobe 1 with 14 marginal spines and setae including 4 on the posterior surface and 1 on the anterior surface; inner lobe 2 basipod and endopod segment 2 with 5 setae, inner lobe 3 and endopod segment with 1–4 setae each; endopod segment with 3–7 setae; exopod with 11 setae; outer lobe 2 without a seta; outer lobe 1 with 9 setae. Maxilla 2, lobes 1–5, with 3–5, 3, 3, 3, and 4 setae, respectively. Maxilliped 5 terminal segments with 4, 4, 3, 4 and 4 setae respectively, basipod 2 with inner distal row of fine spines. Basipod segment 1 of swimming legs 2–4 with a plumose seta on its inner edge, basipod 2 of leg 1 with 1 inner seta. Basipod segment 2 of swimming legs 2 and 3 without an articulated spine on the outer edge. Basipod 2 of legs 2 and 3 may be ornamented with spines on the posterior surface. Exopods of swimming legs 1–4 3-segmented, usually with 1 outer-edge spine on segments 1 and 2; segment 3 of legs 2–4 with 3 outer-edge spines (1 subterminal) and 1 distal spine with a coarsely toothed outer border; exopod segment 3 of leg 1 with 1 outer-edge and one terminal spine. Endopods of leg 1 1-segmented, of leg 2 2-segmented, of legs 3 and 4 3-segmented. Surfaces of the legs with or without spinules. Exopod segments with the following setation on their inner margins: segment 1 with 1 seta on legs 2–4, naked on leg 1; segment 2 with 1 seta on legs 1–4; segment 3 of legs 2–4 with 4 setae, leg 1 with 3 setae. Endopods with the following setation on their margins: endopod of leg 1 with 3 inner and 2 terminal setae; endopod segment 1 of legs 2–4 with 1 inner seta; segment 2 of leg 2 with 2 inner, 2 terminal and 1 outer seta, of legs 3 and 4 with 1 inner seta; segment 3 of legs 3 and 4 with 2 inner, 2 terminal, and 1 outer seta. Leg 5 absent, rudimentary or uniramous. (Frost & Fleminger 1968)

Male: Urosome 5-segmented. Rostrum with or without filaments. Cephalic dorsal hump absent. Antenna 1 with segments 1–2 and 8–10 always fused; several other segments may also be fused. Antenna 2, mandible, maxilla 1 and maxilla 2 usually reduced in size and setation: antenna 2 with exopod segments 2 and 3 elongate relative to that of female, setae on exopod segments 1 and 2 small or absent; mandible blade reduced in size with teeth rudimentary or absent, palp with slightly reduced number of setae; maxilla 1 sometimes with reduced inner lobes; maxilla 2 small with only small setae; maxilliped with reduced inner setae and less robustly built than in the female. Swimming legs 1–4 as in the female, although there may be some sexual dimorphism in the proportions of legs and spinulation. Leg 5 asymmetrical, uniramous, or biramous with rudimentary endopods.

(Frost & Fleminger 1968)

An example of this family is *Clausocalanus brevipes* (Figs 60, 61).

REMARKS: The precedence of the family name Clausocalanidae over Pseudocalanidae was set in the ruling of the International Commission of Zoological Nomenclature (Opinion 1503, Bulletin of Zoological Nomenclature 45(3): 228–229, 1988).

This family contains at least six genera: *Clausocalanus* Giesbrecht, 1888; *Ctenocalanus* Giesbrecht, 1888; *Drepanopus* Brady, 1883; *Farrania* Sars, 1920; *Microcalanus* Sars, 1901; and *Pseudocalanus* Boeck, 1873. *Spicipes* Grice & Hulsemann, 1965 may also belong in this family.

This family contains epipelagic genera as well a species with a deep-living or benthopelagic habit. They are either herbivores (Arashkevich 1969; Arashkevich & Timonin 1970; Itoh 1970) or omnivores (Harding 1974). Members of *Pseudocalanus* are unusual for the family (and Calanoida) in that the females carry their eggs in an egg sac until they are ready to hatch.

Clausocalanus Giesbrecht, 1888

DEFINITION: As in the family definition with the following additional characters. Head and pedigerous segment 1, pedigerous segments 4 and 5 fused. Male rostrum reduced to a single median, ventrally protruding knob or not well developed. Medial caudal setae short, located on dorsal surface of caudal ramus, lateral-most seta reduced to a short, lateral spine. Male anal segment very short. Antenna 1 of female with segments 24–25 fused; in male, segments 1–2, 8–10, 13–14, 15–16, 20–21, and 24–25 are completely fused with incomplete fusion between other segments. Exopod of antenna 2 with segments 2 and 3 fused, exopod 1.5 or more times as long as endopod, segments 2 and 3 of exopod fused. Male antenna 2 exopod segment 2 elongate so that exopod is more than 2 times as long as the endopod; exopod segments 1 and 2 without setae. Basipod 2 of legs 2 and 3 broadened distally to about 1.5 or more times their width proximally, distoposterior margin with 3 or more spiniform

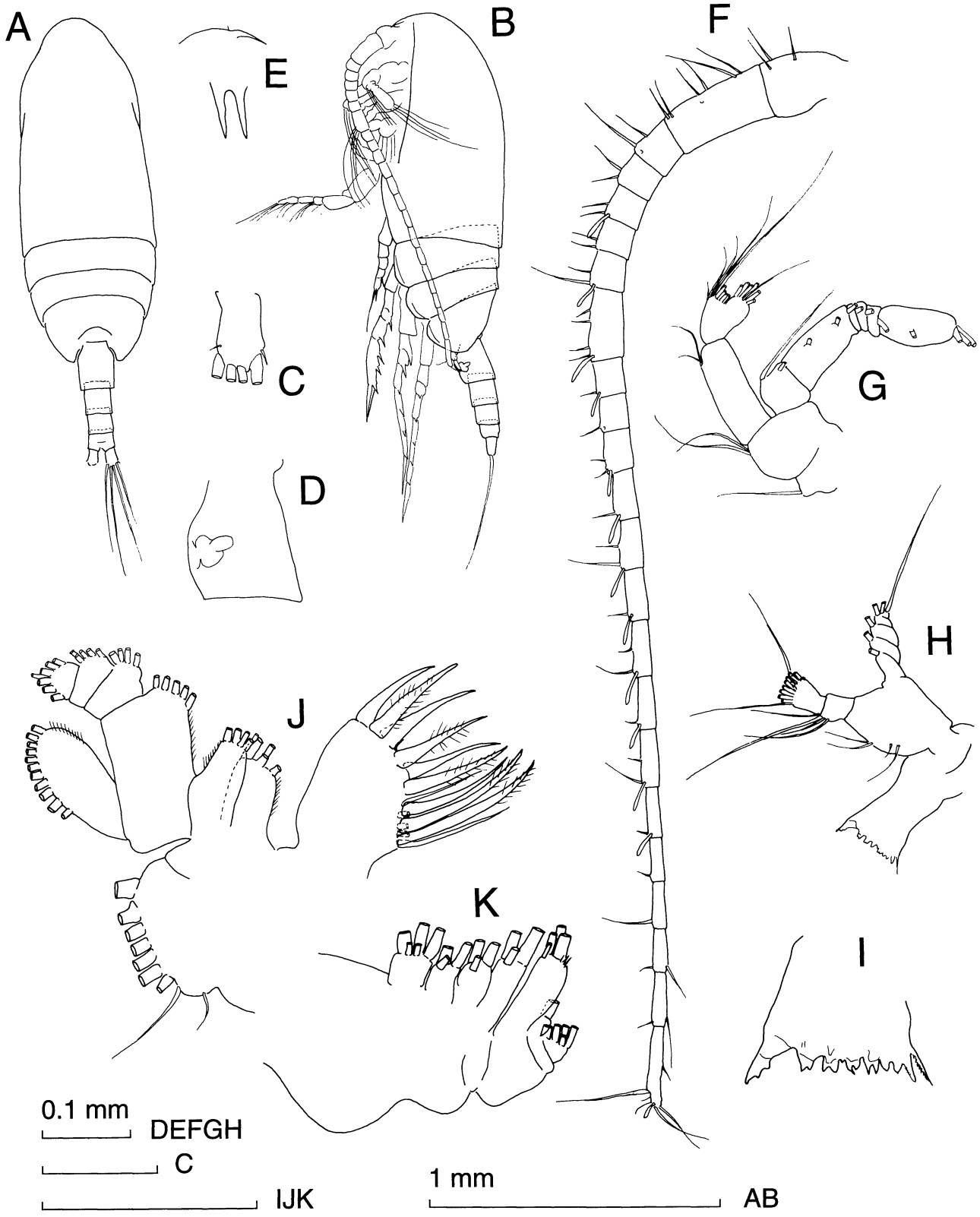
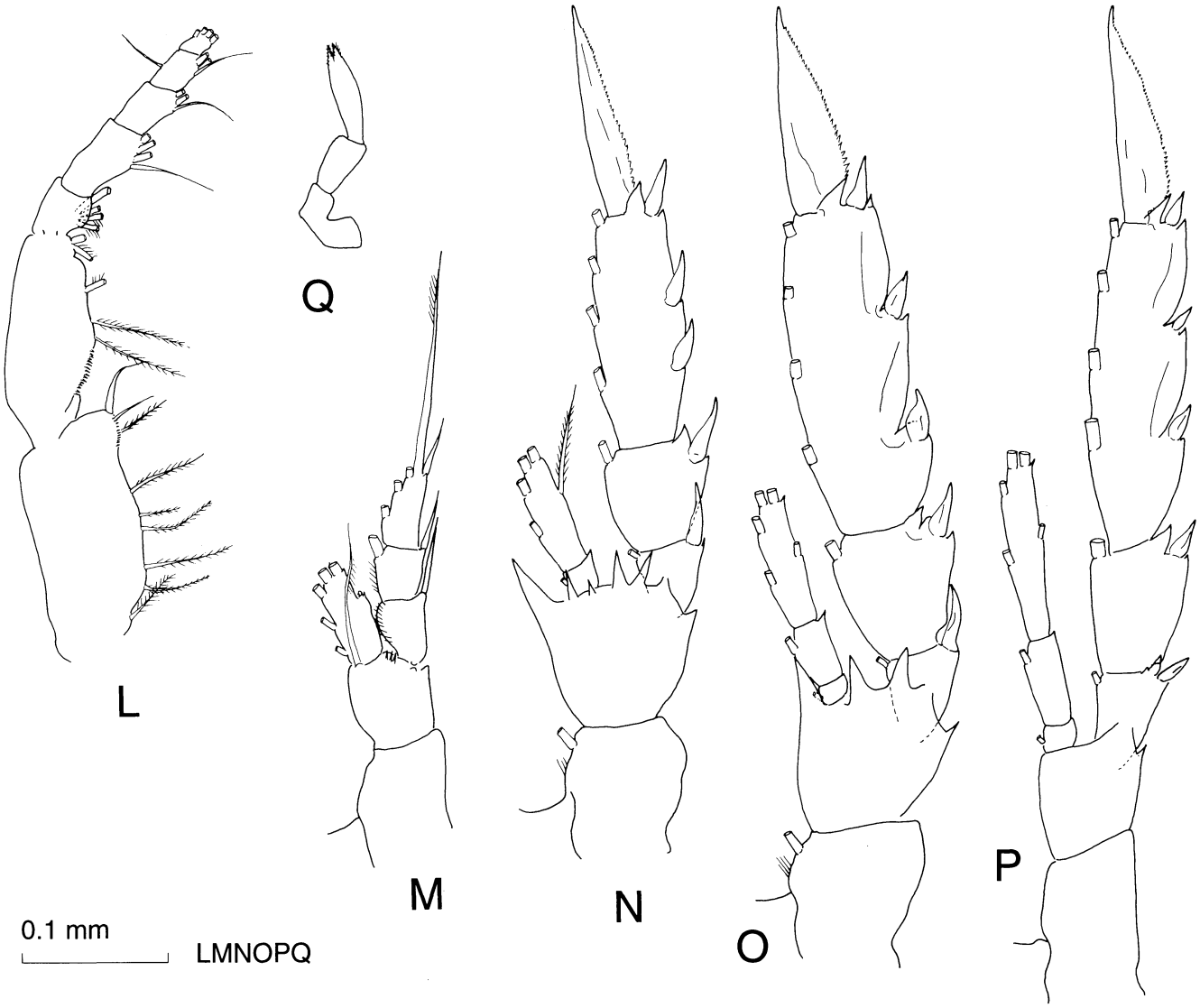


Fig. 60 (Above and opposite). *Clausocalanus brevipes* female from NZOI Stn B120: A, dorsal view; B, lateral view; C, dorsal view of right caudal ramus; D, lateral view of genital segment; E, rostrum; F, antenna 1; G, antenna 2; H, mandible; I, distal part of mandibular blade; J, maxilla 1; K, maxilla 2; L, maxilliped; M, leg 1; N, leg 2; O, leg 3; P, leg 4; Q, leg 5.



processes. Female leg 5 uniramous on both sides,symmetrical, 3-segmented; segment 3 produced distally into short, bifid, pointed processes. Male leg 5 present on both sides but of unequal length, uniramous; longer leg nearly always on the left, 5-segmented with segment 5 short and attached subapically to the previous segment; shorter leg 1 3-segmented, less than half the length of segment 1 of the other leg. (Frost & Fleminger 1968)

TYPE SPECIES: *Calanus mastigophorus* Claus, 1863

REMARKS: This genus now contains the following species most of which are recorded from the Southwest Pacific. *Clausocalanus arcuicornis* (Dana, 1849); *C. brevipes* Frost & Fleminger, 1968; *C. farrani* Sewell, 1929; *C. furcatus* (Brady, 1883); *C. ingens* Frost & Fleminger, 1968; *C. jobei* Frost & Fleminger, 1968; *C. laticeps* Farran, 1929; *C. lividius* Frost & Fleminger, 1968; *C. mastigophorus* (Claus, 1863); *C. minor* Sewell, 1929; *C. parapergens* Frost & Fleminger, 1968; *C. paululus* Farran, 1926; *C. pergens* Farran, 1926. Frost and Fleminger (1968) point out that *C. dubius* Brodsky, 1950 does not agree with the diagnosis for the genus. An excellent key to the species in this genus was prepared by Frost and Fleminger (1968).

Clausocalanus arcuicornis (Dana, 1849)
(Figs 62, 94)

DESCRIPTION: Size: females 1.15–1.62 mm, males 0.97–1.17 mm.

Female: As in the family and generic descriptions with the following additional characters. Rostrum in lateral view short, thick at its base, usually straight or slightly curved, and directed ventrally or slightly ventroposteriorly. Ventral profile of the genital segment in lateral view straight or, more often, slightly concave in the region of the seminal receptacle. Genital segment more than 1.5 times as

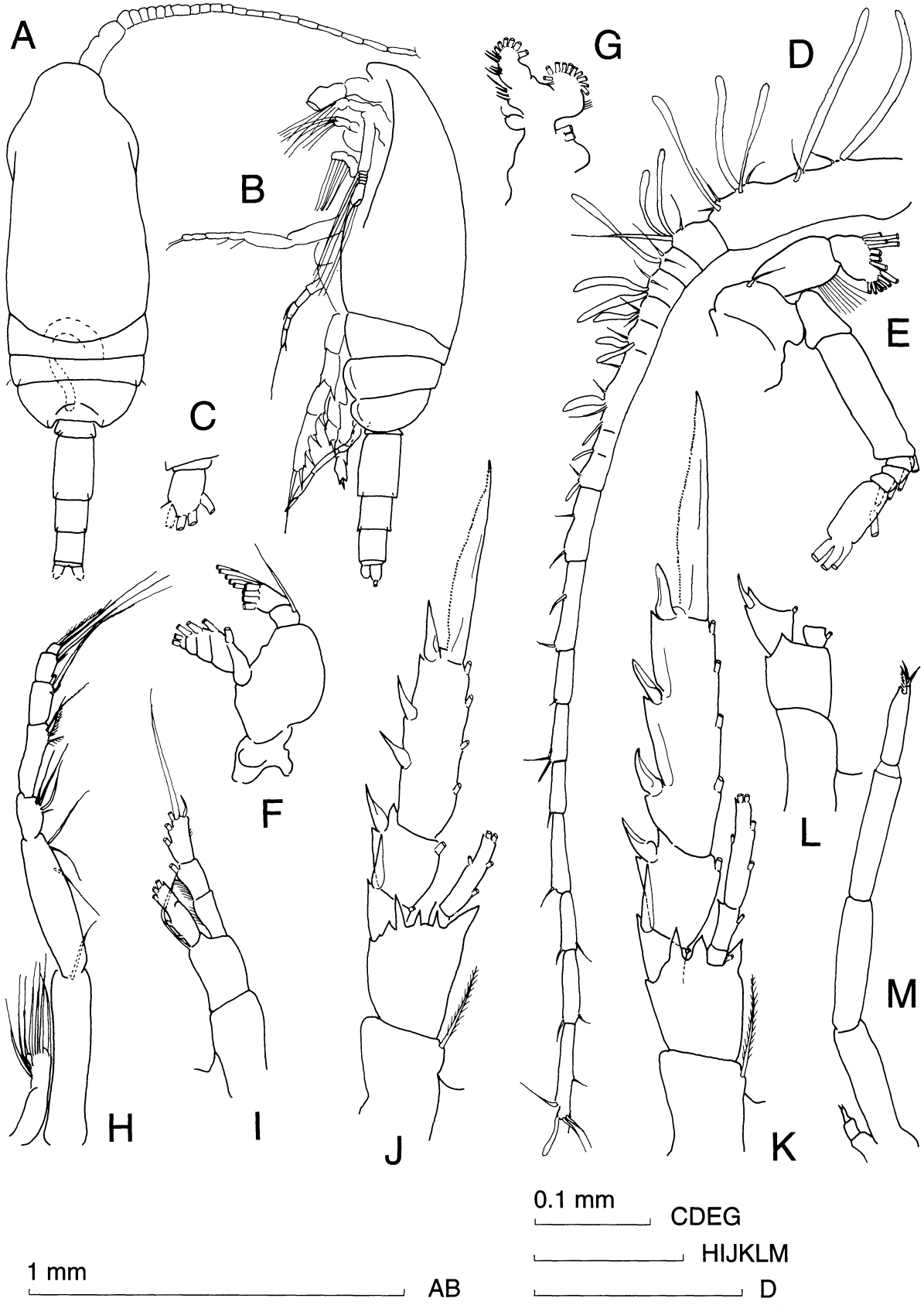


Fig. 61. *Clausocalanus brevipes* male from NZOI Stn B120: A, dorsal view; B, lateral view; C, dorsal view of left caudal ramus; D, antenna 1; E, antenna 2; F, mandible; G, maxilla 1; H, maxilla 2 and maxilliped; I, leg 1; J, leg 2; K, leg 3; L, leg 4; M, leg 5.

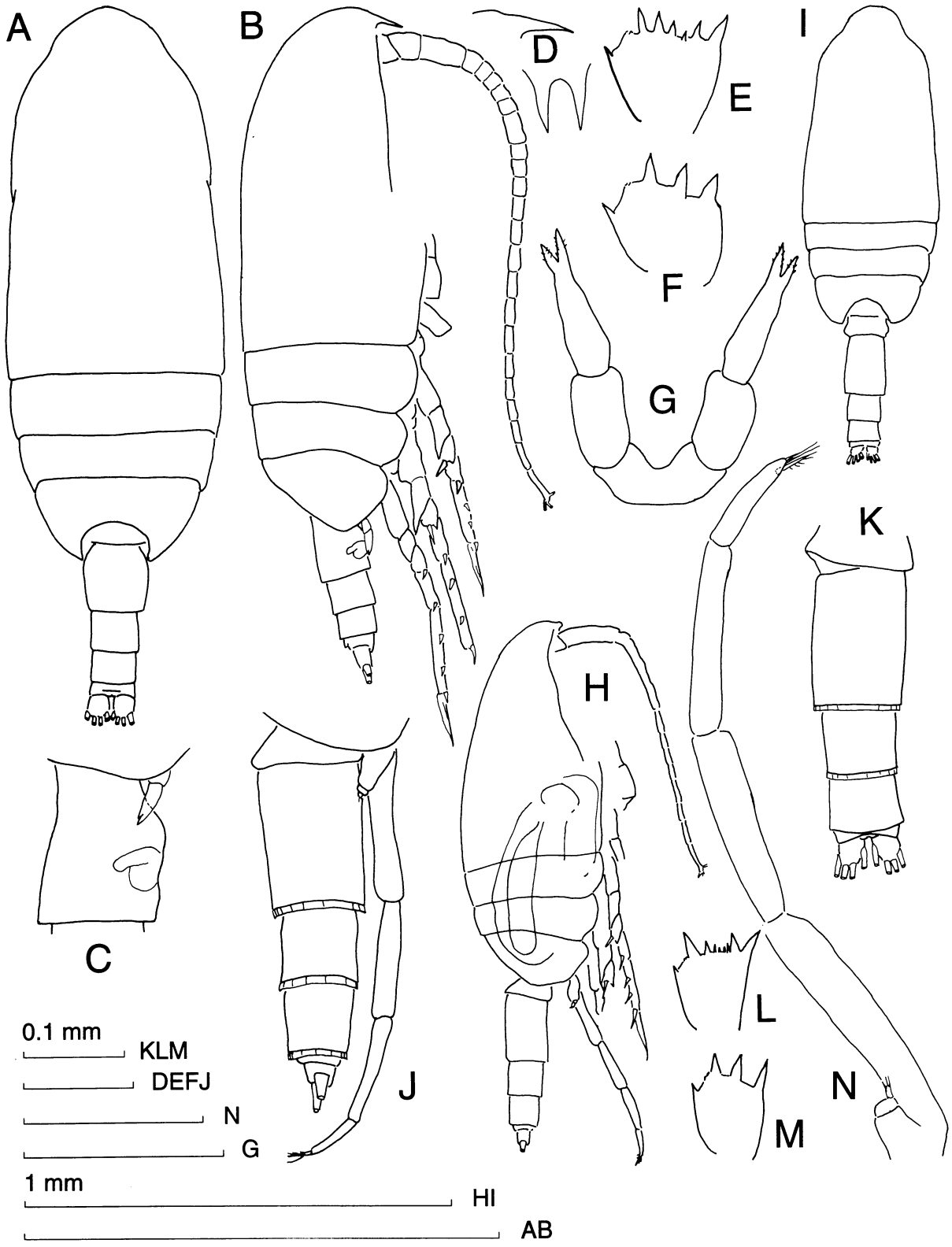


Fig. 62. *Clausocalanus arcuicornis* (from Frost & Fleminger 1968). Female: A, dorsal view; B, lateral view; C, lateral view of genital segment; D, rostrum in anterior and lateral view; E, basipod 2 of leg 2; F, basipod 2 of leg 3; G, leg 5. Male: H, lateral view; I, dorsal view; J, lateral view of urosome; K, dorsal view of urosome; L, basipod 2 of leg 2; M, basipod 2 of leg 3; N, leg 5.

long as urosome segment 3. Dorsal lobe of seminal receptacle in lateral view finger-like, not constricted in the region of attachment of the ventral lobe, straight or slightly curved, directed dorsally or posterodorsally, attached to the anterior edge of the ventral lobe; dorsal lobe in ventral view barely visible in the region of attachment to the ventral lobe. Leg 3 with basipod 2 spiniform processes 2 and 3 not tapered uniformly from their bases, and with the distance between processes 2 and 3 (l) less than 1.5 times the proximal width of process 3 (d) (*see* Fig. 72). Terminal points of segment 3 of leg 5 divergent and, when spinulate, with spinules on both inner and outer margins.

(Frost & Fleminger 1968)

Male: As in the family and generic descriptions with the following additional characters. Rostrum in lateral view knoblike and protruding ventrally. Longer ramus of leg 5 and genital pore on the left side; left leg 5 longer than the urosome, armed distally with long, slender, straight setae; right leg 5 usually 3-segmented. (Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group II.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Frost and Fleminger (1968); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	surface	1 female 1.10 mm
A313	0–914	1 male
F947	0–200	1 female

DISTRIBUTION: Tropical-subtropical, circumglobal (Frost & Fleminger 1968).

Clausocalanus brevipes Frost & Fleminger, 1968
(Figs 60, 61, 95)

DESCRIPTION: Size: females 1.24–1.62 mm, males 1.12–1.2 mm.

Female: As for the family and generic descriptions with the following additional characters. Similar to *C. pergens* but posterior margin of last mesosomal segment more angular in lateral view than in *C. pergens*. Rostrum in lateral view slender or thick and curved ventroposteriorly. Ventral profile of genital segment in lateral view not as convex as in *C. pergens*. Genital segment more than 1.5 times as long as urosome segment 3. Ventral lobe of the seminal receptacle in lateral view large, visible anterior to the base of its dorsal lobe; dorsal lobe bulb-shaped, constricted in the region of attachment to the ventral lobe; dorsal and ventral lobes conspicuous in ventral view. Leg 3 with basipod 2 spiniform processes 2 and 3 usually not tapered uniformly from their bases; the spacing of processes 2 and 3 as in *C. pergens*. Segment 3 of leg 5 more than 2.0 times as long as segment 1.

(Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body larger and more robust than in *C. pergens*. Rostrum in lateral view knob-like and protruding ventrally. Leg 3 with basipod 2 spiniform processes 2 and 3 not tapered uniformly from their bases. Longer ramus of leg 5 and genital pore on the left, and much shorter than the urosome.

(Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group III.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Bradford (1972 as *C. arcuicornis*); Frost & Fleminger (1968); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B111	0–500	1 female 1.50 mm
B113	0–500	1 female, 1 male
B114	0–500	2 females 1.50, 1.45 mm
B116	0–125	12 females, 5 males
B117	0–500	8 females, 4 males
B118	0–125	3 females, 1 male
	0–500	10 females 1.56 mm, 5 males
B119	0–500	7 females, 3 males
B120	0–400	21 females 1.4 mm 5 males
	0–150	16 females, 11 males
D599	0–100	25 females, 1 male
Mu67/4	0–150	1 female
Mu67/77	0–150	6 females

DISTRIBUTION: Subantarctic, circumglobal (Frost & Fleminger 1968).

Clausocalanus furcatus (Brady, 1883)

(Figs 63, 95)

DESCRIPTION: Size: females 0.94–1.31 mm, males 0.70–0.92 mm.

Female: As for the family and generic descriptions with the following additional characters. Rostrum in lateral view usually thick, short, and slightly curved. Ventral profile of the genital segment in lateral view somewhat undulant. Genital segment length equal to or less than urosome segment 3 and slightly greater than the length of urosome segment 2. Ventral lobe of seminal receptacle in lateral view relatively small; dorsal lobe large and bulbous; dorsal lobe conspicuous in lateral, dorsal, and ventral views. Antenna 1 with a single aesthete on segments 2–7, 10–19, 22, and fused segments 24–25; 2 aesthetes on fused segments 8–9. Leg 3 with form and spacing of basipod 2 spiniform processes 2 and 3 as in *C. pergens*. Segment 3 of leg 5 equal to or more than 2.0 times as long as segment 1; terminal points of segment 3 never spinulate.

(Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Rostrum in lateral view not well developed and not protruding ventrally. Leg 3 with basipod 2 spiniform processes 2 and 3 usually not tapering uniformly from their bases. Longer ramus of leg 5 and genital pore usually on the right side, occasionally on the left; longer ramus of leg 5 longer than the urosome; shorter ramus usually 2-segmented, distal segment small. (Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group III.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Frost & Fleminger (1968); Greenwood (1976).

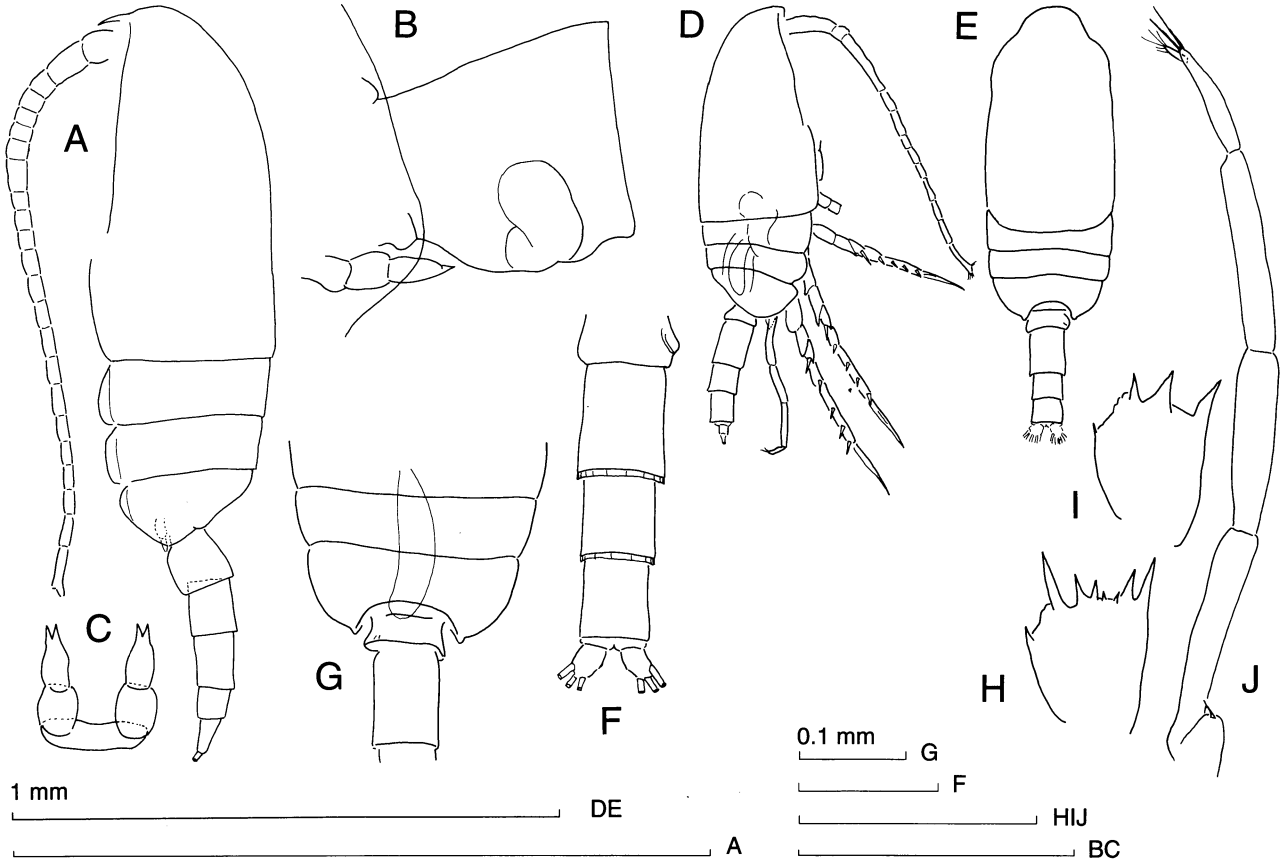


Fig. 63. *Clausocalanus furcatus*. Female from NZOI Stn C544: A, lateral view; B, lateral view of genital segment; C, leg 5. Male (from Frost & Fleminger 1968): D, dorsal view; E, lateral view; F, dorsal view of urosome; G, dorsal view of posterior part of the metasome and anterior segment of the urosome; H, basipod 2 of leg 2; I, basipod 2 of leg 3; J, leg 5.

NEW RECORD:

Station No.	Depth of Haul (m)	Specimens
C544	surface	13 females 1.00–1.10 mm

DISTRIBUTION: Tropical-subtropical, circumglobal (Frost & Fleminger 1968).

Clausocalanus ingens Frost & Fleminger, 1968
(Figs 64, 93)

DESCRIPTION: Size: females 1.44–1.90 mm, males 0.99–1.08 mm.

Female: As for the family and generic descriptions with the following additional characters. Body similar to *C. lividus;* outline of dorsal surface of the head and pedigerous segment 1 in lateral view rounded from the base of the rostrum to the region above the maxillae, then straight to the articulation with pedigerous segment 2; forehead protuberant anterior to the rostrum, greatest anterior extension of the forehead well dorsal to the frontal organ. Rostrum in lateral view long, slender, and curved ventroposteriorly; in lateral and anteroventral view it is uniformly tapered from its base. Ventral profile of the genital segment nonprotuberant in lateral view. Genital segment more than 1.5 times as long as urosome segment 3. Ventral lobe of seminal receptacle small in lateral view; dorsal lobe long and thick, directed dorsally or dorsoanteriorly; ventral lobe conspicuous in ventral view. Leg 3 with form and spacing of basipod 2 spiniform processes 2 and 3 as in *C. mastigophorus.* Terminal points of segment 3 of leg 5 not spinulate.
(Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Rostrum in lateral view knob-like and protruding ventrally.

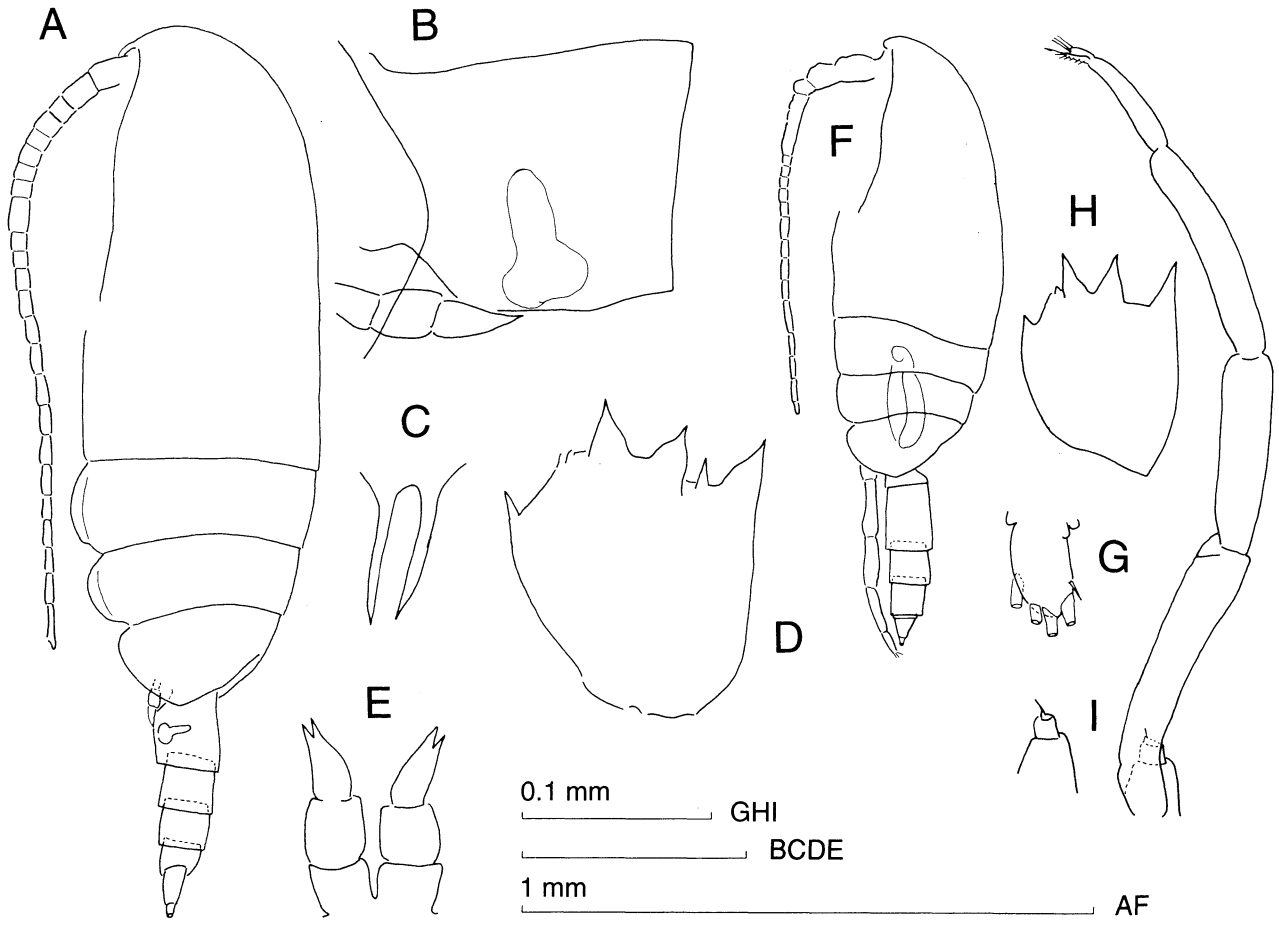


Fig. 64. *Clausocalanus ingens* from NZOI Stn C587. Female: A, lateral view; B, lateral of genital segment; C, anterodorsal view of rostrum; D, basipod 2 of leg 3; E, leg 5. Male: F, lateral view; G, dorsal view of left caudal ramus; H, basipod 2 of leg 3; I, leg 5.

Caudal rami less than 1.6 times as long as wide. Leg 3 with basipod 2 spiniform processes 2 and 3 not tapered uniformly. Longer ramus of leg 5 and genital pore on the left and longer than the urosome; right leg 5 3-segmented.
(Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group I.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Frost & Fleminger 1968; Nyan Taw 1978.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A295	0–500	1 female
A303	0–1000	1 female
A307	surface	2 females, 1 male
A313	0–914	3 females
A318	surface	48 females
A332	surface	9 females 1.30 mm
A341	surface	4 females
A343	0–500	9 females, 1 male 0.92 mm
B97	surface	15 females 1.46–1.72 mm
		2 males 1.00, 1.11 mm
B98	surface	18 females 1.60–1.79 mm
		2 males 1.00, 1.13 mm
B106	surface	1 female
C544	surface	1 female
C575	surface	2 females
C587	surface	7 females, 4 males
D599	0–100	4 females
D614	100–250	8 females
	250–500	3 females, 1 male
F947	0–200	1 female
	0–500	1 female
Mu66/67A	0–150	4 females 1.50–1.70 mm
Mu67/4	0–150	2 females, 1 male
Mu67/7	0–150	3 females 1.40–1.55 mm
Mu67/8	0–150	3 females
Mu67/44	0–150	5 females 1.40–1.70 mm
Mu67/45	0-150	8 females 1.401.70 mm
		1 male
Mu67/48	0–150	2 females 1.50, 1.50 mm
Mu67/50	0–150	4 females 1.40–1.70 mm
Mu67/52	0–150	1 female 1.55 mm, 1 male
Mu67/55	0–150	1 female 1.45 mm
Leigh 24/4/65	0–45	1 male

DISTRIBUTION: Warm-temperate, southern hemisphere, circumglobal (Frost & Fleminger 1968).

Clausocalanus jobei Frost & Fleminger, 1968
(Figs 65, 94)

DESCRIPTION: Size: females 1.01–1.56 mm, males 0.87–1.07 mm.

Female: As for the family and generic descriptions with the following additional characters. Body similar to *C. farrani* except the forehead is slightly more rounded in lateral view. Rostrum in lateral view long and slender, curved ventroposteriorly. Ventral profile of the genital segment and structure of the seminal receptacle as in *C. farrani*. Genital segment more than 1.5 times as long as urosome segment 3. Leg 3 with the form and spacing of basipod 2 spiniform processes 2 and 3 as in *C. arcuicornis*. Terminal points of segment 3 of leg 5 divergent and always spinulate only on the inner margins. (Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body and rostrum in lateral view as in *C. farrani*. Longer ramus of leg 5 on the left and longer than the urosome, segment 5 armed distally with 2 thick, curved spiniform setae; right leg 5 as in *C. farrani*.
(Frost & Fleminger 1968)

REMARKS: This species belongs to Frost & Fleminger's (1968) Group II.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Frost & Fleminger (1968); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A295	0–500	1 female
F945	0–500	2 female
F947	0–200	2 female
	0–500	3 females
Leigh 24/4/65	0–45	20 females
Leigh 25/7/64	0–45	1 female
Leigh 22/8/64	0–45	10 females
Leigh 19/9/64	0–45	26 females, 5 males
LB (B) 1/3/64	0-45	3 females, 1 male
L (A&B) 23/5/64	0-45	1 female

DISTRIBUTION: Tropical or tropical-subtropical, circumglobal; appears to have a broadly neritic distribution throughout its range (Frost & Fleminger 1968).

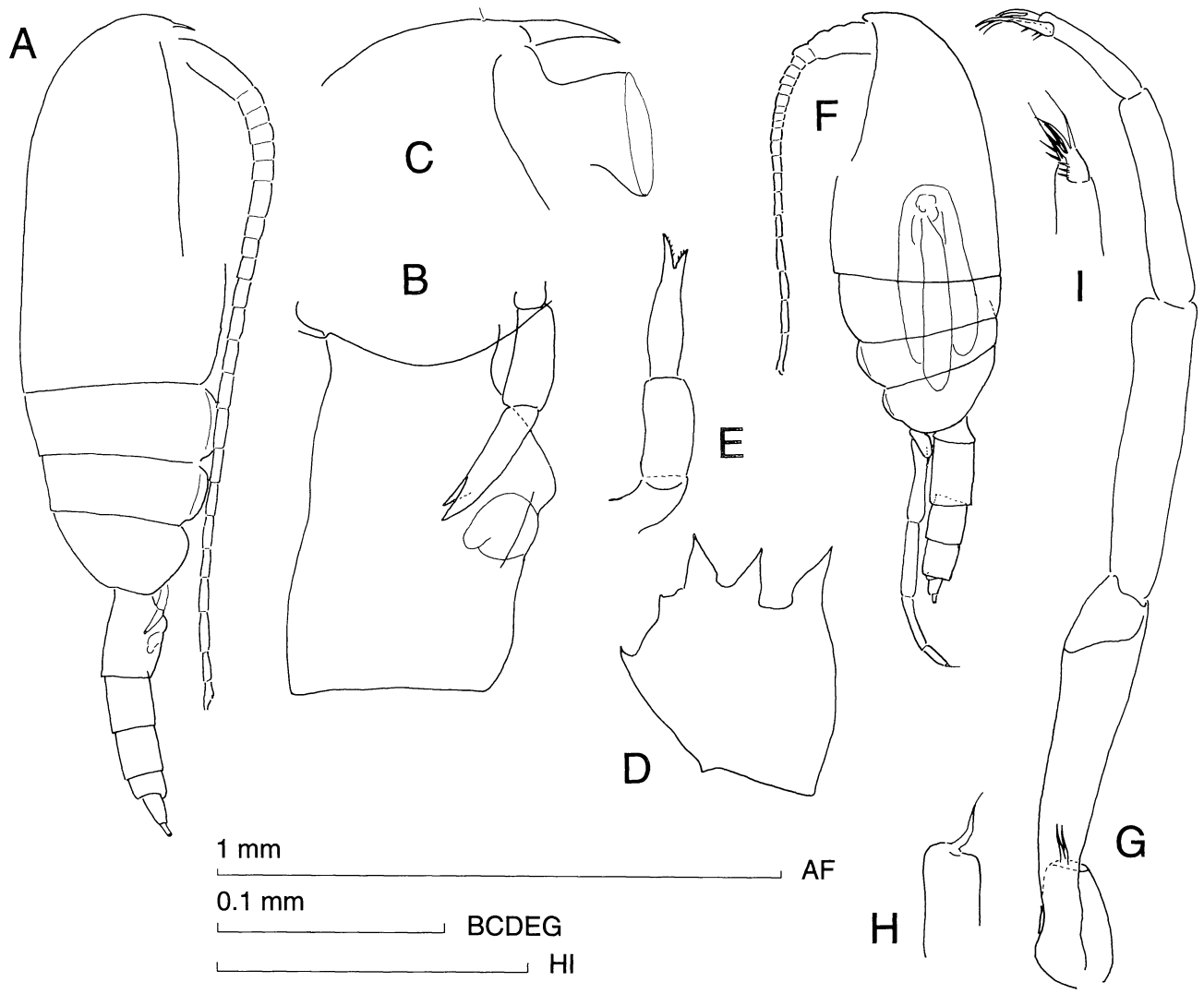


Fig. 65. *Clausocalanus jobei* from Leigh Stn 19/9/64. Female: A, lateral view; B, lateral view of genital segment; C, lateral view of rostrum; D, basipod 2 of leg 3; E, leg 5. Male: F, lateral view; G, leg 5; H, terminal part of right leg 5; I, terminal part of left leg 5.

Clausocalanus laticeps Farran, 1929 (Figs 66, 93)

DESCRIPTION: Size: females 1.25–1.67 mm, males 1.01–1.10 mm.

Female: As for the family and generic descriptions with the following additional characters. Frontal region of the head in lateral view usually vaulted, in dorsal view rounded and without indented lateral margins; forehead in lateral view usually flattened but sometimes rounded. Rostrum in lateral view short, usually straight, directed ventro-posteriorly. Ventral profile of the genital segment nonpro-tuberant. Genital segment more than 1.5 times as long as urosome segment 3. Ventral lobe of the seminal receptacle in lateral view large; dorsal lobe slender, digitiform, directed dorsally or slightly dorsoposteriorly; dorsal and ventral lobes conspicuous in ventral view. Leg 3 with basipod spiniform processes 2 and 3 slender and uniformly tapered from their bases; the distance between processes 2 and 3 (l) equal to or more than 2.0 times the proximal width of process 3 (d) (*see* Fig. 72). Terminal points of segment 3 of leg 5 not spinulate. (Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Rostrum in lateral view knob-like and protruding ventrally. Caudal rami more than 1.6 times as long as wide.

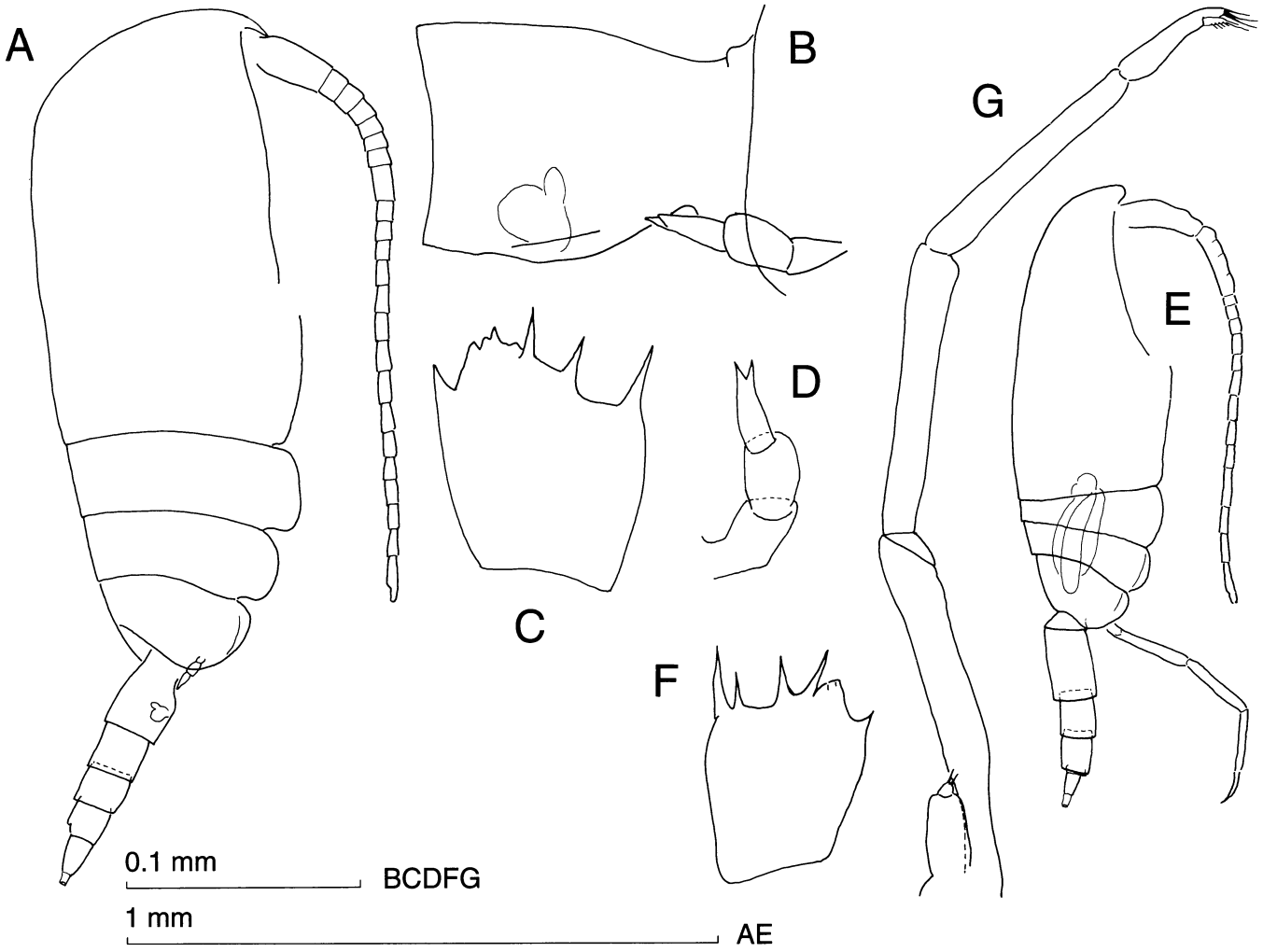


Fig. 66. *Clausocalanus laticeps* from NZOI Stn B111. Female: A, lateral view; B, lateral view of genital segment; C, basipod 2 of leg 3; D, leg 5. Male: E, lateral view; F, basipod 2 of leg 3; G, leg 5.

Leg 3 with basipod 2 spiniform processes uniformly tapered from their bases. Longer ramus of leg 5 and genital pore on the left, longer than urosome; right leg 5 3-segmented. (Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group I.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Bary (1951); Farran (1929); Vervoort (1957); Frost & Fleminger (1968); Jillett (1976); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B97	surface	2 females 1.00, 1.10 mm
B98	surface	7 females 1.50–1.68 mm
		4 males 1.02–1.20 mm
B106	surface	11 females 1.46–1.60 mm
B107	surface	1 female 1.20 mm
B109	0–125	1 female 1.50 mm
B110	0–125	12 females
	0–500	1 female
B111	0–200	3 females, 3 males 0.90–1.05 mm
B112	0–125	few females
	0–500	6 females
B113	0–500	3 females
B114	0–125	11 females, 2 males
	0–500	4 females, 1 male 1.12 mm
B116	0–125	15 females, 2 males
B117	0–500	3 females
B119	0–500	6 females
B120	0–150	13 females
	0–400	9 females
D599	100–250	2 females

DISTRIBUTION: Antarctic to subantarctic, circumglobal (Frost & Fleminger 1968).

Clausocalanus lividus Frost & Fleminger, 1958
(Figs 67, 93)

DESCRIPTION: Size: females 1.26–1.77 mm, males 1.13–1.45 mm.

Female: As for the family and generic descriptions with the following additional characters. Body similar of *C. mastigophorus* but urosome relatively longer; outline of dorsal surface of head in lateral view rounded from the base of the rostrum to the region above the maxillae, then straight to the articulation with pedigerous segment 2; forehead usually not conspicuously protuberant anterior to the rostrum, greatest anterior extension of the forehead at the level of the frontal organ or, rarely, slightly dorsal to the frontal organ. Rostrum in lateral view long, thick, usually straight, tapered uniformly; uniformly tapered in anterior view. Ventral profile of the genital segment nonprotuberant. Genital segment more than 1.5 times as long as urosome segment 3. Ventral lobe of seminal receptacle in lateral view large; dorsal lobe usually thick, directed dorsally or dorsoanteriorly; ventral lobe conspicuous in ventral view. Leg 3 with the form and spacing of basipod 2 spiniform processes 2 and 3 as in *C. mastigophorus*. Terminal points of segment 3 of leg 5 not spinulate.

(Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body more robust than in *C. mastigophorus*, urosome relatively longer; outline of dorsal surface of the prosome in lateral view usually continously rounded from the base of the rostrum to the posterior margin of the

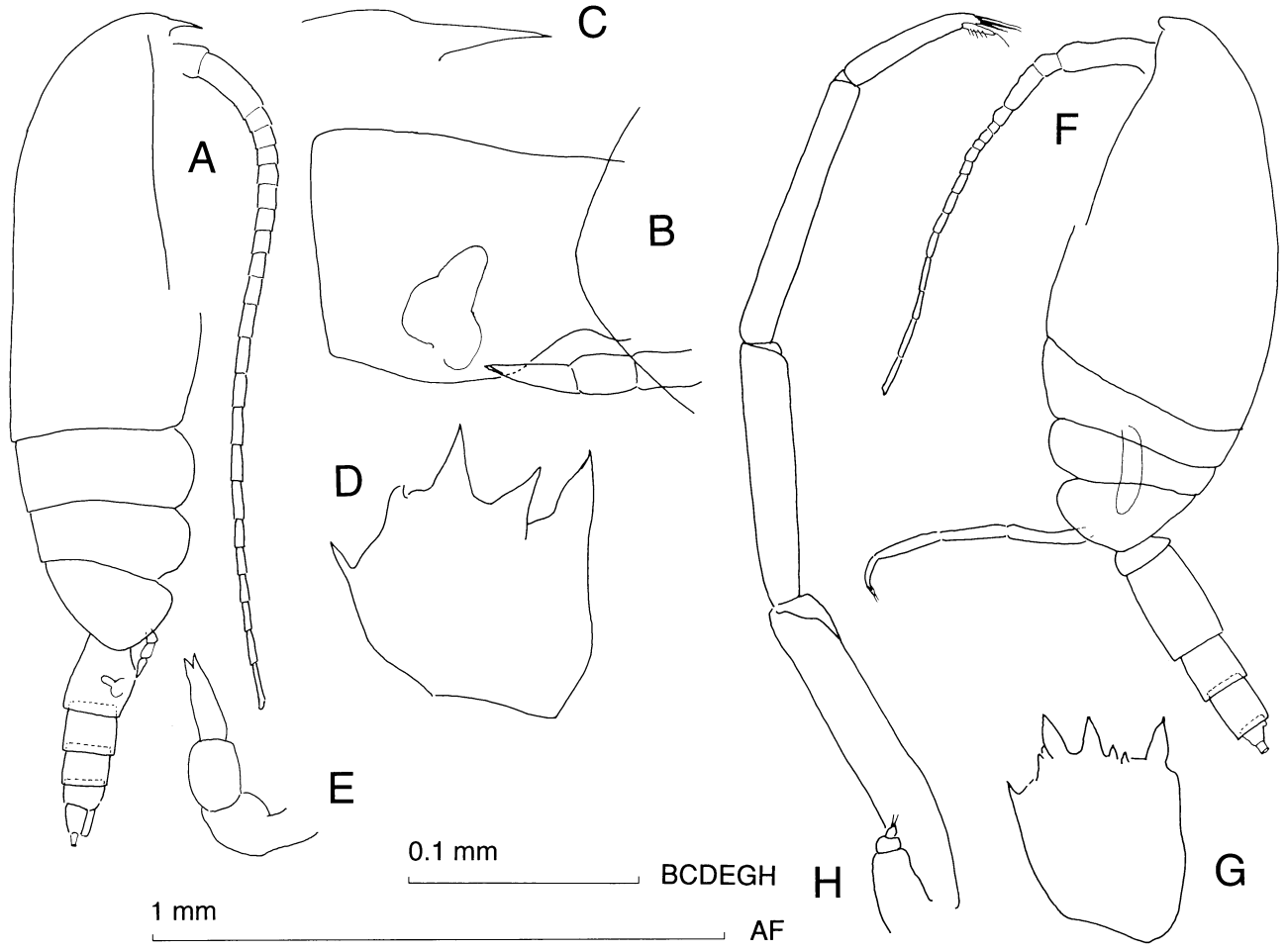


Fig. 67. *Clausocalanus lividus* from NZOI Stn A303. Female: A, lateral view; B, lateral view of genital segment; C, lateral view of rostrum; D, basipod 2 of leg 3; E, leg 5. Male: F, lateral view; G, basipod 2 of leg 3; H, leg 5.

last pedigerous segment; posterolateral margin of pedigerous segment 1 oblique, dorsal side extending farther posteriorly than the ventral side. Rostrum in lateral view knob-like and protruding ventrally. Caudal rami less than 1.6 times as long as wide. Leg 3 with basipod 2 spiniform processes 2 and 3 not tapered uniformly from the base. Longer ramus of leg 5 and genital pore on left side, left leg 5 longer than urosome; right leg 5 3-segmented.

(Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group I.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Frost & Fleminger (1968).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A292	surface	14 females 1.30–1.35 mm
		1 male 1.20 mm
A295	surface	6 females, 1 male
	0–500	5 females 1.20–1.40 mm
		1 male 1.20 mm
	400-1000	1 male 1.15 mm
A302	surface	7 females
	0–500	3 females 1.50 mm
	500–1000	1 female 1.70 mm
A303	surface	10 females 1.36–1.44 mm
		5 males 1.30 mm
	450-1000	2 females 1.40–1.45 mm
A343	0–500	2 females
C537	0–250	13 females, 1 male
C544	surface	18 females
C587	surface	2 females, 1 male
F947	0–500	4 females

DISTRIBUTION: Subtropical, circumglobal (Frost & Fleminger 1968).

Clausocalanus mastigophorus (Claus, 1863) (Fig. 68)

DESCRIPTION: Size: females 1.23–1.84 mm, males 1.05–1.45 mm.

Female: As for the family and generic descriptions with the following additional characters. Body with the frontal region in lateral view usually rounded from the base of the rostrum to the region above the maxillipeds then straight to the articulation with pedigerous segment 2, forehead not conspicuously protuberant anterior to the rostrum, greatest anterior extension of the forehead at the level of the frontal organ. Rostrum in lateral view long, slender or thick, not tapering uniformly, directed ventroposteriorly, rostrum also not tapering uniformly in anteroventral view. Ventral profile of the genital segment nonprotuberant in lateral view. Genital segment more than 1.5 times as long as urosome segment 3. Ventral lobe of seminal receptacle in lateral view large; dorsal lobe often inconspicuous, long and slender, usually directed dorsally or dorsoanteriorly; ventral lobe conspicuous in ventral view. Leg 3 with basipod 2 spiniform processes 2 and 3 not uniformly tapered from their bases, distance between them (l) less than 1.5 times the proximal width of process 3 (d) (see Fig. 72). Terminal points of segment 3 of leg 5 not spinulate.

(Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body as in the figure, outline of the dorsal surface of the prosome in lateral view usually not continuously rounded from the rostrum to the posterior margin of the last pedigerous segment, posterolateral margin of pedigerous segment 1 nearly perpendicular to the longitudinal axis of the body. Rostrum in lateral view knob-like and protruding ventrally. Caudal rami less than 1.6 times as long as wide. Leg 3 with basipod 2 spiniform processes 2 and 3 usually not tapered uniformly from their bases. Longer ramus of leg 5 and genital pore on left side, left leg 5 longer than urosome; right leg 5 3-segmented, distal segments usually well developed.

(Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group I.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nyan Taw (1978).

NEW RECORDS: Nil.

DISTRIBUTION: Tropical-subtropical circumglobal (Frost & Fleminger 1968).

Clausocalanus minor Sewell, 1929 (Figs 69, 94)

DESCRIPTION: Size: females 1.08–1.26 mm, males 0.79–1.04 mm.

Female: As for the family and generic descriptions with the following additional characters. Body similar to *C. jobei*, but relatively stouter. Rostrum in lateral

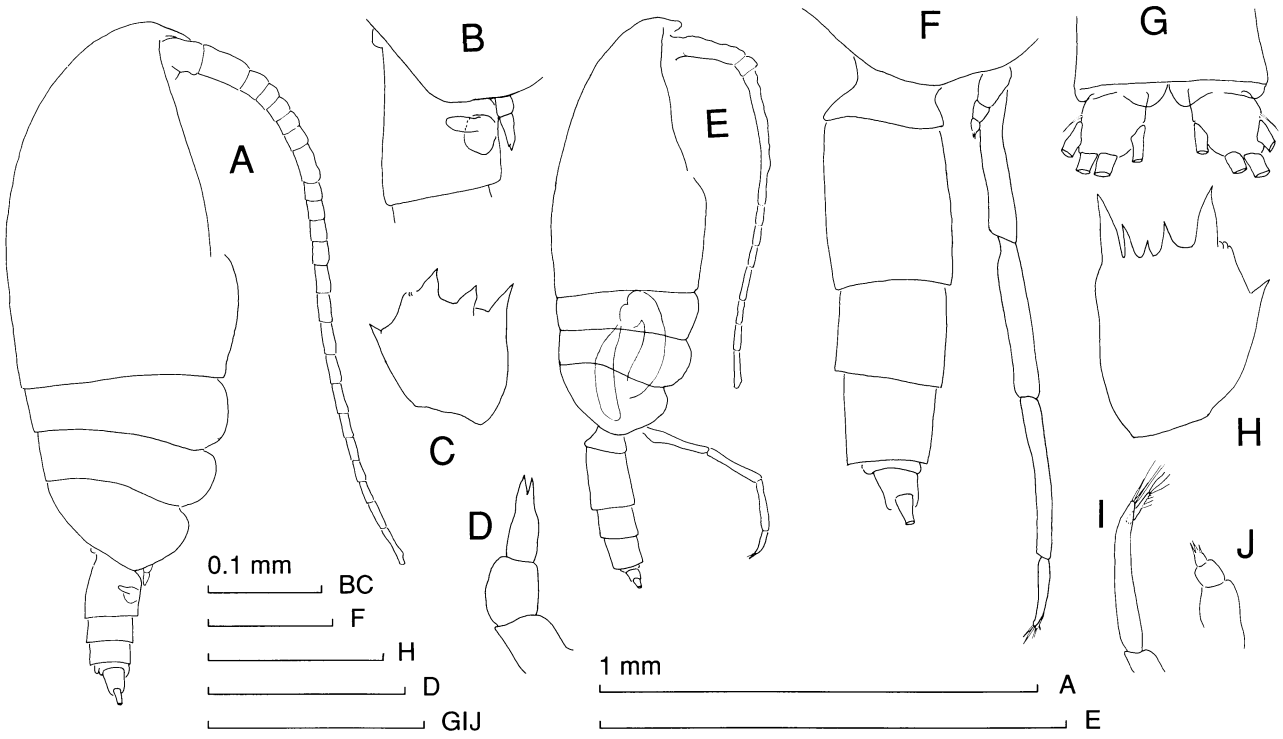


Fig. 68. *Clausocalanus mastigophorus* (from Frost & Fleminger 1968). Female: A, lateral view; B, lateral view of genital segment; C, basipod 2 of leg 3; D, leg 5. Male: E, lateral view; F, lateral view of urosome and leg 5; G, dorsal view of caudal rami; H, basipod 2 of leg 3; I, terminal part of left leg 5; J, right leg 5.

view slender and curved ventroposteriorly. Ventral profile of the genital segment in lateral view with a prominent step posterior to the genital pores. Genital segment more than 1.5 times as long as urosome segment 3. Dorsal lobe of the seminal receptacle in lateral view conspicuous; a second lobe present anterior and medial to the dorsal lobe; dorsal lobe in ventral view conspicuous and directed obliquely posteriorly. Leg 3 with the form and spacing of basipod 2 spiniform processes 2 and 3 as in *C. arcuicornis*, the bases of spiniform processes 1 and 2 set close together. Terminal points of segment 3 of leg 5 divergent and always spinulate only on the inner margins. (Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body and rostrum in lateral view similar to *C. farrani*. Longer ramus of leg 5 and genital pore on the left; left leg 5 longer than the urosome, segment 5 armed distally with slender, straight setae; right leg 5 2- or 3-segmented, distal segments usually large. (Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group II.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Dakin & Colefax (1940); Frost & Fleminger (1968); Greenwood (1976).

NEW RECORD:

Station No.	Depth of Haul (m)	Specimens
F947	0–200	2 females

DISTRIBUTION: Tropical, confined to the Indian and Pacific Oceans (Frost & Fleminger 1968).

Clausocalanus parapergens Frost & Fleminger, 1968 (Figs 70, 95)

DESCRIPTION: Size: females 0.971.38 mm, males 0.97–1.14 mm.

Female: As for the family and generic descriptions with the following additional characters. Body similar to *C. brevipes*, but urosome relatively shorter. Rostrum in lateral view usually short, thick, and curved ventroposteriorly. Ventral profile of the genital segment in lateral view somewhat undulant. Genital

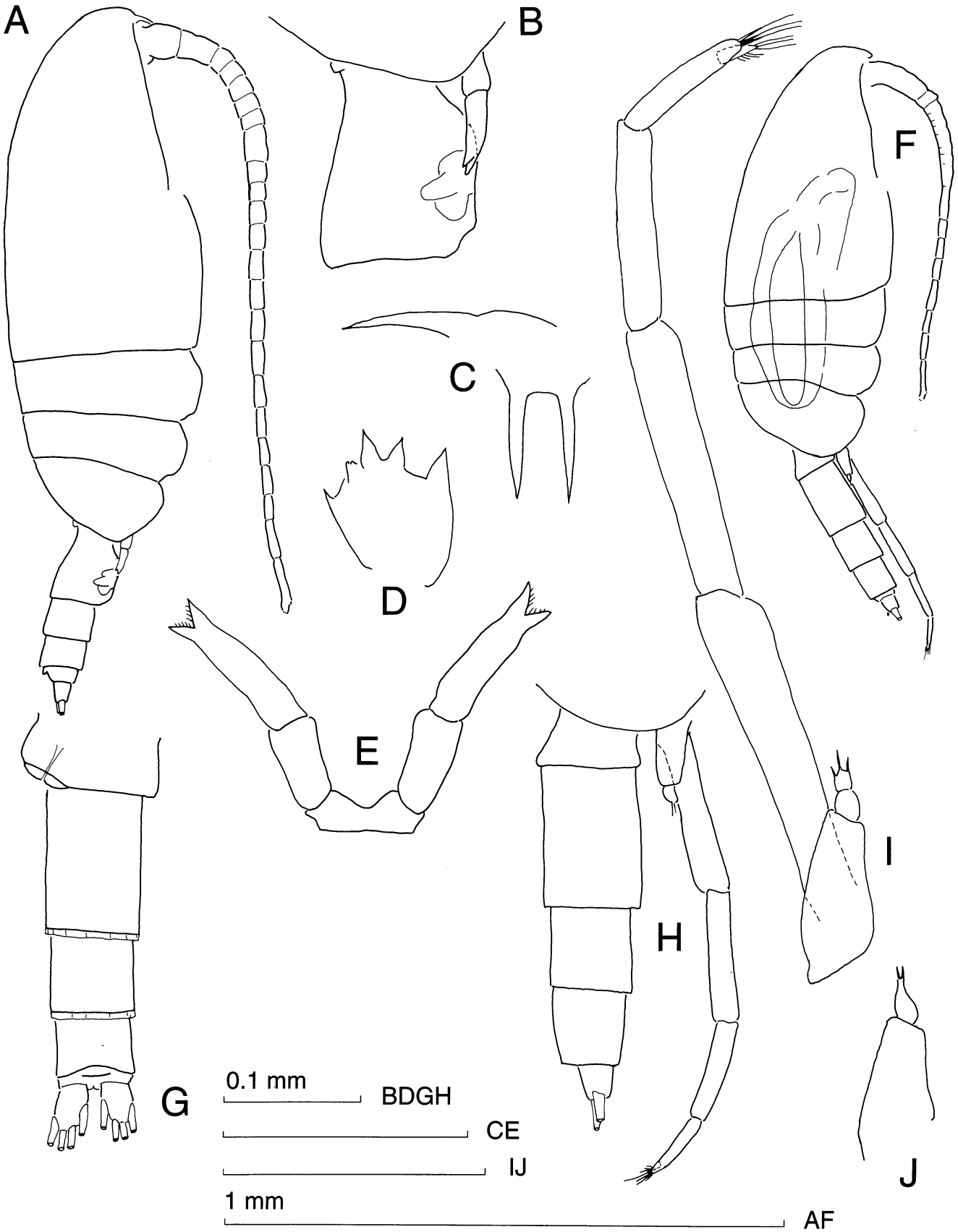


Fig. 69. *Clausocalanus minor* (from Frost & Fleminger 1968). Female: A, lateral view; B, lateral view of genital segment; C, rostrum lateral and anterior views; D, basipod 2 of leg 3; E, leg 5. Male: F, lateral view; G, dorsal view of urosome; H, lateral view of urosome; I, leg 5; J, right leg 5.

segment more than 1.5 times as long as urosome segment 3. Structure of the seminal receptacle in lateral and ventral views as in *C. brevipes*. Leg 3 with form and spacing of basipod 2 spiniform processes 2 and 3 as in *C. brevipes*. Segment 2 of leg 5 more than 2.0 times as long as segment 1.

(Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body similar to *C. arcuicornis*. Rostrum in lateral view knob-like and protruding ventrally. Caudal ramus less than 1.6 times as long as wide. Leg 3 with basipod 2 spiniform processes 2 and 3 not tapered uniformly from their bases. Longer ramus of leg 5 and genital pore on left; left leg 5 longer than urosome segments 1–4 of variable thickness, often very slender in lateral view; right leg 5 2- or 3-segmented, distal segments usually reduced in size. (Frost & Fleminger 1968)

REMARKS: This species belongs to Frost & Fleminger's (1968) Group III.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Frost & Fleminger (1968); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A302	0–500	1 male 1.20 mm
D599	0–100	1 female
F945	0–500	1 male
F946	0–1000	1 female
F947	0–200	1 female

DISTRIBUTION: Tropical-subtropical, circumglobal; it is spasmodic in occurrence in the tropical Pacific (Frost & Fleminger 1968).

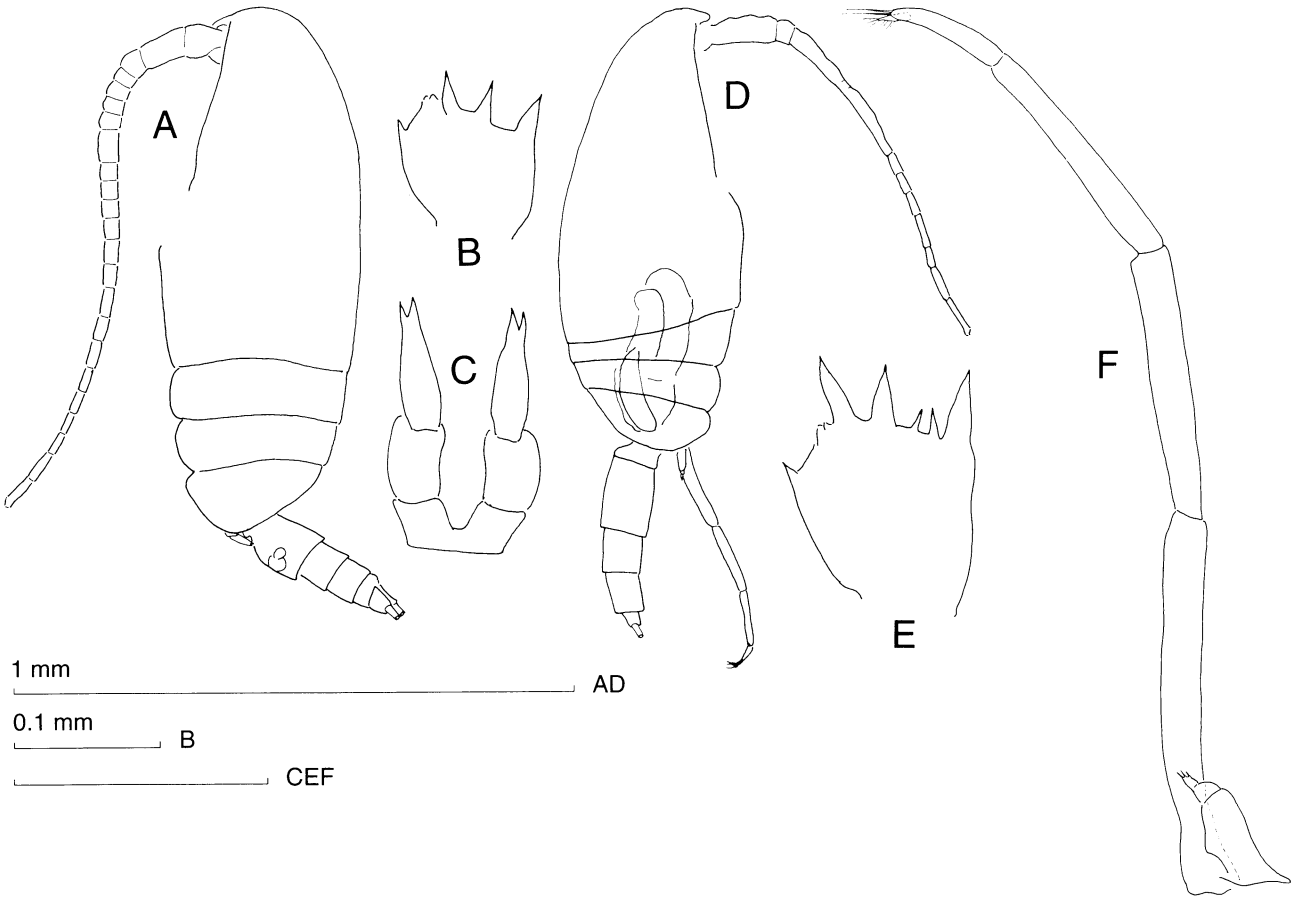


Fig. 70. *Clausocalanus parapergens* (from Frost & Fleminger 1968). Female: A, lateral view; B, basipod 2 of leg 3; C, leg 5. Male: D, lateral view; E, basipod 2 of leg 3; F, leg 5.

Clausocalanus paululus Farran, 1926 (Figs 71, 94)

DESCRIPTION: Size: females 0.66–0.80 mm, males 0.47–0.56 mm.

Female: As for the family and generic descriptions with the following additional characters. Rostrum in lateral view slender and curved ventroposteriorly. Ventral profile of the genital segment in lateral view with a step posterior to the genital pores. Genital segment more than 1.5 times as long as urosome segment 3. Seminal receptacle in lateral and ventral view often inconspicuous; dorsal lobe in lateral view not well separated from the ventral lobe; dorsal lobe in ventral view well demarcated from the ventral lobe and directed lateroposteriorly. Leg 3 with basipod 2 spiniform processes 2 and 3 uniformly tapered from their bases, the distance between processes 2 and 3 (l) more than 2.0 times the proximal width of process 3 (d) (see Fig. 72). Terminal points of segment 3 of leg 5 not divergent and, when spinulate, with spinules on both inner and outer margins. (Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body short and stocky. Rostrum in lateral view knob-like and protruding ventrally. Leg 3 basipod 2 spiniform processes as in female except basipod 2 usually with more intercalary processes. Longer ramus of leg 5 and genital pore on the left; left leg 5 longer than the urosome; right leg 5 2-segmented, distal segment small. (Frost & Fleminger 1968)

REMARKS: This species belongs to Frost & Fleminger's (1968) Group II.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Frost & Fleminger (1968).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A295	surface	1 female 0.73 mm
A303	surface	3 females 0.76 mm

DISTRIBUTION: Subtropical, circumglobal; biantitropical in the Pacific Ocean (Frost & Fleminger 1968).

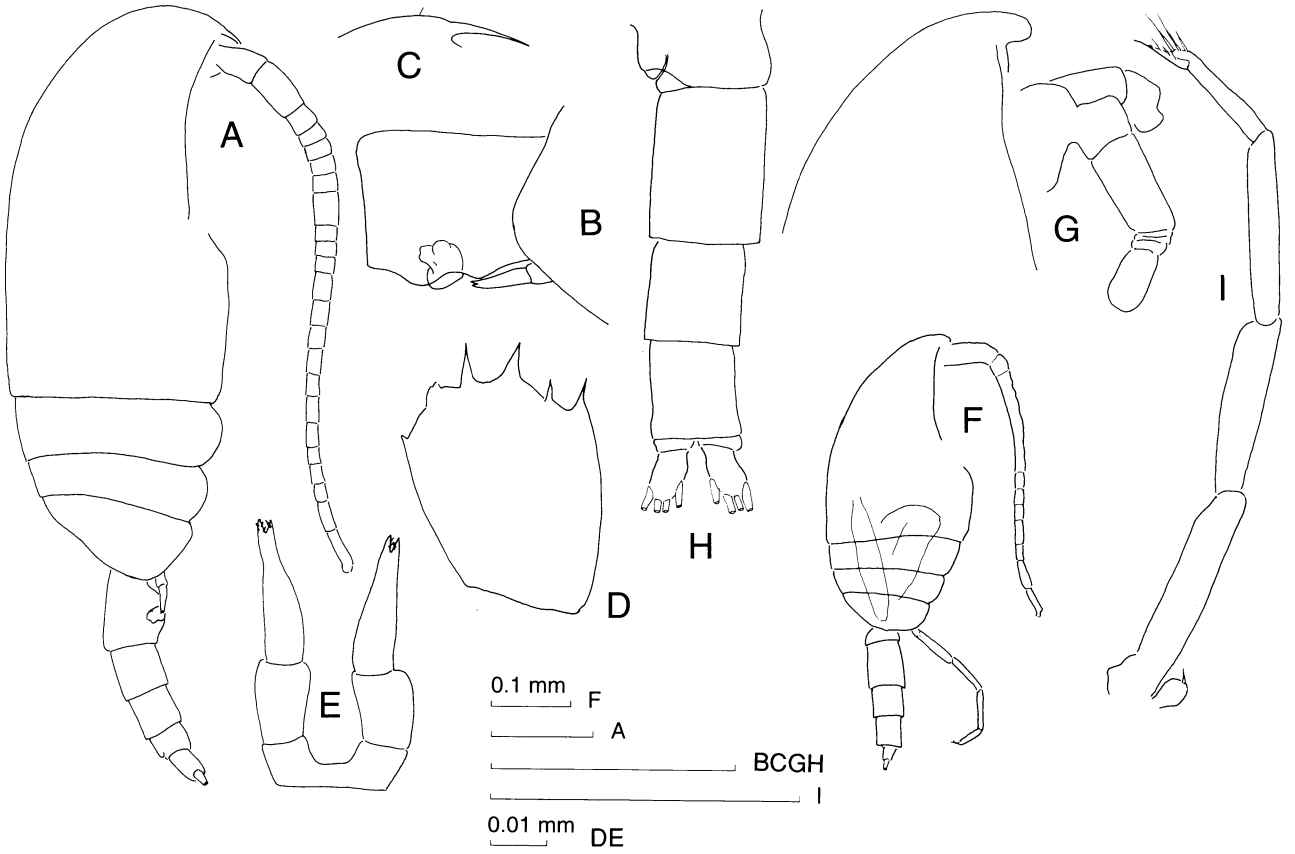


Fig. 71. *Clausocalanus paululus* (from Frost & Fleminger 1968). Female: A, lateral view; B, lateral view of genital segment; C, lateral view of rostrum; D, basipod 2 of leg 3; E, leg 5. Male: F, lateral view; G, lateral view of anterior head; H, dorsal view of urosome; I, leg 5.

Clausocalanus pergens Farran, 1926 (Figs 72, 95)

DESCRIPTION: Size: females 0.70–1.10 mm, males 0.52–0.67 mm.

Female: As for family and generic descriptions with the following additional characters. Outline of dorsal surface of the prosome in lateral view, particularly the head, not as rounded as in *C. paululus;* pedigerous segments 2–5 not as strongly tapered posteriorly in dorsal view as in *C. paululus*. Rostrum in lateral view slender and curved ventroposteriorly. Ventral profile of genital segment in lateral view somewhat convex, but without definite step. Genital segment more than 1.5 times as long as urosome segment 3. Ventral lobe of seminal receptacle in lateral view large and visible anterior to the base of the dorsal lobe; dorsal lobe short and digitiform or, rarely, slightly constricted in the region of the attachment to the ventral lobe; dorsal and ventral lobes conspicuous in ventral view. Leg 3 with basipod 2 spiniform processes 2 and 3 usually not tapered uniformly from their bases; the distance between processes 2 and 3 (l) less than 1.5 times the proximal width of process 3 (d) (*see* Fig. 72). Segment 3 of leg 5 more than 2.0 times as long as segment 1. (Frost & Fleminger 1968)

Male: As for the family and generic descriptions with the following additional characters. Body similar to *C. paululus,* but relatively more slender and longer, with pedigerous segments 2–5 in dorsal view not as strongly tapered posteriorly. Rostrum in lateral view knob-like and protruding ventrally. Leg 3 with basipod 2 spiniform processes 2 and 3 not tapered uniformly from their bases. Longer ramus of leg 5 and genital pore on the left; left leg 5 longer than the urosome; right leg 5 2-segmented, distal segment small. (Frost & Fleminger 1968)

REMARKS: This species belongs to Frost and Fleminger's (1968) Group III.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Frost & Fleminger (1968).

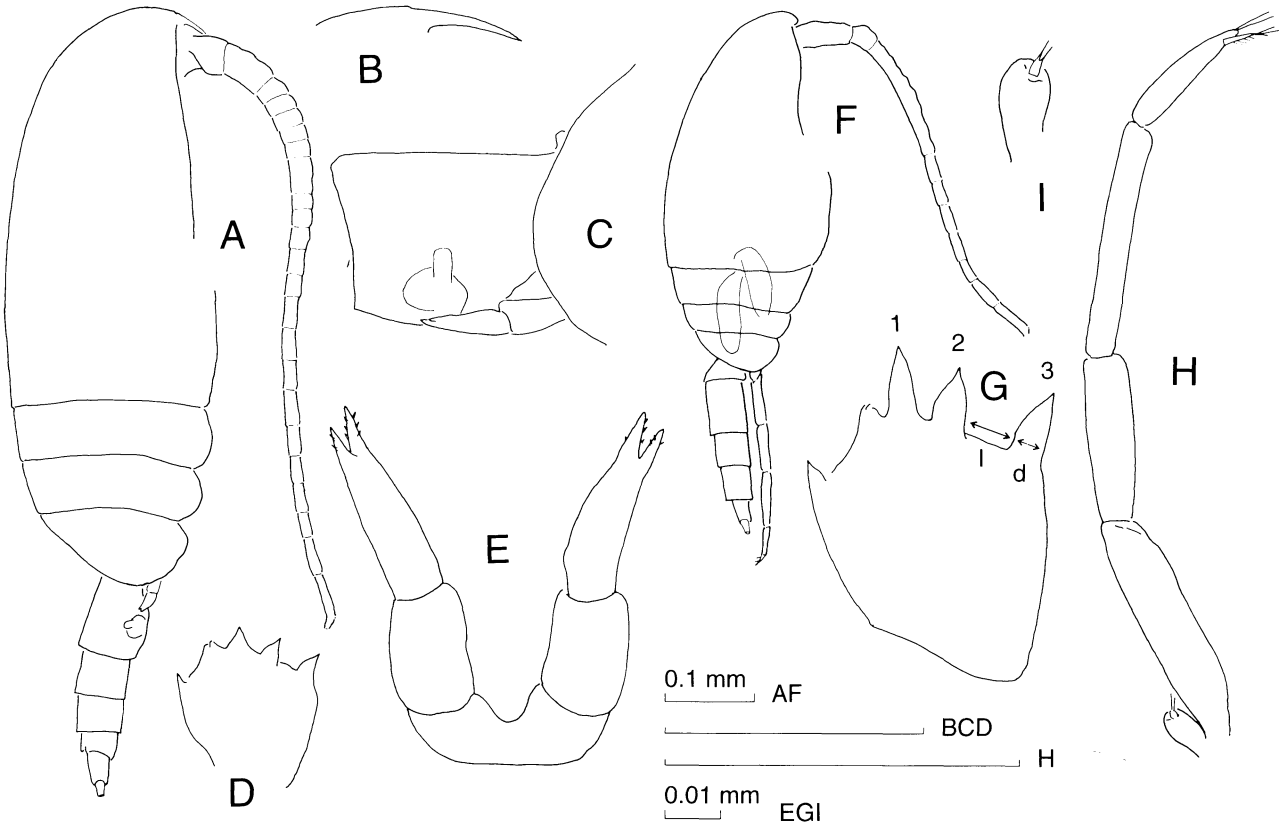


Fig. 72. *Clausocalanus pergens* (from Frost & Fleminger 1968). Female: A, lateral view; B, lateral view of rostrum; C, lateral view of genital segment; D, basipod 2 of leg 3; E, leg 5. Male: F, lateral view; G, basipod 2 of leg 3; H, leg 5; I, right leg 5.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
A332	surface	3 females 0.80 mm
D614	0–100	6 females
	100–250	16 females
	250–500	11 females
G142	0–100	3 males 0.66 mm
Leigh 27/3/65	0–45	1 female
Mu67/4	0–150	2 males

DISTRIBUTION: Warm temperate, circumglobal; apparently biantitropical in the Pacific Ocean (Frost & Fleminger 1968).

Ctenocalanus Giesbrecht, 1888

DEFINITION: As in the family definition with the following additional characters. Head and pedigerous segment 1 and pedigerous segments 4 and 5 fused. Rostrum of 2 fine filaments in both sexes. Antenna 1 of female with segments 1 and 2, 9 and 10, and 24 and 25 usually separate, of the male usually with segments 1 and 2, 8 to 10, and 23 to 25 fused. Antenna 2 exopod segments 2 and 3 fused. Male leg 1 exopod segments 1 and 2 without outer-edge spines. Basipod 2 of legs 2 and 3 not enlarged posterodistally but have posterodistal spinules which are very small in female but larger in the male. External spines on exopod segment 3 of legs 3 and 4 finely toothed. Female leg 5 asymmetrical, present on left. Male leg 5 asymmetrical, uniramous on left, very reduced on right.

(Heron & Bowman 1971)

TYPE SPECIES: *Ctenocalanus vanus* Giesbrecht, 1888

REMARKS: This genus contains the following species: *Ctenocalanus campaneri* (Almeida Prado-Por, 1984); *C. citer* Heron & Bowman, 1971; *C. heronae* Vega-Pérez & Bowman, 1992 (male unknown); *C. tageae* Almeida Prado-Por, 1984; *C. vanus* Giesbrecht, 1888 (male Wolfenden 1904) (= *C. longicornis* Mori, 1937, *see* Tanaka 1956). This genus needs to be revised on a world-wide basis. Species appear to be distinguished from one another by subtleties in the length of antenna 1, ornamentation and form of the female genital segment, form of the ctenoid spines on exopod segments 2 and 3 of leg 4, segmentation of male and female leg 5, and the decoration of the terminal segments of the male left leg 5.

Ctenocalanus vanus Giesbrecht, 1888

(Figs 73, 96)

DESCRIPTION: Size: females 0.92–1.16 mm, males 1.20–1.26 mm.

Female: As for the family and generic descriptions with the following additional characters. Antenna 1 extends beyond the caudal rami by the last 2 segments, segments 1 and 2, 9 and 10 not separated but their boundaries are still discernable. Leg 5 consists of a very small appendage, only developed on the left and of somewhat variable form; of 2 to 4 segments and sometimes a tiny spinule can be detected at its tip. (Giesbrecht 1892)

Male: As for the family and generic descriptions with the following additional characters. Antenna 1 21-segmented. Leg 5 long on the left, 5-segmented, 2 basal segments largest and broadest, the distal 3 segments small, the terminal segment spatulate with bundles of short, stiff spinules on the inner margin; right leg represented by a short stump only. (Wolfenden 1904)

REMARKS: This species was originally described (female only) from the Pacific Ocean at 132°W 14°N. The males described by Wolfenden (1904) were taken in the Faröe Channel and off the west coast of Ireland. The Southwest Pacific specimens from about 31–63°S appear to fall into two groups. One group has females with a relatively long antenna extending beyond the caudal rami and males with no right leg 5 and basipod 2 of legs 2 and 3 with a long, stout spine on the inner distal corners of this joint; these spines are quite different from the fine spines located in the middle of the posterodistal border of the same joints. These specimens were taken mostly at stations north of 40°S and appear to be close to *C. vanus* (*see* Fig. 73 A–I). The second group has females with a relatively short antenna not extending as far as the caudal rami and males with a 2-segmented right leg 5 (*see* male from G142, Fig. 73 O) and basipod 2 of legs 2 and 3 with a fine spine on the inner distal corner of these joints, similar in appearance to the spines located in the middle of the posterodistal border of the same joints; these specimens were taken mainly south of 50°S (*see* male from G142, Fig. 73 M–O). They appear to be similar to *C. citer* although the form of the ctenoid spines on leg 4 exopod segment 3 do not quite conform to those described by Heron and Bowman (1971); the proximal spine has more teeth in the Southwest Pacific specimens. Very few of the Southwest Pacific specimens of *Ctenocalanus* were intact; most had

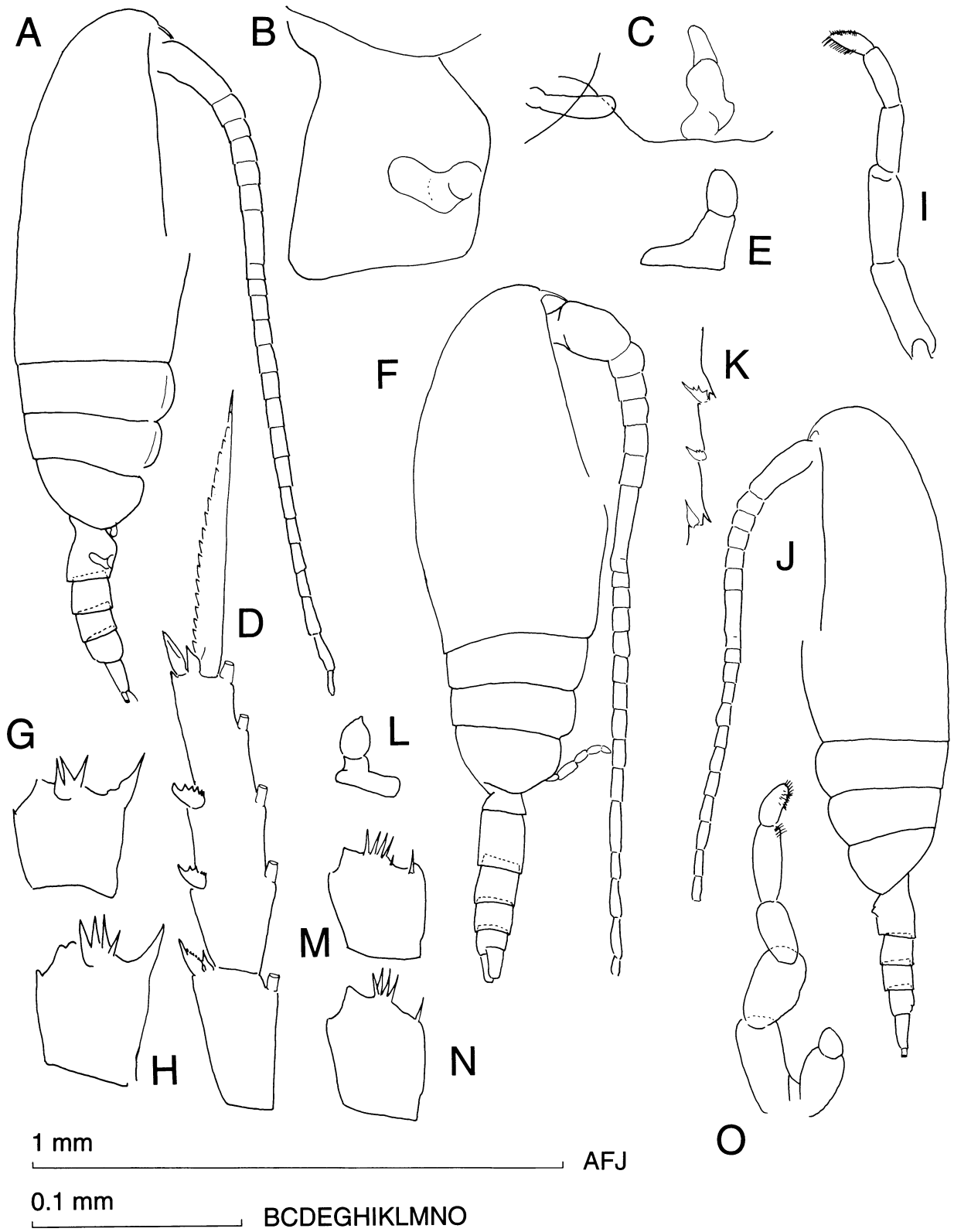


Fig. 73. *Ctenocalanus vanus* from Leigh Stn 19/9/64. Female *vanus* type: A, lateral view; B, lateral view of genital segment; C, lateral view of leg 5 and ventral genital segment; D, exopod segments 2 and 3 of leg 4; E, leg 5. Male *vanus* type: F, lateral view; G, basipod 2 of leg 2; H, basipod 2 of leg 3; I, leg 5. Female *citer* type from NZOI Stn B111: J, lateral view; K, outer-edge spines of exopod segments 2 and 3 of leg 4; L, leg 5. Male *citer* type from NZOI Stn G142: M, basipod 2 of leg 2; N, basipod 2 of leg 3; O, leg 5.

damaged antenna 1 and swimming legs 3 and 4. Also there were few male specimens in the collections examined. Until this genus is reviewed I am recording the Southwest Pacific specimens under the name *C. vanus*. The specimens assigned to *C. vanus* in the Ross Sea by Bradford (1971) are *C. citer*.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Farran (1929); Vervoort (1957); Dakin & Colefax (1940); Jillett (1971); Bradford (1972); Nyan Taw (1978).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B108	0–500	females 0.98–1.09 mm
B109	0–125	1 female 1.20 mm, 2 males ?
	0–500	females
B110	0–125	females 1.20 mm
	0–500	6 females 1.00–1.32 mm
B111	0–500	13 females 1.00–1.35 mm
B112	0–125	females
	0–500	6 females 1.03 mm
B113	0–500	2 females 1.18 mm
B114	0–125	10 females 1.24 mm
	0–500	1 female
B116	0–125	1 female 1.13 mm 2 males 1.18 mm
B117	0–500	2 females, one 1.40 mm?
D614	250–500	1 female
F945	0–200	3 females 1.10–1.21 mm 2 males 1.16, 1.30 mm
	0–500	1 females 1.08 mm
F946	200–500	1 male 1.24 mm
F947	0–500	1 male 1.22 mm
Leigh 23/5/64	0–45	2 females
Leigh 20/6/64	0–45	4 females
Leigh 25/7/64	0–45	2 females. 1 male
Leigh 22/8/64	0–45	6 females
Leigh 19/9/64	0–45	20 females, 1 male
Leigh 27/3/65	0–45	1 female

DISTRIBUTION: Because of the confused state of the taxonomy of this genus no general distribution is given.

Drepanopus Brady, 1883

DEFINITION: As in the family definition with with following additional characters. Male rostrum with 2 filaments. Head and pedigerous segment 1, pedigerous segments 4 and 5 fused or separate. Antenna 1 of female 23- or 24-segmented; of male slightly asymmetrical, 21- to 23-segmented on the left and 20- to 22-segmented on the right. Female genital segment long with distinct anteroventral swelling. Both male and female leg 1 exopods with 3 external spines. Endopods of leg 2 1- or 2-segmented, of leg 3 2- or 3-segmented. Basipod 2 of legs 2 and 3 not widened and without dentiform processes. Exopod segment 3 of legs 2–4 with 2 (*D. bispinosus*) or 3 outer-edge spines. Posterior surfaces of legs 2 and 3 may carry spinules in the female. Female leg 5 symmetrical, 2-segmented with a large curved terminal spine, pectinated along its distal outer half. Male leg 5 prehensile, asymmetrical, exopods 2- or 3-segmented on right ending in a long curved claw, 3-segmented and much shorter on the left; endopods rudimentary or absent.
(Giesbrecht 1892; Bayly 1982)

TYPE SPECIES: *Drepanopus pectinatus* Brady, 1883

REMARKS: This genus now contains the species: *Drepanopus bungei* Sars, 1898; *D. bispinosus* Bayly, 1982; *D. forcipatus* Giesbrecht, 1888; *D. pectinatus* Brady, 1883. The following species has been taken in the Southwest Pacific:

Drepanopus pectinatus Brady, 1883 (Figs 74, 96)

DESCRIPTION: Size: females 1.74–2.7 mm, males 1.51–1.80 mm.

Female: As for the family and generic descriptions with the following additional characters. Anterior face of the endopod of leg 1 with a straight row of spinules slightly on the proximal side of midlength, across the outer half of the segment; typically 10 to 14 spinules in the row; 1 spinule located on the outer edge distinctly larger than the remainder. Posterior face of segment 2 of both the endopod and exopod of legs 2 and 3 typically bearing a number of spinules; terminal exopod spine of legs 2–4 coarsely toothed relative to *D. bispinosus*. Endopod segment 2 of leg 4 often with facial armature more in the form of hairs; the face of exopod segment 2 of leg 4 always naked. (Bayly 1982)

Male: As for the family and generic descriptions with the following additional characters. Rostrum of 2 fine filaments. Head and pedigerous segment partially fused, pedigerous segments 4 and 5 fused. First antenna slightly asymmetrical, 21-segmented on the left, 20-segmented on the right; left antenna 1 with segments 1–2, 8–10, and 24–25 fused; on the right, segments 20–21 are also fused. Antenna 2

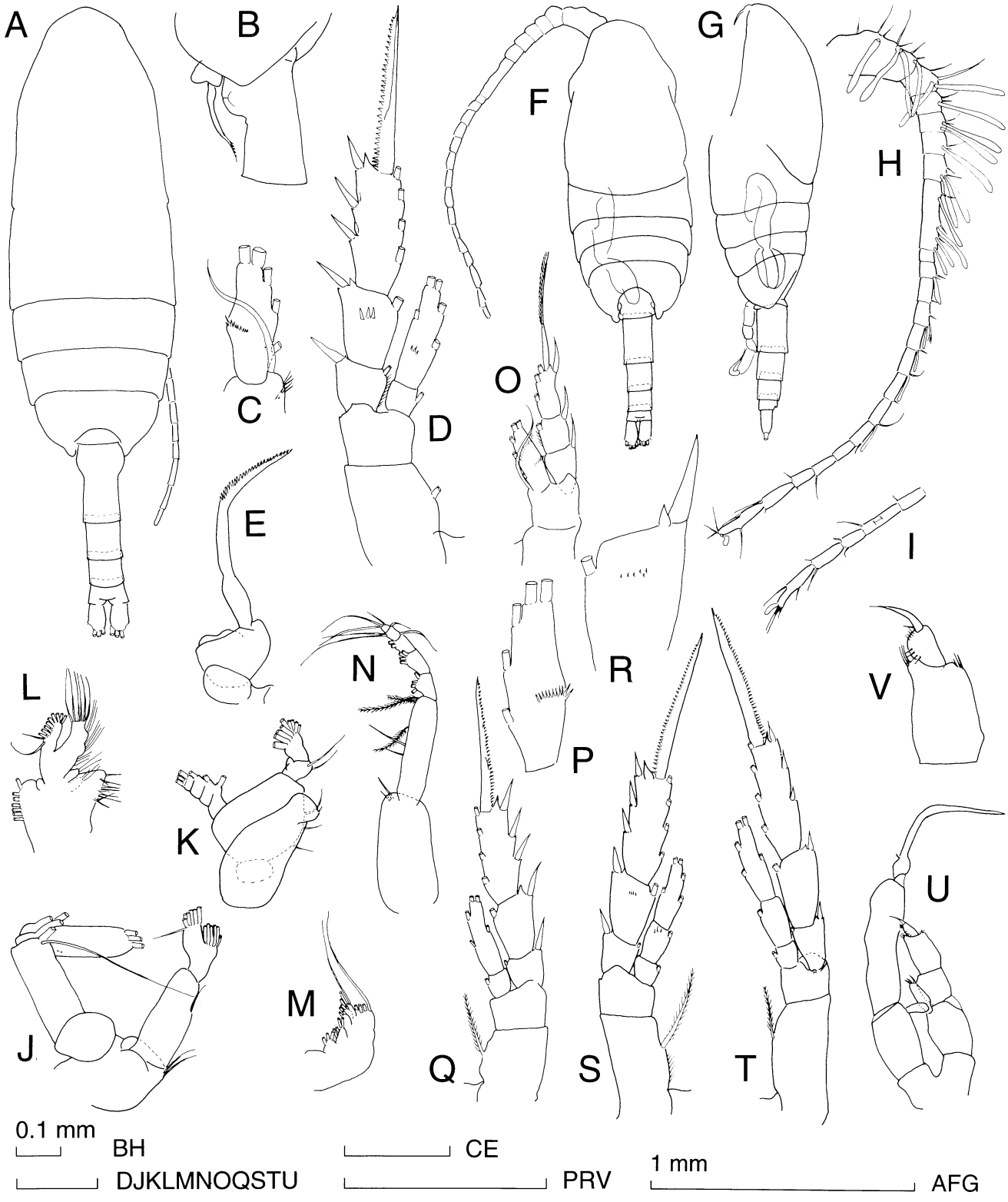


Fig. 74. *Drepanopus pectinatus* from Campbell Is. Female: A, dorsal view; B, lateral view of genital segment; C, endopod of leg 1; D, leg 2; E, leg 5. male: F, dorsal view; G, lateral view; H, left antenna 1; I, terminal segment of right antenna 1; J, antenna 2; K, mandible; L, maxilla 1; M, maxilla 2; N, maxilliped; O, leg 1; P, endopod of leg 1; Q, leg 2; R, exopod segment 2 of leg 2 anterior view; S, leg 3; T, leg 4; U, leg 5; V, terminal part of left leg 5.

exopod extends beyond the distal border of the fused endopod segments 2 and 3; the seta attributable to endopod segment 2, long but finer than the remaining setae on this branch. Mandibular blade without teeth; basipod 2 with 3 setae; endopod segment 1 with 2 setae, segment 2 with 9 setae; exopod about the same size as the endopod. Maxilla 1 reduced in size; all parts present but setae reduced in size especially on the inner border. Maxilla 2 reduced in size; all parts present but setae reduced in size. Maxilliped reduced, all parts and setae present, outer-edge setae on endopod segments 3 and 4 reasonably well developed. Swimming legs 1–4 as in the female with the characteristics of this species, i.e., a straight row of spinules across the anterolateral outer surface just proximal to midlength of leg 1 endopod, some or all posterior surfaces of exopod and endopod segment 2 of legs 2 and 3 ornamented with a few spinules, exopod segment 3 of legs 2–4 with the typical 3 outer-edge spines. Left leg 5 when fully extended does not reach beyond the first 0.75% of the right exopod segment 1; endopods represented by a single segment: on the left almost as long as exopod segment 1 and with terminal hairs, naked on the right; left exopod segment 2 with 2 groups of distal spinules, 1 on the inner corner, the other on the outer corner.

REMARKS: Tanaka's (1964) figure of the male leg 5 of *D. pectinatus* (erroneously as *Drepanopsis*) is the first since Brady's (1883) original description. Bayly (1982) and Hulsemann (1985) subsequently redescribed this species. There appear to be one or two differences between the male leg 5 of present specimens and Tanaka's figure but the Campbell Island specimens agree in most respects with those figured by Hulsemann (1985). The terminal spine of legs 2–4 seem to have a slightly greater number of not so widely spaced teeth compared with the specimens described by Hulsemann (1985).

PREVIOUS SOUTHWEST PACIFIC RECORDS: Nil.

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
Campbell Is 9.3.66	Surface	2 females 1.55, 2.2 mm 1 male 1.65 mm
Campbell Is 17.11.66	Surface	14 females 1.74–2.27 mm 8 males 1.51–1.67 mm

DISTRIBUTION: Crozet, Kerguelen, and Heard Islands (Bayly 1982). The present records extend the distribution of this species from neritic island waters of the Indian Ocean sector of the subantarctic to the Pacific sector.

Farrania Sars, 1920

Drepanopsis Wolfenden, 1911

DEFINITION: As in the family definition with with following additional characters. Rostrum or rostral filaments absent. Head and pedigerous segment 1 fused or separate, pedigerous segments 4 and 5 separate, usually extended into points. Antenna 1 24-segmented, segments 8–9 fused, all segments with very long setae. Antenna 2 endopod longer than or equal to the exopod which is 7-segmented. Mandible with a very small endopod. Posterior surfaces of basipods 1 and 2 and endopods of legs 2 and 3 may be ornamented with spinules. Female leg 5 3-segmented with 2 or 3 terminal spines. Male leg 5 biramous and styliform and asymmetrical; endopods 1-segmented, exopods 3-segmented, left exopod shorter than the right, terminated by an elongate spine.

(Tanaka 1956b; Grice & Hulsemann 1967)

TYPE SPECIES: *Farrania oblonga* Sars, 1920

REMARKS: This genus now contains the following species: *Farrania frigida* (Wolfenden, 1911) (male *see* Grice & Hulsemann 1967); *F. oblonga* Sars, 1920 (male unknown); *F. orba* (Tanaka, 1956); *F. pacifica* (Brodsky, 1950) (male unknown). Vervoort (1951) suggested that *F. oblonga* may be a synonym of *F. frigida*. None of these species has been taken in the Southwest Pacific.

Microcalanus Sars, 1901

DEFINITION: As in the family definition with with following additional characters. Female with 2 rostral filaments. Head and pedigerous segment 1 and pedigerous segments 4 and 5 fused. Antenna 1 of female 24-segmented with segments 8 and 9 fused; male antenna 1 20-segmented, segments 1–2, 8–11, and 24–25 fused. Antenna 2 exopod longer than the endopod, exopod segments 2–3 fused. Leg 1 exopod segment 1 without an external edge spine, endopod with 4 setae. Female leg 5 absent. Male leg 5 small, asymmetrical, left leg slender, 6-segmented, right leg very small 3-segmented, last joint not styliform.

(Sars 1901; Rose 1933)

TYPE SPECIES: *Pseudocalanus pygmaeus* Sars, 1900

REMARKS: This genus contains *Microcalanus pusillus* Sars, 1903; *M. pygmaeus* (Sars, 1900) (male unknown). Farran and Vervoort (1951) consider these two species to be forms of the variable *M. pygmaeus.*

The following species has been taken in the Southwest Pacific.

Microcalanus pygmaeus pygmaeus (Sars, 1900) (Fig. 75)

DESCRIPTION: Size: females 0.70–0.88 mm, males 0.80 mm.

Female: As for the family and generic descriptions with the following additional characters. Antenna 1 extends at least as far as the caudal rami. Swimming legs 2–4 slender, terminal exopod spines finely denticulate. (Vervoort 1957)

REMARKS: The present specimens were all damaged; only one antenna 1 was intact and appears to be long enough to extend as far as the caudal rami. Only the first swimming leg was intact. It is presumed that the *pygmaeus* form was captured in the southern part of the study area. The male of *M. pygmaeus* has not been specifically described although both Farran (1929) and Vervoort (1957) record male specimens in the collections they examined. The male of *M. pygmaeus pusillus* is figured here to aid in the identification of Southwest Pacific specimens.

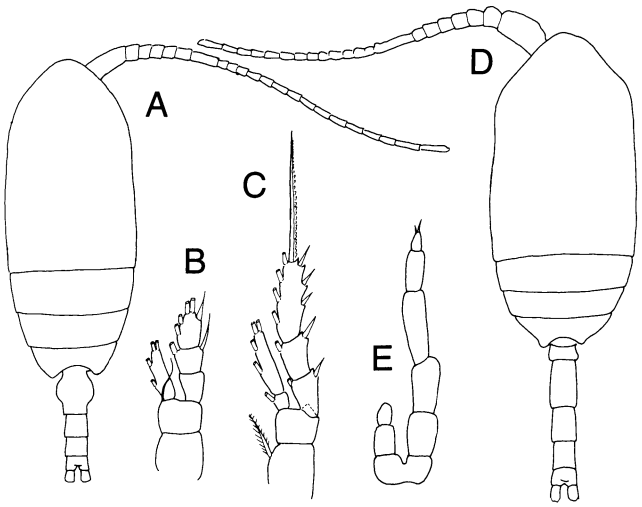


Fig. 75. *Microcalanus pygmaeus pygmaeus.* Female (from Sars 1900): A, dorsal view; B, leg 1; C, leg 2. *Microcalanus pygmaeus pusillus.* Male (from Sars 1903): D, dorsal view; E, leg 5.

PREVIOUS SOUTHWEST PACIFIC RECORDS: Vervoort (1957).

NEW RECORDS:

Station No.	Depth of Haul (m)	Specimens
B109	0–125	4 females 0.65–0.72 mm 1 CV female, CV male
B110	0–500	2 females 0.65, 0.72 mm

DISTRIBUTION: If we accept Vervoort's (1957) conclusion that there is one variable species *Microcalanus pygmaeus,* then this species shows a circumpolar distribution being found in Arctic as well as Antarctic waters. At lower latitudes this species has been taken at 1000–3000 m depth north of the equator in the Indian Ocean (Grice & Hulsemann 1967). Present records show that this species also extends into subantarctic waters.

Pseudocalanus Boeck, 1873

DEFINITION: As for the family with the following additional characters. Small copepods with total length less than 2.5 mm. Pedigerous segments 4 and 5 fused, last metasomal segment with rounded corners. Rostrum in male consisting of 2 filaments. Antenna 1 does not extend beyond the caudal rami; 24-segmented in the female (segments 8 and 9 fused), in male usually 19-segmented. Leg 5 absent in the female. Male leg 5 uniramous, left slightly longer than the right; terminal segment of left leg 5 much shorter than the preceding segment and bearing a row of spinules and a long, slender terminal spine, segments of the right leg taper distally with the terminal segment about as long as the preceeding segments and styliform. (Frost 1989)

TYPE SPECIES: *Clausia elongata* Boeck, 1865

REMARKS: Recently this genus was reviewed (Frost 1989), with the result that there are now known to be seven species entirely confined to high latitudes in the northern hemisphere. This genus now contains: *Pseudocalanus acuspes* (Giesbrecht, 1881); *P. elongatus* (Boeck, 1865); *P. major* Sars, 1900; *P. mimus* Frost, 1989; *P. minutus* (Kröyer, 1845) (= *P. gracilis* Sars, 1903); *P. moutloni* Frost, 1989; and *P. newmani* Frost, 1989.

Spicipes Grice & Hulsemann, 1965

DEFINITION: Head and pedigerous segment 1 and pedigerous segments 4 and 5 separate. Rostrum small and rounded. Antenna 1 23-segmented extending to the end of the caudal rami, segments 8 and 9, 24 and 25 fused. Exopod of antenna 2 longer than its endopod, segments 1 to 3 apparently fused. Endopod and exopod of the mandible subequal, blade with small uniform teeth. Maxilla 1 and 2 appears to have a reduced compliment of setae. Exopod of leg 1 1-segmented, of legs 2–4 3-segmented. Endopod of legs 1–4 1-segmented. Exopod segment 3 of legs 2–4 with 2 outer edge spines and 4 inner setae. The terminal spines of legs 2 and 3 with outer margins serrate (leg 4 damaged). Leg 5 3-segmented, the terminal segment bearing a single spiniform seta. Male unknown.
(Grice & Hulsemann 1965)

TYPE SPECIES: *Spicipes nansen*i Grice & Hulsemann, 1965

REMARKS: Grice and Hulsemann (1965) believed this genus is close to *Farrania* in spite of the 1-segmented endopods and exopod segment 3 of legs 2 and 3 at least having two outer-edge spines. The discovery of a species of *Drepanopus (D. bispinosus)* which also has two outer-edge spines on exopod segment 3 of swimming legs 2–4 indicates that *Spicipes* is not alone in the Clausocalanidae in blurring the distinction between it and the Paracalanidae (*see* Bayly 1982). The apparent reduction in the female mouthparts is not typical for the Clausocalanidae so the position of this genus must remain provisional until more specimens, species, and males are discovered. No examples of this genus have been discovered in the Southwest Pacific.

Family **PSEUDOCYCLOPIIDAE** Sars, 1902

DEFINITION: Form of the body very compact, similar to some Cyclopoida. Head and pedigerous segment 1 fused, rostrum strong and pointed, pedigerous segments 4 and 5 fused. Urosome of female 4-segmented, 5-segmented in the male. Antenna 1 of similar appearance in both sexes (there may be slight sexual dimorphism), but remarkable for their shortness and restricted number of segments. Antenna 2 with basipod imperfectly separated from the endopod which is much longer than the exopod; last endopod segment without a distinct inner lobe. Mouthparts normally developed. Swimming legs with 3-segmented exopods, endopods of legs 1–4 1-, 2-, 3-, 3-segmented respectively, although of unusually short and compact form recalling that of the Cyclopoida; a strong, spinous seta is present on the inner margin of basipod 1. Leg 5 of the female simple and short. Leg 5 of the male uniramous, asymmetrical, sometimes with complex structure, right leg longer and more slender than the left leg. (Sars 1902; Fosshagen & Iliffe 1985)

REMARKS: The following genera and species have been described although none of them has been recorded from the Southwest Pacific:

Paracyclopia Fosshagen & Iliffe, 1985

DEFINITION: In dorsal view the prosome is broadest at about 0.33 its length from the posterior end. The posterior margins of the urosomal segments, except the anal segment, are finely striated. Antenna 1 reaches about half the length of the prosome, 24-segmented in the female, 23-segmented on the right side of the male. Antenna 2 exopod and endopod of equal length. The mandibular blade with fine hyaline teeth. Swimming leg 1 endopod with 4 setae. Inner distal margin of basipod 2 of legs 2–4 with a long strong spine, flanged distally. Leg 5 3-segmented including a common basal segment in the female, ending in a short segment with two distal points; simple, slender, asymmetrical with right leg longer in the male.
(Fosshagen & Iliffe 1985)

TYPE SPECIES: *Paracyclopia naessi* Fosshagen & Iliffe, 1985

REMARKS: This is a monotypic genus which has not been found in the Southwest Pacific.

Pseudocyclopia T. Scott, 1892

DEFINITION: Body short and compact with the anterior head strongly vaulted dorsally and more or less compressed laterally. Rostral prominence with rostral filaments. Last pedigerous segment rounded off posteriorly. Urosome with anal segment well developed in both sexes; caudal rami short with 4 terminal setae. Antenna 1 unusually short and tapering rapidly distally, 16- to 20-segmented, the first segment very large. Antenna 2 with 6-segmented exopod which is much shorter than the endopod. Mandibular blade very strong, masticatory part

thickened with cutting edge irregularly curved and minutely denticulate; palp with both rami well-developed. Maxilla 1 normal. Maxilla 2 bearing terminal setae. Maxillipeds slender with basipod 1 remarkably produced distally; terminal part reflexed. Swimming legs with very strong outer-edge spines on the exopods; terminal spine on legs 2–4 coarsely serrate; basipod 1 seta on leg 3 transformed into a strong spine. Female leg 5 3-segmented including a common basal segment, terminal segment largest and spiniferous. Male leg 5 of moderate size, uniramous on both sides; terminating in a styliform claw on the right; on the left with the basal part very swollen, remaining part 3-segmented.
(Sars 1902)

TYPE SPECIES: *Pseudocyclopia crassicornis* T. Scott, 1892

REMARKS: This genus contains the following species: *P. caudata* T. Scott, 1894; *P. crassicornis* T. Scott, 1892; *P. giesbrechti* Wolfenden, 1902; *P. minor* T. Scott, 1892; *P. stephoides* J.C. Thompson, 1895, none of which has been taken in the Southwest Pacific.

Family **STEPHIDAE** Sars, 1902

DEFINITION: The form of the body generally short and stout, similar in both sexes. Head and pedigerous segment 1 fused, rostrum absent, pedigerous segments 4 and 5 fused. Urosome 3- or 4-segmented in the female, 5-segmented in the male. Antenna 1 similar in both sexes, slender, last 2 segments separate. Antenna 2 and mouthparts normal, similar in both sexes; last endopod segment with a distinct inner lobe. Maxilla 2 without terminal sensory appendages. Swimming legs with 3-segmented exopods, endopods of legs 1–4 1-, 2-, 3-, 3-, segmented respectively. Leg 5 present in both sexes; in the female it is small and of simple structure; in the male uniramous and largely developed, the left leg largest having some joints conspicuously dilated.
(Sars 1902; Bowman 1976)

REMARKS: The following genera and species have been described although none of them has been recorded from the Southwest Pacific:

Miostephos Bowman, 1976

DEFINITION: Urosome 3-segmented in the female, 5-segmented in the male. Female leg 5 symmetrical, 3-segmented, last segment small and extending into a point. Male leg 5 very asymmetrical; left leg slender, elongate, 6-segmented; right leg rudimentary, 3-segmented, similar to the female leg 5.
(Bowman 1976)

TYPE SPECIES: *Miostephos cubrobex* Bowman, 1976

REMARKS: This genus contains two species: *M. cubrobex* Bowman, 1976; *M. leamingtonensis* Yeatman, 1980, neither of which has been taken in the Southwest Pacific.

Parastephos Sars, 1902

DEFINITION: Body of more slender form than in *Stephos*. Female urosome powerfully developed with 1 or more of the anterior segments decorated with spines. Anterior of head, antenna 1, and mouthparts very similar in the male and female; and similar to those of *Stephos* except that the distal part of the mandibular blade is considerably more expanded, with the outermost cutting tooth very large and claw-like. Swimming legs not very powerful; male leg 4 asymmetrical. Female leg 5 symmetrical or asymmetrical, 3-segmented; with a common basal segment, one globular segment and a terminal claw-like segment with a sharp lateral projection near its base. Male leg 5 largely developed and very asymmetrical, right leg slender, terminating in a strong denticulate claw, left leg much coarser, with the antepenultimate segment the largest. (Sars 1902, 1919; Damkaer 1971)

TYPE SPECIES: *Parastephos pallidus* Sars, 1902

REMARKS: This genus contains three species: *P. esterlyi* Fleminger, 1988; *P. occatum* Damkaer, 1971; *P. pallidus* Sars, 1902 (*see* Sars 1919), none of which has been taken in the Southwest Pacific.

Stephos T. Scott, 1892

DEFINITION: Body of short compact form with metasome swollen. Rostrum absent. Posterior pedigerous segment rounded off and sometimes expanded; may be asymmetrical. Urosome comparatively short. Antenna 1 24-segmented, antenna 2 with exopod longer than the endopod. Mandibles strong with the distal part of the mandibular blade somewhat expanded, palp with both rami of similar size. Maxilla 2 comparatively small, maxilliped well developed with the terminal part not reflexed.

Swimming legs with the rami normal in both sexes. Female leg 5 3-segmented with the last segment spine-like. Male leg 5 very large, right leg 4-segmented, terminating in a claw-like segment; left leg 5-segmented with the penultimate segment swollen, the last segment incurved and provided with a number of delicate leaf-like appendages.

(Sars 1902)

TYPE SPECIES: *Stephos minor* T. Scott, 1892

REMARKS: The following species have been described in the genus *Stephos: S. antarcticum* Wolfenden, 1908; *S. arcticus* Sars, 1909 (= *S. sinuatus* Willey, 1923); *S. canariensis* Boxshall, Stock & Sánchez, 1990; *S. deichmannae* Fleminger, 1957; *S. exumensis* Fosshagen, 1970; *S. fultoni* T. & A. Scott, 1898; *S. gyrans* (Giesbrecht, 1892); *S. kurilensis* Kos, 1972; *S. lamellatus* Sars, 1902; *S. longipes* Giesbrecht, 1902; *S. lucayensis* Fosshagen, 1970; *S. maculosus* Andronov, 1974; *S. margalefi* Riera, Vives & Gili, 1992; *S. minor* T. Scott, 1892; *S. morii* Greenwood, 1978 (1977 as *S. tropicus*); *S. pacificus* Ohtsuka & Hiromi, 1987; *S. pentacanthos* Chen & Zhang, 1965; *S. perplexus* Wilson, 1950; *S. robustus* Ohtsuka & Hiromi, 1987; *S. rustadi* Strömgren, 1969; *S. scotti* Sars, 1902; *S. tropicus* Mori, 1942; *S. tsuyazakiensis* Tanaka, 1966. No species of *Stephos* have been taken in the Southwest Pacific. Brady (1918) described *S. simillimus* from Macquarie Island. It is more likely that he observed a scolecithricid than a stephid.

Family **MESAIOKERATIDAE** Matthews, 1961

DEFINITION: Body short and stout. Pedigerous segments 4 and 5 fused or separate. Urosome 4-segmented in the female and 5-segmented in the male. Antenna 1 23- and 24-segmented in the female depending on whether the last two segments are fused or separate; s[illegible]htly asymmetrical with some fused segments in the male. Mouthparts identical in both sexes and as in the Stephidae. Swimming legs as in the Diaixidae. Leg 5 of the female small, sometimes lacking on the right. Left leg 5 of the male greatly elongated, the right leg small.

(Matthews 1961; Fosshagen 1978)

REMARKS: The following genus and species have been described but none has been recorded from the Southwest Pacific:

Mesaiokeras Matthews, 1961

DEFINITION: Small rostral filaments present. Setation on the caudal rami may be asymmetrical. Last endopod segment of antenna 2 elongate, with no distinct inner lobe. Endopod of leg 1 with a straight outer margin and exopod usually with a reduced number of spines on the outer margin. Left leg 5 of the male very long, uniramous and 5-segmented; right leg short, not extending beyond exopod segment 1 of the left leg.

(Matthews 1961; Fosshagen 1978)

TYPE SPECIES: *Mesaiokeras nanseni* Matthews, 1961

REMARKS: The following species have been described: *M. heptneri* Andronov, 1973; *M. kaufmanni* Fosshagen, 1978; *M. nanseni* Matthews, 1961; *M. semiplenus* Andronov, 1973b; *M. tantillus* Andronov, 1973, none of which has been found in the Southwest Pacific.

DISTRIBUTION OF SOUTHWEST PACIFIC CALANOIDA MEGACALANIDAE, CALANIDAE, PARACALANIDAE, MECYNOCERIDAE, EUCALANIDAE, SPINOCALANIDAE, AND CLAUSOCALANIDAE

Vertical Distribution

The material studied was collected with a wide variety of gear between 23°S and 64°S. Near-surface layers down to 500 m were more comprehensively sampled than deep waters (Fig. 97), but depths to 1000 m were also well represented in the collections, particularly by the series of Otago University stations. Bathypelagic depths were only sparsely sampled, often with inappropriate gear. These limitations accepted, the present collection, together with previous records from the area, are sufficiently comprehensive to demonstrate broad features of vertical and latitudinal distribution.

The characteristic depth zones of each species (Figs 98-101) were determined by several criteria

apart from their observed occurrence in the present records. Where a species occurred in hauls from deep water to the surface we have assumed that it was caught in deep water provided that the species was absent from the numerous shallow samples. Also, existing records of distribution in other parts of the world have been considered in the determination of each characteristic vertical and latitudinal distribution. Bathypelagic species are defined as those which usually occurred in the present samples with a maximum depth around 1000 m.

Megacalanidae: Only one species was taken in the Southwest Pacific and this is bathypelagic (Fig. 98). It has a broad distribution at bathypelagic depths.

Calanidae: Most Calanidae are epipelagic with tropical-subtropical, subantarctic, or Antarctic distributions (Fig. 98). Three species (*Neocalanus tonsus, Calanoides macrocarinatuus,* and *C. acutus*) perform ontogenetic vertical migrations so are also found at mesopelagic depths at some times of the year.

Paracalanidae: The Paracalanidae are exclusively epipelagic (Fig. 99). Their exact geographic distributions are not well known because they have not been well sampled; their small size means they have probably been extruded through the plankton-net mesh sizes commonly used. No specimens were taken south of the Subtropical Convergence.

Mecynoceridae: *Mecynocera clausi* is the only representative of this family. In the Southwest Pacifc it was a relatively common member of the epipelagic zooplankton extending in subtropical water as far as the Subtropical Convergence.

Eucalanidae: The Eucalanidae are an exclusively epipelagic family (Fig. 100) with species with tropical-subtropical or subantarctic, or subantarctic-Antarctic distributions.

Spinocalanidae: The Spinocalanidae are an exclusively bathypelagic family (Fig. 101). Their distributions extend from low latitudes into mid to high latitudes in the Southwest Pacific.

Clausocalanidae: The Clausocalanidae comprise almost entirely epipelagic species (Fig. 101), apart from *Microcalanus pygmaeus* which is found at the surface in Arctic and Antarctic waters but which is carried to bathypelagic depths in equatorial waters. *Drepanopus pectinatus* is a neritic species found around subantarctic islands. The remaining species have tropical, subtropical, or subantarctic distributions.

Maintenance of Horizontal Patterns of Distribution of Epipelagic Species

Among the Southwest Pacific epipelagic species only the Calanidae, Paracalanidae, and Clausocalanidae contain coastal forms which are rarely encountered in oceanic water. *Calanus australis* is found at least in New Zealand and southeastern Australian coastal waters where it is essentially restricted to mid-shelf (Bradford 1985). It appears that this species may maintain itself in coastal waters, especially under upwelling conditions by its behaviour (Bradford-Grieve *et al.* 1993). This deduction is made based on some local data and by analogy with *C. marshallae* whose offshore developmental stages cease diel vertical migration into surface waters, thus being transported into the upwelling frontal region where they lay their eggs (Petersen *et al.* 1979). *Paracalanus indicus* is restricted to coastal waters with maximum concentrations occurring close to shore (Bradford 1985) although the work of Cassie (1959b, 1960) shows that this species is apparently sensitive to lowered salinities and does not extend into the upper reaches of harbours and estuaries to any great extent. This species also appears to be able to maintain itself in coastal waters by altering its vertical position in the water column depending on how far it is from shore (Bradford-Grieve *et al.* 1993) although the details of this behaviour have not yet been worked out. *Clausocalanus jobei* has a tropical or subtropical, broadly coastal distribution (Frost & Fleminger 1968; Bradford-Grieve *et al.* 1993) and *Drepanopus pectinatus* has a coastal distribution around subantarctic islands.

Oceanic epipelagic species in the Southwest Pacific have distributions which are approximately related to water mass distribution (*see* e.g., McGowan 1974). The exact extent of the global distribution of some species is not well known, either because sampling of the species is not extensive (e.g., *Calocalanus*), or the taxonomic status of species is not yet stable (e.g., *Ctenocalanus*). Some oceanic species are capable of responding rapidly to the heightened productivity of coastal waters and may attain maximum numbers close to the coast. Examples of species with this type of distribution are *Nannocalanus minor* and *Undinula vulgaris* (Khromov 1973), also *Clausocalanus ingens* (Bradford 1985).

Warm-water (tropical) epipelagic species usually

have a cosmopolitan distribution if they are able to breed at a range of latitudes which extend to 40°S whereas those with breeding ranges restricted to lower latitudes are not circumglobal in distribution because of the geographical barriers (South American and African continents) presented to their distribution (Fleminger & Hulsemann 1973). In warm (tropical) Southwest Pacific waters epipelagic species whose distributions extend to 35°S at the most are: *Undinula vulgaris, Cosmocalanus darwini, Acrocalanus longicornis, Calocalanus pavoninus, C. plumulosus, C. neptunus, C. pavo, Clausocalanus furcatus,* and *C. minor.*

In tropical or subtropical/warm-temperate southwest Pacific waters, epipelagic species whose distributions extend to 40°S and sometimes as far as the Subtropical Convergence are: *Nannocalanus minor, Neocalanus gracilis,* many of the *Calocalanus* species, *Eucalanus hyalinus, Pareucalanus sewelli, Rhincalanus nasutus, Subeucalanus crassus, Clausocalanus arcuicornis, C. lividus, C. parapergens, C. paululus, C. pergens,* and *Mecynocera clausi* (*see* Frost & Fleminger 1968 for details of *Clausocalanus* distributions).

Species with warm-temperate (transition-zone) southern hemisphere distributions include: *Pareucalanus langae* (Fleminger 1973) and *Clausocalanus ingens* (Frost & Fleminger 1968). *Calanoides macrocarinatus* may also be classified as a transition zone species although its behaviour does have some similarities to that of *Neocalanus tonsus;* the distribution of *C. macrocarinatus* is not well known because of its previously confused taxonomic status.

Species with subantarctic distributions include: *Calanus simillimus, Neocalanus tonsus, Subeucalanus longiceps,* and *Clausocalanus brevipes.* Species with Antarctic-subantarctic distributions include: *Rhincalanus gigas, Clausocalanus laticeps,* and *Microcalanus pygmaeus.* Species with Antarctic distributions include: *Calanoides acutus* and *Calanus propinquus.*

How are the above oceanic distributions maintained? The processes that maintain the distribution patterns of species must be related to those that maintain the shape of the water-mass patterns, because planktonic species by definition are not able to alter their position substantially against currents (McGowan 1971). The water-mass gyre systems, as closed circulation structures, act as conservers of populations although there is clearly a large amount of leakage along their edges. In addition to the impact of recirculation patterns, a combination of, at least, physiological requirements (temperature, salinity, food, etc.), behaviour, competition, and predation are also probably involved in the maintenance of distributions. As yet, we do not have a lot of information on many of these subjects but our knowledge of behaviour is improving and is discussed in the following paragraph.

Knowledge of the behaviour of some species in relation to vertical and horizontal water movements is increasing our understanding of what maintains distributions. In water masses such as those south of the Subtropical Convergence there is a slow drift to the north at the surface which means that species whose optimal living space is found in these waters must have a mechanism for maintaining themselves in the preferred water mass. The means of doing this has been suggested for species which perform ontogenetic annual vertical migrations. For example the Antarctic species *Calanus propinquus, Calanoides acutus,* and *Rhincalanus gigas* perform seasonal vertical migrations (Vervoort 1965; Marin 1988) which take them into the deep, warm current in winter which carries them south to counter the drift to the north in surface waters in summer. *Neocalanus tonsus* and other surface-living subantarctic species maintain themselves in subantarctic waters in a similar manner. Deacon (1937) proposed a return mechanism, which has apparently been confirmed by Heath (1976). Subantarctic surface water drifts to the north, with a southerly drift proposed at about 100–150 m based on the presence of a salt tongue extending to the south from the Subtropical Convergence, sometimes almost to the Antarctic Convergence. The daily vertical range of *N. tonsus* in late September is between the surface and at least 500 m (Bradford 1970a) so it is possible that daily vertical migration is sufficient to balance northwards and southwards transport to maintain this species in subantarctic water. The deep winter migration of *N. tonsus* to below 500 m (Jillett 1968; Ohman *et al.* 1989) explains why this species sometimes appears north of the STC in summer, where it has probably been transported in Antarctic Intermediate Water. Another mechanism for large-scale maintenance of subantarctic populations could be the suggested counterclockwise westwards circulation in the subantarctic sector of the southern ocean between 40° and 45°S (Deacon 1977), and smaller-scale mid-ocean eddies (Angel & Fasham 1983) with advective properties that may be capable of maintaining individuals geographically over time against a slow drift to the north.

The mechanisms by which transition-zone species maintain their distributions are not obvious, especially when we consider that population continuity is apparently interrupted by the South American continent (*see* e.g., *P. langae* in Fleminger 1973). The

boundary between subtropical and subantarctic waters is unstable and produces frontal eddies (Angel & Fasham 1983). It is possible that individual copepods are not transported very far from their birthplace in an east–west sense and could survive as long as they are able to tolerate the variable conditions in such eddies and are able to take advantage of periods of high productivity when they occur. The fact that there is a slow drift towards the Subtropical Convergence, both north and south of the boundary, means that a transitional-zone species which is seriously displaced from its normal range will be gradually returned if it remains at the surface.

In order to answer completely the question of what maintains all distribution patterns, we need to know a lot more about the ecology, and sometimes the taxonomy, of the species involved.

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REFERENCES

ALMEIDA PRADO-POR, M.S. 1984: Two new sympatric species of *Ctenocalanus* (Calanoida) from the Gulf of Elat (Aqaba). *Crustaceana, Supplement 7* : 85–90.

ANDRONOV, V.N. 1970: Some problems of taxonomy of the family Paracalanidae (Copepoda). *Zoologicheskii Zhurnal, Moskva 49* : 980–985, 2 figs. [In Russian with English summary.]

ANDRONOV, V.N. 1972a: *Bestiola* gen. nov. (Copepoda, Paracalanidae). *Zoologicheskii Zhurnal, Moskva 51* : 290–292. [In Russian with English summary.]

ANDRONOV, V.N. 1972b: Some new species of the genus *Parvocalanus* (Copepoda, Paracalanidae). *Zoologicheskii Zhurnal, Moskva 51* : 139–144. [In Russian with English summary.]

ANDRONOV, V.N. 1972c: The systematic status of *Paracalanus nudus* (Copepoda, Paracalanidae). *Zoologicheskii Zhurnal, Moskva 51* : 597–599. [In Russian with English summary.]

ANDRONOV, V.N. 1973a: New species of *Calocalanus* (Copepoda, Paracalanidae) from the Atlantic and Indian oceans. *Zoologicheskii Zhurnal, Moskva 52* : 1405–1410, 3 figs. [In Russian with English summary.]

ANDRONOV, V.N. 1973b: New species of the Family Mesaiokeratidae (Copepoda) from the Atlantic waters of the United States and South-west Africa. *Zoologicheskii Zhurnal, Moskva 52* : 1242–1245. [In Russian with English summary.]

ANDRONOV, V.N. 1973c: Taxonomic status of *Mecynocera clausi* (Copepoda, Calanoida). *Zoologicheskii Zhurnal, Moskva 52* : 1719-1721. [In Russian with English summary.]

ANDRONOV, V.N. 1974a: New species of Diaixidae and Stephidae (Copepoda) from the northern regions of the Indian Ocean. *Zoologicheskii Zhurnal, Moskva 53* : 460–464. [In Russian with English summary.]

ANDRONOV, V.N. 1974b: Phylogenetic relations of large taxa within the suborder Calanoida (Crustacea, Copepoda). *Zoologicheskii Zhurnal, Moskva 53* : 1002–1011. [In Russian with English summary.]

ANDRONOV, V.N. 1977: *Paracalanus tropicus* sp. n. (Copepoda, Paracalanidae) from south-east Atlantic. *Zoologicheskii Zhurnal, Moskva 56* : 154–156. [In Russian with English summary.]

ANDRONOV, V.N. 1991: On renaming of some taxa in

Calanoida (Crustacea). *Zoologicheskii Zhurnal 70(6)* : 133–134. [In Russian with English summary.]

ANDRONOV, V.N. 1992: *Ryocalanus admirabilis* sp. n. (Copepoda, Calanoida, Ryocalanidae) from the central-eastern Atlantic. *Zoologicheskii Zhurnal 71(7)* : 140–144. [In Russian with English summary.]

ANGEL, M.V.; FASHAM, M.J.R. 1983: Eddies and biological processes. Pp 492–524 *in* Robinson, A.R. (ed.) "Eddies in Marine Science". Springer-Verlag, Berlin.

ARASHKEVICH, Y.G. 1969: The food and feeding of copepods in the northwestern Pacific. *Okeanologiya 9* : 857–873. [English translation in *Oceanology 9* : 695–709.]

ARASHKEVICH, Y.G.; TIMONIN, A.G. 1970: Pitaniye kopepod tropicheskoy chasti tikhogo okeana [Copepod feeding in the tropical Pacific]. *Doklady Akademii Nauk SSSR 191* : 935–938.

BARY, B.M. 1951: A systematic and ecological survey of the summer macroplankton, southern New Zealand. Ph.D. Thesis, Victoria University of Wellington.

BARY, B.M. 1956: Notes on ecology, systematics and development of some Mysidacea and Euphausiacea (Crustacea) from New Zealand. *Pacific Science 10* : 431–467.

BARY, B.M. 1959: Species of zooplankton as a means of identifying different surface waters and demonstrating their movements and mixing. *Pacific Science 8* : 14–53.

BAYLY, I.A.E. 1982: The genus *Drepanopus* (Copepoda: Calanoida) : a review of species in Antarctic and sub-Antarctic waters, with a description of *D. bispinosus*, sp. n. *Australian Journal of Marine and Freshwater Research 33* : 161–172.

BÉ, A.W.H. 1962: Quantitative multiple opening-and-closing plankton samplers. *Deep-Sea Research 9* : 144–151.

BERNARD, M. 1958: Révision des *Calocalanus* (Copépodes Calanoida) avec description d'un genre nouveau et deux espèces nouvelles. *Bulletin de la Société zoologique de France 83* : 185–199.

BERNARD, M. 1963: Rectifications des noms donnés à deux genres de Calocalanides (Copepodes Calanoida). *Crustaceana 5* : 160.

BJÖRNBERG, T.K.S. 1968: Four new species of Megacalanidae (Crustacea: Copepoda). *Antarctic Research Series 11* : 73–90.

BJÖRNBERG, T.K.S. 1972: Developmental stages of some tropical and subtropical planktonic marine copepods. *Studies on the Fauna of Curaçao and other Caribbean Islands 40(136)* : 1-185, 645 figs.

BJÖRNBERG, T.K.S. 1980: Revisão da distribuição dos gêneros *Paracalanus, Clausocalanus* e *Ctenocalanus* (Copepoda, Crustacea) ao largo do Brasil. *Boletim do Instituto oceanografico. São Paulo 29* : 65–68.

BOECK, A. 1865: Oversigt over de ved Norges Kyster iagttagne Copepoder, henhörende til Calanidernes, Cyclopidernes og Harpactidernes Familier. *Forhandlingar i Videnskabsselskabet i Kristiania 1864* : 226–282.

BOECK, A. 1873: Nye Slaegter og Arter af Saltvands — Copepoder. *Forhandlingar i Videnskabsselskabet i Kristiania 1872, 24* : 35–60.

BOWMAN, T.E. 1955: A new copepod of the genus *Calanus* from the northeastern Pacific with notes on *Calanus tenuicornis* Dana. *Pacific Science 9* : 413–422.

BOWMAN, T.E. 1958: A new species of *Acrocalanus* (Copepoda: Calanoida) from off the southeastern coast of the United States. *Bulletin of Marine Science of the Gulf and Caribbean 8* : 118–124.

BOWMAN, T.E. 1971: The distribution of calanoid copepods off the southeastern United States between Cape Hatteras and southern Florida. *Smithsonian Contributions to Zoology 96* : 1–58.

BOWMAN, T.E. 1976: *Miostephos cubrobex*, a new genus and species of copepod from an anchihaline pool in Cuba (Calanoida: Stephidae). *Proceedings of the Biological Society of Washington 89(11)* : 185–190.

BOXSHALL, G.A.; STOCK, J.H.; SANCHEZ, E. 1990: Stygofauna of the Canary Islands, No. 16. A new species of *Stephos* Scott, 1892 (Copepoda: Calanoida) from an anchihaline lava pool on Lanzarote, Canary Islands. *Stygologia 5(1)* : 33–41.

BRADFORD, J.M. 1970a: Diurnal variation in vertical distribution of pelagic copepods off Kaikoura, New Zealand. *N.Z. Journal of Marine and Freshwater Research 4* : 337–350.

BRADFORD, J.M. 1970b: Records of pelagic copepods off Kaikoura, New Zealand. *N.Z. Journal of Marine and Freshwater Research 4*: 351-363.

BRADFORD, J.M. 1971: Fauna of the Ross Sea. Part 8. Pelagic Copepoda. *Memoirs. N.Z. Oceanographic Institute 59* : 9–31.

BRADFORD, J.M. 1972: Systematics and ecology of New Zealand central east coast sampled at Kaikoura. *Memoirs. N.Z. Oceanographic Institute 54* : 1–87. [N.Z. D.S.I.R Bulletin 207.]

BRADFORD, J.M. 1978: *Paracalanus indicus* Wolfenden and *Corycaeus aucklandicus* Kraemer, two neritic pelagic copepods from New Zealand. *Journal of the Royal Society of N.Z. 8(2)* : 133–141.

BRADFORD, J.M. 1985: Distribution of zooplankton off Westland, New Zealand, June 1979 and February 1982. *N.Z. Journal of Marine and Freshwater Research 19* : 311–326.

BRADFORD, J.M. 1988: Review of the taxonomy of the Calanidae (Copepoda) and the limits to the genus *Calanus*. *Hydrobiologia 167/168* : 73–81.

BRADFORD, J.M.; JILLETT, J.B. 1974: A revision of generic definitions in the Calanidae (Copepoda, Calanoida). *Crustaceana 27* : 5–16.

BRADFORD, J.M.; JILLETT, J.B. 1980: The marine fauna of New Zealand: pelagic calanoid copepods: Family Aetideidae. *Memoirs. N.Z. Oceanographic Institute 86* : 1–102.

BRADFORD, J.M.; RIDGWAY, N.M.; ROBERTSON, D.A.; STANTON, B.R. 1980: Hydrology, plankton and nutrients in Hawke Bay, September 1976. *NZOI Oceanographic Field Report 15* : 1–38.

BRADFORD, J.M.; HAAKONSEN, L.; JILLETT, J.B. 1983: The marine fauna of New Zealand: pelagic calanoid copepods: Families Euchaetidae, Phaennidae, Scolecithricidae, Diaixidae, and Tharybidae. *Memoirs. N.Z. Oceanographic Institute 90* : 1–150.

BRADFORD, J.M.; OHMAN, M.D.; JILLETT, J.B. 1988: Larval morphology and development of *Neocalanus tonsus, Calanoides macrocarinatus*, and *Calanus australis* (Copepoda: Calanoida) in the laboratory. *N.Z. Journal of Marine and Freshwater Research 22* : 301–320.

BRADFORD-GRIEVE, J.M.; MURDOCH, R.C.; CHAPMAN, B.E. 1993: Composition of macrozooplankton assemblages associated with the formation and decay of pulses within an upwelling plume in greater Cook Strait, New Zealand. *N.Z. Journal of Marine and Freshwater Research 27* : 1–22.

BRADY, G.S. 1883: Report on the Copepoda collected by H.M.S. "Challenger" during the years 1873–76. *Report on the Scientific Results of the Voyage of H.M.S Challenger 1873–76, Zoology 8* : 1–142, 55 pls.

BRADY, G.S. 1899: On the marine Copepoda of New Zealand. *Transactions of the Zoological Society of London 15(2)* : 31–54, pls 9–13.

BRADY, G.S. 1914: On some pelagic Entomostraca collected by Mr. J.Y. Gibson in Durban Bay. *Annals of the Durban Museum 1* : 1–9, pls 1–4.

BRADY, G.S. 1918: Copepoda. *Scientific Reports of the Australasian Expedition, 1911–1914. Series C. 5* : 1–48, 15 pls.

BRODSKY, K.A. 1948: The free-swimming Copepoda of the Japan Sea. *Izvestiya Tikhookeanskogo nauchno-issledovatel'skogo Instituta rybnogo Khozyaistva i Okeanografii 26* : 28–32. [In Russian.]

BRODSKY, K.A. 1950: Calanoida of the far eastern seas and polar basin of the U.S.S.R. *Opredeliteli po Faune SSSR 35* : 1–442. [Israel Program for Scientific Translations, Jerusalem, 1967.]

BRODSKY, K.A. 1955: The Calanoida of the Kurile – Kamchatka Trench. *Trudy Instituta Okeanologii Akademiya Nauk SSSR 12* : 184–209. [In Russian.]

BRODSKY, K.A. 1959: On the phylogenetic relations of some *Calanus* (Copepoda) species of the northern and southern hemispheres. *Zoologicheskii Zhurnal, Moskva 38* : 1537–1553. [In Russian.]

BRODSKY, K.A. 1961: Comparison of *Calanus* species (Copepoda) from the Southern and Northern hemispheres. *Information Series. N.Z. Department of Scientific and Industrial Research 33* : 1–22.

BRODSKY, K.A. 1965: Sistematika morskikh planktonnykh organismov i okeanologiya [The systematics of marine plankton organisms and oceanology.] *Okeanologiya 5* : 557–591. [In Russian.]

BRODSKY, K.A. 1967: Distribution and size variability of species of Calanidae (Copepoda) on the basis of a comparative morphological analysis of its characters. Geographical and seasonal variability of marine plankton. *Issledovaniya Fauny Morei 4* : 190–219. [Israel Program for Scientific Translations, 1968.]

BRODSKY, K.A. 1972: Phylogeny of the family Calanidae (Copepoda) on the basis of a comparative morphological analysis of its characters. *Issledovaniya Fauny Morei 12* : 1–127. [Israel Program for Science Translations, 1975.]

BRODSKY, K.A.; VYSHKVARTZEVA, N.V.; KOS, M.S.; MARKHASEVA, E.L. 1983: Veslonogie rakoobraznie (Copepoda: Calanoida) morei SSSR i sopredel'nikh vod. I. *Opredeliteli po Faune SSSR 135* : 1–358. [In Russian.]

CASSIE, R.M. 1959a: An experimental study of factors inducing aggregation in marine plankton. *N.Z. Journal of Science 2* : 339–365.

CASSIE, R.M. 1959b: Micro-distribution of plankton. *N.Z. Journal of Science 2* : 398–409.

CASSIE, R.M. 1960: Factors influencing the distribution

pattern of plankton in the mixing zone between oceanic and harbour waters. *N.Z. Journal of Science 3* : 26–50.

CASSIE, R.M. 1963: Multivariate analysis in the interpretation of numerical plankton data. *N.Z. Journal of Science 6* : 36–59.

CHAPMAN, P.M. 1981: Evidence for dissolved glucose uptake from seawater by *Neocalanus plumchrus* (Arthropoda, Copepoda). *Canadian Journal of Zoology 59* : 1618–1621.

CHEN, Q.-C.; ZHANG, S.-Z. 1965: The planktonic copepods of the Yellow Sea and the East China Sea. 1. Calanoida. *Studia Marina Sinica 7* : 20–131. [In Chinese with English summary.]

CHEN, Q.-C.; ZHANG, S.-Z. 1974: The pelagic copepods of the South China Sea I. *Studia Marina Sinica 9* : 101–116, 8 pls. [In Chinese with English summary.]

CHIBA, T.; HIRAKAWA, K. 1972: Classification and communities of the zooplankton in the south-western Pacific Ocean, with special reference to copepods. *Journal of the Shimonoseki University of Fisheries 21(1)* : 67–80.

CLARK, G.L.; BUMPUS, D.F. 1940: The plankton sampler — an instrument for quantitative plankton investigations. *Special Publications. American Society of Limnology and Oceanography 5* : 8 p.

CLAUS, C. 1863: "Die freilebenden Copepoden mit besonderer Berücksichtigung der Fauna Deutschlands, der Nordsee und des Mittelmeeres". Englemann, Leipzig 230 p, 37 pls.

CLAUS, C. 1866: "Die Copepoden-Fauna von Nizza. Ein Beitrag zur Charakteristik der Formen und deren Abänderungen "im sinne Darwin's"". Marburg and Leipzig, 34 p, 5 pls.

CORRAL, J. 1972a: *Diaxis durani,* nueva especie de Copépodo Calanoide procedente de la Ria de Arosa, NW de España. *Boletin del Instituto español de Oceanografia 150* : 51–59.

CORRAL, J. 1972b: La familia Calocalanidae (Copepoda, Calanoida) en aguas del archipiélago canario. *Boletin del Instituto español de Oceanografia 149* : 3-47.

DAHL, F. 1894: Die Copepodenfauna des unteren Amazones. *Bericht der Naturforschenden Gellschaft zu Freiburg i. Br. 8* : 10–23, pl. 1.

DAKIN, W.J.; COLEFAX, A.N. 1933: The marine plankton of the coastal waters of New South Wales. 1. The chief planktonic forms and their seasonal distribution. *Proceedings of the Linnaean Society of New South Wales 58* : 186–222.

DAKIN, W.J.; COLEFAX, A.N. 1940: The plankton of the Australian coastal waters off New South Wales. Part 1. *Publications of the University of Sydney, Department of Zoology, Monograph 1* : 215 p, 4 pls.

DAMKAER, D.M. 1971: *Parastephos occatum,* a new species of hyperbenthic copepod (Calanoida: Stephidae) from the inland marine waters of Washington State. *Proceedings of the Biological Society of Washington 83*: 505–514.

DAMKAER, D.M. 1975: Calanoid copepods of the genera *Spinocalanus* and *Mimocalanus* from the central Arctic Ocean, with a review of the Spinocalanidae. *NOAA Technical Report NMFS CIRC 391* : 1–88.

DANA, J.D. 1847: Conspectus Crustaceorum, in orbis terrarum circumnavigatione, C. Wilkes, e classe Republicae Foederatae duce, collectorum. *Proceedings of the American Academy of Arts and Science 1* : 149–155.

DANA, J.D. 1849: Conspectus Crustaceorum, in orbis terrarum circumnavigatione, C. Wilkes, e classe Republicae Foederatae duce, collectorum. *Proceedings of the American Academy of Arts and Science 2* : 9–61.

DANA, J.D. 1852: Crustacea, Part II. *United States Exploring Expedition during the years 1838–1842, under the command of Charles Wilkes 13* : 1019–1262, atlas (1855), pls 70–88.

DAVIS, C.C. 1949: The pelagic copepoda of the northeastern Pacific Ocean. *University of Washington Publications in Biology 14(4)* : 1–18.

DEACON, G.E.R. 1937: The hydrology of the Southern Ocean. *Discovery Report 15* : 3–124, pls I–XLIV.

DEACON, G.E.R. 1977: Comments on a counter-clockwise circulation in the Pacific subantarctic sector of the Southern Ocean suggested by McGinnis. *Deep-Sea Research 24* : 927–930.

DE DECKER, A.H.B.; KACZMARUK, B.Z.; MARSKA, G. 1991: A new species of *Calanus* (Copepoda, Calanoida) from South African waters. *Annals of the South African Museum 101* : 27–44.

DEEVEY, G.B. 1966: Seasonal variations in length of copepods in south Pacific New Zealand waters. *Australian Journal of Marine and Freshwater Research 17* : 155–168.

FARRAN, G.P. 1908: Second report on the Copepoda of the Irish Atlantic Slope. *Scientific Investigations of the Fisheries Branch, Ireland, 1906 2* : 1–104, 11 pls. [Also published in 1909 as *Report on the Sea and Inland Fisheries of Ireland for 1906, 2,* appendix 2 : 19–120, pls 1–11.]

FARRAN, G.P. 1926: Biscayan plankton collected during a cruise of H.M.S. "Research" 1900. Part XIV. The Copepoda. *Journal of the Linnean Society, Zoology 36(243)* : 219–310, pls 5–10.

FARRAN, G.P. 1929: Crustacea, Pt. 10. Copepoda. *British Antarctic ("Terra Nova") Expedition, 1910, Natural History Reports, Zoology 8* : 203–306, 4 pls.

FARRAN, G.P. 1936: Copepoda. *Scientific Reports of the Great Barrier Reef Expedition, 1928-29 5* : 73–142.

FARRAN, G.P. 1939: Note on the nomenclature of the copepod genus *Megacalanus* Wolfenden and allied genera. *Annals and Magazine of Natural History, ser. 11, 4* : 355–361.

FARRAN, G.P.; VERVOORT, W. 1951a: Copepoda. Suborder: Calanoida. Family: Pseudocalanidae. Genera *Pseudocalanus, Microcalanus. Fiches d'Identification Zooplancton 37* : 1–4.

FARRAN, G., P; VERVOORT, W. 1951b: Copepoda. Suborder: Calanoida. Family: Megacalanidae. *Fiches d'Identification Zooplancton 33* : 1–4.

FLEMINGER, A. 1957: New calanoid copepods of the families Aetideidae, Euchaetidae, and Stephidae from the Gulf of Mexico. *Fishery Bulletin 57* : 355–363.

FLEMINGER, A. 1973: Pattern, number, variability and taxonomic significance of integumental organs (sensilla and glandular pores) in the genus *Eucalanus* (Copepoda: Calanoida). *Fishery Bulletin 71* : 965–1010.

FLEMINGER, A. 1983: Description and phylogeny of *Isaacsicalanus paucisetus,* n. gen., n. sp., (Copepoda: Calanoida: Spinocalanidae) from an east Pacific hydrothermal vent site (21°N). *Proceedings of the Biological Society of Washington 96* : 605–622.

FLEMINGER, A. 1988: *Parastephos esterlyi,* a new species of copepod (Stephidae: Calanoida: Crustacea) from San Diego Bay, California. *Proceedings of the Biological Society of Washington 101* : 309–313.

FLEMINGER, A.; HULSEMANN, K. 1987: Geographical variation in *Calanus helgolandicus s.l.* (Copepoda, Calanoida) and evidence of recent speciation of the Black Sea population. *Biological Oceanography 5* : 43–81.

FLEMINGER, A.; HULSEMANN, K. 1973: Relationship of Indian Ocean epiplanktonic calanoids to the world oceans. Pp 339–348 *in* Zeitzshel, B. (ed.) "Ecological Studies. Analysis and Synthesis", Vol 3. Springer-Verlag, Berlin.

FOSSHAGEN, A. 1970: Marine biological investigations in the Bahamas. 12. Stephidae (Copepoda, Calanoida) from the Bahamas, with remarks on *Stephos sinuatus* Willey and *S. arcticus* Sars. *Sarsia 41* : 37–48.

FOSSHAGEN, A. 1978: *Mesaiokeras* (Copepoda, Calanoida) from Colombia and Norway. *Sarsia 63* : 177–183.

FOSSHAGEN, A. 1983: A new genus of calanoid copepod from the Norwegian Sea. *Sarsia 68* : 257–262.

FOSSHAGEN, A.; ILIFFE, T.M. 1985: Two new genera of Calanoida and a new order of Copepoda, Platycopioida, from marine caves on Bermuda. *Sarsia 70* : 345–358.

FROST, B.W. 1974: *Calanus marshallae,* a new species of calanoid copepod closely allied to the sibling species *C. finmarchius* and *C. glacialis. Marine Biology 26* : 77–99.

FROST, B.W. 1989: A taxonomy of the marine calanoid copepod genus *Pseudocalanus. Canadian Journal of Zoology 67* : 525–551.

FROST, B.W.; FLEMINGER, A. 1968: A revision of the genus *Clausocalanus* (Copepoda: Calanoida) with remarks on the distributional patterns in diagnostic characters. *Bulletin. Scripps Institution of Oceanography. Technical ser. 12* : 1–99.

FRÜCHTL, F. 1923: Cladocera und Copepoda der Aru-Inseln (Vorläufige Mitteilung: Artenliste und kurze Diagnosen der neuen Formen). *Abhandlungen hrsg. von der Senckenbergischen naturforschenden Gesellschaft 35* : 449–457.

GELETIN, Y.V. 1976: The ontogenetic abdomen formation in copepods of genera *Eucalanus* and *Rhincalanus* (Calanoida, Eucalanidae) and new system of these copepods. *Issledovaniya Fauny Morei 18* : 75–93. [In Russian with English summary.]

GIESBRECHT, W. 1881: Vorläufige Mittheilung aus einer Arbeit über die freilebenden Copepoden des Kieler Hafens. *Zoologischer Anzeiger 4* : 254–258.

GIESBRECHT, W. 1888: Elenco dei copepodi pelagici raccolti dal tenente di vascello Gaetano Chierchia durante il viaggio della R. Corvetta "Vettor Pisani" negli anni 1882–1885, e dal tenente di vascello Francesco Orsini nel Mar Rosso, nel 1884. *Atti dell'Accademia nazionale dei Lincei. Rendiconti 4* : 284–287, 330–338.

GIESBRECHT, W. 1892: Systematik und Faunistik der pelagischen Copepoden des Golfes von Neapel. *Fauna und Flora des Golfes von Neapel und der angrenzenden Meeresabschnitte 19* : 831 p, 54 pls.

GIESBRECHT, W. 1902: Copepoden. *Résultats du Voyage*

du S.Y. Belgica en 1887-1889, Expedition Antarctique Belge. Rapports Scientifique, Zoologie : 1–49, 13 pls.

GONZALEZ, J.G.; BOWMAN, T.E. 1965: Planktonic copepods from Bahía Fosforescente, Puerto Rico, and adjacent waters. *Proceedings of the U.S. National Museum 117(3513)* : 241–304.

GOWING, M.M.; WISHNER, K.F. 1986: Trophic relationships of deep-sea calanoid copepods from the benthic boundary layer of the Santa Catalina Basin, California. *Deep-Sea Research 33(7a)* : 939–961.

GREENE, C.H.; LANDRY, M.R. 1988: Carnivorous suspension feeding by the subarctic copepod *Neocalanus cristatus*. *Canadian Journal of Fisheries and Aquatic Science 45* : 1069–1074.

GREENWOOD, J.G. 1976: Calanoid copepods of Moreton Bay (Queensland) 1. Families Calanidae, Eucalanidae, and Paracalanidae. *Proceedings of the Royal Society of Queensland 87* : 1-28.

GREENWOOD, J.G. 1977: Calanoid copepods of Moreton Bay (Queensland). 2. Families Calocalanidae to Centropagidae. *Proceedings of the Royal Society of Queensland 88* : 49–67.

GREENWOOD, J.G. 1978: A replacement name *Stephos morii* proposed for the preoccupied name *S. tropicus* (Copepoda, Calanoida). *Proceedings of the Royal Society of Queensland 89* : 131.

GRICE, G.D.; HULSEMANN, K. 1965: Abundance, vertical distribution and taxonomy of calanoid copepods at selected stations in the northeast Atlantic. *Journal of Zoology 146* : 213–262.

GRICE, G.D.; HULSEMANN, K. 1967: Bathypelagic calanoid copepods of the western Indian Ocean. *Proceedings of the U.S. National Museum 122(3583)* : 1–67.

GUEREDRAT, J.-A. 1969a: Distribution de quatre especes de Copépodes bathypélagiques dans l'ouest du Pacifique équatorial et tropical Sud. *Deep-Sea Research 16* : 361–375.

GUEREDRAT, J.-A. 1969b: Variations morphologiques de *Megacalanus princeps*. *Crustaceana 17* : 64–68.

GUNNERUS, J.E. 1770: Nogle smaa rare, mestendelen nye Norske Söedyr, beskrevene. *Skrifter som udi det Kiöbenhavnske Selskab Laerd. og Videnskabernes Elsk., 1765–1769 10* : 175.

HAMILTON, A. 1896: "Deep-sea fauna of New Zealand. Extracted from the reports of the Challenger Expedition". New Zealand Institute, Wellington. 29 p.

HARDING, G.C.H. 1974: The food of deep-sea copepods. *Journal of the Marine Biological Association of the U.K. 54* : 141–155, 4 pls.

HEATH, R.A. 1976: Models of the diffusive-advective balance at the Subtropical Convergence. *Deep-Sea Research 23* : 1153–1164.

HEINRICH, A.K. 1968: [Quantitative distribution of the plankton animals in the west Pacific.] Pp. 29–86 *in* Semina, H.J. (ed.) "Plankton of the Pacific Ocean". Nauka, Moscow. [In Russian.]

HERON, A.C. 1982: A vertical free fall plankton net with no mouth obstructions. *Limnology and Oceanography 27* : 380–383.

HERON, G.A.; BOWMAN, T.E. 1971: Postnaupliar developmental stages of the copepod crustaceans *Clausocalanus laticeps, C. brevipes* and *Ctenocalanus citer* (Calanoida: Pseudocalanidae). *Antarctic Research Series 17* : 141–165.

HISLOP, J.R.G. 1970: Preliminary investigations on the pelagic 0-group phase of some demersal gadoids. *International Council for the Exploration of the Sea C.M. 1970/F:12* : 5 p, 1 table, 5 figs.

HULSEMANN, K. 1985: Two species of *Drepanopus* Brady (Copepoda Calanoida) with discrete ranges in the Southern Hemisphere. *Journal of Plankton Research 7* : 909–925.

HULSEMANN, K. 1991: *Calanus euxinus*, new name, a replacement name for *Calanus ponticus* Karavaev, 1894 (Copepoda: Calanoida). *Proceedings of the Biological Society of Washington 104* : 620–621.

ISAACS, J.D.; KIDD, L.W. 1953: Isaacs-Kidd midwater trawl. Final report. *Scripps Insitution of Oceanography Ref. ser. 53–3* : 1–18.

ITOH, K. 1970: A consideration on feeding habits of planktonic copepods in relation to the structure of their oral parts. *Bulletin of the Plankton Society of Japan / Nihon Purankuton Gakkaiho 17* : 1–10. [British Library RTS 10131.]

JILLETT, J.B. 1968: *Calanus tonsus* (Copepoda, Calanoida) in southern New Zealand waters with notes on the male. *Australian Journal of Marine and Freshwater Research 19* : 19–30.

JILLETT, J.B. 1971: Zooplankton and hydrology of Hauraki Gulf, New Zealand. *Memoirs. N.Z. Oceanographic Institute 53* : 103 p. [N.Z. Department of Scientific and Industrial Research Bulletin 204.]

JILLETT, J.B. 1976: Zooplankton associations off Otago Peninsula, south-eastern New Zealand, related to

different water masses. *N.Z. Journal of Marine and Freshwater Research 10* : 543–557.

JOHNSON, M.W. 1938: Concerning the Copepod *Eucalanus elongatus* Dana and its varieties in the Northeast Pacific. *Bulletin. Scripps Institution of Oceanography. Technical ser. 4* : 165–180.

JOHNSON, M.W. 1958: *Bathycalanus sverdrupi*, n.sp., a copepod crustacean from great depths in the Pacific Ocean. *Proceedings of the Californian Academy of Science 29* : 257–265.

KEMP, S.; HARDY, A.C. 1929: The Discovery investigations, objects, equipment and methods. Part II, The ships, their equipment and the methods used in research. *Discovery Reports 1* : 151–222.

KHROMOV, N.S. 1973: Distinguishing features of some mass species of copepods in zones where the northern subtropical circulation of Atlantic waters impinges on the coasts. *Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Morskogo Rybnogo Khozyaistva i Okeanografii 84* : 81–112. [Translation]

KITOU, M.; TANAKA, O. 1969: Note on a species of *Calanoides* (Copepoda; Calanoida) from the Western North Pacific. *Oceanographical Magazine 21* : 67–81.

KOS, M.S. 1972: A new species of Stephos (Copepoda, Calanoida) from coastal waters of the Kuril Islands. *Crustaceana 23* : 113–118.

KOVALEV, A.V.; SHMELEVA, A.A. 1982: Fauna of Copepoda in the Mediterranean. *Ekologija Morja 8* : 37–46. [In Russian with English summary.]

KRÄMER, A. 1894: On the most frequent pelagic copepods and cladoceres of the Hauraki Gulf. *Transactions and Proceedings of the N.Z. Institute, ser. 2, 10* : 214–223, pls 15–18.

KRÖYER, H. 1838: [Greenland Amphipods (An addition: Description of some other crustaceans from Greenland, and an enumeration of the known Greenland species of the crustacean class, in connection with some zoological-geographical remarks about the boreal Crustacea)]. *Kongelige Danske Videnskabernes Selskabs Skrifter (Naturv. og Matematisk Afdeling) 4* : 231–326, 4 pls. [Translation by C.C. and D.M. Damkaer, 1979, *Transactions of the American Philosophical Society 69* : 9–10.]

KRÖYER, H. 1845: Crustacés. Pp xx pls 41–43 *in* Bertrand, A. (ed.) "Atlas de Zoologie. Voyages de la Commission scientifique du nord en Scandinavie, en Laponie, au Spitzberg et aux Feroe pendant les années 1838-1840, sur la Corvette "La Recherche" commandée par M. Favre". Firmin-Didot, frères, Paris.

KRÖYER, H. 1848, 1849: Karcinologiske Bidrag. *Naturhistorisk Tidsskrift. Kjobenhavn 2(2)* : 527–560, pl. 6.

LANDRY, M.R. 1981: Switching between herbivory and carnivory by the planktonic marine copepod *Calanus pacificus*. *Marine Biology 65* : 77–82.

LEACH, W.E. 1816: "Encyclopaedia Britannica" *Suppl. to edns 4–6, 2(2)* : 407.

LUBBOCK, J. 1860: On some oceanic Entomostraca collected by Captain Toynbee. *Transactions of the Linnean Society of London, ser. 2, 23* : 173–193.

McGOWAN, J.A. 1974: The nature of ecosystems. Pp 9–28 in "The Biology of the Oceanic Pacific". Oregon State University Press, Corvallis.

MARIN, V. 1988: Independant life cycles: an alternative to the asynchronous hypothesis for Antarctic calanoid copepods. *Hydrobiologia 167/168* : 161–168.

MARUKAWA, H. 1921: Plankton list and some new species of Copepoda from northern waters of Japan. *Bulletin de l'Institut océanographique de Monaco 384* : 15 p, 4 pls., 1 map.

MATTHEWS, J.B.L. 1961: A new species of copepod (Calanoida) from western Norway. *Sarsia 4* : 33–38.

MATTHEWS, J.B.L. 1968: *Eucalanus monachus* Giesbrecht, 1892, off the coast of Nigeria. *Crustaceana 1968* : 35–36.

MATTHEWS, L.H. 1925: A new Antarctic Copepod, belonging to the genus *Eucalanus*. *Annals and Magazine of Natural History. ser. 9, 15* : 127–129.

MAUCHLINE, J. 1988: Taxonomic value of pore pattern in the integument of calanoid copepods (Crustacea). *Journal of Zoology 214* : 697–749.

MENZIES, R.J. 1962: The isopods of abyssal depths in the Atlantic Ocean. *Vema Research Series 1* : 79–205, figs 1–74.

MILLER, C.B. 1988: *Neocalanus flemingeri*, a new species of Calanidae (Copepoda: Calanoida) from the Subarctic Pacific Ocean, with a comparative redescription of *Neocalanus plumchrus* (Marukawa) 1921. *Progress in Oceanography 20* : 223–273.

MILLER, C.B.; JUDKINS, D.C. 1981: Design of pumping systems for sampling zooplankton, with descriptions of two high capacity samplers for coastal waters. *Biological Oceanography 1* : 29–56.

MORI, T. 1937: "The pelagic Copepoda from the neighbouring waters of Japan". 2nd edn. The Soyo Company Inc., Tokyo. 150 p.

MULLIN, M.M. 1969: Distribution, morphometry, and seasonal biology of the planktonic copepods *Calanus tenuicornis* and *C. lighti*, in the Pacific Ocean. *Pacific Science 23* : 438-446.

MULLIN, M.M.; BROOKS, E.R. 1967: Laboratory culture, growth rate, and feeding behaviour of a planktonic marine copepod. *Limnology and Oceanography 12* : 657–666.

NISHIDA, S. 1989: Distribution, structure and importance of the cephalic dorsal hump, a new sensory organ in calanoid copepods. *Marine Biology 101* : 173–185.

NYAN TAW 1978: Some common components of the plankton of the southeastern coastal waters of Tasmania. *Papers and Proceedings of the Royal Society of Tasmania 112* : 69–136.

OHMAN, M.D.; BRADFORD, J.M.; JILLETT, J.B. 1989: Seasonal growth and lipid storage of the circumglobal, subantarctic copepod, *Neocalanus tonsus* (Brady). *Deep-Sea Research 36* : 1309–1326.

OHTSUKA, S.; HIROMI, J. 1987: Calanoid copepods collected from the near-bottom in Tanabe Bay on the Pacific coast of the Middle Honshu, Japan. 3. Stephidae. *Publications of the Seto Marine Biological Laboratory 32* : 219–232.

PAFFENHÖFER, G.-A. 1984: Food ingestion by the marine planktonic copepod *Paracalanus* in relation to abundance and size distribution of food. *Marine Biology 80* : 323-333.

PARK, T. 1970: Calanoid copepods from the Caribbean Sea and the Gulf of Mexico. 2. New species and new records from plankton samples. *Bulletin of Marine Science 20* : 472–546.

PARK, T. 1982: Calanoid copepods of the genus *Scaphocalanus* from Antarctic and Subantarctic waters. *Antarctic Research Series 34* : 75–127.

PARK, T. 1983a: Calanoid copepods of some scolecithricid genera from Antarctic and Subantarctic waters. *Antarctic Research Series 38* : 165–213.

PARK, T. 1983b: Copepods of the Family Phaennidae from Antarctic and Subantarctic waters. *Antarctic Research Series 39* : 317–368.

PARK, T.S. 1986: Phylogeny of calanoid copepods. *Syllogeus 58* : 191–196.

PARK, T. 1988: Calanoid copepods of the genus *Haloptilus* from Antarctic and Subantarctic waters. *Antarctic Research Series 47* : 1–25.

PETERSON, W.T.; MILLER, C.B.; HUTCHINSON, A. 1979: Zonation and maintenance of copepod populations in the Oregon upwelling zone. *Deep-Sea Research 26A* : 467–494.

PINTAR, Z. 1988: "Two new species of *Calanus* s. str. (Copepoda: Calanoida) from the South Adriatic". Izdavac: Skupstina opcine Karlovac i Gradska biblioteka "I.G. Kovacic", Karlovac, Yugoslavia. 27 p.

POSGAY, J.A.; MARAK, R.R. 1990: The MARMAP bongo zooplankton sampler. *Journal of the Northwest Atlantic Fisheries Science 1* : 91–99.

RIERA, T.; VIVES, F.; GILI, J.-M. 1991: *Stephos margalefi* sp. nov. (Copepoda: Calanoida) from a submarine cave of Majorca Island (western Mediterranean). *Oecologia Aquatica 10* : 317–323.

ROBERTS, P.E. 1972: The plankton of Perseverance Harbour, Campbell Island, New Zealand. *Pacific Science 26* : 296–309.

ROE, H.S.J. 1972: The vertical distributions and diurnal migrations of calanoid copepods collected on the SOND cruise, 1965. 2. Systematic account. Families Calanidae up to and including the Aetideidae. *Journal of the Marine Biological Association of the U.K. 52* : 315–343.

ROE, H.S.J. 1975: Some new and rare species of calanoid copepods from the northeastern Atlantic. *Bulletin of the British Museum (Natural History), Zoology 28* : 295–372.

ROSE, M. 1933: Copépodes pélagiques. *Faune de France 26* : 1–374.

SAMYSHEV, E.Z. 1970: On nutrition of *Nannocalanus minor* (Claus) and *Eucalanus subtenuis* (Giesbrecht) in the Guinea Bay. *Gidrobiologicheskii Zhurnal 6(4)* : 44–59. [English translation in *Hydrobiological Journal 6(4)* : 32–45.]

SARS, G.O. 1898: The Cladocera, Copepoda and Ostracoda of the Jana Expedition. *Annuaire du Musée Zoologique de l'Academie Imperiale des Sciences de St Petersbourg 3* : 324–359, pls 6–11.

SARS, G.O. 1900: Crustacea. *Scientific Results of the Norwegian North Polar Expedition 1893–96 1(5)* : 137 p, 36 pls.

SARS, G.O. 1901: "An account of the Crustacea of Norway. 4. Copepoda, Calanoida. Parts 1, 2, Calanidae, Eucalanidae, Paracalanidae, Pseudocalanidae, Aetideidae (partial)". Bergen Museum, Bergen. 28 p., 16 pls.

SARS, G.O. 1902: "An account of the Crustacea of Norway. 4. Copepoda, Calanoida. Parts 3–12". Bergen Museum, Bergen. Pp 29–144, pls 17–96.

SARS, G.O. 1903: "An account of the Crustacea of Norway. 4. Copepoda, Calanoida. Parts 13, 14". Bergen Museum, Bergen. Pp 145–171, pls 97–102, suppl. pls 1–6.

SARS, G.O. 1905: Liste préliminaire des Calanoidés recueillis pendant les campagnes de S.A.S. le Prince Albert de Monaco avec diagnoses des genres et des espèces nouvelles (1 er partie). *Bulletin du Musée Océanographique de Monaco 26* : 22 p.

SARS, G.O. 1907: Notes supplémentaires sur les Calanoidés de la Princesse-Alice (Corrections et additions). *Bulletin de l'Institut Océanographique 101* : 27 p.

SARS, G.O. 1909: Crustacea. *Report of the 2nd Norwegian Arctic Expedition in the Fram 1898–1902 18* : 1–47.

SARS, G.O. 1919: Copepoda. Supplement. *An Account of the Crustacea of Norway 7* : 1–24, pls 1–14.

SARS, G.O. 1920: Calanoidés recueillis pendant les campagnes de S.A.S. le Prince Albert de Monaco (Nouveau supplément). *Bulletin de l'Institut Océanographique 377* : 20 p.

SARS, G.O. 1924, 1925: Copépodes particulièrement bathypélagiques provenant des campagnes scientifiques du Prince Albert 1 er de Monaco. *Résultats des Campagnes Scientifiques accompliés par le Prince Albert 1er de Monaco 69* : [Atlas 1924], 127 pls, text 1925, 408 p.

SCHMAUS, P.H.; LEHNHOFER, K. 1927: Copepoda (4): *Rhincalanus* Dana 1852 der Deutschen Tiefsee Expedition. Systematik und Verbreitung der Gattung. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer 'Valdivia' 1898–1899 23* : 355–400.

SCHULZ, K. 1989: Notes on rare spinocalanid copepods from the eastern North Atlantic, with descriptions of new species of the genera *Spinocalanus* and *Teneriforma* (Copepoda, Calanoida). *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut 86* : 185–208.

SCOTT, A. 1909: The Copepoda of the Siboga Expedition. Part 1. Free-swimming, littoral and semi-parasitic Copepoda. *Siboga Expeditie 17(Mon. 29a)* : 324 p, 69 pls.

SCOTT, T. 1892: Additions to the fauna of the Firth of Forth. *Annual Report of the Fishery Board for Scotland 10* : 246.

SCOTT, T. 1894: Report on Entomostraca from the Gulf of Guinea. *Transactions of the Linnean Society of London, ser. 2, 6* : 1-161, 15 pls.

SCOTT, T.; SCOTT, A. 1898: Descriptions of three apparently new copepods from the Clyde. *Annals and Magazine of Natural History, ser. 7, 1* : 185–190.

SEWELL, R.B.S. 1912: Notes on the surface-living Copepoda of the Bay of Bengal, I and II. *Records of the Indian Museum 7* : 313–382, pls 14–24.

SEWELL, R.B.S. 1914: Notes on the surface Copepoda of the Gulf of Mannar. *Spolia Zeylanica 9* : 191–263, pls 17–21.

SEWELL, R.B.S. 1929: The Copepoda of Indian seas. *Memoirs of the Indian Museum 10* : 1–221.

SEWELL, R.B.S. 1947: The free-swimming planktonic Copepoda. Systematic account. *Scientific Reports. John Murray Expedition 8* : 1–303.

SHEN, C.-J.; BAI, S.-O. 1956: The marine Copepoda from the spawning ground of *Pneumatophorus japonicus* (Houttuyn) off Chefoo, China. *Acta Zoologica Sinica 8* : 217–234, pls 1–13.

SHEN, C.-J.; LEE, F.-S. 1963: The estuarine Copepoda of Chiekong and Zaikong Rivers, Kwangtung Province, China. *Acta Zoologica Sinica 15* : 571–596, 51 figs.

SHEN, C.-J.; LEE, F.-S. 1966: On the estuarine copepods of Chaikiang River, Kwangtung Province. *Acta Zoologica Sinica 3* : 215–223, 26 figs. [In Chinese with English summary.]

SHMELEVA, A.A. 1965: New species of the planktonic copepods from the Adriatic Sea. *Bulletin de l'Institut océanographique de Monaco 65* : 1–15.

SHMELEVA, A.A. 1968: New *Calocalanus* (Copepoda, Calanoida) species from the Adriatic Sea. *Zoologicheskii Zhurnal. Moskva 47* : 1411–1414, 3 figs. [In Russian with English summary.]

SHMELEVA, A.A. 1973: A new species and previously unknown males of *Calocalanus* (Copepoda, Calanoida) from the Adriatic Sea.*Zoologicheskii Zhurnal. Moskva 52* : 1721–1725. [In Russian with English summary.]

SHMELEVA, A.A. 1974: New species of planktonic Copepoda Calanoida from the Indian Ocean. *Zoologicheskii Zhurnal. Moskva 53* : 1717–1721.

SHMELEVA, A.A. 1975: New species of Copepoda (Calanoida) from the Indian Ocean. *Zoologicheskii Zhurnal. Moskva 54* : 1250–1253. [In Russian with English summary.]

SHMELEVA, A.A. 1975a: New species of *Calocalanus* (Copepoda, Calanoida) from the Atlantic Ocean. Pp 101–106 *in* Greze, V.N. (ed.) "Ekspeditsionnye Issledovaniya v Yuzhnoj Atlantike i Sredizemnom

More". Institute of Biology of the Southern Seas A.O. Kobalevskogo, Akademia of Sciences, USSR.

SHMELEVA, A.A. 1978: New Species of the copepod genus *Calocalanus* from the Indian sector of the Antarctic and South Atlantic. *Biologiya Morya 2* : 82–86.

SHMELEVA, A.A. 1979: New species of the genus *Calocalanus* (Copepoda, Calanoida) from the west part of the Mediterranean Sea. *Zoologicheskii Zhurnal, Moskva 58* : 122–125.

SHMELEVA, A.A. 1987a: New species of the genus *Calocalanus* (Copepoda, Calanoida) from Indian Ocean. *Vestnik Zoologii 1987* : 8-13. [In Russian with English summary.]

SHMELEVA, A.A. 1987b: New species of the genus *Calocalanus* (Copepoda, Calanoida) from the bank Saia-de-Malia (the Indian Ocean). *Zoologicheskii Zhurnal. Moskva 66* : 1576–1579. [In Russian with English summary.]

STRÖMGREN, T. 1969: A new species of *Stephos* (Copepoda, Calanoida) from the Norwegian west coast. *Sarsia 37* : 1–8.

TAIT, R.I.; BARKER, P.H.; GILPIN-BROWN, J.B. 1965: *Tui* oceanographic cruise (Auckland to Norfolk Island and Raoul Island) 1962. *N.Z. Journal of Science 8* : 583–603.

TANAKA, O. 1956a: The pelagic copepods of the Izu region, middle Japan. Systematic account. I. Families Calanidae and Eucalanidae. *Publications of the Seto Marine Biological Laboratory 5* : 251–272.

TANAKA, O. 1956b: The pelagic copepods of the Izu region, middle Japan. Systematic account. II. Families Paracalanidae and Pseudocalanidae. *Publications of the Seto Marine Biological Laboratory 5* : 367–406.

TANAKA, O. 1956c: Rare species of Copepoda, Calanoidea, taken from the Izu region. *Breviora 64* : 1–8.

TANAKA, O. 1964: Two small collections of copepods from the Antarctic. *JARE Scientific Reports. Biology 22* : 1–20.

TANAKA, O. 1966: Neritic Copepoda Calanoida from the north-west coast of Kyushu. Pp 38–50 *in* "Symposium Series of the Marine Biological Association of India. 2. Proceedings of the Symposium on Crustacea. Part 1" .

THOMPSON, I.C. 1888: Copepoda of Madeira and the Canary Islands, with descriptions of new genera and species. *Journal of the Linnean Society, Zoology 20* : 145–156.

THOMSON, G.M.; ANDERTON, T. 1921: The Crustacea of Otago Harbour and neighbouring seas. Pp 97–119 *in* Thomson, G.M.; Anderton, T. (eds) "History of the Portobello Marine Fish-Hatchery and Biological Station". *Dominion of New Zealand. Board of Science and Art. Bulletin No. 2.* Government Printer, Wellington.

TUCKER, G.H. 1951: Relation of fishes and other organisms to the scattering of underwater sound. *Journal of Marine Research 10* : 215–238.

VEGA-PÉREZ, L.A.; BOWMAN, T.E. 1992: Description of the pelagic copepod *Ctenocalanus heronae* Vega-Pérez and Bowman, from off Sao Paulo, Brazil (Calanoida: Clausocalanidae). *Proceedings of the Biological Society of Washington 105* : 97–101.

VERVOORT, W. 1946: The bathypelagic Copepoda Calanoida of the Snellius Expedition 1. Families Calanidae, Eucalanidae, Paracalanidae, and Pseudocalanidae. *Biological results of the Snellius Expedition 15. Temminckia 8* : 1–181.

VERVOORT, W. 1949: Some new and rare Copepoda Calanoida from East Indian Seas. *Zoologische Verhandelingen. Leiden 5* : 1–53.

VERVOORT, W. 1951: Plankton Copepods from the Atlantic sector of the Antarctic. *Verhandelingen der K. Akademie van Wetenschappen, Amsterdam, ser. 2. 47(4)* : 1–156.

VERVOORT, W. 1957: Copepods from Antarctic and subantarctic plankton samples. *Report of the British, Australian and New Zealand Antarctic Research Expedition 1929-31, ser. B 3* : 1–160, figs 1–138.

VERVOORT, W. 1963: Pelagic Copepoda. Part 1. Copepoda Calanoida of the families Calanidae up to and including Euchaetidae. *Atlantide Report 7* : 77–194.

VERVOORT, W. 1965: Notes on the biogeography and ecology of free-living marine Copepoda. *In* Van Oye, P.; Van Miegnem, J. (eds) "Biogeography and Ecology in Antarctica" *Monographiae Biologicae 15* . W. Junk, The Hague. 762 p.

VOLKOV, A.F. 1971: [New species of *Eucalanus genera* (Crustacea, Copepoda) from Peruan current.] *Izvestiya Tikhookeanskogo nauchno-issledovatel'skogo Instituta rybnogo Khozyaistva i Okeanografii 79* : 141-143.

WELLERSHAUS, S. 1969: On the taxonomy of planktonic Copepoda in the Cochin backwater (a South Indian estuary). *Veröffentlichungen des Instituts für Meeresforschung in Bremerhaven 11* : 245–286.

WHEELER, E.H. 1970: Atlantic deep-sea calanoid Copepoda. *Smithsonian Contributions to Zoology 55* : 1–31.

WILLEY, A. 1923: Notes on the distribution of free-living Copepoda in Canadian waters. *Contributions to Canadian Biology and Fisheries, n.s. 1* : 303–334.

WILSON, C.B. 1950: Copepods gathered by the United States Fisheries Steamer "Albatross" from 1877 to 1909, chiefly in the Pacific Ocean. *Bulletin of the U.S. National Museum 100, 14* : i-ix, 141–441, pls 2–36.

WOLFENDEN, R.N. 1904: Notes on the Copepoda of the North Atlantic Sea and the Faröe Channel. *Journal of the Marine Biological Association of the U.K., n.s. 7* : 110–146, pl. 9.

WOLFENDEN, R.N. 1905a: Notes on the collection of Copepoda. Pp 989–1040 *in* Stanley Gardiner, J.S. (ed.) "The Fauna and Geography of the Maldive and Laccadive Archipelagoes". University Press, Cambridge. 1079 p.

WOLFENDEN, R.N. 1905b: "Plankton studies. Preliminary notes upon new or interesting species. Part 1. Copepoda". Rebman Company, London and New York 24 p, 7 pls.

WOLFENDEN, R.N. 1906: "Plankton studies. Preliminary notes upon new or interesting species. Part 2. Copepoda". Rebman Ltd, London. Pp 25–44, pls 8–15.

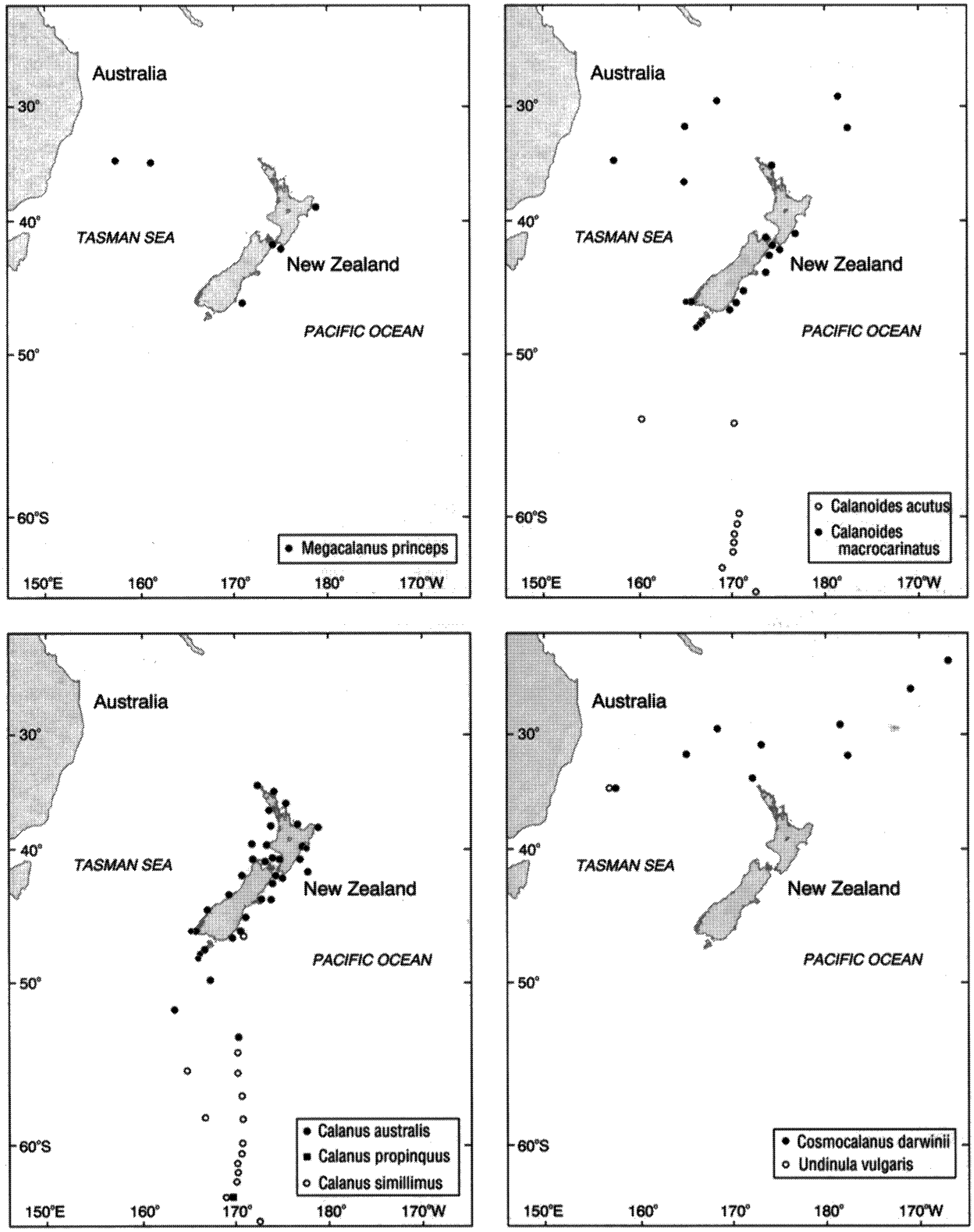
WOLFENDEN, R.N. 1908: Crustacea. 8. Copepoda. Pp. 1–46, 7 pls *in* "National Antarctic Expedition 1901–1904".

WOLFENDEN, R.N. 1911: Die marinen copepoden der Deutschen Südpolar-Expedition 1901–1903, II. Die pelagischen copepoden der West-wind drift und des südlichen Eismeers mit Bescreibung mehrerer neuer Arten aus dem Atlantischen Ozean. *Deutsche Südpolar-Expedition, 1901–1903 12 (zoologie 4)* : 181–380, 19 pls.

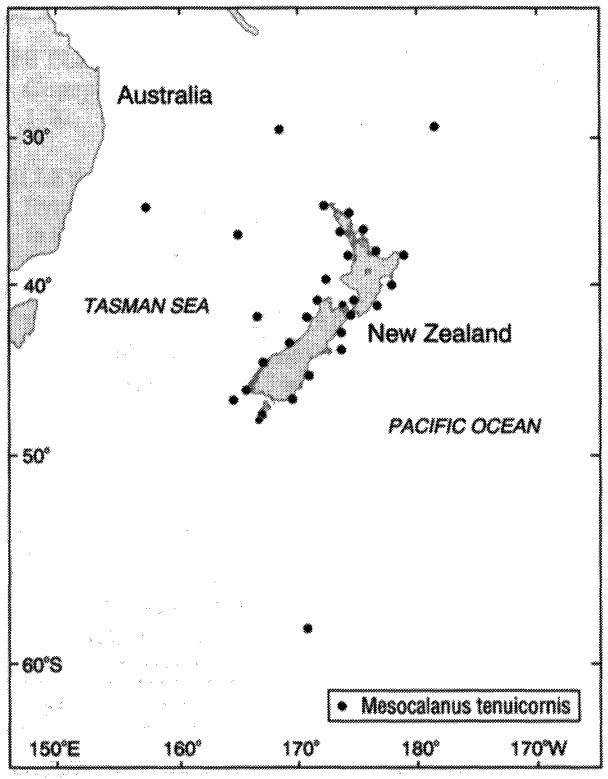
YASHNOV, V.A. 1955: The morphology, distribution and systematics of *Calanus finmarchius* s.l.. *Zoologicheskii Zhurnal, Moskva 34* : 1210–1223. [In Russian.]

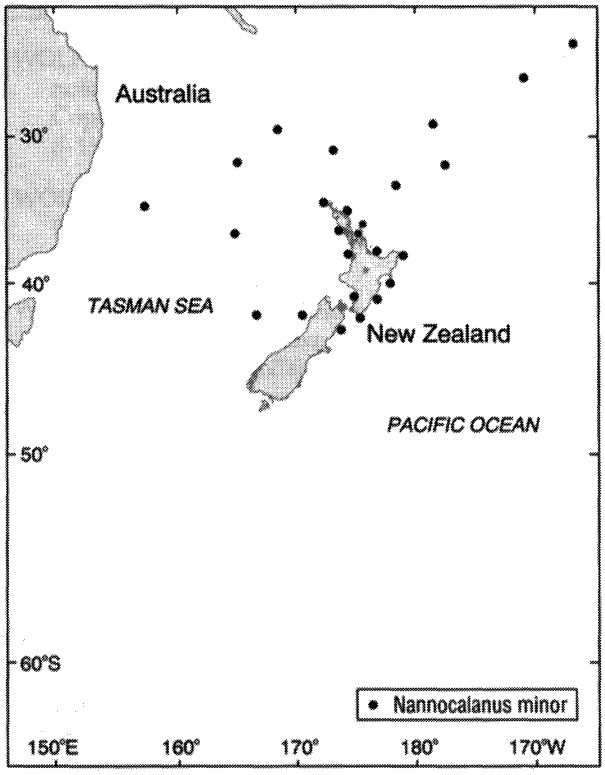
YASHNOV, V.A. 1975: On the systematic status of Pacific *Calanus glacialis, C. sinicus* and *C. orientalis* sp. n.. *Zoologicheskii Zhurnal, Moskva 54* : 32–38. [In Russian]

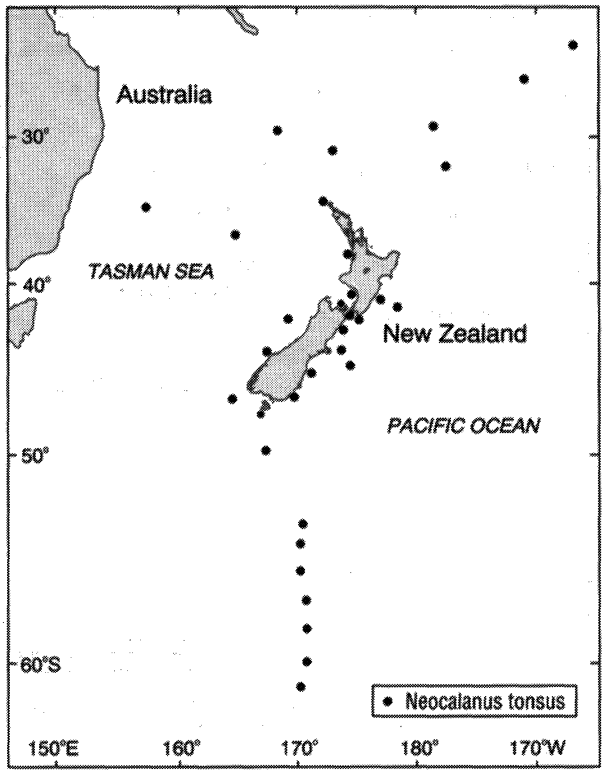
YEATMAN, H.C. 1980: *Miostephos leamingtonensis*, a new species of copepod from Bermuda. *Journal of the Tennessee Academy of Science 55* : 20–21.

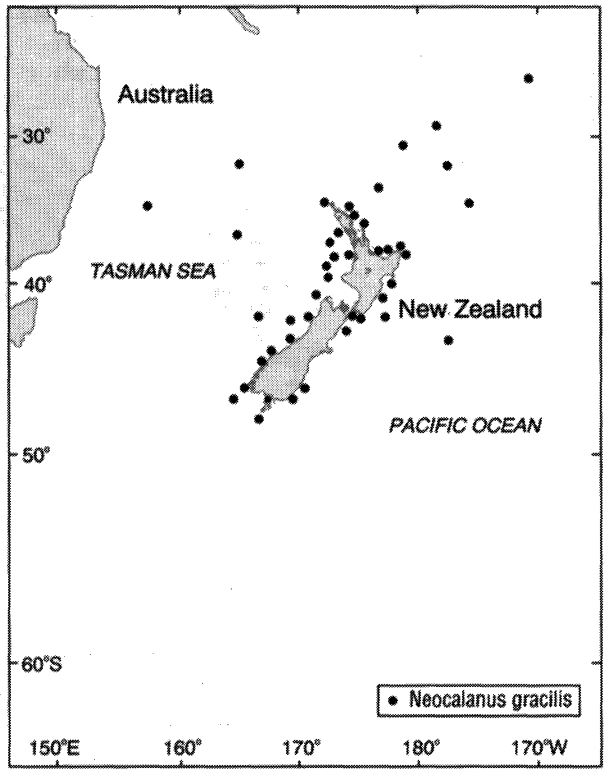


Top left: Fig. 76. New records of *Megacalanus princeps* in the Southwest Pacific.
Top right: Fig. 77. New records of *Calanoides acutus* and *C. macrocarinatus* in the Southwest Pacific.
Bottom left: Fig. 78. New records of *Calanus australis*, *C. propinquus*, and *C. simillimus* in the Southwest Pacific.
Bottom right: Fig. 79. New records of *Cosmocalanus darwinii* and *Undinula vulgaris* in the Southwest Pacific.

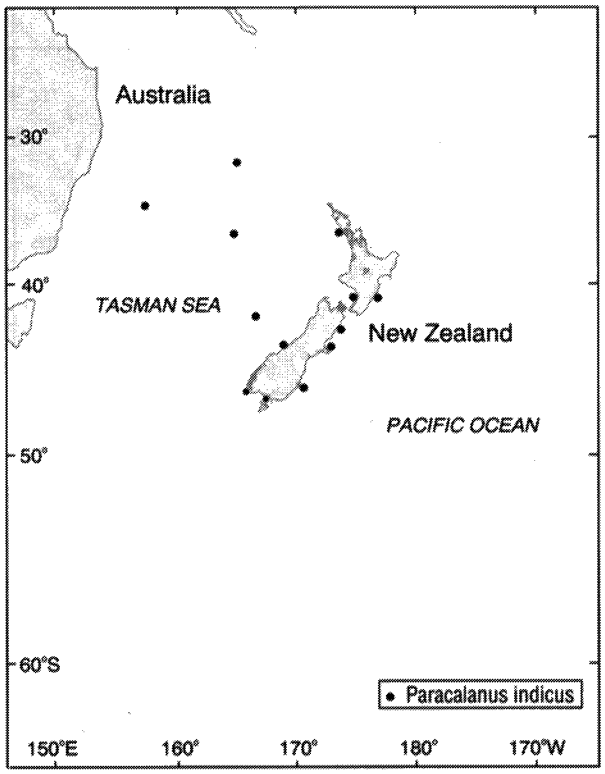


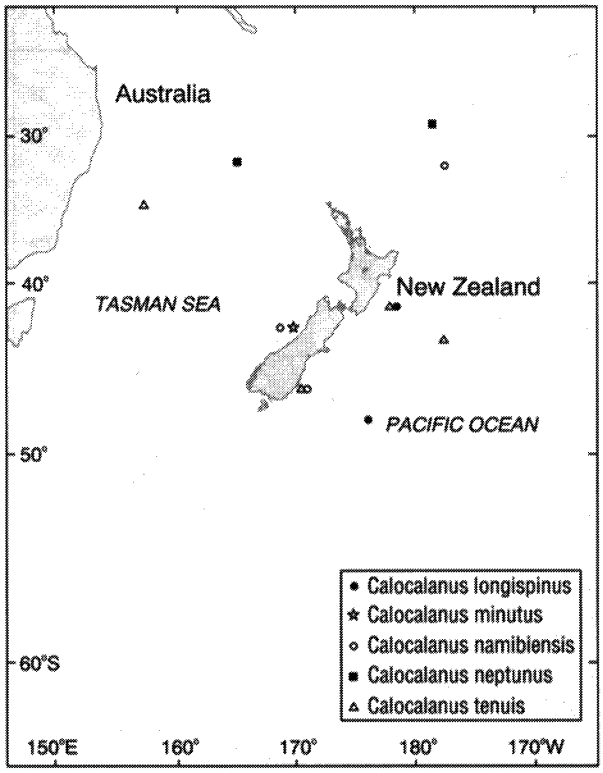


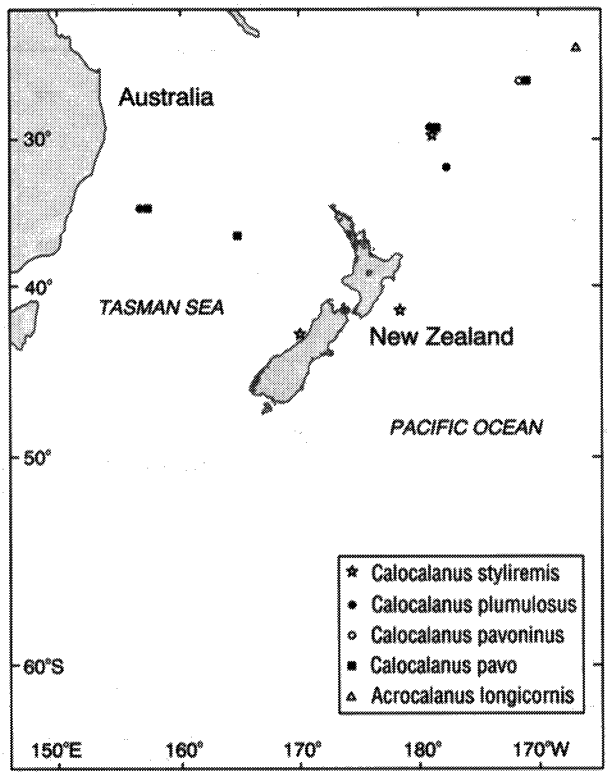


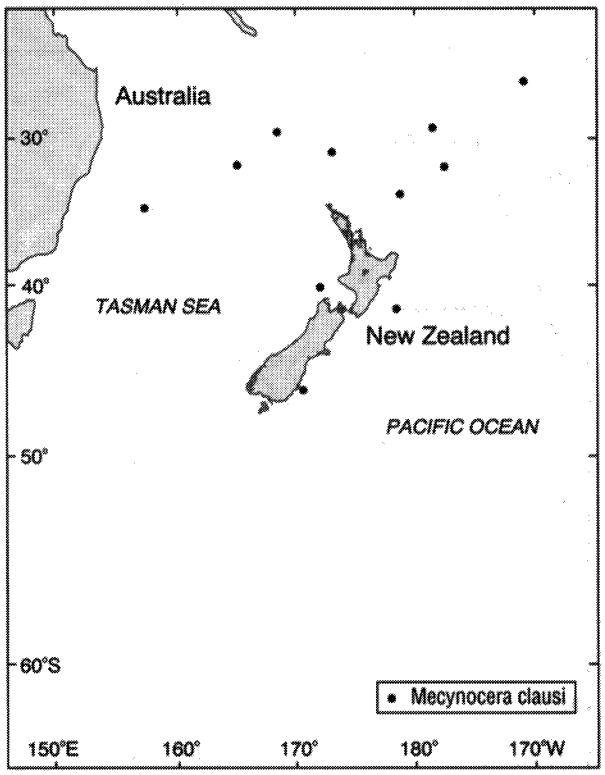


Top left: Fig. 80. New records of *Mesocalanus tenuicornis* in the Southwest Pacific.
Top right: Fig. 81. New records of *Nannocalanus minor* in the Southwest Pacific..
Bottom left: Fig. 82. New records of *Neocalanus tonsus* in the Southwest Pacific.
Bottom right: Fig. 83. New records of *Neocalanus gracilis* in the Southwest Pacific.

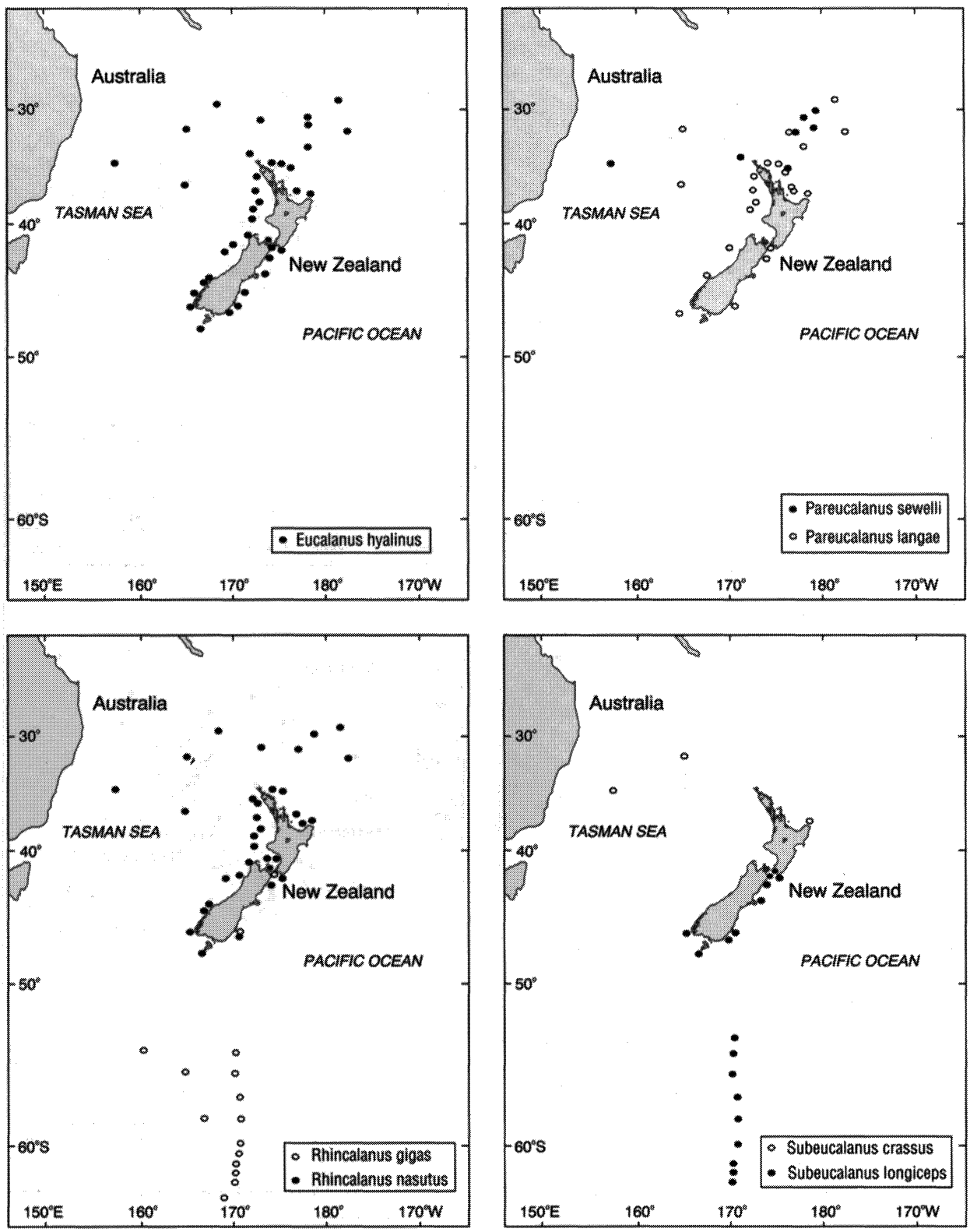




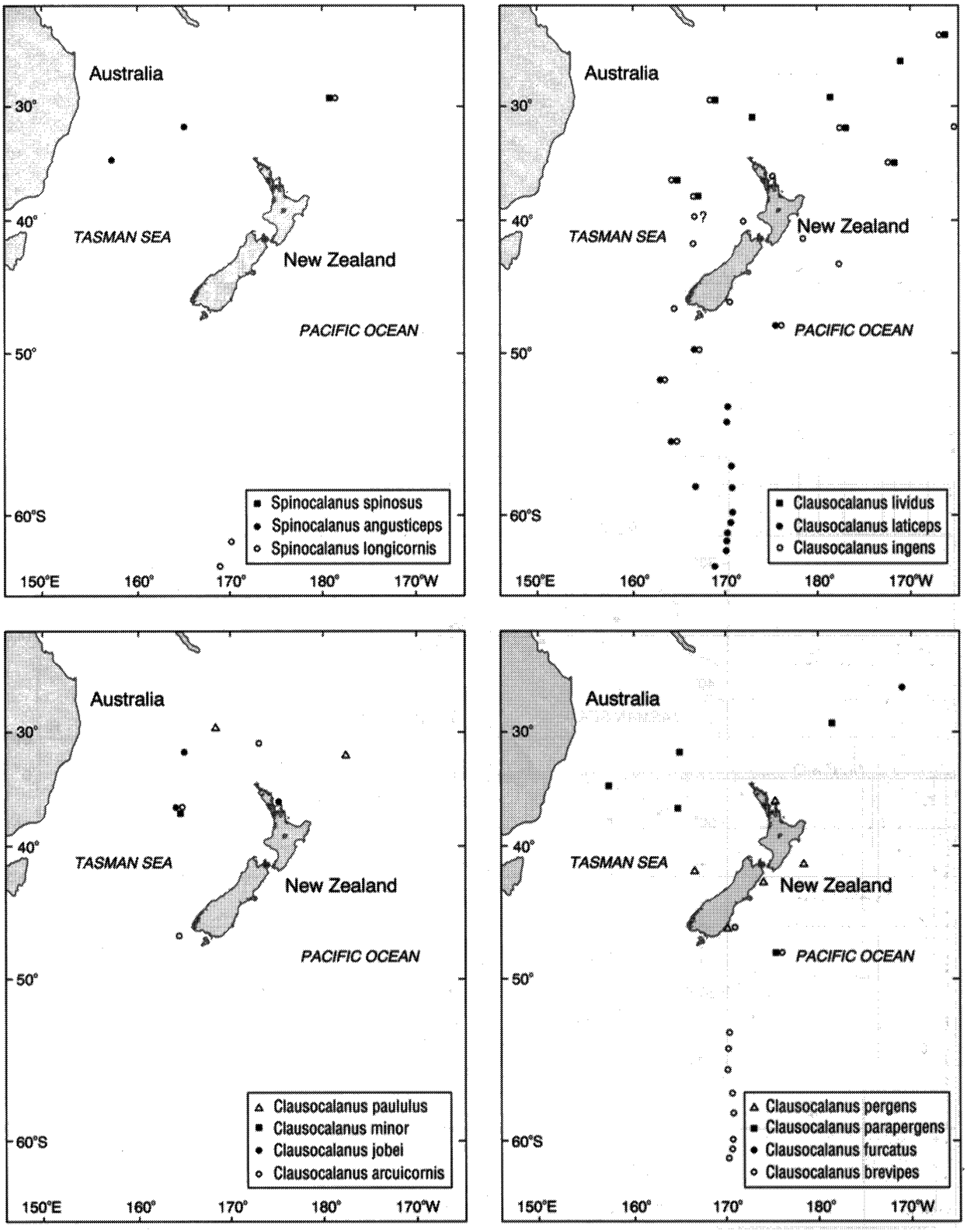




Top left: Fig. 85. New records of *Paracalanus indicus* in the Southwest Pacific.
Top right: Fig. 85. New records of *Calocalanus longispinus*, *C. minutus*, *C. namibiensis*, *C. neptunus*, and *C. tenuis* in the Southwest Pacific.
Bottom left: Fig. 86. New records of *Calocalanus styliremis*, *C. plumulosus*, *C. pavoninus*, *C. pavo* and *Acrocalanus longicornis* in the Southwest Pacific.
Bottom right: Fig. 87. New records of *Mecynocera clausi* in the Southwest Pacific.



Top left: Fig. 88. New records of *Eucalanus hyalinus* in the Southwest Pacific.
Top right: Fig. 89. New records of *Pareucalanus sewelli* and *P. langae* in the Southwest Pacific.
Bottom left: Fig. 90. New records of *Rhincalanus gigas* and *R. nasutus* in the Southwest Pacific.
Bottom right: Fig. 91. New records of *Subeucalanus crassus* and *S. longiceps* in the Southwest Pacific.



Top left: Fig. 92. New records of *Spinocalanus spinosus, S. augusticeps and S. longicornis* in the Southwest Pacific.
Top right: Fig. 93. New records of *Clausocalanus lividus, C. laticeps* and *C. ingens* (Group I species) in the Southwest Pacific.
Bottom left: Fig. 94. New records of *Clausocalanus paululus, C. minor, C. jobei* and *C. arcuicornis* (Group II species) in the Southwest Pacific.
Bottom right: Fig. 95. New records of *Clausocalanus pergens, C. parapergens, C. furcatus* and *C. brevipes* (Group III species) in the Southwest Pacific.

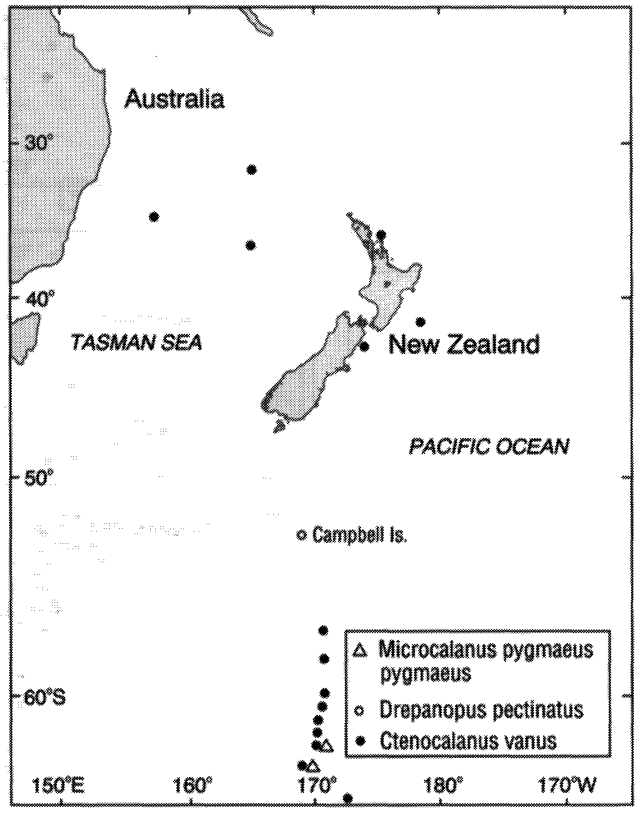


Fig. 96. New records of *Microcalanus pygmaeus, Drepanopus pectinatus and Ctenocalanus "vanus"* in the Southwest Pacific.

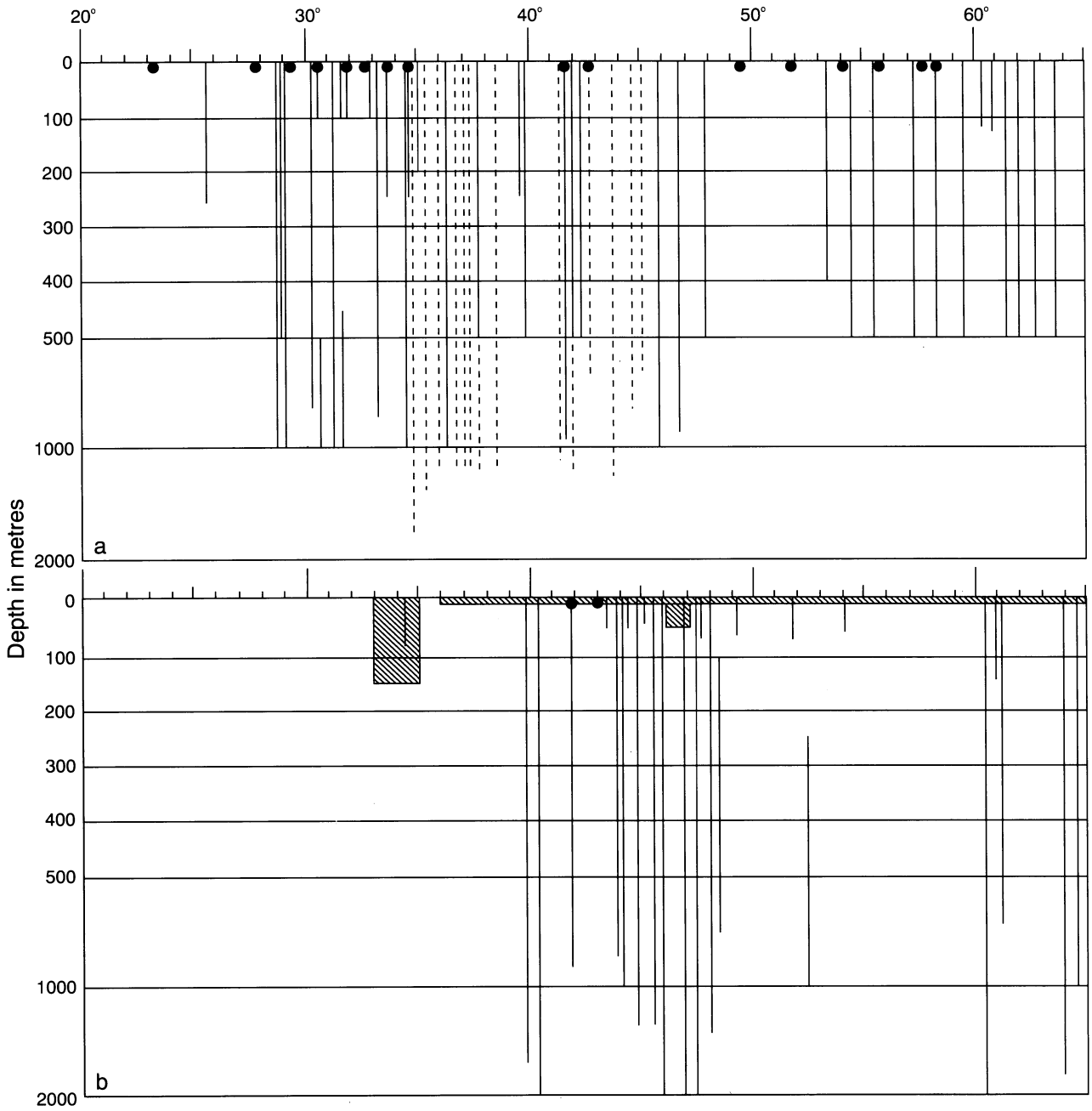


Fig. 97. Distribution of samples with latitude and depth from which the present records are derived: a, new records; b, previous records. --- Menzies trawl hauls, —— vertical hauls, • surface hauls, hatched areas represent a number of samples.

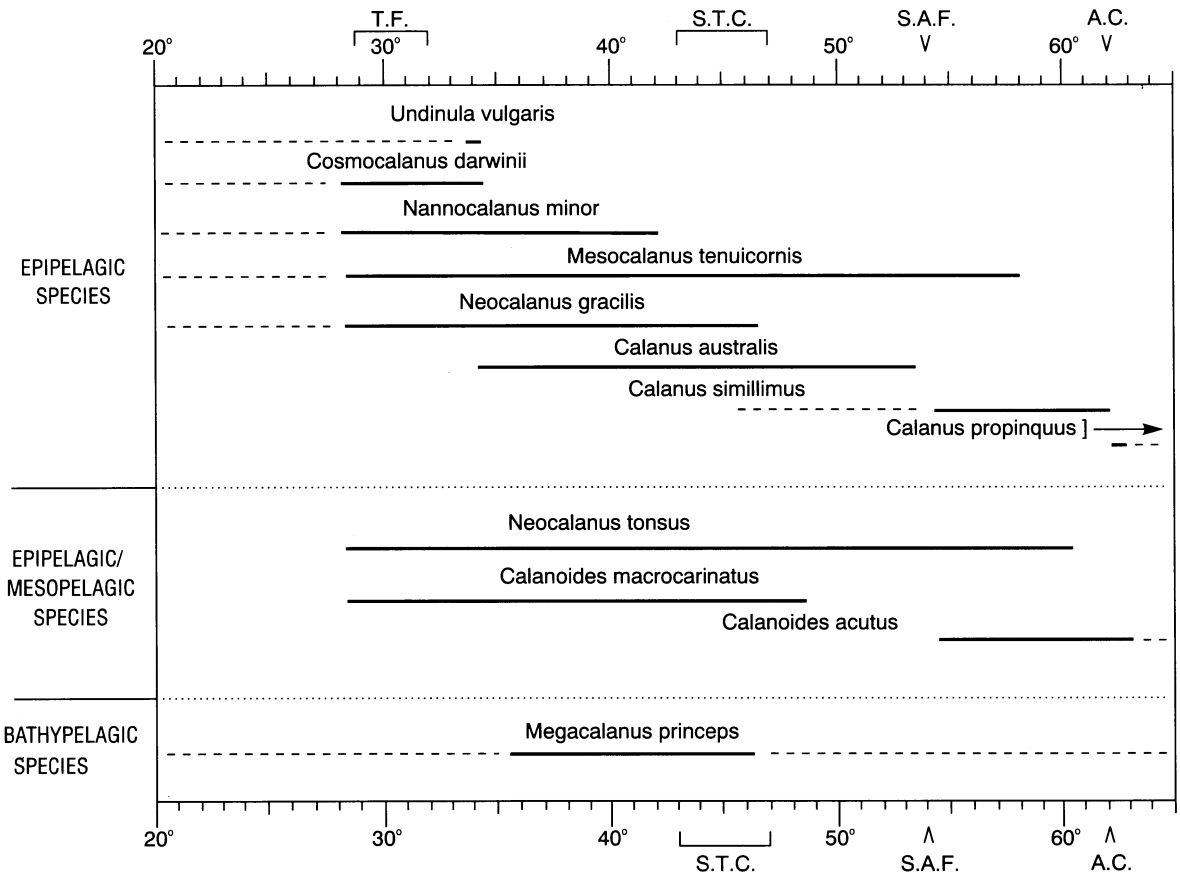


Fig. 98. Distribution of Megacalanidae and Calanidae with depth and latitude: —— Southwest Pacific records, ---- likely distribution from all existing records. T.F. = Tasman front, S.T.C. = Subtropical Convergence region, S.A.F. = Subantarctic Front, A.C. = Antarctic Convergence.

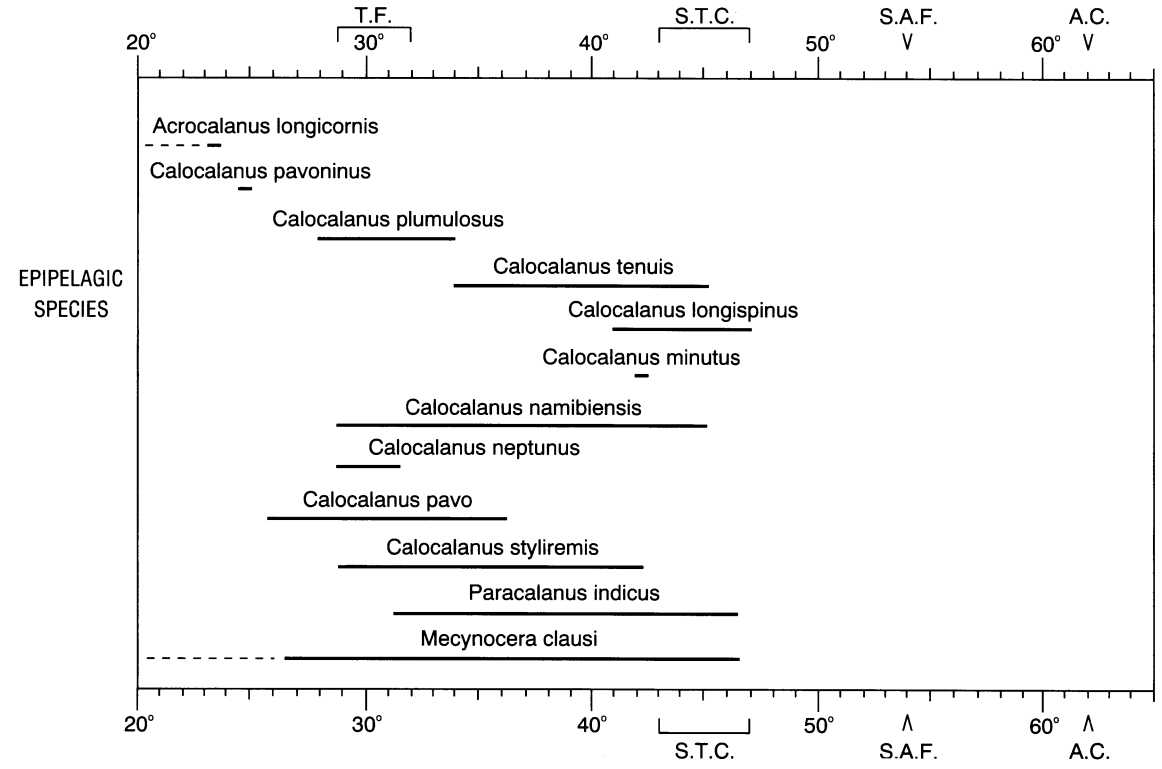


Fig. 99. Distribution of Paracalanidae and Mecynoceridae with depth and latitude. —— Southwest Pacific records, ---- likely distribution from all existing records. T.F. = Tasman front, S.T.C. = Subtropical Convergence region, S.A.F. = Subantarctic Front, A.C. = Antarctic Convergence.

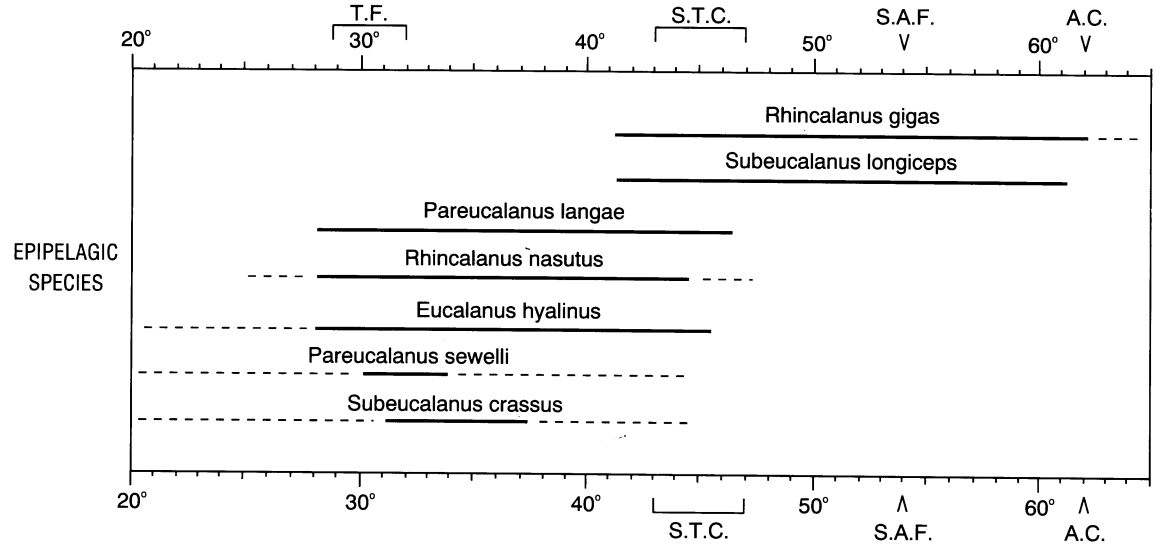


Fig. 100. Distribution of Eucalanidae with depth and latitude: —— Southwest Pacific records, ---- likely distribution from all existing records. T.F. = Tasman front, S.T.C. = Subtropical Convergence region, S.A.F. = Subantarctic Front, A.C. = Antarctic Convergence.

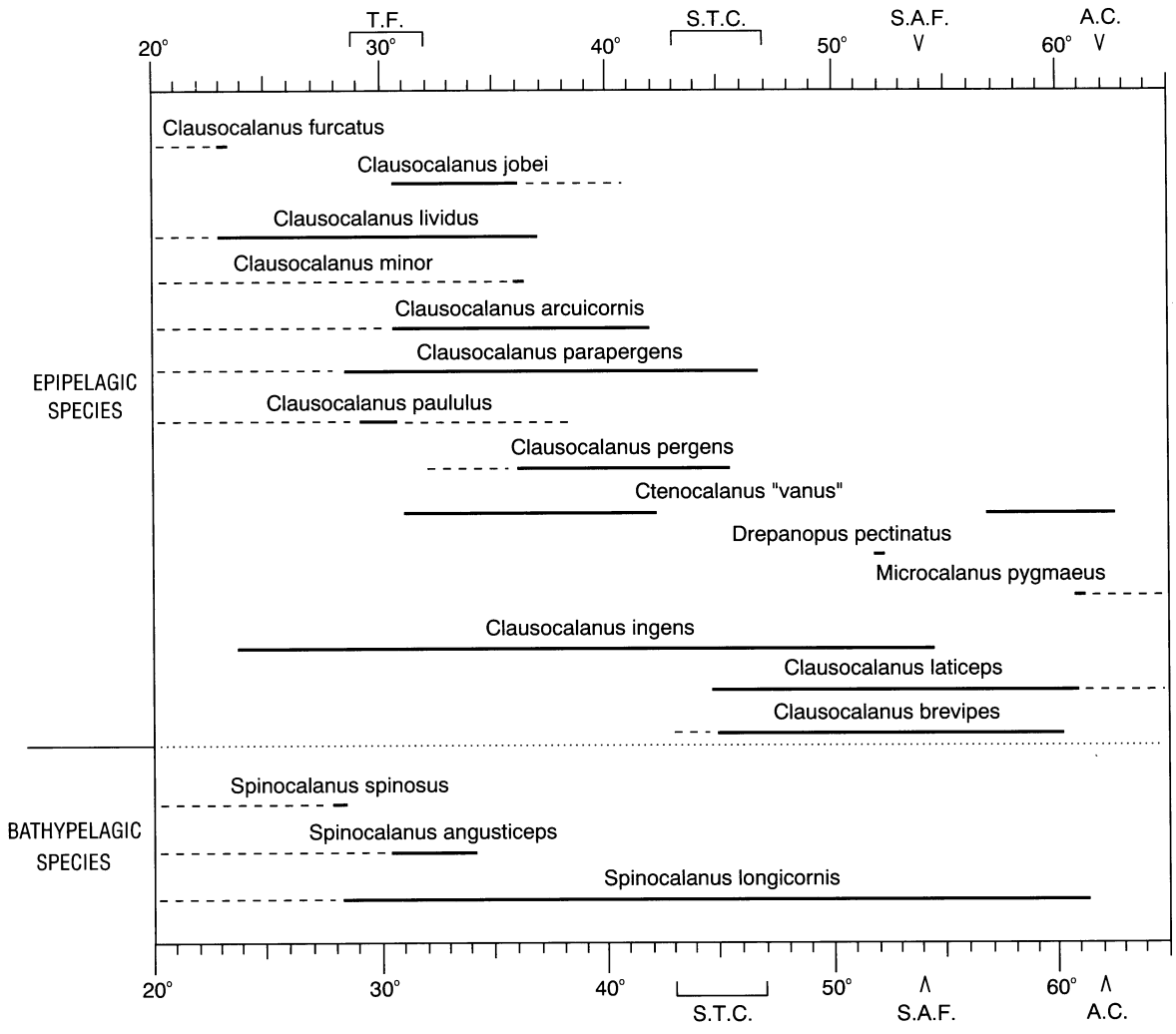


Fig. 101. Distribution of Spinocalanidae and Clausocalanidae with depth and latitude: —— Southwest Pacific records, ---- likely distribution from all existing records. T.F. = Tasman front, S.T.C. = Subtropical Convergence region, S.A.F. = Subantarctic Front, A.C. = Antarctic Convergence.

INDEX

The index covers the introduction, systematics, and notes on distribution.
Italic numerals indicate a text-figure; major references are indicated in bold type.