

**Zooplankton sampling from two separate surveys by RSV *Aurora Australis* and the training vessel *Umitaka-maru* in Lützow-Holm Bay during the 50th Japanese Antarctic Research Expedition in January 2009**

Kunio T. TAKAHASHI<sup>1,2\*</sup>, Atsushi TANIMURA<sup>1,2</sup>, Keishi SHIMADA<sup>3</sup> and Tsuneo ODATE<sup>1,2</sup>

<sup>1</sup> National Institute of Polar Research, Research Organization of Information and Systems,  
10-3 Midori-cho, Tachikawa, Tokyo, 190-8518.

<sup>2</sup> Department of Polar Science, School of Multidisciplinary Sciences, SOKENDAI (The Graduate University for Advanced Studies), 10-3 Midori-cho, Tachikawa, Tokyo 190-8518.

<sup>3</sup> Observation and Research Center of Ocean System, Tokyo University of Marine Science and Technology, 4-5-7 Konan, Minato-ku, Tokyo, 108-8477.

\*Corresponding author. E-mail: takahashi.kunio@nipr.ac.jp

## 1. Introduction

During implementation of the 4-year plan of the Japanese Antarctic Research Expedition (JARE) phase VII by the National Institute of Polar Research (NIPR), joint studies of the oceanography and marine biology of Lützow-Holm Bay off Syowa Station were carried out by the NIPR and Tokyo University of Marine Science and Technology (TUMSAT) on two separate oceanographic surveys conducted as a part of JARE project number P3-1 (principal investigator: Professor Tsuneo Odate, NIPR). Sampling in one survey was carried out in the pack-ice region using the ice breaking capability of Research/Survey Vessel (RSV) *Aurora Australis* (Australian National Antarctic Research Expedition), which was chartered by the 50th JARE (2008–2009). In the second survey during the 13th *Kaiyodai* Antarctic Research Expedition, samples were collected in the marginal ice and ice-free open-ocean regions by the training vessel *Umitaka-maru* (TUMSAT).

This report presents the zooplankton data acquired from both surveys and the vertical profile data from seven stations sampled by the *Aurora Australis*. The phytoplankton chlorophyll *a*

concentrations obtained by the *Aurora Australis* have been published previously (Iida and Fukuchi, 2010).

## 2. Zooplankton Sampling

Zooplankton sampling was conducted on two separate oceanographic surveys in Lützow-Holm Bay off Syowa Station in January 2009. In one survey by RSV *Aurora Australis*, samples were collected from three stations in pack ice (A0, A1, and A12) and from an ice-free, open-ocean station (A3) during 15–23 January. In the second survey by the *Umitaka-maru*, samples were collected during 13–19 January from three stations in the marginal ice (L12, L25, and L37) and from nine ice-free, open-ocean stations (L2–L11, L33, and L35) ([Figure 1](#)).

A twin NORPAC standard net made of nylon bolting cloth (mesh sizes of 100  $\mu\text{m}$  and 60  $\mu\text{m}$ ) used at 12 stations during the *Umitaka-maru* cruise ([Table 1](#)). The net was hauled vertically at a speed of about 1  $\text{m s}^{-1}$  from a depth of approximately 200 m. The maximum depth reached was estimated from the wire angle and length of wire paid out. All samples obtained were immediately preserved onboard in seawater with 5–10% buffered formalin. The volume of water filtered by each net was estimated using a flowmeter mounted at the center of the mouth ring of each net. A twin NORPAC standard net samples obtained by *Aurora Australis* has been published previously (Takahashi *et al.*, 2014).

A closing net (mouth diameter 0.75 m, mesh size 60  $\mu\text{m}$ ) equipped with a flowmeter was hauled vertically through three layers (0–100, 100–200, and 200–500 m) during both surveys ([Tables 2](#) and [3](#)). At station A0 ([Table 3](#)), the deepest sampling was carried out in the 200–300-m layer. The 100–200 and 200–500-m samplings at stations L4 and L7, respectively ([Table 2](#)), failed because of net troubles. All samples were immediately fixed in buffered 5% formaldehyde-in-seawater solutions.

[Figure 1](#) shows the locations of the sampling stations during the two surveys, and [Tables 1](#), [2](#) and [3](#) show zooplankton sampling information and wet weights. For a detailed description of zooplankton processing for wet-weight measurements, see Ukai *et al.* (2014).

### **3. Vertical profiles taken from the *Aurora Australis***

At seven sampling stations, temperature and salinity were measured at 1-m intervals using a conductivity-temperature-depth (CTD) profiler to depths of 500 m, or to just above the bottom at stations shallower than 500 m ([Figure 2](#)). The data were downloaded from the CTD to a laptop computer immediately after each cast. The CTD sensor was calibrated by the manufacturer prior to the cruise. Note that bottle salinity data measured with a salinometer were not used to correct the salinity data in this report.

### **4. Scientists on board**

The sampling during each cruise was carried out by K. T. Takahashi (National Institute of Polar Research) on the *Umitaka-maru* and by A. Tanimura and T. Iida (National Institute of Polar Research) on the *Aurora Australis*.

### **5. Data archive**

The data presented in this report are archived and available as a csv file from the web site (<http://biows.nipr.ac.jp/JARE/>). Permission to use these data for publication or presentation should be obtained in writing. Inquiries about details of the data record should be addressed to:

Kunio T. Takahashi

National Institute of Polar Research

Tel: +81-42-512-0743

E-mail: takahashi.kunio@nipr.ac.jp

### **Acknowledgments**

We are grateful to the officers and crew of the training vessel *Umitaka-maru* for their assistance during the cruise. We would like to thank the officers and crew of RSV *Aurora Australis* and the 50th Japanese Antarctic Research Expedition members for collecting the zooplankton samples and environmental data.

### References

- Iida, T. and Fukuchi, M. (2010): Chlorophyll *a* concentration of phytoplankton during cruises of the 49th and 50th Japanese Antarctic Research Expedition in 2007–2009. JARE Data Rep., **316** (Mar. Biol. **40**), 13 p.
- Takahashi, K.T., Ojima, M., Ukai, Y. and Tanimura, A. (2014): Plankton sampling from the *Aurora Australis* and the *Shirase* in 2009–2013 —NORPAC standard net & closing net samples—. JARE data reports, **329** (Marine biology **46**), 19 p.
- Ukai Y., Takahashi, K.T., Fukuchi, M. and Tanimura, A. (2014): Revaluation of zooplankton wet weight data of the NORPAC net samples collected in the Indian sector of the Southern Ocean. Nankyoku Shiryo (Antarctic Record), **58**, 19–41 (in Japanese with English abstract).

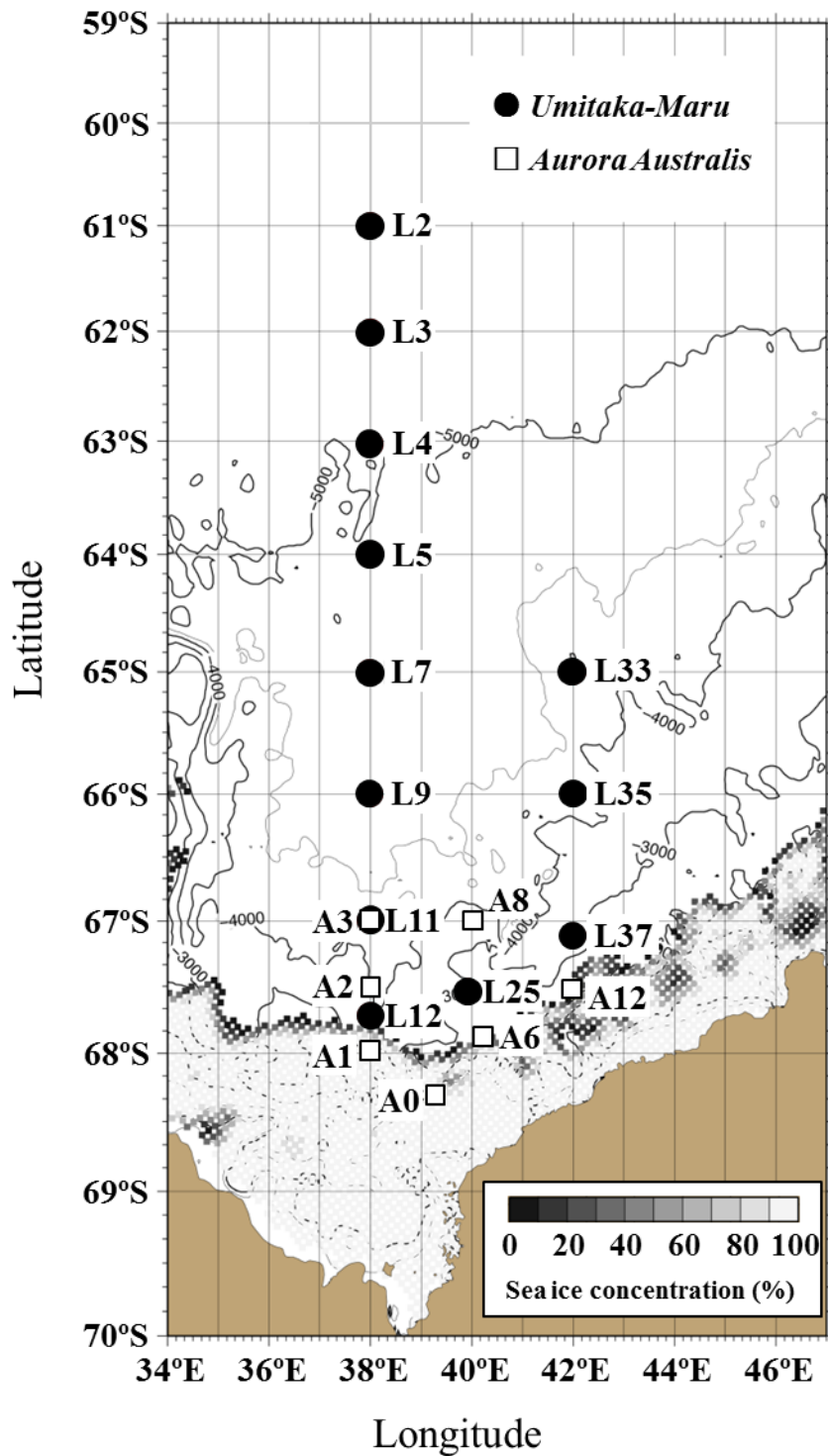


Fig. 1. Sampling stations in the seasonal ice zone of Lützw-Holm Bay in January 2009. Sea ice concentration data were obtained from daily Advanced Microwave Scanning Radiometer 2 (AMSR2) sea ice maps (<http://www.iup.uni-bremen.de:8084/amr2/>).

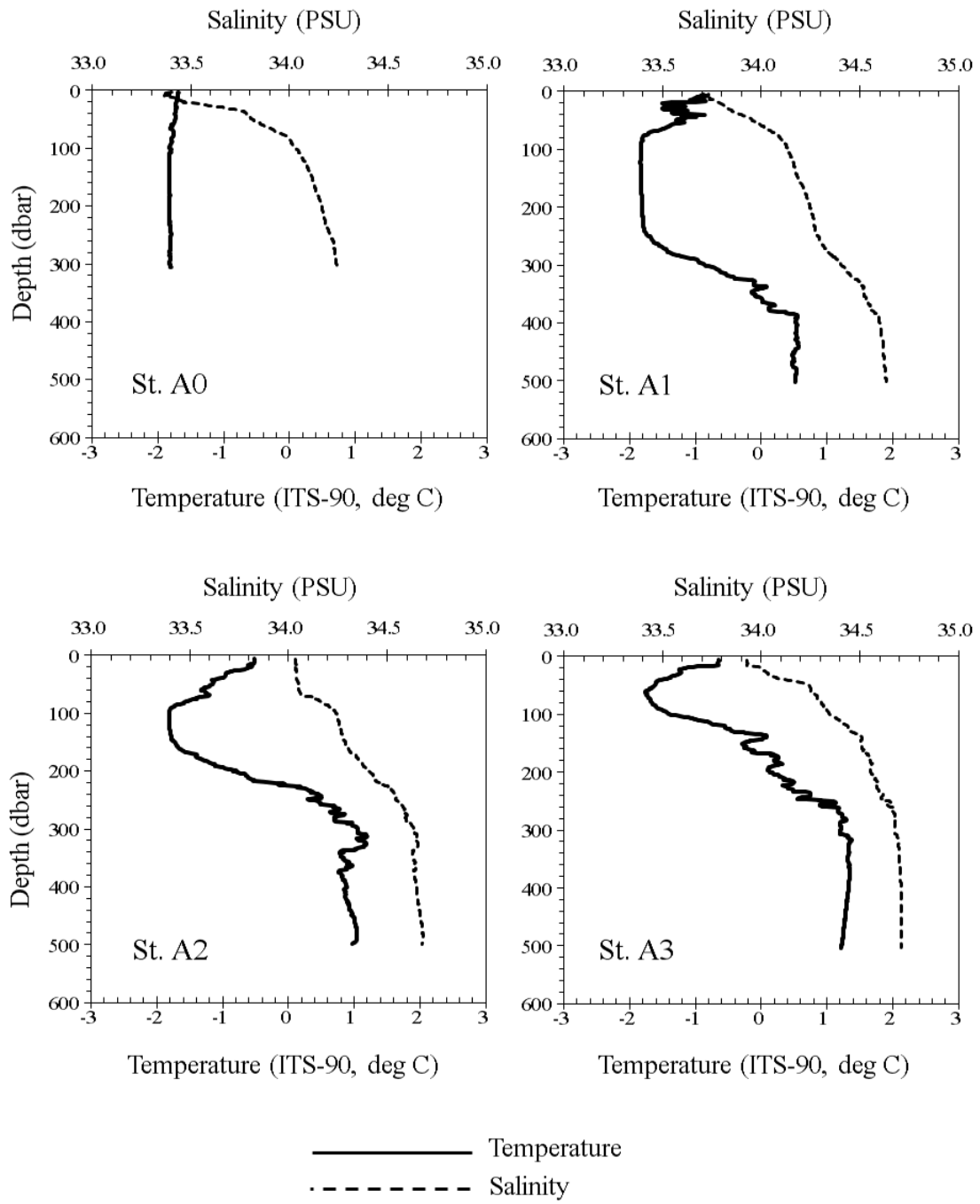


Fig. 2. Vertical profiles of temperature and salinity at each station.

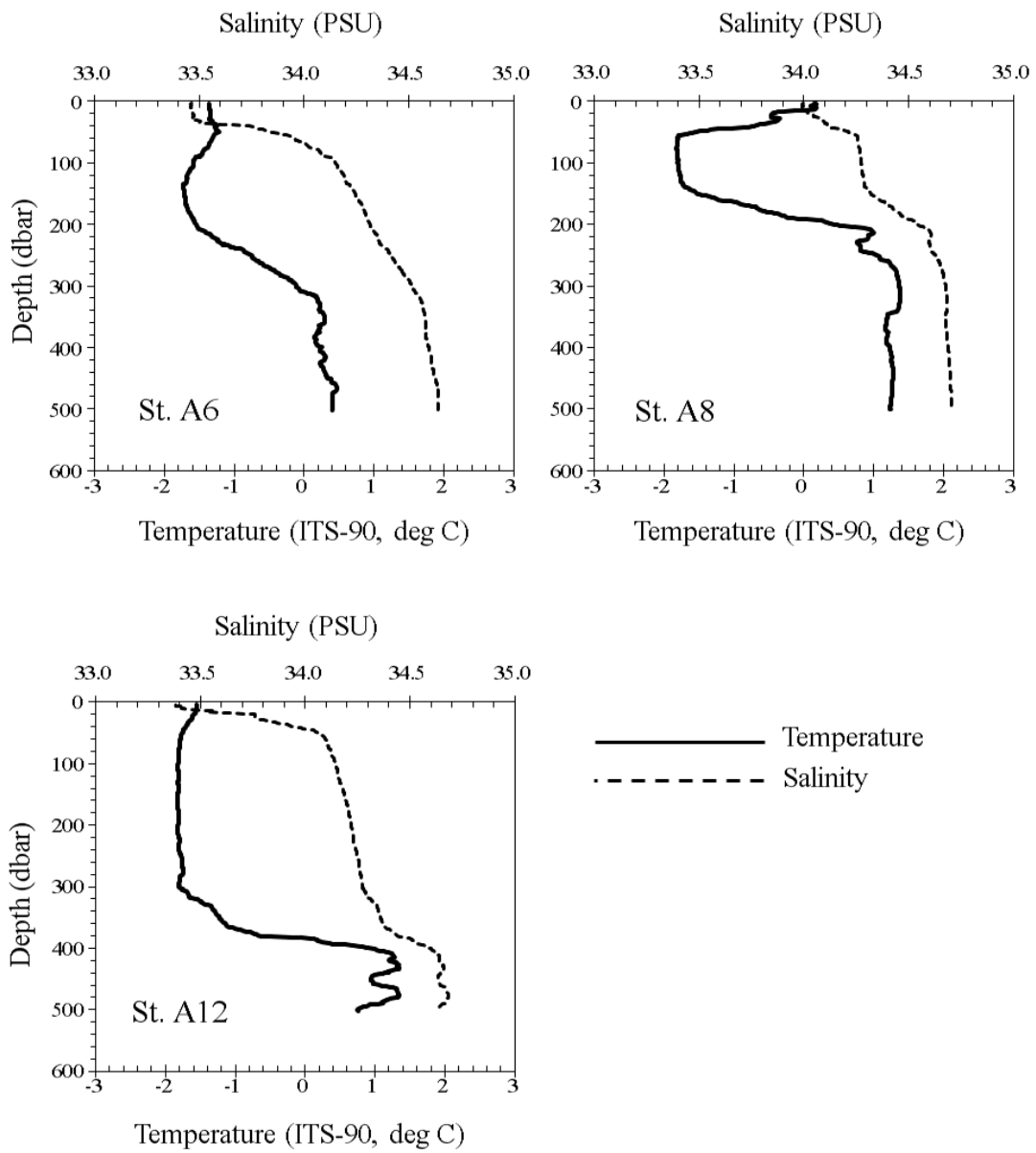


Fig. 2. Continued.

Table 1. Plankton data collected by vertical hauls using a twin NORPAC standard net during the JARE-50 cruise of *Umitaka-maru* in Lützw-Holm Bay, off Syowa Station during January 2009. Sampling was performed by K.T. Takahashi.

Station No.	Position	Ship's time (LMT)		Length of wire (m)	Angle of wire (°)	Estimated depth of haul (m)	Flow-meter		Estimated volume of water filtered (m <sup>3</sup> )	Wet weight of sample in a haul (mg)	Wet weight of sample per m <sup>3</sup> (mg)	Mesh size (µm)	Sample No.
		Date	Time				No.	Revolutions					
L2	60°59'S 38°01'E	Jan. 13	2156	203	3	200	3383	3958	59.77	555	9.3	60	L2-N60
							2471	4046	59.88	356	5.9	100	L2-N100
L3	62°00'S 38°00'E	Jan. 14	0808	201	5	200	3383	3879	58.57	593	10.1	60	L3-N60
							2471	4109	60.81	1646	27.1	100	L3-N100
L4	63°01'S 38°00'E	Jan. 15	0151	201	3	200	3383	3683	55.61	590	10.6	60	L4-N60
							2471	3116	46.12	67	1.5	100	L4-N100
L5	64°00'S 38°00'E	Jan. 15	1214	200	0	200	3383	2311	34.90	277	7.9	60	L5-N60
							2471	3070	45.44	169	3.7	100	L5-N100
L7	65°00'S 37°59'E	Jan. 16	0250	201	5	200	3383	3757	56.73	313	5.5	60	L7-N60
							2471	3952	58.49	105	1.8	100	L7-N100
L9	66°00'S 37°58'E	Jan. 16	1423	201	5	200	3383	5474	82.66	245	3.0	60	L9-N60
							2471	5865	86.80	705	8.1	100	L9-N100
L11	67°00'S 38°00'E	Jan. 17	0801	205	12	200	3383	2635	39.79	483	12.1	60	L11-N60
							2471	2838	42.00	222	5.3	100	L11-N100
L12	68°18'S 38°16'E	Jan. 17	1739	202	8	200	3383	4625	69.84	1388	19.9	60	L12-N60
							2471	5333	78.93	541	6.9	100	L12-N100
L25	67°33'S 39°54'E	Jan. 18	0545	201	4	200	3383	1221	18.44	1221	66.2	60	L25-N60
							2471	2128	31.49	193	6.1	100	L25-N100
L37	67°06'S 42°00'E	Jan. 18	1718	200	0	200	3383	1109	16.75	2036	121.6	60	L37-N60
							2471	1769	26.18	222	8.5	100	L37-N100
L35	66°00'S 42°00'E	Jan. 19	0421	205	13	200	3383	1270	19.18	243	12.7	60	L35-N60
							2471	1845	27.31	142	5.2	100	L35-N100
L33	65°00'S 41°59'E	Jan. 19	1458	203	10	200	3383	1222	18.45	650	35.2	60	L33-N60
							2471	1846	27.32	123	4.5	100	L33-N100



Table 2. Data on plankton collected by vertical hauls with closing net in the JARE-50 cruise of *Umitaka-maru* in Lützw-Holm Bay, off Syowa Station during January 2009. Sampling was performed by K.T. Takahashi.

Station No.	Position		Ship's time (LMT)		Sampling Interval (m)	Flowmeter		Estimated volume of water filtered (m <sup>3</sup> )	Wet weight of sample in a haul (mg)	Wet weight of sample per m <sup>3</sup> (mg)	Mesh size (μm)	Sample No. & Remarks
	Lat	Long	Date	Time		No.	Revolutions					
L2	60°59'S	38°01'E	Jan. 13	2348	0–100	141	1685	23.59	1055	44.7	60	St. L2-G (0–100)
				0002	100–200	141	2212	30.97	648	20.9	60	St. L2-G (100–200)
				0024	200–500	141	5266	73.72	5444	73.8	60	St. L2-G (200–500)
L3	62°00'S	38°00'E	Jan. 14	1110	200–500	141	1653	20.66	638	30.9	60	St. L3-G (200–500)
				1131	100–200	141	1198	16.77	231	13.8	60	St. L3-G (100–200)
				1159	0–100	141	4705	65.87	251	3.8	60	St. L3-G (0–100)
L4	63°01'S	38°00'E	Jan. 15	0010	200–500	141	4788	67.03	1972	29.4	60	St. L4-G (200–500)
				0100	100–200	141	—	—	—	—	60	<i>Failed</i>
				0117	0–100	141	1131	15.83	356	22.5	60	St. L4-G (0–100)
L5	64°00'S	38°00'E	Jan. 15	1038	200–500	141	2959	41.43	1138	27.5	60	St. L5-G (200–500)
				1122	100–200	141	1053	14.74	575	39.0	60	St. L5-G (100–200)
				1144	0–100	141	632	8.85	260	29.4	60	St. L5-G (0–100)
L7	65°00'S	37°59'E	Jan. 16	0433	100–200	141	2092	29.29	175	6.0	60	St. L7-G (100–200)
				0534	0–100	141	4438	62.13	107	1.7	60	St. L7-G (0–100)
L9	66°00'S	37°58'E	Jan. 16	1157	200–500	141	4030	56.42	1019	18.1	60	St. L9-G (200–500)
				1316	100–200	141	2558	35.81	327	9.1	60	St. L9-G (100–200)
				1343	0–100	141	2108	29.51	494	16.7	60	St. L9-G (0–100)
L11	67°00'S	38°00'E	Jan. 17	0850	0–100	141	1173	16.42	426	25.9	60	St. L11-G (0–100)
				0906	100–200	141	2225	31.15	284	9.1	60	St. L11-G (100–200)
				1017	200–500	141	5608	78.51	305	3.9	60	St. L11-G (200–500)
L12	68°18'S	38°16'E	Jan. 17	1537	200–500	141	2978	41.69	534	12.8	60	St. L12-G (200–500)
				1650	100–200	141	1062	14.87	178	12.0	60	St. L12-G (100–200)
				1709	0–100	141	536	7.50	1270	169.3	60	St. L12-G (0–100)

Table 2. Continued.

Station No.	Position		Ship's time (LMT)		Sampling Interval (m)	Flow-meter		Estimated volume of water filtered (m <sup>3</sup> )	Wet weight of sample in a haul (mg)	Wet weight of sample per m <sup>3</sup> (mg)	Mesh size (μm)	Sample No. & Remarks
	Lat	Long	Date	Time		No.	Revolutions					
L25	67°33'S	39°54'E	Jan. 18	0630	200–500	141	1869	26.17	577	22.0	60	St. L25-G (200–500)
				0708	100–200	141	405	5.67	528	93.1	60	St. L25-G (100–200)
				0727	0–100	141	165	2.31	2325	1006.5	60	St. L25-G (0–100)
L37	67°06'S	42°00'E	Jan. 18	1520	200–500	141	2062	28.87	534	18.5	60	St. L37-G (200–500)
				1630	100–200	141	565	7.91	559	70.7	60	St. L37-G (100–200)
				1647	0–100	141	239	3.35	805	240.3	60	St. L37-G (0–100)
L35	66°00'S	42°00'E	Jan. 19	0501	0–100	141	256	3.58	312	87.2	60	St. L35-G (0–100)
				0514	100–200	141	487	6.82	618	90.6	60	St. L35-G (100–200)
				0637	200–500	141	1337	18.72	1265	67.6	60	St. L35-G (200–500)
L33	65°00'S	41°59'E	Jan. 19	1305	200–500	141	1899	26.59	1355	51.0	60	St. L33-G (200–500)
				1414	100–200	141	1710	23.94	354	14.8	60	St. L33-G (100–200)
				1430	0–100	141	386	5.40	159	29.4	60	St. L33-G (0–100)

Table 3. Data on plankton collected by vertical hauls with closing net during the JARE-50 cruise of RSV *Aurora Australis* in Lützow-Holm Bay, off Syowa Station, during January 2009. Sampling was carried out by A. Tanimura & T. Iida.

Station No.	Position		Ship's time (LMT)		Sampling Interval (m)	Flow-meter		Estimated volume of water filtered (m <sup>3</sup> )	Wet weight of sample in a haul (mg)	Wet weight of sample per m <sup>3</sup> (mg)	Mesh size (µm)	Sample No. & Remarks
	Lat	Long	Date	Time		No.	Revolutions					
A3	67°00'S	38°02'E	Jan. 15	1116	200–500	3306	1327	15.90	558	35.1	60	St. A3-G (200–500)
				1154	100–200	3306	—	—	—	60	<i>Failed</i>	
				1213	0–100	3306	1327	15.90	532	33.5	60	St. A3-G (0–100)
				1226	100–200	3306	3981	47.69	753	15.8	60	St. A3-G (100–200)
A1	67°59'S	38°01'E	Jan. 23	0851	200–500	3306	—	—	—	—	60	<i>Failed</i>
				0932	200–500	3306	3981	47.69	185	3.9	60	St. A1-G (200–500)
				1009	100–200	2891	1333	15.90	420	26.4	60	St. A1-G (100–200)
				1028	0–100	2891	1333	15.90	174	10.9	60	St. A1-G (0–100)
A12	67°30'S	41°59'E	Jan. 24	0916	100–200	3202	—	—	—	—	60	<i>Failed</i>
				0934	0–100	3202	1315	15.90	62	3.9	60	St. A12-G (0–100)
				0948	100–200	3202	1315	15.90	230	14.5	60	St. A12-G (100–200)
				1107	200–500	3202	3945	47.70	394	8.3	60	St. A12-G (200–500)
A0	68°18'S	38°16'E	Jan. 30	1058	100–200	3202	1315	15.90	136	8.6	60	St. A0-G (100–200)
				1030	200–300	3202	1315	15.90	66	4.2	60	St. A0-G (200–300)
				1118	0–100	3202	—	—	—	—	60	<i>Failed</i>
				1137	0–100	3202	1315	15.90	128	8.1	60	St. A0-G (0–100)