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23

ADBEX II Cruise Krill/Zooplankton Sampling Data

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ANTARCTIC DIVISION
DEPARTMENT OF SCIENCE AND TECHNOLOGY

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ADBEX II CRUISE KRILL/ZOOPLANKTON SAMPLING DATA

by

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ABSTRACT

Body length, wet weight and maturity stage of krill (*Euphausia superba*) collected with RMT and bongo nets during the cruise of MS *Nella Dan* to Prydz Bay, Antarctica in January-February 1984 are reported. Non-krill zooplankton data from RMT samples (density and biomass), and euphausiid larvae (density) data from bongo samples are also presented.

1. INTRODUCTION

Following FIBEX (First International BIOMASS Experiment) in 1980-81, SIBEX I (Second International BIOMASS Experiment, phase I) was planned for 1983-84. Australia was to work with Japan, South Africa and France in Prydz Bay, Antarctica, with a particular emphasis on the relationship between krill (*Euphausia superba*) distribution and current patterns. Unfortunately, Australian participation in SIBEX I was cancelled because of a supply program delayed by heavy pack ice.
Reported here are results of a reduced sampling program of krill and zooplankton carried out in Prydz Bay during the supply cruise of the MS *Nella Dan* to the Australian stations Davis and Mawson. CTD and chlorophyll data collected during the cruise will be reported by other participants.

For convenience this reduced sampling cruise is referred to as ADBEX II (Antarctic Division BIOMASS Experiment II). ADBEX I was the sampling cruise of the MS *Nella Dan* made during late 1982.

2. METHODS

2.1 RECTANGULAR MIDWATER TRAWL (RMT)

RMT-8 of mesh size 4.5 mm designed by Baker et al. (1973) was used to collect juvenile and adult krill (Euphausia superba). The trawl had an effective mouth area of 8 m^2 when towed at a speed of 2 knots. In this investigation, the RMT-8 was towed horizontally and obliquely.

Horizontal tows were made for krill swarms located at a particular depth by a Simrad EK 120 echo-sounder. A net monitor system was mounted in front of the net, comprising an electronic open-closing system and depth-temperature sensors. Commands for opening and closing were sent through the electronic towing wire and both depth and temperature were read in real time in the ship's laboratory. In oblique tows, the net was kept open throughout. The RMT-8 was towed at a speed of 1.8-3.0 knots.

To register the amount of water that passed through the net, a flow-meter (General Oceanics) was hung by a cord over the upper net bar and positioned near the centre of the net mouth when open. When the net was closed, the flow-meter was not functional as it was held between the nettings. The effective mouth area of the RMT-8 is a function of towing speed. In this study the authors assumed 8 m^2 mouth area for horizontal tows. An error in the order of ± 1 m^2 is likely considering the range of towing speed (cf. Roe et al. 1980). The revolution of the flow-meter during descent and ascent while the net was closed was checked twice and the resulting figure subtracted from the readings of the horizontal tows. Estimation of the effective mouth area of oblique tows is much more complex than horizontal tows (Roe et al. 1980). The authors tentatively used the same figure (8 m^2) as that of horizontal tows in this study.

2.2 BONGO NET

To collect primarily krill larvae a 300 µm mesh bongo net of 0.5 m^2 total mouth area was towed obliquely down to approximately 200 m depth at a speed of 1.2-3.1 knots. A flow-meter (TSK) was attached to the mouth ring of the net to estimate water passing through. A depth-distance recorder (TSK) was attached to the mouth ring of a second net to trace the locus of the net.

Prior to the cruise all flow-meters and depth distance recorders were calibrated over the flow-rate range of 0.25-3.0 m/sec using a flow tank at the Australian Maritime College, Launceston, Tasmania.

3. PROCESSING OF SAMPLES

On board the ship, large and fragile zooplankton (jellyfish, salp etc.) were initially sorted from the rest of the specimens. All specimens were subsequently preserved in Steedman's solution (Steedman 1976) for later examination at the Antarctic Division. Krill catches from swarms were weighed by means of a clock-faced spring balance and part of the catches, (>200 specimens) preserved in Steedman's solution for later examination.

After the cruise, RMT-8 samples of krill were sorted into juvenile, male and female, and body length (standard measurement and reference measurement, Mauchline, 1980) and body wet weight were measured. Body length was measured by using a slide caliper (accuracy: 0.01 mm) and body wet weight by a Mettler top-pan balance (accuracy: 0.001g). Male and female krill were further classified into maturation stages according to the system of Makarov and Denys (1981).

Specimens of juvenile and adult krill were also collected with the bongo net. These specimens were used to obtain supplementary data on body length and maturation stage, but not for quantitative calculation of biomass or density.

Non-krill zooplankton in RMT-8 samples were identified to species to the lowest possible taxonomic level. Because of large mesh size (4.5 mm) the data of this non-krill zooplankton are informative only. Only euphausiid larvae were sorted from bongo net samples. For the identification of euphausiid larvae, Makarov (1980) was consulted. The larvae of *E. superba* and *E. crystallorophias* raised from eggs in the authors' laboratory were also used as a reference.

4. DATA

Station number (STN. NO.) refers to locality where oceanographic data were collected, and is the principal reference number for ADBEX II data. Haul number (HAUL NO.) refers to RMT and bongo net sampling sites and is used in all tables and figures of this report.

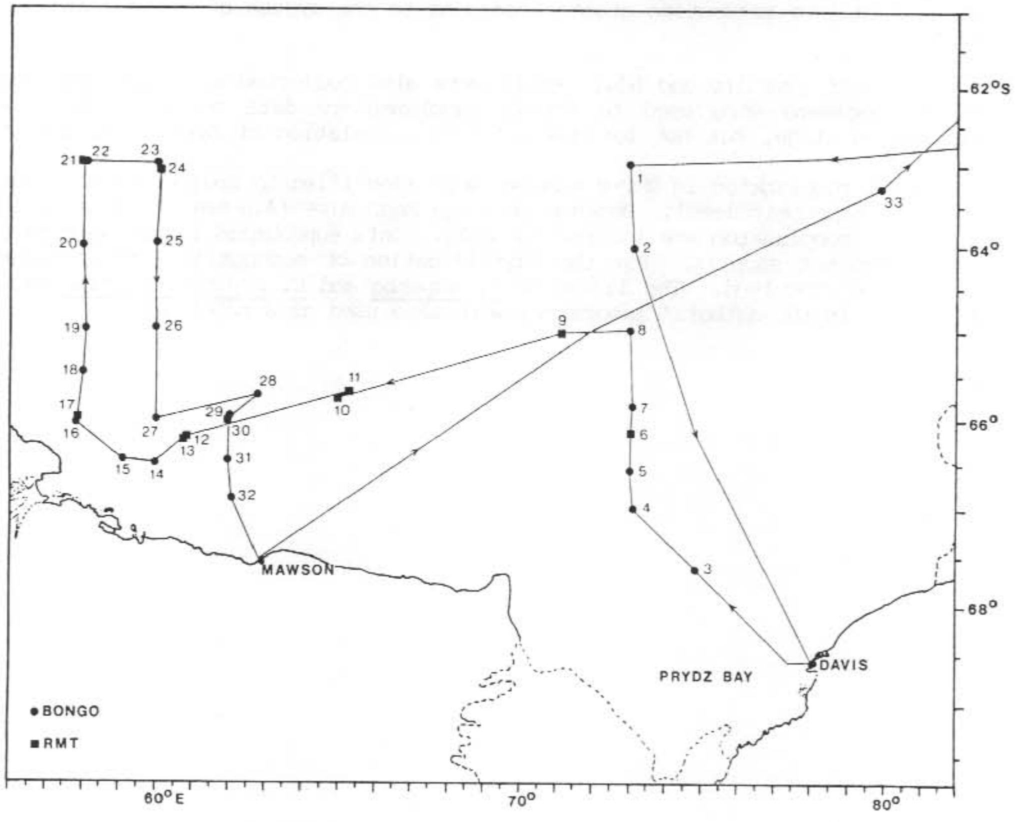

Figure 1. Cruise track and sampling sites, expressed as haul numbers.

TABLE 1. RMT SAMPLING DATA

STN. NO.	HAUL NO.	DATE LOCAL/GMT	NET IN-OUT LOCAL TIME	NET IN-OUT GMT TIME	LAT(S)	LONG(E)	ICE**
		JAN					
10	06	17/16	0305-0325	2005-2025	66°09.9'	73°00.8'	0
13	09	17/17	2305-2336	1625-1656	65°02.0'	71°07.3'	0
14	10	18/18	1310-1334	0710-0734	65°47.1'	64°58.1'	0
14	11	18/18	1346-1418	0746-0818	65°42.6'	65°15.5'	0
15	12	18/18	*2120-2125	1520-1525	66°13.6'	61°47.7'	0
15	13	18/18	*2155-2203	1555-1603	66°14.1'	61°45.6'	0
19	17	19/19	*1936-1946	1336-1346	66°01.8'	57°50.1'	0
23	21	20/20	2004-2030	1404-1430	62°59.9'	58°00.5'	0
24	24	21/21	0715-0741	0115-0141	63°05.5'	60°04.4'	0
29	30	23/23	*2036-2052	1436-1452	66°01.0'	61°57.7'	0

*: Times refer to opening and closing of the net.

**: Graded from 0 to 10 depending on the degree of ice coverage, 0= no ice, 10= complete ice cover.

TABLE 2 RMT SAMPLING DATA

HAUL NO.	DEPTH RANGE (m)	FLOW-METER READING	VOLUME FILTERED (m^{-3})	KRILL BIOMASS ($g.1000m^{-3}$)	KRILL DENSITY ($No.1000m^{-3}$)
06	0- 15	37553	8073.30	2.59	60.20
09	0-125	85931	18473.81	0.05	0.92
10	0- 50	68866	14805.10	368.75	805.80
11	42- 55	37359	8031.60	182.42	291.22
12	45- 50	17854	2421.19	425.28	494.78
13	79- 87	3599	-2393.58 (3991)*	-	0.75*
17	0- 40	23517	4025.14	35.02	80.99
21	0-200	55607	11954.63	0.00	0.00
24	75-120	94055	20220.34	0.00	0.00
30	30- 25	56510	10602.79	687.84	1725.96

Volumes are adjusted for the amount of water flowing through the net when open.
*: The adjusted water flow for haul 13 produced a negative value. The volume of water sampled was therefore calculated from the volume:time relationships of the other hauls.

TABLE 3. RMT KRILL DATA
SIZE-CLASS VS. DENSITIES (NO. 1000m^{-3})

SIZE-CLASS* (mm)	HAUL NUMBER 06	09	10	11	12	17	30
8-11.99	0.372	-	-	-	-	-	-
12-15.99	10.900	-	-	-	-	-	-
16-19.99	39.885	0.522	-	-	-	-	-
20-23.99	7.060	0.184	-	-	-	-	10.280
24-27.99	0.372	0.184	11.415	2.615	-	-	15.373
28-31.99	0.124	-	11.415	1.245	-	1.242	333.874
32-35.99	0.124	-	140.627	16.933	-	24.099	729.431
36-39.99	-	-	425.732	117.536	25.607	43.228	369.808
40-43.99	-	-	201.485	116.291	201.967	10.931	154.110
44-47.99	-	-	11.415	32.621	216.009	0.745	92.429
48-51.99	-	-	3.782	3.860	48.736	-	15.373
52-55.99	-	-	-	-	2.478	-	5.093

*: Size refers to standard 1 measurement (Mauchline, 1980).

TABLE 4. RMT KRILL DATA
WEIGHT-CLASS VS. DENSITIES (NO. $1000m^{-3}$)

WEIGHT-CLASS (wet wt., g)	HAUL NUMBER 06	09	10	11	12	17	30
0.000-0.099	59.633	0.736	3.801	-	-	-	5.152
0.100-0.199	0.424	0.184	11.403	1.306	-	-	66.978
0.200-0.299	0.141	-	22.806	1.306	-	5.265	479.147
0.300-0.399	-	-	182.446	13.509	-	26.328	540.973
0.400-0.499	-	-	319.281	53.544	9.292	30.842	283.367
0.500-0.599	-	-	152.038	70.521	30.199	14.293	123.651
0.600-0.699	-	-	87.422	71.827	78.982	3.009	51.521
0.700-0.799	-	-	15.204	41.790	85.957	1.003	46.369
0.800-0.899	-	-	-	11.753	72.013	-	56.673
0.900-0.999	-	-	11.403	13.059	97.566	0.250	41.217
1.000-1.099	-	-	-	6.530	78.982	-	15.456
1.100-1.199	-	-	-	5.224	27.876	-	10.304
1.200-1.299	-	-	-	1.306	6.969	-	-
1.300-1.399	-	-	-	-	2.323	-	-
1.400-1.499	-	-	-	-	-	-	5.152
1.500-1.599	-	-	-	-	-	-	-
1.600-1.699	-	-	-	-	2.323	-	-
1.700-1.799	-	-	-	-	-	-	-
1.800-1.899	-	-	-	-	2.323	-	-

TABLE 5. RMT KRILL DATA
MATURITY VS. DENSITIES (NO. 1000m^{-3})

MATURITY STAGE	HAUL NUMBER 06	09	10	11	12	17	30
1	60.057	0.920	18.980	2.615	-	0.752	205.512
MALE							
2M	0.141	-	182.437	54.908	4.543	26.328	518.826
3AM	-	-	243.295	67.851	60.301	9.779	148.923
3BM	-	-	26.612	48.309	74.344	1.254	56.495
FEMALE							
2F	-	-	121.647	44.449	55.758	29.588	575.320
3AF	-	-	174.872	30.006	32.629	11.785	133.550
3BF	-	-	26.612	22.162	190.402	1.003	20.561
3CF	-	-	11.415	13.073	76.822	0.251	56.495
3DF	-	-	-	7.844	-	0.251	10.280
% females (stage 3 only)			44.10	39.62	72.54	54.64	51.88
% females (stages 2 & 3)			42.52	40.72	71.87	53.44	52.37

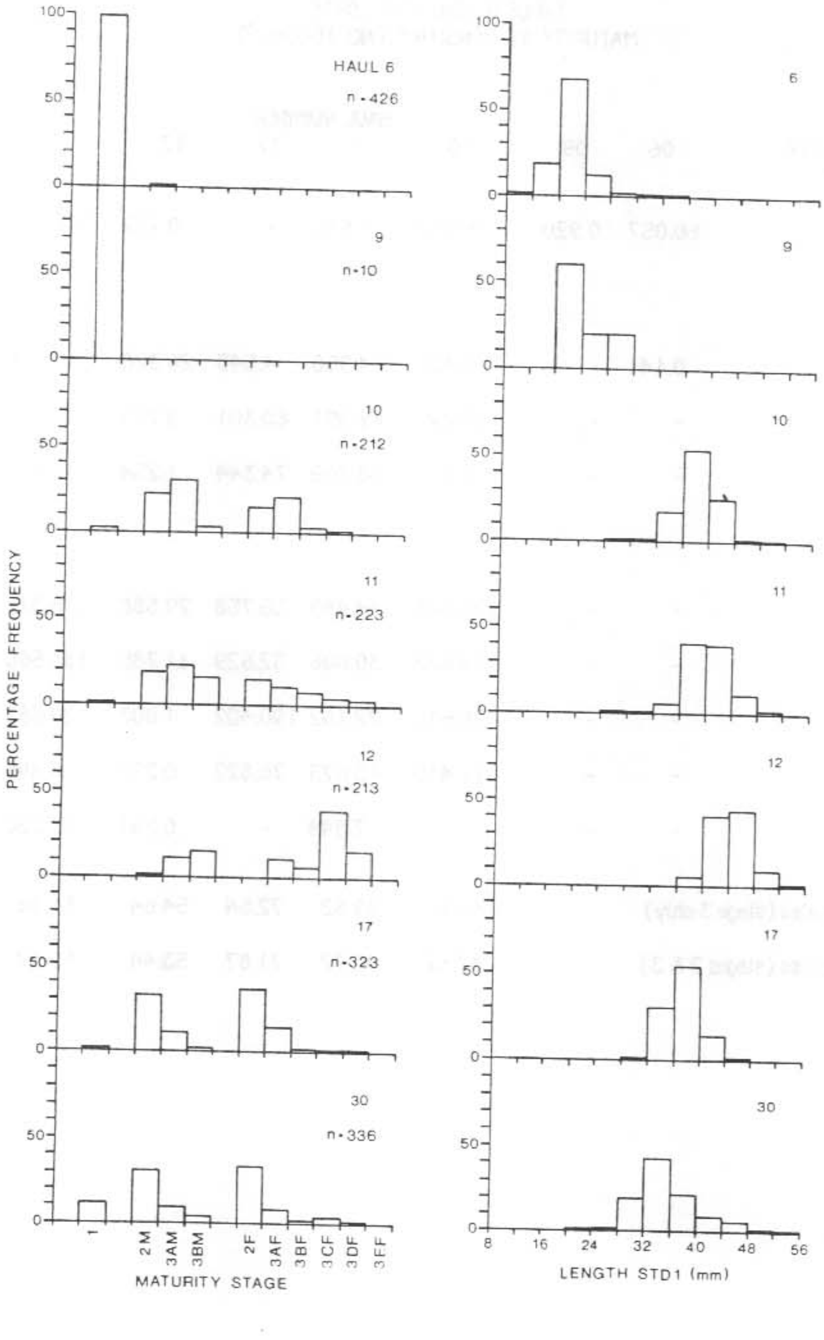

Figure 2. RMT krill body length and maturity stage composition.

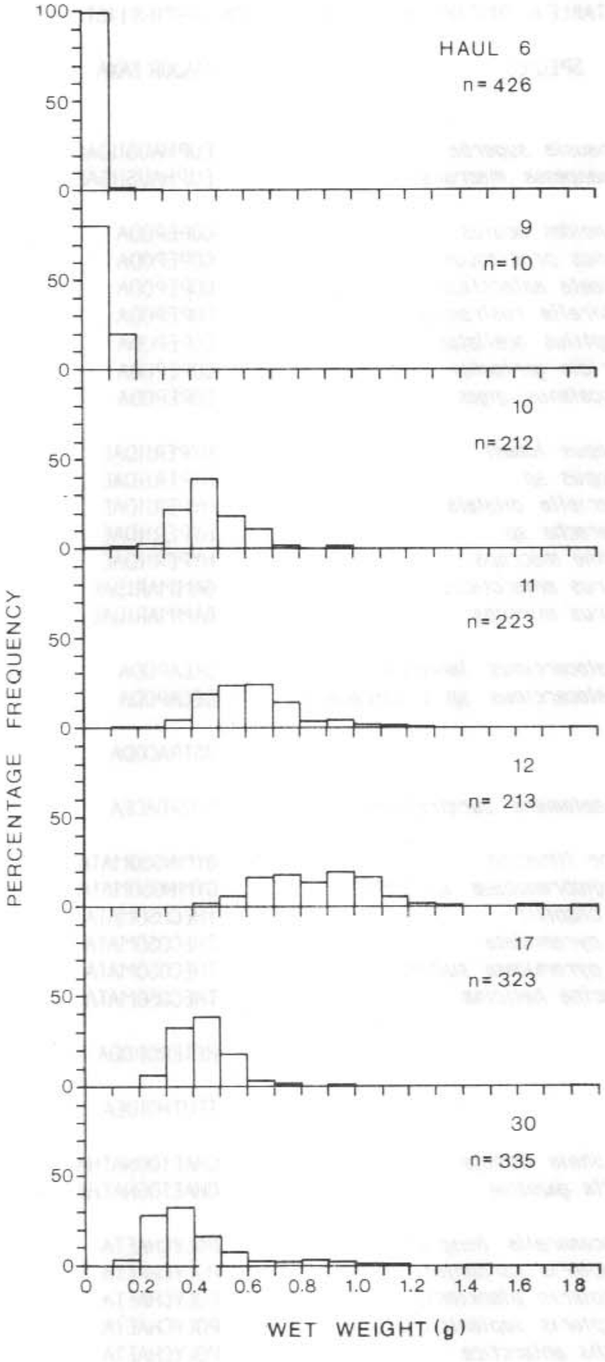

Figure 3. RMT krill wet weight composition.

TABLE 6. RMT NON-KRILL ZOOPLANKTON SPECIES LIST

SPECIES NO.	SPECIES	MAJOR TAXA
1	*Euphausia superba*	EUPHAUSIIDAE
2	*Thysanoessa macrura*	EUPHAUSIIDAE
3	*Calanoides acutus*	COPEPODA
4	*Calanus propinquus*	COPEPODA
5	*Euchaeta antarctica*	COPEPODA
6	*Euchirella rostromagna*	COPEPODA
7	*Haloptilus ocellatus*	COPEPODA
8	*Metridia gerlachei*	COPEPODA
9	*Rhincalanus gigas*	COPEPODA
10	*Cyllopus lucasi*	HYPERIIDAE
11	*Cyllopus sp.*	HYPERIIDAE
12	*Hyperiella dilatata*	HYPERIIDAE
13	*Hyperoche sp.*	HYPERIIDAE
14	*Primno macropa*	HYPERIIDAE
15	*Eusirus antarcticus*	GAMMARIDAE
16	*Eusirus microps*	GAMMARIDAE
17	*Nematocarcinus lanceopes*	DECAPODA
18	*Nematocarcinus sp. (?lanceopes)*	DECAPODA
19		OSTRACODA
20	*Euchaetomera zurstrasseni*	MYSIDACEA
21	*Clione limacina*	GYMNOSOMATA
22	*Spongiobranchaea australis*	GYMNOSOMATA
23	*Clio chaptlii*	THECOSOMATA
24	*Clio pyramidata*	THECOSOMATA
25	*Clio pyramidata sulcata*	THECOSOMATA
26	*Limacina helicina*	THECOSOMATA
27		HETEROPODA
28		TEUTHOIDEA
29	*Eukrohnia hamata*	CHAETOGNATHA
30	*Sagitta gazellae*	CHAETOGNATHA
31	*Rhynconorella bongraini*	POLYCHAETA
32	*Tomopteris carpenteri*	POLYCHAETA
33	*Tomopteris planktonis*	POLYCHAETA
34	*Tomopteris septentrionalis*	POLYCHAETA
35	*Vanadis antarctica*	POLYCHAETA
36	*Vanadis longissima*	POLYCHAETA

SPECIES NO.	SPECIES	MAJOR TAXA
37	*Ihlea racovitzai* (aggregate form)	SALPIDA
38	*Ihlea racovitzai* (solitary form)	SALPIDA
39	*Salpa thompsoni* (aggregate form)	SALPIDA
40		APPENDICULARIA
41	*Calycopis borchgrevinki*	ANTHOMEDUSAE
42	*Russellia mirabilis*	ANTHOMEDUSAE
43		SIPHONOPHORE-BRACT
44		SIPHONOPHORE-NECTOPHORE
45		SCYPHOZOA:CORONATAE
46		MEDUSAE (INDET)
47	*Beroe sp.*	CTENOPHORA
48		MERTENSIIDAE:CTENOPHORA
49		PLEUROBRACHIIDAE: CTENOPHORA
50		CTENOPHORA (INDET)
51	*Calonemertes hardyi*	NEMERTEA
52	*Protopelagonemertes hubrechti*	NEMERTEA
53		NEMERTEA
54	*Electrona antarctica* larva	OSTEICHTHYES
55	Harpagiferid larvae INDET	OSTEICHTHYES
56	Myctophid larvae INDET	OSTEICHTHYES
57	Eggs INDET	
58	Residue	

INDET: Indeterminable, i.e. unidenitied.

ANARE Research Note Number 23
Erratum
Species No. 1 Euphausia superba

should read

Euphausia crystallorophias

TABLE 7. RMT NON-KRILL ZOOPLANKTON DATA
DENSITIES (D: NO. 1000m^{-3}) AND BIOMASS (B: g.1000m^{-3}), +: < 0.001 g.1000m^{-3})

SPP.	HAUL NUMBER 06		09		10		11		12		13		17		21		24		30	
NO.	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B
1	-	-	-	-	-	-	-	-	-	-	-	-	471.04	73.699	-	-	-	-	-	-
2	1.73	0.059	0.38	0.020	-	-	0.75	0.026	2.48	0.133	0.75	0.037	-	-	-	-	-	-	-	-
3	-	-	19.92	0.060	-	-	0.75	0.005	116.47	0.313	9.52	0.026	-	-	-	-	0.05	+	-	-
4	97.73	0.065	22.19	0.143	-	-	0.75	0.004	67.74	0.375	4.26	0.033	-	-	0.59	0.002	0.20	0.001	-	-
5	-	-	1.08	0.003	-	-	-	-	21.89	0.060	2.51	0.013	-	-	0.08	+	-	-	-	-
6	-	-	0.05	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	0.16	0.002	-	-	-	-	-	-	0.50	0.009	-	-	-	-	0.05	+	-	-
8	0.25	+	0.60	0.001	-	-	-	-	88.80	0.180	3.76	0.008	-	-	-	-	-	-	-	-
9	0.12	0.001	3.68	0.019	-	-	-	-	2.89	0.014	21.80	0.190	-	-	-	-	0.05	+	-	-
10	0.12	0.014	0.16	0.020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.007	0.10	0.011	-	-
12	0.50	0.005	0.27	0.002	-	-	-	-	-	-	0.25	0.003	-	-	0.08	0.001	-	-	-	-
13	-	-	0.05	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09	0.015
14	0.37	0.017	0.22	0.020	-	-	1.49	0.112	0.41	0.021	-	-	-	-	0.08	0.003	0.05	0.004	-	-
15	0.12	0.007	0.11	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	0.12	0.023	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	0.12	0.051	-	-	-	-	-	-	0.41	0.002	0.50	0.001	-	-	-	-	-	-	-	-
18	0.12	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.005	0.05	0.001	-	-
21	0.99	0.079	0.11	0.018	-	-	0.75	0.073	0.83	0.095	0.75	0.055	-	-	1.67	0.182	0.10	0.002	0.09	0.006
22	-	-	0.16	0.028	-	-	-	-	0.83	0.095	-	-	-	-	0.33	0.037	-	-	0.09	0.029
23	0.12	0.098	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	32.21	10.986	5.41	1.148	16.14	2.569	1.49	0.410	33.45	5.601	3.01	0.451	-	-	0.75	0.098	0.99	0.117	-	-
25	-	-	-	-	-	-	-	-	-	-	2.26	0.070	-	-	3.43	0.069	0.54	0.014	-	-
26	0.50	0.014	0.27	0.006	-	-	-	-	11.98	0.421	2.26	0.035	-	-	-	-	-	-	-	-
	-	-	0.11	0.004	-	-	1.49	0.158	6.61	0.233	0.50	0.014	-	-	-	-	0.05	+	-	-
	0.12	0.073	0.11	0.006	-	-	-	-	0.41	0.025	-	-	-	-	0.08	0.004	0.05	0.002	-	-
	0.62	0.010	3.41	0.015	0.95	0.009	-	-	28.09	0.161	4.76	0.020	-	-	0.42	0.001	0.74	0.001	-	-
	9.04	1.968	3.36	0.321	-	-	-	-	0.41	0.106	1.25	0.072	-	-	0.84	0.021	0.89	0.023	-	-
	-	-	0.22	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	0.74	0.788	0.38	0.220	-	-	-	-	0.83	0.178	-	-	-	-	0.32	0.032	-	-	-	-
	-	-	-	-	-	-	-	-	0.41	+	-	-	-	-	-	-	-	-	-	-
	0.12	0.004	0.65	0.015	-	-	0.75	0.110	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	0.21	0.121	0.95	0.057	-	-	-	-	-	-	-	-	-	-	0.84	0.428	-	-

SPP.	06		09		10		11		12		13		17		21		24		30	
NO.	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B.	D	B	D	B
36	-	-	-	-	-	-	-	-	0.41	0.021	-	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	-	-	1.00	0.030	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	10.96	2.270	0.83	0.025	-	-	31025.01	2537.271	1.09	0.106	-	-	-	-
39	0.50	0.091	0.87	1.017	-	-	-	-	-	-	-	-	-	-	0.17	0.016	-	-	-	-
40	5.33	0.011	2.22	0.004	-	-	-	-	15.69	0.062	0.50	+	-	-	0.17	+	-	-	-	-
41	-	-	0.16	0.239	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	0.05	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	-	2.331	-	0.753	-	-	-	0.073	-	1.074	-	+	-	-	-	-	-	-	-	-
44	-	-	1.25	0.370	-	-	-	-	-	-	1.25	0.273	-	-	4.68	0.522	7.76	0.137	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	301.139	-	-	-	-
46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.680	-	-	-	-
47	-	0.403	-	-	-	-	-	-	-	0.231	-	-	-	-	-	-	-	-	-	-
48	0.12	0.201	-	-	-	-	-	-	78.47	18.834	-	-	-	-	-	-	-	-	-	-
49	0.12	0.014	-	-	-	-	0.75	0.036	-	-	2.76	0.288	-	-	-	-	-	-	-	-
50	-	0.120	-	-	-	-	-	-	-	0.293	-	-	-	12.303	-	-	-	-	-	-
51	-	-	0.05	0.021	0.20	0.103	2.24	0.865	0.41	0.050	-	-	-	-	-	-	-	-	0.09	0.053
52	-	-	0.05	0.035	-	-	0.75	0.205	-	-	-	-	-	-	-	-	-	-	-	-
53	-	-	0.05	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54	-	-	-	-	-	-	-	-	-	-	0.25	0.025	-	-	-	-	0.84	0.056	-	-
55	0.12	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.006	-	-	-	-
57	1.49	0.001	1.03	+	-	-	1.49	0.001	4.54	0.002	1.25	0.001	-	-	-	-	0.10	+	-	-
58	-	0.184	-	0.187	-	-	-	0.276	-	0.167	-	-	-	-	-	0.128	-	-	-	-

TABLE 8. BONGO SAMPLING DATA

STN. NO.	HAUL NO.	DATE LOCAL/GMT	NET IN-OUT LOCAL TIME	NET IN-OUT GMT TIME	LAT(S)	LONG(E)	ICE*
		JAN					
3	01	14/13	0224-0248	1924-1948	64°00.2'	72°59.3'	0
4	02	14/14	1051-1124	0351-0424	64°00.6'	73°03.5'	0
7	03	16/16	1005-1030	0305-0330	67°38.8'	74°50.0'	0
8	04	16/16	1614-1630	0914-0930	67°00.6'	73°05.2'	0
9	05	16/16	2153-2223	1435-1523	66°36.7'	72°58.5'	0
11	07	17/16	0607-0630	2307-2330	65°51.3'	73°02.8'	0
12	08	17/17	1610-1642	0910-0942	64°59.1'	73°01.0'	0
16	14	19/18	0158-0221	1958-2021	66°30.3'	59°58.4'	0
17	15	19/19	0725-0759	0125-0159	66°28.7'	59°03.6'	0
19	16	19/19	1844-1906	1244-1306	66°04.0'	57°44.2'	0
20	18	19/19	2243-2307	1643-1707	65°29.2'	57°59.8'	0
21	19	20/19	0439-0504	2239-2304	65°01.2'	58°02.3'	0
22	20	20/20	1420-1450	0820-0850	64°00.0'	57°59.5'	0
23	22	20/20	2052-2117	1452-1517	62°59.2'	57°59.6'	0
24	23	21/20	0527-0558	2327-2358	63°01.4'	60°01.5'	0
25	25	21/21	1239-1305	0639-0705	63°59.4'	59°59.9'	0
26	26	21/21	1940-2010	1340-1410	64°59.7'	59°59.3'	0
27	27	22/21	0306-0400	2106-2200	66°01.0'	60°00.4'	0
28	28	22/22	2323-2355	1723-1755	65°45.3'	62°42.7'	0
29	29	23/23	1837-1904	1237-1904	66°00.5'	61°57.4'	0
30	31	23/23	2352-0042	1752-1842	66°30.4'	62°00.0'	0
31	32	24/23	0415-0446	2215-2246	66°55.3'	62°02.3'	1
		FEB					
33	33	06/06	1008-1034	0308-0334	63°17.3'	79°49.0'	0

*: Graded from 0 to 10 depending on the degree of ice coverage, 0= no ice, 10= complete ice cover.

TABLE 9. BONGO SAMPLING DATA

HAUL NO.	DEPTH RANGE (m)	FLOW-METER READING	VOLUME-FILTERED (m^{-3})
01	190-0	8700	660.09
02	195-0	13335	1011.76
03	200-0	5950	451.44
04	190-0	7330	556.15
05	165-0	11850	899.09
07	140-0	14323	1086.72
08	180-0	14395	1092.19
14	105-0	15452	1172.38
15	290-0	11987	909.48
16	160-0	9450	717.00
18	210-0	9580	726.86
19	240-0	5185	393.40
20	140-0	19657	1491.43
22	220-0	8092	613.96
23	240-0	6560	497.72
25	225-0	9492	720.18
26	240-0	13414	1017.75
27	220-0	13062	991.05
28	180-0	11190	849.01
29	235-0	12290	932.47
31	190-0	10850	823.22
32	220-0	8788	666.77
33	215-0	9572	726.25

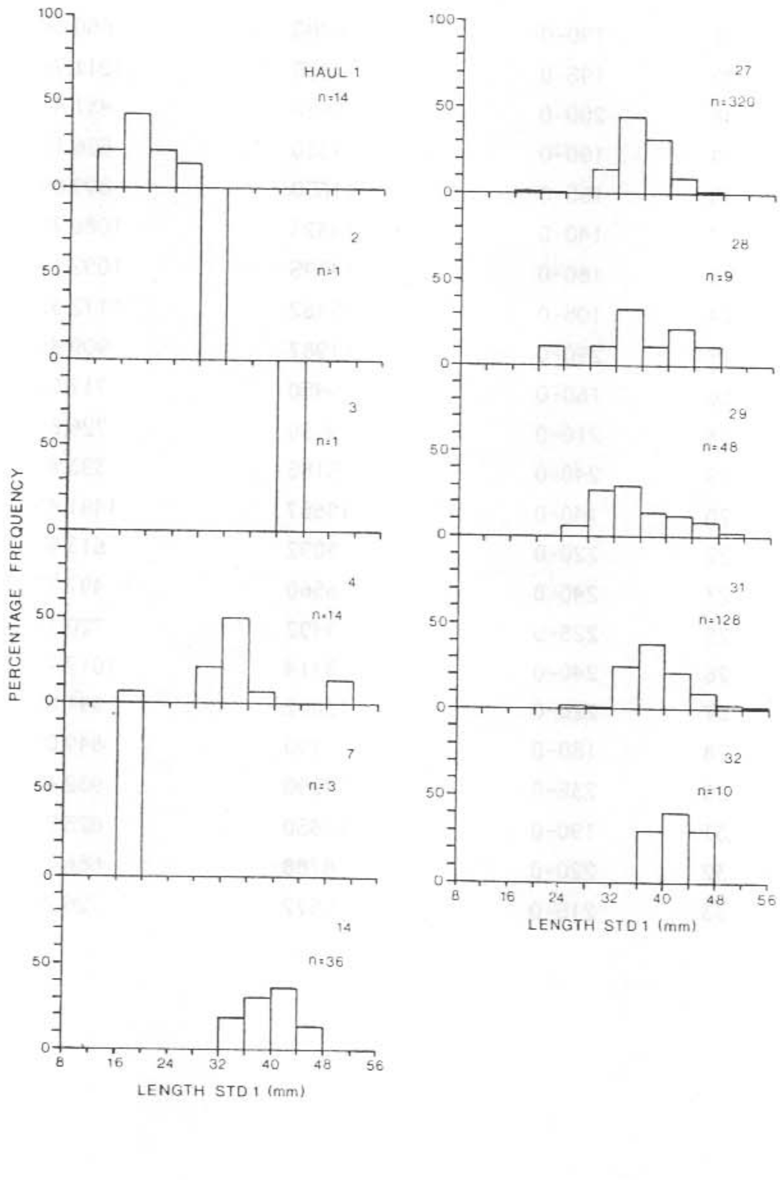

Figure 4. Bongo krill body length composition.

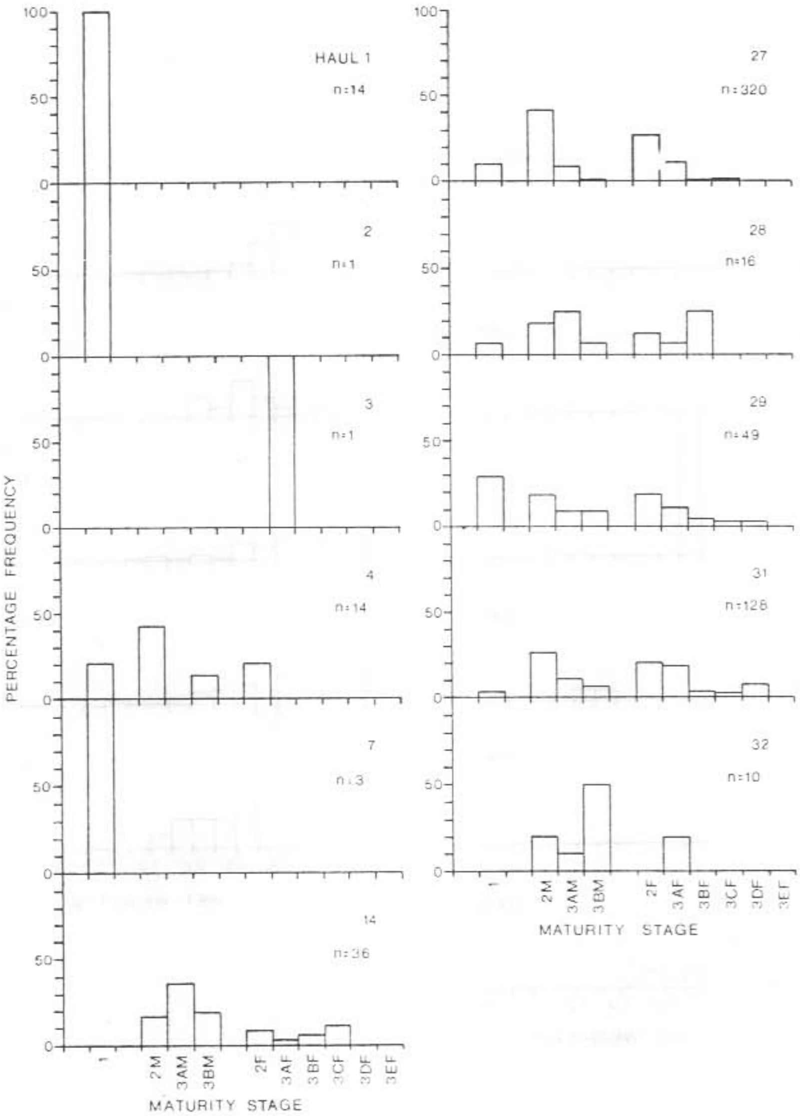

Figure 5. Bongo krill maturity stage composition.

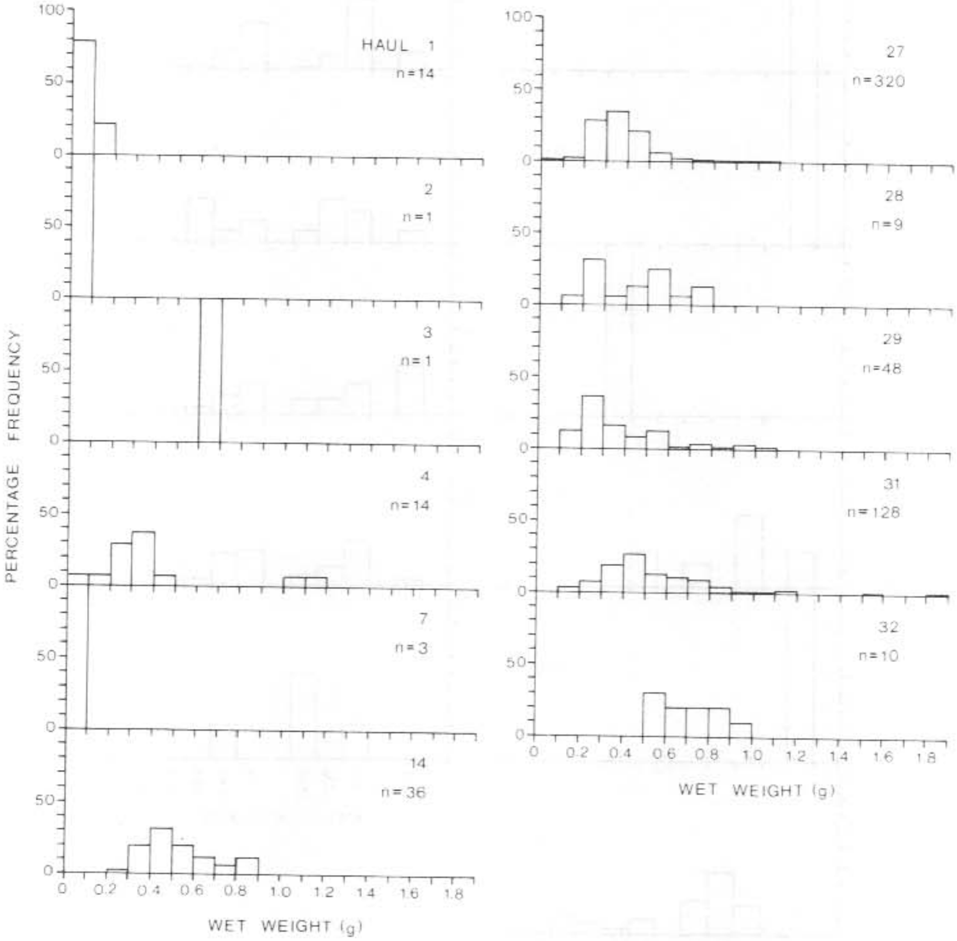

Figure 6. Bongo krill wet weight composition.

TABLE 10. BONGO NET EUPHAUSIID LARVAE DATA
LARVAL STAGE VS. DENSITIES (NO. $1000m^{-3}$)

N: Nauplius, MN: Metanauplius, C: Calyptopis, F: Furcilia, BF: Broken (damaged) furcilia that could not be classified to a particular stage, B1 & B2: Bongo net 1 and 2, respectively, *: Data from both nets combined.

HAUL NO.	STAGE	*Thysanoessa macrura*		*Euphausia crystallorophias*		*Euphausia superba*		*Euphausia frigida*	
		B1	B2	B1	B2	B1	B2	B1	B2
01	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	278.37	269.66	–	–	3.02	3.02	27.26	48.48
	CII	275.72	206.04	–	–	3.02	3.02	3.02	–
	CIII	84.84	69.68	–	–	–	–	–	–
	FI	342.38	381.76	–	–	–	–	–	–
	FII	54.54	12.12	–	–	–	–	–	–
	FIII	72.72	36.36	–	–	–	–	–	–
	FIV	21.20	9.08	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	309.04	381.76	–	–	–	–	6.06	–
02	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	3.96	5.94	–	–	–	–	–	–
	CII	11.86	25.70	–	–	–	–	–	–
	CIII	5.94	9.88	–	–	–	–	–	–
	FI	49.42	59.30	–	–	–	–	–	–
	FII	–	1.98	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	–	–	–	–	–	–	–	–
03	NI	–	–	13.30	26.58	–	–	–	–
	NII	–	–	26.58	31.01	–	–	–	–
	MN	–	–	8.86	79.74	–	–	–	–
	CI	–	–	17.72	97.46	–	–	–	–
	CII	–	–	8.86	44.30	–	–	–	–
	CIII	–	–	–	–	–	–	–	–
	FI	–	–	–	–	–	–	–	–
	FII	–	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	13.30	4.44	–	–	–	–
	FVI	–	–	31.02	8.86	–	–	–	–
	BF	–	–	–	–	–	–	–	–

HAUL NO.	STAGE	*Thysanoessa macrura*		*Euphausia crystallorophias*		*Euphausia superba*		*Euphausia frigida*	
		B1	B2	B1	B2	B1	B2	B1	B2
04	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	10.79	14.38	–	–	–	–
	CI	21.58	32.36	32.37	39.56	–	–	–	–
	CII	143.84	68.36	3.60	–	–	–	–	–
	CIII	21.58	39.56	–	–	–	–	–	–
	FI	7.2	14.38	–	–	–	–	–	–
	FII	–	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	–	–	–	–	–	–	–	–
05	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	4.44	15.58	–	–	–	–	–	–
	CII	8.90	20.02	–	–	–	–	–	–
	CIII	4.44	2.22	–	–	–	–	–	–
	FI	–	–	–	–	–	–	–	–
	FII	–	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	–	–	–	–	–	–	–	–
07	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	38.64	22.08	–	–	–	–	–	–
	CII	66.26	71.78	–	–	–	–	–	–
	CIII	16.56	22.08	–	–	–	–	–	–
	FI	5.52	1.84	–	–	–	–	–	–
	FII	–	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	1.84	–	–	–	–	–	–	–
08	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	1.84	–	–	–	–	–	–
	CI	18.32	43.94	–	–	–	–	–	–
	CII	43.94	53.10	–	–	–	–	–	–
	CIII	25.64	32.96	–	–	–	–	–	–
	FI	71.42	82.40	–	–	–	–	–	–
	FII	67.76	43.94	–	–	–	–	–	–
	FIII	56.76	36.62	–	–	–	–	–	–
	FIV	10.07	13.73	–	–	–	–	–	–
	FV	1.84	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	7.32	3.66	–	–	–	–	–	–

HAUL NO.	STAGE	*Thysanoessa macrura*		*Euphausia crystallorophias*		*Euphausia superba*		*Euphausia frigida*	
		B1	B2	B1	B2	B1	B2	B1	B2
14	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	3.42	13.64	736.48	883.68	–	–	–	–
	CII	44.36	34.12	211.54	194.48	3.42	6.82	–	–
	CIII	10.24	6.82	–	–	–	6.82	–	–
	FI	–	–	–	–	–	–	–	–
	FII	3.42	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	–	–	–	–	–	–	–	–
15	NI	–	–	–	–	–	–	–	–
	NII	–	–	6.60	8.80	–	–	–	–
	MN	–	–	28.59	37.38	–	–	–	–
	CI	83.56	83.56	2007.74	2291.42	–	–	–	–
	CII	237.50	197.92	266.09	288.08	–	–	–	–
	CIII	107.75	81.37	6.60	2.20	–	–	–	–
	FI	8.80	4.40	–	–	–	–	–	–
	FII	–	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	2.20	2.20	–	–	–	–	–
	BF	–	–	–	–	–	–	–	–
16	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	–	–	66.95	41.84	–	–	–	–
	CII	11.16	5.58	30.65	5.58	–	–	–	–
	CIII	–	–	–	–	–	–	–	–
	FI	–	–	–	–	–	–	–	–
	FII	–	2.79	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	–	–	–	–	–	–	–	–
18	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	2.75	–	–	–	–	–	–
	CI	88.05	118.32	–	8.25	–	–	–	–
	CII	44.02	38.52	–	–	–	–	–	–
	CIII	5.50	11.01	–	–	–	–	–	–
	FI	33.02	30.27	–	–	–	–	–	–
	FII	24.76	8.25	–	–	–	–	–	–
	FIII	16.51	13.76	–	–	–	–	–	–
	FIV	11.01	16.51	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	8.25	5.50	–	–	–	–	–	–

HAUL NO.	STAGE	*Thysanoessa macrura* B1	*Thysanoessa macrura* B2	*Euphausia crystallorophias* B1	*Euphausia crystallorophias* B2	*Euphausia superba* B1	*Euphausia superba* B2	*Euphausia frigida* B1	*Euphausia frigida* B2
19	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	61.01	20.34	–	–	–	–	–	–
	CII	66.09	71.17	–	–	–	–	–	–
	CIII	25.42	15.25	–	–	–	–	–	–
	FI	55.92	71.17	–	–	–	–	–	–
	FII	20.34	20.34	–	–	–	–	–	–
	FIII	15.25	25.42	–	–	–	–	–	–
	FIV	5.08	25.42	–	–	–	–	–	–
	FV	–	5.08	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	10.17	5.08	–	–	–	–	–	–
20	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	54.98	32.18	–	–	–	–	–	–
	CII	8.05	8.05	–	–	–	–	–	–
	CIII	4.02	1.34	–	–	–	–	–	–
	FI	20.11	6.70	–	–	–	–	–	–
	FII	5.36	8.05	–	–	–	–	–	–
	FIII	1.34	2.68	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	1.34	1.34	–	–	–	–	–	–
22	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	6.52	74.92	–	–	–	–	–	–
	CII	3.26	9.77	–	–	–	–	–	–
	CIII	–	9.77	–	–	–	–	–	–
	FI	–	16.29	–	–	–	–	–	–
	FII	6.52	9.77	–	–	–	–	–	–
	FIII	16.29	6.52	–	–	–	–	–	–
	FIV	6.52	9.77	–	–	–	–	–	–
	FV	3.26	13.03	–	–	–	–	–	–
	FVI	6.52	–	–	–	–	–	–	–
	BF	–	26.06	–	–	–	–	–	–
23	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	84.38	20.09	–	–	8.04	–	4.02	4.02
	CII	32.15	32.15	–	–	4.02	–	–	–
	CIII	12.05	8.04	–	–	–	–	–	–
	FI	80.37	88.40	–	–	–	–	4.02	–
	FII	8.04	4.02	–	–	–	8.04	–	–
	FIII	88.40	100.46	–	–	–	–	–	–
	FIV	52.24	56.26	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	4.02	32.15	–	–	–	–	–	–

HAUL NO.	STAGE	*Thysanoessa macrura* B1	*Thysanoessa macrura* B2	*Euphausia crystallorophias* B1	*Euphausia crystallorophias* B2	*Euphausia superba* B1	*Euphausia superba* B2	*Euphausia frigida* B1	*Euphausia frigida* B2
25	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	2.78	–	–	–	–	–	–
	CI	19.44	41.66	–	–	–	–	5.55	8.33
	CII	30.55	33.33	–	–	–	–	2.78	–
	CIII	13.89	11.11	–	–	–	–	–	–
	FI	316.59	261.05	–	–	–	–	–	–
	FII	41.66	30.55	–	–	–	–	–	–
	FIII	49.99	44.43	–	–	–	–	–	–
	FIV	72.20	33.33	–	–	–	–	–	–
	FV	11.11	11.11	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	36.10	61.10	–	–	–	–	–	–
26	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	43.23	39.30	–	–	11.79	–	–	1.97
	CII	15.72	17.69	–	–	–	–	–	–
	CIII	5.90	1.97	–	–	–	–	–	–
	FI	11.79	1.97	–	–	–	–	–	–
	FII	3.93	–	–	–	–	–	–	–
	FIII	27.51	5.90	–	–	–	–	–	–
	FIV	19.65	7.86	–	–	–	–	–	–
	FV	1.97	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	64.85	56.99	–	–	–	–	–	–
27*	NI	–		–		–		–	
	NII	–		–		–		–	
	MN	–		1.06		–		–	
	CI	26.55		267.66		5.31		–	
	CII	137.02		126.39		3.19		–	
	CIII	310.14		–		–		–	
	FI	127.46		–		–		–	
	FII	1.06		–		–		–	
	FIII	28.68		–		–		–	
	FIV	3.19		–		–		–	
	FV	–		–		–		–	
	FVI	1.06		–		–		–	
	BF	2.12		–		–		–	
28	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	–	–	16.49	21.20	–	–	–	2.36
	CII	9.42	44.76	11.78	7.07	–	2.36	–	–
	CIII	7.07	30.62	–	–	–	–	–	–
	FI	30.62	87.16	–	–	–	–	–	–
	FII	11.78	16.49	–	–	–	–	–	–
	FIII	14.13	21.20	–	–	–	–	–	–
	FIV	11.78	21.20	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	2.36	–	–	–	–	–	–	–
	BF	4.71	18.85	–	–	–	–	–	–

HAUL NO.	STAGE	*Thysanoessa macrura*		*Euphausia crystallorophias*		*Euphausia superba*		*Euphausia frigida*	
		B1	B2	B1	B2	B1	B2	B1	B2
29	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	10.72	–	–	–	–	–	–	–
	CII	8.58	–	–	–	–	–	–	–
	CIII	–	–	–	–	–	–	–	–
	FI	12.87	12.87	–	–	–	–	–	–
	FII	2.14	–	–	–	–	–	–	–
	FIII	17.16	10.72	–	–	–	–	–	–
	FIV	6.43	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	6.43	2.14	–	–	–	–	–	–
31	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	2.43	12.15	46.16	65.60	12.15	9.72	–	–
	CII	–	7.29	12.15	24.29	–	–	–	–
	CIII	–	2.43	–	–	–	–	–	–
	FI	2.43	–	–	–	–	–	–	–
	FII	–	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	–	4.86	–	–	–	–	–	–
32	NI	–	–	–	–	–	–	–	–
	NII	–	–	21.00	3.00	–	–	–	–
	MN	–	–	15.00	15.00	–	–	–	–
	CI	–	–	49.99	30.00	–	–	–	–
	CII	–	3.00	15.00	3.00	–	–	–	–
	CIII	–	6.00	–	–	–	–	–	–
	FI	–	–	–	–	–	–	–	–
	FII	–	–	–	–	–	–	–	–
	FIII	–	–	–	–	–	–	–	–
	FIV	–	–	–	–	–	–	–	–
	FV	–	–	–	–	–	–	–	–
	FVI	–	–	–	–	–	–	–	–
	BF	–	–	–	–	–	–	–	–
33	NI	–	–	–	–	–	–	–	–
	NII	–	–	–	–	–	–	–	–
	MN	–	–	–	–	–	–	–	–
	CI	16.52	13.77	–	–	–	–	–	2.75
	CII	49.57	41.31	–	–	–	–	–	–
	CIII	19.28	13.77	–	–	–	–	–	–
	FI	71.60	33.05	–	–	–	–	–	–
	FII	2.75	8.26	–	–	–	–	–	–
	FIII	19.28	13.77	–	–	–	–	–	–
	FIV	30.29	35.80	–	–	–	–	–	–
	FV	68.85	49.57	–	–	–	–	–	–
	FVI	5.51	5.51	–	–	–	–	–	–
	BF	256.11	192.77	–	–	–	–	–	–

TABLE 11. RMT AND BONGO KRILL LENGTH/WEIGHT REGRESSION ANALYSIS.

Expressed as $\log_{10} w = \log_{10} a + b.\log_{10} l$, where w is wet weight in g, l is standard 1 measurement in mm. n: sample size, r^2: correlation coefficient. Hauls with less than 10 specimens are not displayed but are included in the total analysis.

HAUL NO.	n	b	$\log_{10}a$	r^2
RMT				
06	426	2.9622	-5.0651	0.8571
09	10	2.7728	-4.8423	0.9426
10	212	3.1984	-5.3979	0.9120
11	223	3.0781	-5.1521	0.8371
12	213	3.3850	-5.6511	0.8002
17	323	3.0082	-5.0937	0.8348
30	335	3.3247	-5.5726	0.9257
BONGO				
01	14	3.0648	-5.1624	0.9802
04	14	3.3015	-5.5441	0.9744
14	36	2.8337	-4.8166	0.9259
27	320	3.1960	-5.4034	0.9102
29	48	3.2431	-5.4650	0.9569
31	128	3.4486	-5.7736	0.9038
32	10	2.5246	-4.2539	0.9109
TOTAL	2326	3.1603	-5.3189	0.9853

TABLE 12. RMT AND BONGO KRILL LENGTH/WEIGHT REGRESSION STATISTICAL PARAMETERS.

For the relationship $\log_{10}w = \log_{10}a + b.\log_{10}l$, where w is wet weight in g, l is standard 1 measurement in mm. n: sample size. Hauls with less than 10 specimens are not displayed but are included in the total analysis.

HAUL NO.	n	$\Sigma \log_{10}l$	$\Sigma \log_{10}w$	$\Sigma(\log_{10}l)^2$	$\Sigma(\log_{10}w)^2$	$\Sigma(\log_{10}l)(\log_{10}w)$
RMT						
06	426	530.0743	-587.5511	660.9655	824.4961	-726.9230
09	10	12.9780	-12.4376	16.8848	15.8127	-16.0248
10	212	334.8043	-73.5231	529.0534	28.9566	-115.1264
11	223	357.3597	-48.9094	572.9767	14.1715	-77.4411
12	213	350.7292	-16.4727	577.6668	3.4294	-26.6147
17	323	506.6107	-121.2894	794.8921	48.7580	-189.3453
30	335	518.1514	-144.1387	802.3985	73.5180	-219.7402
BONGO						
01	14	17.9085	-17.3885	23.0126	22.5983	-21.9228
04	14	21.3361	-7.1763	32.6462	5.1323	-10.5076
14	36	57.4936	-10.4740	91.8853	3.6149	-16.5420
27	320	494.5088	-148.6680	764.8593	76.6453	-227.5850
29	48	73.9019	-22.6577	114.0075	13.1778	-34.1428
31	128	202.8214	-39.5747	321.7196	16.7152	-61.5338
32	10	16.1973	-1.6474	26.2453	0.3409	-2.6433
TOTAL	2326	3515.5321	-1261.4850	5359.9926	1156.4489	-1759.3659

5. STUDIES UNDERTAKEN BY NON-DIVISIONAL SCIENTISTS

Drs. S. Grant and D. Miller, Sea Fisheries Research Institute, South Africa, collected approximately two hundred krill specimens at three stations. The specimens were frozen in liquid nitrogen and airfreighted to South Africa for genetic studies.

Miss S. Harrington, Zoology Department, The University of New England, collected matured specimens for her Ph.D. study on krill gametogenesis.

Dr G. Ettershank, Zoology Department, Monash University collected two hundred krill specimens at each station and preserved them in Steedman's solution for his analysis of age-pigment "lipofuscin".

Dr I. Neering, School of Physiology and Pharmacology, The University of New South Wales collected krill and other zooplankton specimens for the study of bioluminuscence in marine animals.

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