CRUISE REPORT FOR THE HUDSON MISSION HUD 2008-037

Leg 1: Sept 23-Oct 1, Leg 2 : Oct 1-Oct 15

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Objectives

The main objectives of the mission were:

- to obtain synoptic fall observations of the hydrography and the distributions of nutrients, phytoplankton, zooplankton and bacteria along three sections on the Scotian Shelf and one in Cabot Strait, i.e. to carry out the fall Atlantic Zone Monitoring Programme (AZMP).
- to retrieve and deploy moorings along a portion of the Halifax Line in the slope waters of the central Scotian Shelf and to take hydrographic profiles and collect water samples at mooring stations. This part of the programme was in collaboration with members of the UK RAPID-WAVE (West Atlantic Variability Experiment) programme.

Additional objectives were:

- to carry out hydrographic, chemical and biological sampling at stations in the Gully and Roseway Basin, on the Halifax Line Extension (to HL14), and at stations along transects across the NE Channel and St Anns Bank
- to examine the vertical distribution of mesozooplankton at depths of up to 1000 m beyond the shelf-break
- to investigate the vertical distribution of macroplankton (e.g. krill) in NE Channel, the shelf basins, the Gully and Cabot Strait
- to record acoustic backscattering along the ship's track
- to deploy/recover moorings at inner shelf stations of the Halifax Section (OTN moorings)

- to identify and enumerate birds during transit between stations and lines
- to collect and preserve water samples for analysis of carbon dioxide concentration
- to retrieve a 'whale listening' mooring in the Gully and to deploy a new one
- to collect stage V *Calanus finmarchicus* at their overwintering depths at stations on the Western Scotian Shelf, for measurements of lipid content
- to investigate the effect of ship direction and speed on the vessel mounted ADCP and its estimation of current speed
- to compare the estimates of oxygen concentration from the CTD sensors with those made by Winkler titrations of water samples
- to test a newly constructed MVP package and its tow characteristics

Summary of mission accomplishments

All of the stations of the main AZMP lines were sampled, so that the first major objective, the core AZMP sampling, was successfully completed. All but one of the moorings on extended Halifax Section was recovered, and part of the one that did not release was recovered by dragging. The hydrographic and water sampling associated with the mooring programme were carried out, so that the second major objective was largely successfully completed. Additional stations were sampled as required by the additional objectives stated above and all objectives were achieved.

During the first leg of the cruise the mooring work in the slope waters of the Halifax Line was done in collaboration with the scientists from the UK "RAPID" programme. All but one of the moorings was recovered. The release on this latter mooring (RS6) did respond, and appeared to release the package, but nothing came to the surface. Dragging was attempted, which retrieved only the surface float, the top part of the wire and one of the scientific instruments. The remainder of the package remained unmoved, with the acoustic release still responding. It was decided that a longer dragging wire would be required to get back more of this mooring and the Chief Scientist agreed to undertake this second dragging effort on the second leg, after the dragging wire had been extended back at BIO on Oct. 1 (see Appendix A).

CTD profiles were collected and water sampling was also carried out along with some biological net sampling at all of the mooring site stations, and at the shelf stations of the Halifax Line. During the first leg there were also trials of a newly built MVP, including testing of the dive depths achieved at different vessel speeds and the ship's ADCP system was monitored to test its performance in measuring current speeds at different vessel speeds and in different vessel orientations (see Appendix B). Also during Leg 1 an extensive comparison was made of the performance of the oxygen sensors on the CTD probe versus the results of Winkler titrations made on water samples from discrete depths (see Appendix C) and salinity samples were also run (see Appendix D).

The first part of the second leg of the mission was to the western Scotian Shelf and Northeast Channel, with sampling along the Browns Bank and PS line. The PS (Peter Smith) Line was run in order to examine the fluxes of nutrients into and out of the Gulf of Maine via this route (no project report provided). A BIONESS tow was conducted in the channel to the north of Browns Bank to collect copepods (*C. finmarchicus*) for lipid analysis and Multi-net (vertically stratified) tows were done at stations beyond the shelf-break to examine the abundance and depth distribution of overwintering *C. finmarchicus*. There was sampling at one station beyond the shelf-break to the NE of the Browns Bank Line (RL6), but sampling at RL5 had to be abandoned, because of bad weather. Over the next 36 h, the ship transited to Cabot Strait, and jogged along a NW-SE course in the lee of the Cape Breton highlands, waiting for the storm to die down. There was then AZMP sampling along the Cabot Strait Line and at 5 stations along a section that crosses St Anns Bank in a region which has recently been designated an "Area Of Interest" (AOI) and which may in future become a Marine Protected Area. The section included stations from the Bank itself (~60 m depth) out to the Laurentian Channel (~350 m depth). Following this, there was AZMP sampling along the Louisbourg Line, and similar sampling at three stations across the mouth of the Gully and at one in the Gully itself. An attempt was made in the Gully to recover a "whale-listening" mooring, but communication could not be established with its release. Another similar mooring was deployed, however (see Appendix E).

After the work had been completed in the Gully region, the ship moved back towards the RS6 site to drag for the mooring that had failed to release during the first leg. In fact, however, the vessel arrived in the area at night (when dragging could not be done), so a CTD/biological station was done at HL13. The next day the position of the RSB6 was checked, via communicating with its release, which was still responding and still indicating that it had released its package. Dragging operations were then commenced. The weather was good and the mooring was hooked by circling the dragging wire around it. All but the bottom ~100 m of the mooring wire was recovered, which included another 3 scientific instruments and two sets of floats. Unfortunately, however, several important instruments were on the remaining 100 m of wire; they are still there. The observations made at HL13 suggested that HL14 should be sampled, which was done, and the course was then set to RL5 to sample at the station which had previously been abandoned because of bad weather. En route, there was sampling at another station in the deep waters beyond the shelf-break. The sampling in the deep water will constitute a contribution to a new international programme (BASIN), which includes a investigation of connections among plankton populations throughout the N Atlantic.

Throughout the cruise, except in the Marine Protected Area of the Gully, acoustic backscatter signals were collected at two frequencies to determine the vertical distribution and abundance of macrozooplankton (see Appendix F) and when the ship was under way, during the daylight hours, surveys for pelagic birds was carried out from the bridge (see Appendix G (first leg) and Appendix H (second leg)). In addition to the AZMP sampling, samples were collected along main AMZP lines (the Halifax, Browns Bank, Cabot Strait and Louisbourg Lines), by post-graduate students from Dalhousie University to measure carbon dioxide concentrations (see Appendix I).

Summary bridge log for the Hudson mission 2011-043

Date	Event	Station_name	Lat	Long	Depth	Comments
23-Sep-11	1	**OTN1**	44.3474	-63.3066	127	RECOVER MOORING
23-Sep-11	2	**OTN1**	44.3475	-63.3057	127	REDEPLOY MOORING
23-Sep-11	3	**OTN2**	44.2496	-63.1667		RECOVER MOORING
23-Sep-11	4	**OTN2**	44.2493	-63.1668		REDEPLOY MOORING
23-Sep-11	5	**OTN3**	44.1344	-63.0334		RECOVER MOORING
23-Sep-11	6	**OTN3**	44.1341	-63.0315		REDEPLOY MOORING
23-Sep-11	7	**HL2**	44.2700	-63.3200	146	RING NET 1 -1
24-Sep-11	8	**HL2**	44.2694	-63.3198	146	RING NET 1 -2
24-Sep-11	9	**HL2**	44.2704	-63.3189	146	CTD 1
24-Sep-11	10	**RS1**	42.8553	-61.6321		RECOVER MOORING
24-Sep-11	11	**RS2**	42.7354	-61.5621		RECOVER MOORING
24-Sep-11	12	**RS3**	42.6537	-61.4559		RECOVER MOORING
24-Sep-11	13	**RS4**	42.5558	-61.3712		RECOVER MOORING
24-Sep-11	14	**RS5**	42.3904	-61.2697		RECOVER MOORING
24-Sep-11	15	**HL8**	42.3628	-61.3414	3411	CTD 2
25-Sep-11	16	**HL8**	42.3623	-61.3423	3411	MULTINET 1
25-Sep-11	17	**HL9**	42.2001	-61.1674	4000	CTD 3
25-Sep-11	18	**HL9**	42.1998	-61.1668	4000	MULTINET 2
25-Sep-11	19	**HL10**	42.0303	-61.0649	4145	CTD 4
26-Sep-11	20	**HL10**	42.0301	-61.0651	4145	MULTINET 3
26-Sep-11	21	**HL10**	42.0246	-61.0454	4145	MVP TEST 1
26-Sep-11	22	**HL11**	41.7801	-60.9074	4490	CTD 5
26-Sep-11	23	**HL11**	41.7787	-60.8930	4490	MULTINET 4
26-Sep-11	24	**RS6**	42.1927	-60.9753	3878	RECOVER MOORING (PARTIAL)
26-Sep-11	25	**RS5**	42.3933	-61.2949	3826	MOORING RELEASE TEST 1
26-Sep-11	26	**RS5**	42.3910	-61.2795	3826	REDEPLOY MOORING
26-Sep-11	27	**RS4**	42.3828	-61.2792		MOORING RELEASE TEST 2
26-Sep-11	28	**RS4**	42.5583	-61.3693		REDEPLOY MOORING
26-Sep-11	29	**HL7**	42.5333	-61.4325		RING NET 2 -1
26-Sep-11	30	**HL7**	42.5274	-61.4396		RING NET 2 -2
26-Sep-11	31	**HL7**	42.5310	-61.4330		CTD 6
27-Sep-11	32	**HL7**	42.5312	-61.4416		MULTINET 5
27-Sep-11	33	**HL6.7**	42.6180	-61.5166		CTD 7
27-Sep-11	34	**HL6.7**	42.6184	-61.5171		MULTINET 6
27-Sep-11	35	**HL6.7**	42.5615	-61.4584		MVP TEST 2
27-Sep-11	36	**HL6.7**	42.3763	-61.2894		END MVP 2
28-Sep-11	37	**HL12**	41.4129	-60.6802		CTD 8
28-Sep-11	38	**HL12**	41.4075	-60.6777		MULTINET 7
28-Sep-11	39	**RS6**	42.1770	-61.0098		MOORING RELEASE TEST 3
28-Sep-11	40	**RS6**	42.1822	-61.0032		REDEPLOY MOORING
28-Sep-11	41	**RS6A**	42.2052	-61.1523		DEPLOY MOORING
29-Sep-11	42	**HL6.3**	42.7334	-61.6165	1685	CTD 9

29-Sep-11	43	**HL6.3**	42.7323	-61.6152		MULTINET 8
29-Sep-11	44	**HL6.3**	42.7325	-61.6195		MVP TEST 3
29-Sep-11	45	**HL6**	42.8492	-61.7331	1033	RING NET 3 -1
29-Sep-11	46	**HL6**	42.8435	-61.7419	1055	RING NET 3 -2
29-Sep-11	47	**HL6**	42.8505	-61.7321	1033	CTD 10
29-Sep-11	48	**HL6**	42.8495	-61.7366	1033	MULTINET 9
29-Sep-11	49	**RS1**	42.8327	-61.6220		MOORING RELEASE TEST 4
29-Sep-11	50	**RS1**	42.8524	-61.6333		REDEPLOY MOORING
29-Sep-11	51	**RS2**	42.7387	-61.5726		REDEPLOY MOORING
29-Sep-11	52	**RS3**	42.6433	-61.4590		MOORING RELEASE TEST 5
29-Sep-11	53	**RS3**	42.6569	-61.4554		REDEPLOY MOORING
29-Sep-11	54	**RS3**	42.6568	-61.4715		ACOUSTIC SPHERE
29-Sep-11	55	**HL5.5**	42.9304	-61.8204		RING NET 4 -1
29-Sep-11	56	**HL5.5**	42.9315	-61.8265		CTD 11
29-Sep-11	57	**HL5.5**	42.9374	-61.8231	518	MVP TEST 4
30-Sep-11	58	**HL5**	43.1815	-62.0949		RING NET 5 -1
30-Sep-11	59	**HL5**	43.1819	-62.0939		RING NET 5 -2
30-Sep-11	60	**HL5**	43.1842	-62.0932	100	CTD 12
30-Sep-11	61	**HL4**	43.4777	-62.4519	83	RING NET 6 - 1
30-Sep-11	62	**HL4**	43.4776	-62.4539	86	RING NET 6 - 2
30-Sep-11	63	**HL4**	43.4766	-62.4554	86	CTD 13
30-Sep-11	64	**HL3**	43.8825	-62.8811	266	RING NET 7 - 1
30-Sep-11	65	**HL3**	43.8835	-62.8815	266	RING NET 7 - 2
30-Sep-11	66	**HL3**	43.8852	-62.8832	262	CTD 14
30-Sep-11	67	**HL2**	44.2687	-63.3222	169	RING NET 8 - 1
30-Sep-11	68	**HL2**	44.2702	-63.3249	169	RING NET 8 - 2
30-Sep-11	69	**HL2**	44.2745	-63.3278	169	CTD 15
01-Oct-11	70	**HL1**	44.3985	-63.4494	82	RING NET 9 - 1
01-Oct-11	71	**HL1**	44.3985	-63.4496	82	RING NET 9 - 2
01-Oct-11	72	**HL1**	44.3995	-63.4504	87	CTD 16
02-Oct-11	73	**RL1**	43.2517	-65.0501	165	RING NET 10 - 1
02-Oct-11	74	**RL1**	43.2521	-65.0502	165	CTD 17
02-Oct-11	75	**RL1**	43.2519	-65.0661	165	BIONESS TOW 1
02-Oct-11	76	**BBL1**	43.2494	-65.4812	65	RING NET 11 - 1
02-Oct-11	77	**BBL1**	43.2483	-65.4898	62	CTD 18
02-Oct-11	78	**BBL2**	43.0003	-65.4828	120	RING NET 12 - 1
02-Oct-11	79	**BBL2**	42.9999	-65.4841	122	CTD 19
02-Oct-11	80	**BC-CJ**	42.9082	-66.0331	156	BIONESS TOW 2
02-Oct-11	81	**BC-CJ**	42.9122	-66.0113	150	CTD 20
02-Oct-11	82	**BC-CJ**	42.9138	-66.0095	144	RING NET 13 - 1
02-Oct-11	83	**BC-CJ**	42.9125	-66.0121	154	RING NET 13 - 2
02-Oct-11	84	**BBL3**	42.7587	-65.4773	102	RING NET 13 - 3
02-Oct-11	85	**BBL3**	42.7569	-65.4763	101	CTD 21
03-Oct-11	86	**PS1**	42.4202	-65.7485	100	RING NET 14 - 1
03-Oct-11	87	**PS1**	42.4219	-65.7488	100	CTD 22
03-Oct-11	88	**PS2**	42.3408	-65.8114	201	CTD 23
03-Oct-11	89	**PS3**	42.3011	-65.8410	217	CTD 24

03-Oct-11	90	**PS4**	42.2717	-65.8762	229	RING NET 15 - 1
03-Oct-11	91	**PS4**	42.2702	-65.8751	228	CTD 25
03-Oct-11	92	**PS5**	42.2311	-65.8987	238	CTD 26
03-Oct-11	93	**PS6**	42.2001	-65.9385	227	RING NET 16 - 1
03-Oct-11	94	**PS6**	42.1989	-65.9338	228	CTD 27
03-Oct-11	95	**PS7**	42.1594	-65.9697	225	CTD 28
03-Oct-11	96	**PS8**	42.1198	-66.0486	205	RING NET 17 - 1
03-Oct-11	97	**PS8**	42.1132	-66.0356	205	RING NET 17 - 2
03-Oct-11	98	**PS8**	42.1221	-66.0407	209	CTD 29
03-Oct-11	99	**PS9**	42.0602	-66.0812	96	CTD 30
03-Oct-11	100	**PS10**	41.9903	-66.1401	93	RING NET 18 - 1
03-Oct-11	101	**PS10**	41.9902	-66.1397	93	CTD 31
03-Oct-11	102	**BBL4**	42.4502	-65.4798	102	RING NET 19 - 1
03-Oct-11	103	**BBL4**	42.4500	-65.4800	102	CTD 32
03-Oct-11	104	**BBL5**	42.1298	-65.5006	203	RING NET 20 - 1
03-Oct-11	105	**BBL5**	42.1302	-65.5009	203	CTD 33
04-Oct-11	106	**BBL6**	41.9997	-65.5096	1081	RING NET 21 - 1
04-Oct-11	107	**BBL6**	42.0008	-65.5156	1083	CTD 34
04-Oct-11	108	**BBL6**	41.9995	-65.5107	1085	MULTINET 10
04-Oct-11	109	**BBL7**	41.8677	-65.3495	2000	RING NET 22 - 1
04-Oct-11	110	**BBL7**	41.8680	-65.3628	2000	RING NET 22 - 2
04-Oct-11	111	**BBL7**	41.8815	-65.3568	2000	CTD 35
04-Oct-11	112	**BBL7**	41.8813	-65.3583	2000	CTD 36
04-Oct-11	113	**BBL7**	41.8620	-65.3833	2000	MULTINET 11
04-Oct-11	114	**RL6**	42.3197	-63.8707	1889	CTD 37
04-Oct-11	115	**RL6**	42.3202	-63.8696	1880	MULTINET 12
07-Oct-11	116	**CSL1**	46.9565	-60.2202	82	RING NET 23 - 1
07-Oct-11	117	**CSL1**	46.8533	-60.2182	83	CTD 38
07-Oct-11	118	**CSL2**	47.0198	-60.1185	181	RING NET 24 - 1
07-Oct-11	119	**CSL2**	47.0128	-60.1087	182	CTD 39
07-Oct-11	120	**CSL3**	47.1000	-59.9918	336	RING NET 25 - 1
07-Oct-11	121	**CSL3**	47.0987	-59.9799	344	CTD 40
07-Oct-11	122	**CSL3**	47.0886	-59.9718	342	BIONESS 3
07-Oct-11	123	**CSL4**	47.2556	-59.7637	470	BIONESS 4
07-Oct-11	124	**CSL4**	47.2701	-59.7809	441	RING NET 26 - 1
07-Oct-11	125	**CSL4**	47.2700	-59.7765	441	CTD 41
08-Oct-11	126	**CSL5**	47.4319	-59.5655	480	RING NET 27 - 1
08-Oct-11	127	**CSL5**	47.4333	-59.6474	480	RING NET 27 - 2
08-Oct-11	128	**CSL5**	47.4349	-59.5658	480	CTD 42
08-Oct-11	129	**CSL6**	47.5804	-59.3413	265	RING NET 28 - 1
08-Oct-11	130	**CSL6**	47.5837	-59.3422	265	CTD 43
08-Oct-11	131	**STAB5**	46.4172	-58.8754	350	RING NET 29 - 1
08-Oct-11	132	**STAB5**	46.4172	-58.8705	376	CTD 44
08-Oct-11	133	**STAB5**	46.4103	-58.8558	370	BIONESS 5
08-Oct-11	134	**STAB4**	46.2966	-59.0708	155	RING NET 30 - 1
08-Oct-11	135	**STAB4**	46.2951	-59.0683	155	CTD 45
08-Oct-11	136	**STAB3**	46.2169	-59.2001	92	RING NET 31 - 1
08-Oct-11	137	**STAB3**	46.2166	-59.1985	92	CTD 46
08-Oct-11	138	**STAB2**	46.1076	-59.3611	67	RING NET 32 - 1

08-Oct-11	139	**STAB2**	46.1077	-59.3625	66	CTD 47
08-Oct-11	140	**STAB1**	45.9991	-59.5289	60	RING NET 33 - 1
08-Oct-11	141	**STAB1**	45.9977	-59.5297	59	CTD 48
08-Oct-11	142	**LL1**	45.8307	9689.0000	94	RING NET 34 - 1
08-Oct-11	143	**LL1**	45.8320	-59.8515	94	CTD 49
08-Oct-11	144	**LL2**	45.6595	-59.7012	140	RING NET 35 - 1
08-Oct-11	145	**LL2**	45.6592	-59.7038	138	CTD 50
09-Oct-11	146	**LL3**	45.4893	-59.5186	142	RING NET 36 - 1
09-Oct-11	147	**LL3**	45.4891	-59.5166	151	RING NET 36 - 2
09-Oct-11	148	**LL3**	45.4897	-59.5187	144	CTD 51
09-Oct-11	149	**LL4**	45.1611	-59.1777	105	RING NET 37 - 1
09-Oct-11	150	**LL4**	45.1555	-59.1763	107	CTD 52
09-Oct-11	151	**LL5**	44.8206	-59.8498	207	RING NET 38 - 1
09-Oct-11	152	**LL5**	44.8200	-58.8489	227	CTD 53
09-Oct-11	153	**LL6**	44.4811	-58.5092	69	RING NET 39 - 1
09-Oct-11	154	**LL6**	44.4813	-58.5081	70	CTD 54
09-Oct-11	155	**LL7**	44.1304	-58.1832	690	MULTINET 13
09-Oct-11	156	**LL7**	44.1286	-58.1774	764	RING NET 40 - 1
09-Oct-11	157	**LL7**	44.1260	-58.1798	791	RING NET 40 - 2
09-Oct-11	158	**LL7**	44.1254	-58.1797	776	CTD 55
09-Oct-11	159	**LL8**	43.7785	-57.8277	2800	RING NET 41 - 1
09-Oct-11	160	**LL8**	43.7791	-57.8298	2800	CTD 56
09-Oct-11	161	**LL8**	43.7796	-57.8317	2850	MULTINET 14
10-Oct-11	162	**LL9**	43.4692	-57.5285	3500	RING NET 42 - 1
10-Oct-11	163	**LL9**	43.4678	-57.5275	3500	CTD 57
10-Oct-11	164	**LL9**	43.4613	-57.5260	3600	MULTINET 15
10-Oct-11	165	**H MOORE-ING**	43.9322	-58.9214		DEPLOY MOORING
10-Oct-11	166	**GULD3**	44.0458	-59.0339	500+	BIONESS 6
10-Oct-11	167	**GULD3**	44.0251	-59.0366	448	RING NET 43 - 1
10-Oct-11	168	**GULD3**	44.0199	-59.0416	465	CTD 58
10-Oct-11	169	**SG23**	43.8692	-58.7433	1000	RING NET 44 - 1
10-Oct-11	170	**SG23**	43.8671	-58.7432	960	RING NET 44 - 2
10-Oct-11	171	**SG23**	43.8656	-58.7468	850	RING NET 44 - 3
11-Oct-11	172	**SG23**	43.8640	-58.7480	850	CTD 59
11-Oct-11	173	**GULD4**	43.8098	-58.9100	1800	RING NET 45 - 1
11-Oct-11	174	**GULD4**	43.8108	-58.9131	1800	CTD 60
11-Oct-11	175	**GULD4**	43.8057	-58.9103	1800	MULTINET 16
11-Oct-11	176	**SG28**	43.7105	-59.0099	1000	RING NET 46 - 1
11-Oct-11	177	**SG28**	43.7080	-59.0069	1000	CTD 61
11-Oct-11	178	**HL13**	41.0435	-60.4443	4924	CTD 62
12-Oct-11	179	**HL13**	41.0415	-60.4457	4900	MULTINET 17
12-Oct-11	180	**RS6**	42.2043	-61.1057	3500	RECOVER MOORING M1782
13-Oct-11	181	**HL14**	40.6748	-60.2147	5000	CTD 63
13-Oct-11	182	**HL14**	40.6826	-60.2470	5000	MULTINET 18
13-Oct-11	183	**HL14RL5A**	41.9091	-62.6487	3200	CTD 64
13-Oct-11	184	**HL14RL5A**	41.9091	-62.6558	3200	MULTINET 19
14-Oct-11	185	**RL5**	42.6198	-64.0800	933	CTD 65

14-Oct-11	186	**RL5**	42.6155	-64.0853	950	MULTINET 20
14-Oct-11	187	**HL3**	43.8698	-62.8962	272	BIONESS 7
14-Oct-11	188	**HL2**	44.2695	-63.3203	158	RING NET 47 - 1, 47 - 2
14-Oct-11	189	**HL2**	44.2698	-63.3217	170	RING NET 47 - 3
14-Oct-11	190	**HL2**	44.2698	-63.3227	176	SECCHI DISC
14-Oct-11	191	**HL2**	44.2713	-63.3229	174	CTD 66

Summary of sampling at AZMP and other stations

1. <u>CTD profiles</u>: CTD profiles were collected at all stations. As well as recording temperature, depth and salinity, the CTD was also equipped with an *in situ* and an oxygen sensor, and with Niskin bottles. Water samples were collected at selected depths at all CTD stations. These were used to determine: dissolved oxygen, extracted chlorophyll, nutrients, bacterial abundance and phytoplankton composition. POC, PON and HPLC pigment samples and samples for determination of absorption spectra were also taken at the surface. Not all measurements were made on all water samples or on all profiles. (Total number of CTD profiles = 66)

2. <u>Vertical net tows</u>: At all AZMP stations, and some of the other stations, a 200 µm mesh ring net was towed vertically to collect mesozooplankton. Vertical ring net tows using a 76 µm mesh were taken at stations HL1 to HL7 of the Halifax Line. Tows were to the bottom, or 1000 m. (Total number of vertical net tow stations = 47)

3. <u>BIONESS tows</u>: 0.5 x 0.5 m model, fitted with 233 µm mesh. 1 in the channel to the north of Browns Bank, 1 in Roseway Basin, 2 in Cabot Strait, 1 in the Laurentian Channel off St Anns Bank, 1 in the Gully, and 1 in Emerald Basin. (Total stations sampled =7, maximum of 5 depth ranges per station)

4. <u>MULTI-NET tows</u>: 0.5 x 0.5 m model, fitted with 202 µm mesh. 4 off the western Scotian Shelf, 3 off the eastern Scotian Shelf, 1 in the Gully region, 11 on the extension of the Halifax Section (HL6-HL14) and one in transit between HL14 and the western Scotian Shelf. (Total stations sampled = 20, 5 depth ranges per station)

Water sampling depths and ID numbers for CTD profiles

CTD	EVENT	STN	ID_TAG	DEPTH	CTD	EVENT	STN	ID_TAG	DEPTH
1	9	**HL2**	**382251**	146	32	103	**BBL4**	**382660**	98
1	9	**HL2**	**382252**	146	32	103	**BBL4**	**382661**	80
1	9	**HL2**	**382253**	104	32	103	**BBL4**	**382662**	60
1	9	**HL2**	**382254**	104	32	103	**BBL4**	**382663**	50
1	9	**HL2**	**382255**	80	32	103	**BBL4**	**382664**	40
1	9	**HL2**	**382256**	80	32	103	**BBL4**	**382665**	30
1	9	**HL2**	**382257**	60	32	103	**BBL4**	**382666**	21
1	9	**HL2**	**382258**	60	32	103	**BBL4**	**382667**	11
1	9	**HL2**	**382259**	50	32	103	**BBL4**	**382668**	2
1	9	**HL2**	**382260**	50	33	105	**BBL5**	**382669**	194

1	9	**HL2**	**382261**	39	33	105	**BBL5**	**382670**	151
1	9	**HL2**	**382262**	39	33	105	**BBL5**	**382671**	99
1	9	**HL2**	**382263**	30	33	105	**BBL5**	**382672**	81
1	9	**HL2**	**382264**	30	33	105	**BBL5**	**382673**	60
1	9	**HL2**	**382265**	20	33	105	**BBL5**	**382674**	51
1	9	**HL2**	**382266**	20	33	105	**BBL5**	**382675**	41
1	9	**HL2**	**382267**	10	33	105	**BBL5**	**382676**	29
1	9	**HL2**	**382268**	10	33	105	**BBL5**	**382677**	21
1	9	**HL2**	**382269**	3	33	105	**BBL5**	**382678**	10
1	9	**HL2**	**382270**	3	33	105	**BBL5**	**382679**	3
1	9	**HL2**	**382271**	3	34	107	**BBL6**	**382680**	1096
1	9	**HL2**	**382272**	3	34	107	**BBL6**	**382681**	751
1	9	**HL2**	**382273**	3	34	107	**BBL6**	**382682**	499
1	9	**HL2**	**382274**	3	34	107	**BBL6**	**382683**	249
2	15	**HL8**	**382275**	3445	34	107	**BBL6**	**382684**	100
2	15	**HL8**	**382276**	3000	34	107	**BBL6**	**382685**	80
2	15	**HL8**	**382277**	2499	34	107	**BBL6**	**382686**	61
2	15	**HL8**	**382278**	2000	34	107	**BBL6**	**382687**	50
2	15	**HL8**	**382279**	1499	34	107	**BBL6**	**382688**	40
2	15	**HL8**	**382280**	1000	34	107	**BBL6**	**382689**	30
2	15	**HL8**	**382281**	500	34	107	**BBL6**	**382690**	21
2	15	**HL8**	**382282**	250	34	107	**BBL6**	**382691**	9
2	15	**HL8**	**382283**	100	34	107	**BBL6**	**382692**	3.5
2	15	**HL8**	**382284**	80	35	111	**BBL7**	**999999**	NO BOTTLES
2	15	**HL8**	**382285**	60	36	112	**BBL7**	**382693**	1879
2	15	**HL8**	**382286**	50	36	112	**BBL7**	**382694**	1000
2	15	**HL8**	**382287**	40	36	112	**BBL7**	**382695**	751
2	15	**HL8**	**382288**	31	36	112	**BBL7**	**382696**	502
2	15	**HL8**	**382289**	21	36	112	**BBL7**	**382697**	250
2	15	**HL8**	**382290**	10	36	112	**BBL7**	**382698**	100
2	15	**HL8**	**382291**	2.5	36	112	**BBL7**	**382699**	80
3	17	**HL9**	**382292**	3947	36	112	**BBL7**	**382700**	60
3	17	**HL9**	**382293**	3500	36	112	**BBL7**	**382701**	50
3	17	**HL9**	**382294**	3000	36	112	**BBL7**	**382702**	40
3	17	**HL9**	**382295**	2500	36	112	**BBL7**	**382703**	30
3	17	**HL9**	**382296**	2001	36	112	**BBL7**	**382704**	20
3	17	**HL9**	**382297**	1501	36	112	**BBL7**	**382705**	10
3	17	**HL9**	**382298**	1000	36	112	**BBL7**	**382706**	4
3	17	**HL9**	**382299**	501	37	114	**RL6**	**382707**	1884
3	17	**HL9**	**382300**	250	37	114	**RL6**	**382708**	1499
3	17	**HL9**	**382301**	101	37	114	**RL6**	**382709**	1002
3	17	**HL9**	**382302**	81	37	114	**RL6**	**382710**	501
3	17	**HL9**	**382303**	61	37	114	**RL6**	**382711**	251
3	17	**HL9**	**382304**	54	37	114	**RL6**	**382712**	100
3	17	**HL9**	**382305**	40	37	114	**RL6**	**382713**	80
3	17	**HL9**	**382306**	30	37	114	**RL6**	**382714**	60
3	17	**HL9**	**382307**	20	37	114	**RL6**	**382715**	50
3	17	**HL9**	**382308**	11	37	114	**RL6**	**382716**	40
3	17	**HL9**	**382309**	2	37	114	**RL6**	**382717**	30

4	19	**HL10**	**382310**	4145	37	114	**RL6**	**382718**	20
4	19	**HL10**	**382311**	3500	37	114	**RL6**	**382719**	10
4	19	**HL10**	**382312**	3000	37	114	**RL6**	**382720**	3
4	19	**HL10**	**382313**	2500	38	117	**CSL1**	**382721**	75
4	19	**HL10**	**382314**	2001	38	117	**CSL1**	**382722**	60
4	19	**HL10**	**382315**	1499	38	117	**CSL1**	**382723**	50
4	19	**HL10**	**382316**	1001	38	117	**CSL1**	**382724**	40
4	19	**HL10**	**382317**	500	38	117	**CSL1**	**382725**	31
4	19	**HL10**	**382318**	250	38	117	**CSL1**	**382726**	21
4	19	**HL10**	**382319**	99	38	117	**CSL1**	**382727**	11
4	19	**HL10**	**382320**	80	38	117	**CSL1**	**382728**	2.6
4	19	**HL10**	**382321**	60	39	119	**CSL2**	**382729**	171
4	19	**HL10**	**382322**	51	39	119	**CSL2**	**382730**	150
4	19	**HL10**	**382323**	40	39	119	**CSL2**	**382731**	100
4	19	**HL10**	**382324**	31	39	119	**CSL2**	**382732**	80
4	19	**HL10**	**382325**	20	39	119	**CSL2**	**382733**	60
4	19	**HL10**	**382326**	11	39	119	**CSL2**	**382734**	49
4	19	**HL10**	**382327**	3	39	119	**CSL2**	**382735**	41
5	22	**HL11**	**382328**	4511	39	119	**CSL2**	**382736**	30
5	22	**HL11**	**382329**	4000	39	119	**CSL2**	**382737**	20
5	22	**HL11**	**382330**	3500	39	119	**CSL2**	**382738**	9
5	22	**HL11**	**382331**	3001	39	119	**CSL2**	**382739**	3
5	22	**HL11**	**382332**	2500	40	121	**CSL3**	**382740**	336
5	22	**HL11**	**382333**	2001	40	121	**CSL3**	**382741**	200
5	22	**HL11**	**382334**	1501	40	121	**CSL3**	**382742**	152
5	22	**HL11**	**382335**	1000	40	121	**CSL3**	**382743**	100
5	22	**HL11**	**382336**	500	40	121	**CSL3**	**382744**	80
5	22	**HL11**	**382337**	250	40	121	**CSL3**	**382745**	61
5	22	**HL11**	**382338**	101	40	121	**CSL3**	**382746**	50
5	22	**HL11**	**382339**	80	40	121	**CSL3**	**382747**	41
5	22	**HL11**	**382340**	61	40	121	**CSL3**	**382748**	31
5	22	**HL11**	**382341**	51	40	121	**CSL3**	**382749**	20
5	22	**HL11**	**382342**	40	40	121	**CSL3**	**382750**	10
5	22	**HL11**	**382343**	30	40	121	**CSL3**	**382751**	2.5
5	22	**HL11**	**382344**	20	41	125	**CSL4**	**382752**	455
5	22	**HL11**	**382345**	11	41	125	**CSL4**	**382753**	301
5	22	**HL11**	**382346**	2	41	125	**CSL4**	**382754**	199
6	31	**HL7**	**382347**	2731	41	125	**CSL4**	**382755**	150
6	31	**HL7**	**382348**	2700	41	125	**CSL4**	**382756**	101
6	31	**HL7**	**382349**	2500	41	125	**CSL4**	**382757**	81
6	31	**HL7**	**382350**	2400	41	125	**CSL4**	**382758**	61
6	31	**HL7**	**382351**	2250	41	125	**CSL4**	**382759**	51
6	31	**HL7**	**382352**	2000	41	125	**CSL4**	**382760**	40
6	31	**HL7**	**382353**	1850	41	125	**CSL4**	**382761**	30
6	31	**HL7**	**382354**	1651	41	125	**CSL4**	**382762**	20
6	31	**HL7**	**382355**	1500	41	125	**CSL4**	**382763**	11
6	31	**HL7**	**382356**	1250	41	125	**CSL4**	**382764**	2
6	31	**HL7**	**382357**	1000	42	128	**CSL5**	**382765**	468
6	31	**HL7**	**382358**	749	42	128	**CSL5**	**382766**	301

6	31	**HL7**	**382359**	500	42	128	**CSL5**	**382767**	200
6	31	**HL7**	**382360**	375	42	128	**CSL5**	**382768**	151
6	31	**HL7**	**382361**	250	42	128	**CSL5**	**382769**	101
6	31	**HL7**	**382362**	101	42	128	**CSL5**	**382770**	81
6	31	**HL7**	**382363**	80	42	128	**CSL5**	**382771**	61
6	31	**HL7**	**382364**	60	42	128	**CSL5**	**382772**	51
6	31	**HL7**	**382365**	51	42	128	**CSL5**	**382773**	41
6	31	**HL7**	**382366**	41	42	128	**CSL5**	**382774**	31
6	31	**HL7**	**382367**	31	42	128	**CSL5**	**382775**	20
6	31	**HL7**	**382368**	20	42	128	**CSL5**	**382776**	10
6	31	**HL7**	**382369**	11	42	128	**CSL5**	**382777**	2
6	31	**HL7**	**382370**	3	43	130	**CSL6**	**382778**	247
7	33	**HL6.7**	**382371**	2319	43	130	**CSL6**	**382779**	200
7	33	**HL6.7**	**382372**	2000	43	130	**CSL6**	**382780**	150
7	33	**HL6.7**	**382373**	1501	43	130	**CSL6**	**382781**	99
7	33	**HL6.7**	**382374**	1001	43	130	**CSL6**	**382782**	81
7	33	**HL6.7**	**382375**	751	43	130	**CSL6**	**382783**	61
7	33	**HL6.7**	**382376**	501	43	130	**CSL6**	**382784**	51
7	33	**HL6.7**	**382377**	250	43	130	**CSL6**	**382785**	41
7	33	**HL6.7**	**382378**	100	43	130	**CSL6**	**382786**	30
7	33	**HL6.7**	**382379**	80	43	130	**CSL6**	**382787**	20
7	33	**HL6.7**	**382380**	61	43	130	**CSL6**	**382788**	10
7	33	**HL6.7**	**382381**	50	43	130	**CSL6**	**382789**	2.5
7	33	**HL6.7**	**382382**	41	44	132	**STAB5**	**382790**	364
7	33	**HL6.7**	**382383**	30	44	132	**STAB5**	**382791**	300
7	33	**HL6.7**	**382384**	20	44	132	**STAB5**	**382792**	200
7	33	**HL6.7**	**382385**	11	44	132	**STAB5**	**382793**	152
7	33	**HL6.7**	**382386**	1	44	132	**STAB5**	**382794**	101
8	37	**HL12**	**382387**	4721	44	132	**STAB5**	**382795**	80
8	37	**HL12**	**382388**	4501	44	132	**STAB5**	**382796**	60
8	37	**HL12**	**382389**	4000	44	132	**STAB5**	**382797**	50
8	37	**HL12**	**382390**	3850	44	132	**STAB5**	**382798**	40
8	37	**HL12**	**382391**	3501	44	132	**STAB5**	**382799**	30
8	37	**HL12**	**382392**	3000	44	132	**STAB5**	**382800**	20
8	37	**HL12**	**382393**	2800	44	132	**STAB5**	**382801**	11
8	37	**HL12**	**382394**	2501	44	132	**STAB5**	**382802**	2.3
8	37	**HL12**	**382395**	2001	45	135	**STAB4**	**382803**	146
8	37	**HL12**	**382396**	1500	45	135	**STAB4**	**382804**	125
8	37	**HL12**	**382397**	1299	45	135	**STAB4**	**382805**	100
8	37	**HL12**	**382398**	1001	45	135	**STAB4**	**382806**	80
8	37	**HL12**	**382399**	750	45	135	**STAB4**	**382807**	60
8	37	**HL12**	**382400**	502	45	135	**STAB4**	**382808**	50
8	37	**HL12**	**382401**	251	45	135	**STAB4**	**382809**	41
8	37	**HL12**	**382402**	101	45	135	**STAB4**	**382810**	30
8	37	**HL12**	**382403**	80	45	135	**STAB4**	**382811**	20
8	37	**HL12**	**382404**	60	45	135	**STAB4**	**382812**	10
8	37	**HL12**	**382405**	52	45	135	**STAB4**	**382813**	3
8	37	**HL12**	**382406**	41	46	137	**STAB3**	**382814**	87
8	37	**HL12**	**382407**	31	46	137	**STAB3**	**382815**	80

8	37	**HL12**	**382408**	21	46	137	**STAB3**	**382816**	60
8	37	**HL12**	**382409**	11	46	137	**STAB3**	**382817**	51
8	37	**HL12**	**382410**	2.5	46	137	**STAB3**	**382818**	40
9	42	**HL6.3**	**382411**	1686	46	137	**STAB3**	**382819**	30
9	42	**HL6.3**	**382412**	1500	46	137	**STAB3**	**382820**	20
9	42	**HL6.3**	**382413**	1000	46	137	**STAB3**	**382821**	10
9	42	**HL6.3**	**382414**	750	46	137	**STAB3**	**382822**	2
9	42	**HL6.3**	**382415**	500	47	139	**STAB2**	**382823**	62
9	42	**HL6.3**	**382416**	250	47	139	**STAB2**	**382824**	50
9	42	**HL6.3**	**382417**	100	47	139	**STAB2**	**382825**	40
9	42	**HL6.3**	**382418**	81	47	139	**STAB2**	**382826**	30
9	42	**HL6.3**	**382419**	60	47	139	**STAB2**	**382827**	21
9	42	**HL6.3**	**382420**	51	47	139	**STAB2**	**382828**	10
9	42	**HL6.3**	**382421**	41	47	139	**STAB2**	**382829**	2.2
9	42	**HL6.3**	**382422**	31	48	141	**STAB1**	**382830**	56
9	42	**HL6.3**	**382423**	22	48	141	**STAB1**	**382831**	51
9	42	**HL6.3**	**382424**	10	48	141	**STAB1**	**382832**	40
9	42	**HL6.3**	**382425**	3	48	141	**STAB1**	**382833**	30
10	47	**HL6**	**382426**	1025	48	141	**STAB1**	**382834**	20
10	47	**HL6**	**382427**	751	48	141	**STAB1**	**382835**	10
10	47	**HL6**	**382428**	500	48	141	**STAB1**	**382836**	2.4
10	47	**HL6**	**382429**	251	49	143	**LL1**	**382837**	86
10	47	**HL6**	**382430**	101	49	143	**LL1**	**382838**	80
10	47	**HL6**	**382431**	81	49	143	**LL1**	**382839**	60
10	47	**HL6**	**382432**	60	49	143	**LL1**	**382840**	51
10	47	**HL6**	**382433**	50	49	143	**LL1**	**382841**	41
10	47	**HL6**	**382434**	41	49	143	**LL1**	**382842**	31
10	47	**HL6**	**382435**	30	49	143	**LL1**	**382843**	20
10	47	**HL6**	**382436**	21	49	143	**LL1**	**382844**	10
10	47	**HL6**	**382437**	10	49	143	**LL1**	**382845**	2.6
10	47	**HL6**	**382438**	3	50	145	**LL2**	**382846**	130
11	56	**HL5A**	**382439**	512	50	145	**LL2**	**382847**	100
11	56	**HL5A**	**382440**	250	50	145	**LL2**	**382848**	81
11	56	**HL5A**	**382441**	100	50	145	**LL2**	**382849**	61
11	56	**HL5A**	**382442**	80	50	145	**LL2**	**382850**	50
11	56	**HL5A**	**382443**	61	50	145	**LL2**	**382851**	40
11	56	**HL5A**	**382444**	51	50	145	**LL2**	**382852**	31
11	56	**HL5A**	**382445**	41	50	145	**LL2**	**382853**	20
11	56	**HL5A**	**382446**	31	50	145	**LL2**	**382854**	11
11	56	**HL5A**	**382447**	20	50	145	**LL2**	**382855**	2.3
11	56	**HL5A**	**382448**	11	51	148	**LL3**	**382856**	136
11	56	**HL5A**	**382449**	2.5	51	148	**LL3**	**382857**	100
12	60	**HL5**	**382450**	93	51	148	**LL3**	**382858**	80
12	60	**HL5**	**382451**	80	51	148	**LL3**	**382859**	60
12	60	**HL5**	**382452**	60	51	148	**LL3**	**382860**	51
12	60	**HL5**	**382453**	50	51	148	**LL3**	**382861**	41
12	60	**HL5**	**382454**	40	51	148	**LL3**	**382862**	31
12	60	**HL5**	**382455**	30	51	148	**LL3**	**382863**	21
12	60	**HL5**	**382456**	20	51	148	**LL3**	**382864**	11

12	60	**HL5**	**382457**	10	51	148	**LL3**	**382865**	2.5
12	60	**HL5**	**382458**	2	52	150	**LL4**	**382866**	95
13	63	**HL4**	**382459**	76	52	150	**LL4**	**382867**	80
13	63	**HL4**	**382460**	60	52	150	**LL4**	**382868**	60
13	63	**HL4**	**382461**	51	52	150	**LL4**	**382869**	50
13	63	**HL4**	**382462**	41	52	150	**LL4**	**382870**	41
13	63	**HL4**	**382463**	31	52	150	**LL4**	**382871**	30
13	63	**HL4**	**382464**	21	52	150	**LL4**	**382872**	20
13	63	**HL4**	**382465**	11	52	150	**LL4**	**382873**	10
13	63	**HL4**	**382466**	3	52	150	**LL4**	**382874**	2
14	66	**HL3**	**382467**	257	53	152	**LL5**	**382875**	216
14	66	**HL3**	**382468**	200	53	152	**LL5**	**382876**	100
14	66	**HL3**	**382469**	100	53	152	**LL5**	**382877**	80
14	66	**HL3**	**382470**	79	53	152	**LL5**	**382878**	60
14	66	**HL3**	**382471**	60	53	152	**LL5**	**382879**	50
14	66	**HL3**	**382472**	50	53	152	**LL5**	**382880**	41
14	66	**HL3**	**382473**	40	53	152	**LL5**	**382881**	30
14	66	**HL3**	**382474**	30	53	152	**LL5**	**382882**	21
14	66	**HL3**	**382475**	20	53	152	**LL5**	**382883**	11
14	66	**HL3**	**382476**	10	53	152	**LL5**	**382884**	2.5
14	66	**HL3**	**382477**	3	54	154	**LL6**	**382885**	66
15	69	**HL2**	**382478**	165	54	154	**LL6**	**382886**	50
15	69	**HL2**	**382479**	100	54	154	**LL6**	**382887**	40
15	69	**HL2**	**382480**	78	54	154	**LL6**	**382888**	30
15	69	**HL2**	**382481**	60	54	154	**LL6**	**382889**	20
15	69	**HL2**	**382482**	51	54	154	**LL6**	**382890**	11
15	69	**HL2**	**382483**	40	54	154	**LL6**	**382891**	2
15	69	**HL2**	**382484**	30	55	158	**LL7**	**382892**	771
15	69	**HL2**	**382485**	20	55	158	**LL7**	**382893**	500
15	69	**HL2**	**382486**	11	55	158	**LL7**	**382894**	251
15	69	**HL2**	**382487**	4	55	158	**LL7**	**382895**	100
16	72	**HL1**	**382488**	79	55	158	**LL7**	**382896**	80
16	72	**HL1**	**382489**	60	55	158	**LL7**	**382897**	60
16	72	**HL1**	**382490**	51	55	158	**LL7**	**382898**	51
16	72	**HL1**	**382491**	41	55	158	**LL7**	**382899**	41
16	72	**HL1**	**382492**	30	55	158	**LL7**	**382900**	30
16	72	**HL1**	**382493**	20	55	158	**LL7**	**382901**	20
16	72	**HL1**	**382494**	10	55	158	**LL7**	**382902**	10
16	72	**HL1**	**382495**	2.5	55	158	**LL7**	**382903**	2.6
17	74	**RL1**	**382496**	158	56	160	**LL8**	**382904**	2885
17	74	**RL1**	**382497**	100	56	160	**LL8**	**382905**	2000
17	74	**RL1**	**382498**	81	56	160	**LL8**	**382906**	1500
17	74	**RL1**	**382499**	61	56	160	**LL8**	**382907**	1000
17	74	**RL1**	**382500**	49	56	160	**LL8**	**382908**	500
17	74	**RL1**	**382501**	40	56	160	**LL8**	**382909**	250
17	74	**RL1**	**382502**	28	56	160	**LL8**	**382910**	100
17	74	**RL1**	**382503**	20	56	160	**LL8**	**382911**	80
17	74	**RL1**	**382504**	9	56	160	**LL8**	**382912**	60
17	74	**RL1**	**382505**	2	56	160	**LL8**	**382913**	50

18	77	**BBL1**	**382506**	50	56	160	**LL8**	**382914**	40
18	77	**BBL1**	**382507**	50	56	160	**LL8**	**382915**	30
18	77	**BBL1**	**382508**	40	56	160	**LL8**	**382916**	20
18	77	**BBL1**	**382509**	30	56	160	**LL8**	**382917**	10
18	77	**BBL1**	**382510**	20	56	160	**LL8**	**382918**	2
18	77	**BBL1**	**382511**	10	57	163	**LL9**	**382919**	3785
18	77	**BBL1**	**382512**	2	57	163	**LL9**	**382920**	2999
19	79	**BBL2**	**382513**	119	57	163	**LL9**	**382921**	1999
19	79	**BBL2**	**382514**	80	57	163	**LL9**	**382922**	1501
19	79	**BBL2**	**382515**	60	57	163	**LL9**	**382923**	1001
19	79	**BBL2**	**382516**	50	57	163	**LL9**	**382924**	501
19	79	**BBL2**	**382517**	41	57	163	**LL9**	**382925**	250
19	79	**BBL2**	**382518**	29	57	163	**LL9**	**382926**	101
19	79	**BBL2**	**382519**	20	57	163	**LL9**	**382927**	80
19	79	**BBL2**	**382520**	10	57	163	**LL9**	**382928**	61
19	79	**BBL2**	**382521**	2	57	163	**LL9**	**382929**	51
20	81	**BC-CJ**	**382522**	155	57	163	**LL9**	**382930**	41
20	81	**BC-CJ**	**382523**	101	57	163	**LL9**	**382931**	30
20	81	**BC-CJ**	**382524**	81	57	163	**LL9**	**382932**	20
20	81	**BC-CJ**	**382525**	60	57	163	**LL9**	**382933**	10
20	81	**BC-CJ**	**382526**	50	57	163	**LL9**	**382934**	2
20	81	**BC-CJ**	**382527**	40	58	168	**GULD3**	**382935**	483
20	81	**BC-CJ**	**382528**	29	58	168	**GULD3**	**382936**	251
20	81	**BC-CJ**	**382529**	20	58	168	**GULD3**	**382937**	101
20	81	**BC-CJ**	**382530**	10	58	168	**GULD3**	**382938**	80
20	81	**BC-CJ**	**382531**	2.3	58	168	**GULD3**	**382939**	60
21	85	**BBL3**	**382532**	NOT USED	58	168	**GULD3**	**382940**	50
21	85	**BBL3**	**382533**	90	58	168	**GULD3**	**382941**	40
21	85	**BBL3**	**382534**	80	58	168	**GULD3**	**382942**	30
21	85	**BBL3**	**382535**	60	58	168	**GULD3**	**382943**	20
21	85	**BBL3**	**382536**	50	58	168	**GULD3**	**382944**	10
21	85	**BBL3**	**382537**	40	58	168	**GULD3**	**382945**	2
21	85	**BBL3**	**382538**	30	59	172	**SG23**	**382946**	912
21	85	**BBL3**	**382539**	20	59	172	**SG23**	**382947**	751
21	85	**BBL3**	**382540**	10	59	172	**SG23**	**382948**	500
21	85	**BBL3**	**382541**	2	59	172	**SG23**	**382949**	251
22	87	**PSL1**	**382542**	92	59	172	**SG23**	**382950**	101
22	87	**PSL1**	**382543**	75	59	172	**SG23**	**382951**	81
22	87	**PSL1**	**382544**	61	59	172	**SG23**	**382952**	59
22	87	**PSL1**	**382545**	50	59	172	**SG23**	**382953**	40
22	87	**PSL1**	**382546**	39	59	172	**SG23**	**382954**	40
22	87	**PSL1**	**382547**	30	59	172	**SG23**	**382955**	30
22	87	**PSL1**	**382548**	21	59	172	**SG23**	**382956**	20
22	87	**PSL1**	**382549**	11	59	172	**SG23**	**382957**	10
22	87	**PSL1**	**382550**	2	59	172	**SG23**	**382958**	2
23	88	**PSL2**	**382551**	196	60	174	**GULD4**	**382959**	2159
23	88	**PSL2**	**382552**	174	60	174	**GULD4**	**382960**	1502
23	88	**PSL2**	**382553**	151	60	174	**GULD4**	**382961**	749

23	88	**PSL2**	**382554**	127	60	174	**GULD4**	**382962**	500
23	88	**PSL2**	**382555**	102	60	174	**GULD4**	**382963**	250
23	88	**PSL2**	**382556**	81	60	174	**GULD4**	**382964**	100
23	88	**PSL2**	**382557**	61	60	174	**GULD4**	**382965**	81
23	88	**PSL2**	**382558**	51	60	174	**GULD4**	**382966**	60
23	88	**PSL2**	**382559**	40	60	174	**GULD4**	**382967**	51
23	88	**PSL2**	**382560**	31	60	174	**GULD4**	**382968**	40
23	88	**PSL2**	**382561**	21	60	174	**GULD4**	**382969**	31
23	88	**PSL2**	**382562**	10	60	174	**GULD4**	**382970**	20
23	88	**PSL2**	**382563**	3	60	174	**GULD4**	**382971**	10
24	89	**PSL3**	**382564**	206	60	174	**GULD4**	**382972**	2
24	89	**PSL3**	**382565**	175	61	177	**SG28**	**382973**	896
24	89	**PSL3**	**382566**	151	61	177	**SG28**	**382974**	751
24	89	**PSL3**	**382567**	126	61	177	**SG28**	**382975**	500
24	89	**PSL3**	**382568**	101	61	177	**SG28**	**382976**	251
24	89	**PSL3**	**382569**	82	61	177	**SG28**	**382977**	100
24	89	**PSL3**	**382570**	61	61	177	**SG28**	**382978**	81
24	89	**PSL3**	**382571**	52	61	177	**SG28**	**382979**	60
24	89	**PSL3**	**382572**	41	61	177	**SG28**	**382980**	50
24	89	**PSL3**	**382573**	31	61	177	**SG28**	**382981**	40
24	89	**PSL3**	**382574**	21	61	177	**SG28**	**382982**	30
24	89	**PSL3**	**382575**	11	61	177	**SG28**	**382983**	20
24	89	**PSL3**	**382576**	2.3	61	177	**SG28**	**382984**	11
25	91	**PSL4**	**382577**	220	61	177	**SG28**	**382985**	2
25	91	**PSL4**	**382578**	177	62	178	**HL13**	**382986**	4924
25	91	**PSL4**	**382579**	150	62	178	**HL13**	**382987**	4503
25	91	**PSL4**	**382580**	127	62	178	**HL13**	**382988**	3997
25	91	**PSL4**	**382581**	101	62	178	**HL13**	**382989**	3499
25	91	**PSL4**	**382582**	81	62	178	**HL13**	**382990**	2998
25	91	**PSL4**	**382583**	61	62	178	**HL13**	**382991**	2500
25	91	**PSL4**	**382584**	50	62	178	**HL13**	**382992**	1999
25	91	**PSL4**	**382585**	40	62	178	**HL13**	**382993**	1500
25	91	**PSL4**	**382586**	31	62	178	**HL13**	**382994**	1000
25	91	**PSL4**	**382587**	22	62	178	**HL13**	**382995**	500
25	91	**PSL4**	**382588**	11	62	178	**HL13**	**382996**	251
25	91	**PSL4**	**382589**	2	62	178	**HL13**	**382997**	101
26	92	**PSL5**	**382590**	233	62	178	**HL13**	**382998**	80
26	92	**PSL5**	**382591**	176	62	178	**HL13**	**382999**	60
26	92	**PSL5**	**382592**	151	62	178	**HL13**	**383000**	49
26	92	**PSL5**	**382593**	127	62	178	**HL13**	**383001**	41
26	92	**PSL5**	**382594**	103	62	178	**HL13**	**383002**	32
26	92	**PSL5**	**382595**	80	62	178	**HL13**	**383003**	20
26	92	**PSL5**	**382596**	60	62	178	**HL13**	**383004**	10
26	92	**PSL5**	**382597**	51	62	178	**HL13**	**383005**	2
26	92	**PSL5**	**382598**	40	63	181	**HL14**	**383006**	5042
26	92	**PSL5**	**382599**	30	63	181	**HL14**	**383007**	4501
26	92	**PSL5**	**382600**	20	63	181	**HL14**	**383008**	3999
26	92	**PSL5**	**382601**	11	63	181	**HL14**	**383009**	2500
26	92	**PSL5**	**382602**	2	63	181	**HL14**	**383010**	3001

27	94	**PSL6**	**382603**	223	63	181	**HL14**	**383011**	2500
27	94	**PSL6**	**382604**	174	63	181	**HL14**	**383012**	2000
27	94	**PSL6**	**382605**	149	63	181	**HL14**	**383013**	1500
27	94	**PSL6**	**382606**	125	63	181	**HL14**	**383014**	1000
27	94	**PSL6**	**382607**	102	63	181	**HL14**	**383015**	500
27	94	**PSL6**	**382608**	81	63	181	**HL14**	**383016**	251
27	94	**PSL6**	**382609**	60	63	181	**HL14**	**383017**	101
27	94	**PSL6**	**382610**	51	63	181	**HL14**	**383018**	81
27	94	**PSL6**	**382611**	41	63	181	**HL14**	**383019**	60
27	94	**PSL6**	**382612**	30	63	181	**HL14**	**383020**	51
27	94	**PSL6**	**382613**	20	63	181	**HL14**	**383021**	40
27	94	**PSL6**	**382614**	11	63	181	**HL14**	**383022**	30
27	94	**PSL6**	**382615**	3	63	181	**HL14**	**383023**	20
28	95	**PSL7**	**382616**	221	63	181	**HL14**	**383024**	11
28	95	**PSL7**	**382617**	175	63	181	**HL14**	**383025**	2
28	95	**PSL7**	**382618**	150	64	181	**HL14RL5A**	**383026**	3220
28	95	**PSL7**	**382619**	125	64	181	**HL14RL5A**	**383027**	2500
28	95	**PSL7**	**382620**	101	64	181	**HL14RL5A**	**383028**	2000
28	95	**PSL7**	**382621**	80	64	181	**HL14RL5A**	**383029**	1500
28	95	**PSL7**	**382622**	60	64	181	**HL14RL5A**	**383030**	1001
28	95	**PSL7**	**382623**	51	64	181	**HL14RL5A**	**383031**	501
28	95	**PSL7**	**382624**	41	64	181	**HL14RL5A**	**383032**	250
28	95	**PSL7**	**382625**	31	64	181	**HL14RL5A**	**383033**	100
28	95	**PSL7**	**382626**	21	64	181	**HL14RL5A**	**383034**	80
28	95	**PSL7**	**382627**	9	64	181	**HL14RL5A**	**383035**	60
28	95	**PSL7**	**382628**	3	64	181	**HL14RL5A**	**383036**	50
29	98	**PSL8**	**382629**	200	64	181	**HL14RL5A**	**383037**	40
29	98	**PSL8**	**382630**	174	64	181	**HL14RL5A**	**383038**	30
29	98	**PSL8**	**382631**	150	64	181	**HL14RL5A**	**383039**	20
29	98	**PSL8**	**382632**	125	64	181	**HL14RL5A**	**383040**	10
29	98	**PSL8**	**382633**	101	64	181	**HL14RL5A**	**383041**	2
29	98	**PSL8**	**382634**	80	65	185	**RL5**	**383042**	932
29	98	**PSL8**	**382635**	61	65	185	**RL5**	**383043**	750
29	98	**PSL8**	**382636**	51	65	185	**RL5**	**383044**	499
29	98	**PSL8**	**382637**	41	65	185	**RL5**	**383045**	249
29	98	**PSL8**	**382638**	30	65	185	**RL5**	**383046**	101
29	98	**PSL8**	**382639**	20	65	185	**RL5**	**383047**	81
29	98	**PSL8**	**382640**	10	65	185	**RL5**	**383048**	60
29	98	**PSL8**	**382641**	3	65	185	**RL5**	**383049**	50
30	99	**PSL9**	**382642**	93	65	185	**RL5**	**383050**	40
30	99	**PSL9**	**382643**	81	65	185	**RL5**	**383051**	31
30	99	**PSL9**	**382644**	60	65	185	**RL5**	**383052**	20
30	99	**PSL9**	**382645**	51	65	185	**RL5**	**383053**	10
30	99	**PSL9**	**382646**	40	65	185	**RL5**	**383054**	2.6
30	99	**PSL9**	**382647**	29	66	191	**HL2**	**383055**	185
30	99	**PSL9**	**382648**	20	66	191	**HL2**	**383056**	100
30	99	**PSL9**	**382649**	10	66	191	**HL2**	**383057**	80
30	99	**PSL9**	**382650**	4	66	191	**HL2**	**383058**	60
31	101	**PSL10**	**382651**	89	66	191	**HL2**	**383059**	51

31	101	**PSL10**	**382652**	81	66	191	**HL2**	**383060**	40
31	101	**PSL10**	**382653**	60	66	191	**HL2**	**383061**	30
31	101	**PSL10**	**382654**	50	66	191	**HL2**	**383062**	20
31	101	**PSL10**	**382655**	40	66	191	**HL2**	**383063**	10
31	101	**PSL10**	**382656**	31	66	191	**HL2**	**383064**	2
31	101	**PSL10**	**382657**	20					
31	101	**PSL10**	**382658**	10					
31	101	**PSL10**	**382659**	2.5					

APPENDIX A

RAPID Moorings – Richard Boyce

In support of the RAPID Watch Program sponsored by the National Oceanographic Centre in the United Kingdom, a series of moorings were recovered and re-deployed. Also, three moorings were recovered and deployed in support of the Ocean Tracking Network as well as an attempted recovery and deployment of two moorings in the Gully on behalf of the Oceans and Coastal Management Division (see Appendix E).

Recovery RAPID Moorings:

Moorings 1777 (RS1) through 1781 (RS5) of the RAPID program were recovered completely with 1782 (RS6) being partially recovered. Sea conditions for the recovery of RS1 to RS5 were calm, but foggy. The Iridium beacon was required to find RS2 once on the surface. All Iridium beacons worked well. At 1782 (RS6), the acoustic release appeared to have worked and indicated that it released. However, continuous transponding to the release revealed that it had not moved away from the bottom. After many release commands were sent with no indication the mooring was surfacing, dragging operations were implemented. The first attempt at dragging managed to cut the mooring wire below the 1000 meter Microcat. The top syntactic float, Aanderaa RCM11 s/n 679 and Microcat s/n 8110 were eventually recovered. The drag gear had to be recovered before the released part of the mooring, and during this time, the surface float disappeared into the fog. The Iridium beacon worked, but there was some confusion in the positions being reported, due to a temporary satellite malfunction. This was sorted out, and the mooring was found and recovered the next day. Two more attempts at dragging were unsuccessful on this leg of the cruise. Before the second leg of the mission, an additional 2000 meters of drag wire was added to the Pengo wire in order to improve the chances of snagging the mooring. During the second leg of the mission a fourth attempt at dragging was performed. It was estimated that 8000 meters of wire was paid out and the mooring was circled twice. Microcats at 2200 meters s/n8111, 2700 meters s/n 6436 and 3300 meters s/n 6469 were recovered along with 5 sets of BUB packages; one set was destroyed. Microcats s/n 1785 1600 meters and s/n 6468 3800 meters along with WHADCP s/n 10942, BPR s/n 0051 and release s/n 809 along with 5 BUB packages were not recovered.

Deployment RAPID Moorings:

Moorings 1804 (RS1) to 1810 (RS6A) were deployed successfully without incident. It was previously decided to separate the BPR from the long mooring at RS6 and place it on a separate mooring in the same area, RS6A. Last year in was found to be very problematic to deploy the long mooring with the BPR. The replacement moorings at RS6 were placed approximately 3 kilometres on either side of the lost mooring.

(For more information see “Maqueda 2011 Report”)

Recovery and deployment OTN Moorings:

Moorings 1783 - 1785 were recovered off the approaches to the Halifax in support of the Ocean Tracking Program. These were recovered without incident and replaced with moorings 1794 - 1796. While in this area, the Carioca mooring and its associated Spar buoy were checked and appeared to be in position.

APPENDIX B

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HUD2011043 VADCP and MVP testing - Kate Collins and Randy King

a. VADCP (Vertical Acoustic Doppler Current Profiler)

On board the Hudson, as a member of the Data Services group, Kate Collins worked with Yuri Geshelin and Adam Hartling to getting the vessel mounted ADCP data (VADCP) to display on a computer in the GP Lab in real time. This would allow monitoring of the quality of data being collected by the instrument in real time and allow recognition of any factors that may contribute to poor data collection (wave height, wind speed, ship speed and direction, etc).

The real-time system was developed by modifying existing Matlab code to copy the data files from the computer connected to the VADCP to the lab PC over the ship’s network on a continuous basis. The data were then processed using CODAS software and plotted in Matlab as velocity vectors on the ship track, on a map. Now that the real-time system is working, it can be hooked up on any future Hudson missions so that VADCP data quality can be monitored in real time.

To assist in the determination of how ship speed and direction affected measured water velocities, we conducted a short experiment where ship speed was varied on an eastward track, and then similarly varied on a northward track. This allowed us to distinguish between measured water velocity errors caused by transiting in the North/South direction vs in the East/West direction, and to note differences in data quality at different ship speeds.

b. MVP (Moving Vessel Profiler)

The MVP 200 was deployed on the first leg of the cruise. The objective was to test newly built instruments and the system in general. The MVP 200 system is being shipped to Antarctica for an international mission as part of a NSF project. It will be used on the

Nathaniel B Palmer doing survey lines in the Ross Sea. It was critical for the system to be brought out on the Hudson to be fully tested and to make sure that everything was working properly before we shipped the unit south. It also required testing close to home because we are using new instruments that were recently purchased to replace ones that were lost at sea.

Over the 8 days we were able to do 5 tows along the Halifax Line. These tows varied in the number of casts performed with the average number of casts per tow in the 15 range. During these tows we were able to fully test the systems operation along with the integration of the new CTD and Fluorometer. During the first couple of days we were able to find a connector that was faulty which we were able to repair and we also found a bad splice in the tow cable that we were able to repair as well. We were also able to use the system at different ship speeds which allowed us to see if the speed vs. depth ratio requested by the Antarctica expedition staff were attainable. After all testing and ground proofing was completed we were able to ensure that the system was working as it should be and we are able to provide the speed vs. depth ratio that has been requested. All in all a successful trip and the system can now be confidently shipped to Antarctica with confidence for its next mission.

APPENDIX C

Measuring Dissolved Oxygen Concentration and calibration of Sea-Bird oxygen sensors on the Hudson 2011-043 cruise - Yuri Geshelin

1. Introduction

In the fall of 2011, the CCGS Hudson carried out one field mission: cruise 2011-043 (23-30 Sep 2011), which included the fall occupation of the Halifax line (the fall AZMP survey and RAPID program). Samples and standard measurements of dissolved oxygen (DO) were taken at various depths as per cruise program with the use of titration methods and by means of Sea-Bird DO primary and secondary sensors. During the cruise, calibrations of both sensors were made taking into account the experience gained on previous cruises (2010-009, 2010-014, 2010-049 and 2011-009). Unlike some previous cruises, the inter-comparisons between two Winkler methods of titration (the Scripps system and colorimeter) were not done, because of the relatively short time frame. The Scripps system was set up only as a backup, and this report covers the measurements taken with the use of colorimeter and the BOB software developed at the Maurice Lamontagne Institute, Quebec.

This note describes the methods of collecting samples, data acquisition and processing, presents some preliminary results of the expedition in the form of quantitative estimates and compares those results with some previous cruises.

2. Procedures and methods

Oxygen sub-samples were drawn from 10-L bottles attached to a 24-bottle Rosette Sampler. To reduce air contamination of the samples to a possible minimum, the sampling was done immediately after the Rosette Sampler was drawn on board, prior to sampling any other property. This was possible because on this cruise chlorofluorocarbon samples were not taken[1]. The choice of sampling depths was simple: at least one DO sample was taken from every closed bottle. On all oceanographic stations, replicate samples were collected at one or two depths. Unfortunately, about a third of these replicates were subsequently lost during the analysis stage due to the problem described in Section 3. Fortunately, these losses were not of paramount importance, as it had not been planned to carry out a detailed analysis of the differences between the titration values from the same depth[2]. At the beginning of the cruise, the intention was to collect at least one duplicate from at least two levels at each station. In practice, this plan was not always followed due to operational constraints. In the end, the maximum number of samples taken and successfully analysed from a single level was two (i.e. no triplicates). The 14 stations, at which the duplicates were taken and successfully analysed, are listed with supplementary information in Table 1. The corresponding levels were at the bottom and in some cases in the surface layer.

Seq. #	Event #	HL Station #	Levels, m	Number of levels, at which one duplicate (2 samples in total) are taken and successfully analysed
1	9	HL2	145 (bottom) 3	2
2	17	HL9	3948 (bottom) 10	2
3	19	HL10	4145 (bottom) 10	2
4	22	HL11	4511 (bottom) 11	2
5	31	HL7	2731 (bottom)	1
6	33	HL6.7	2319 (bottom) 11	2
7	37	HL12	4721 (bottom) 11	2
8	42	HL6.3	1686 (bottom)	1
9	47	HL6	1025 (bottom) 10	2
10	56	HL5.5	511 (bottom) 11	2
11	60	HL5	93 (bottom)	1
12	63	HL4	76 (bottom)	1
13	66	HL3	257 (bottom) 10	1
14	69	HL2	164 (bottom)	1

[1] When the CFC samples are part of cruise program, they are taken prior to sampling any other property.
[2] Such analysis was carried out on the previous Hudson cruises, 2010-049 and 2011-009, and described in the respective cruise reports.

TOTAL	22

Table 1. The number of duplicate DO samples taken and successfully analysed per station.

The oxygen sampling bottles were 125 mL Iodine flasks with matched custom ground stoppers. The volumes of flasks with the corresponding stoppers were predetermined gravimetrically, and volume data were saved to titration programs prior to the cruise. The matched flasks and stoppers are etched with identification numbers.

Each oxygen sub-sample was drawn through a silicone tube attached to the spigot of the Rosette bottle. The flask and stopper were thoroughly rinsed. The flow was then allowed to continue until two to three flask volumes overflowed. The sampling tube was then rotated inside the flask and thus rubbed against the neck to prevent bubbles from forming on it. Next, the tube was slowly removed with continuous low flow to ensure that no air was trapped in the flask and the volume kept to the brim until the reagents were added and the stopper inserted.

Samples were immediately oxidized with the addition of 1.0 mL each Alkaline Iodide and Manganous Chloride. The tip of the spout was submerged under the surface of the sample during this procedure. The flask stopper was carefully inserted to avoid introducing air. The flask was then shaken and turned upside down several times.

The samples were stored immediately after collection for at least 1 hour in a dark place at room temperature.

3. Problems

The PC designated for running BOB software often froze. Most often, it happened after it was left idle for an hour or longer. In other words, it happened almost every time I started to titrate a batch of samples or in the beginning of running blanks and standards. Because I was unable to determine which device (or software) was malfunctioning, I re-booted the PC, colorimeter and Dosimat. This resulted in the loss of some samples. Fortunately, it was not a complete loss, because those samples were intended to be replicates. Instead, they served as a backup for the observation made at the bottom, which was titrated first. Consequently, the total number of analysed duplicates (22, see Table 1) was too small to compute a histogram of the differences between them. But a cursory evaluation of the analysed duplicates shows that the difference between them is mostly within 0.02 mL/L, which is consistent with the results obtained on the Hudson 2010-049 and 2011-009 cruises.

4. Sea-Bird – Winkler comparisons

The ultimate goal of the inter-comparisons between Sea-Bird and Winkler is to perform the calibration of the Sea-Bird sensors, because the chemical method should provide more accurate values. The comparisons were carried out for both primary and secondary sensors. The total of 236 data points are employed in the analysis[3], and the results of comparisons are presented in the form of Sea-Bird vs Winkler DO scatter plots in Figure 1. The left panels present the scatter plot of the two concentrations. Plotted on the right panels is the relationship between pressure and the difference between the two concentrations. This was done to ensure that that difference is not dependent on pressure[4].

Despite some obvious outliers, the correlation coefficients between Sea-Bird and Winkler values are 0.99 for both the primary and secondary sensors. This is an apparent improvement over the results obtained on the previous cruises (see Table 2 in Section 5). However, the correlation coefficients between Sea-Bird – Winkler differences and pressure are -0.28 and -0.63 for the primary and secondary sensors respectively. This suggests that the calibration process undesirably depends on pressure. The inspection of Figure 1a reveals that once the outliers are removed, the correlation will be even higher than the one inferred from the coefficient of -0.28. This situation is worse than on some of the previous cruises and must be addressed. Most likely, the pressure term in the Sea-Bird calibration equation needs to be changed.

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[3] This includes the 22 duplicates (see Table 1).

[4] Such undesirable dependence took place on the previous Hudson cruises.

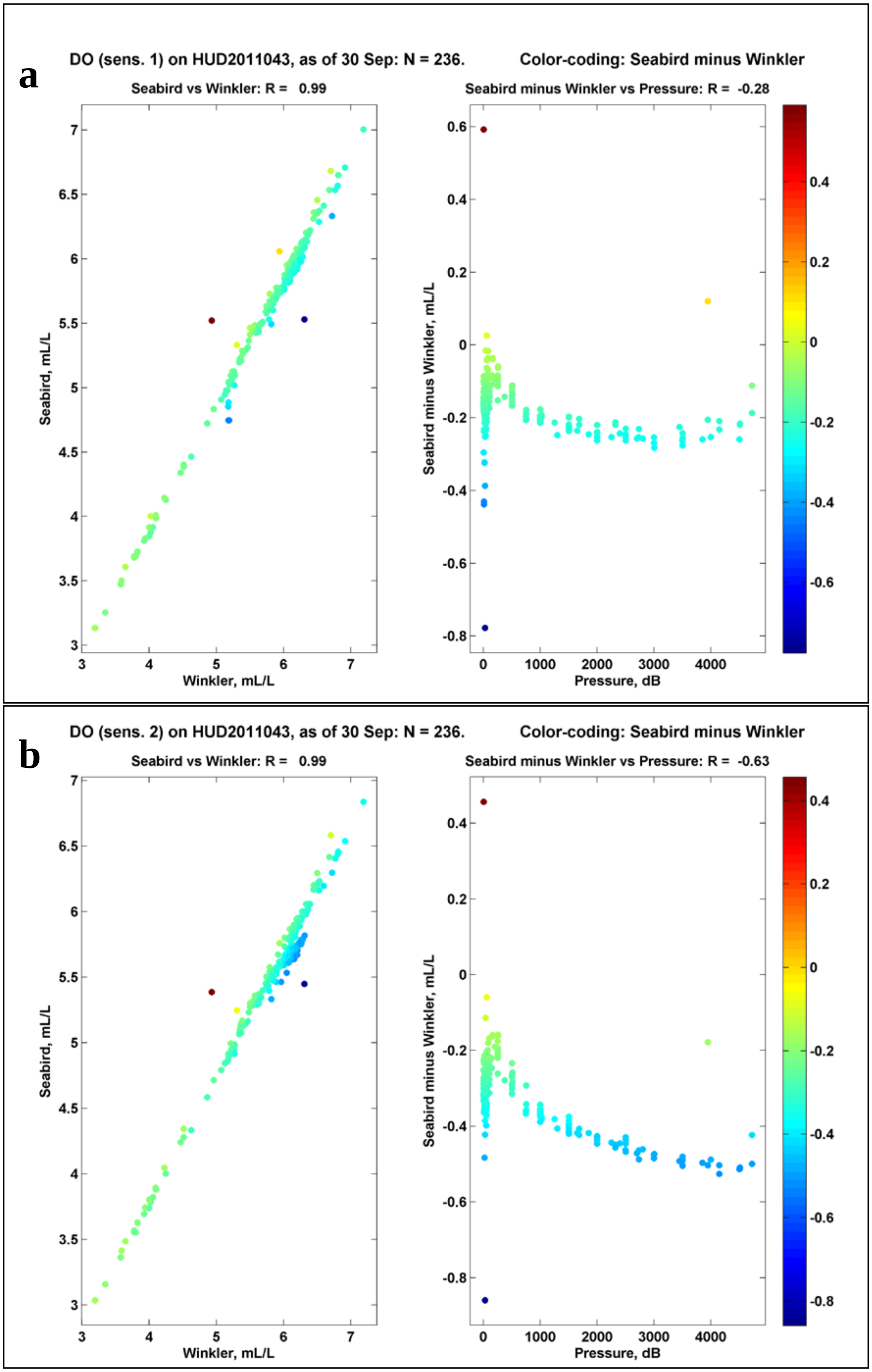

Figure 1. Scatter plot of Sea-Bird vs Winkler DO concentrations (left panels) and Sea-Bird – Winkler difference vs pressure (right panels). (a) – primary; (b) - secondary Sea-Bird sensor.

As of today, the DO data from 4 cruises have been collected and the scatter plots similar to those in left panels of Figure 1 were produced. It is therefore of interest to examine the combined plot, which presents the scatter plots from all cruises (see Figure 2).

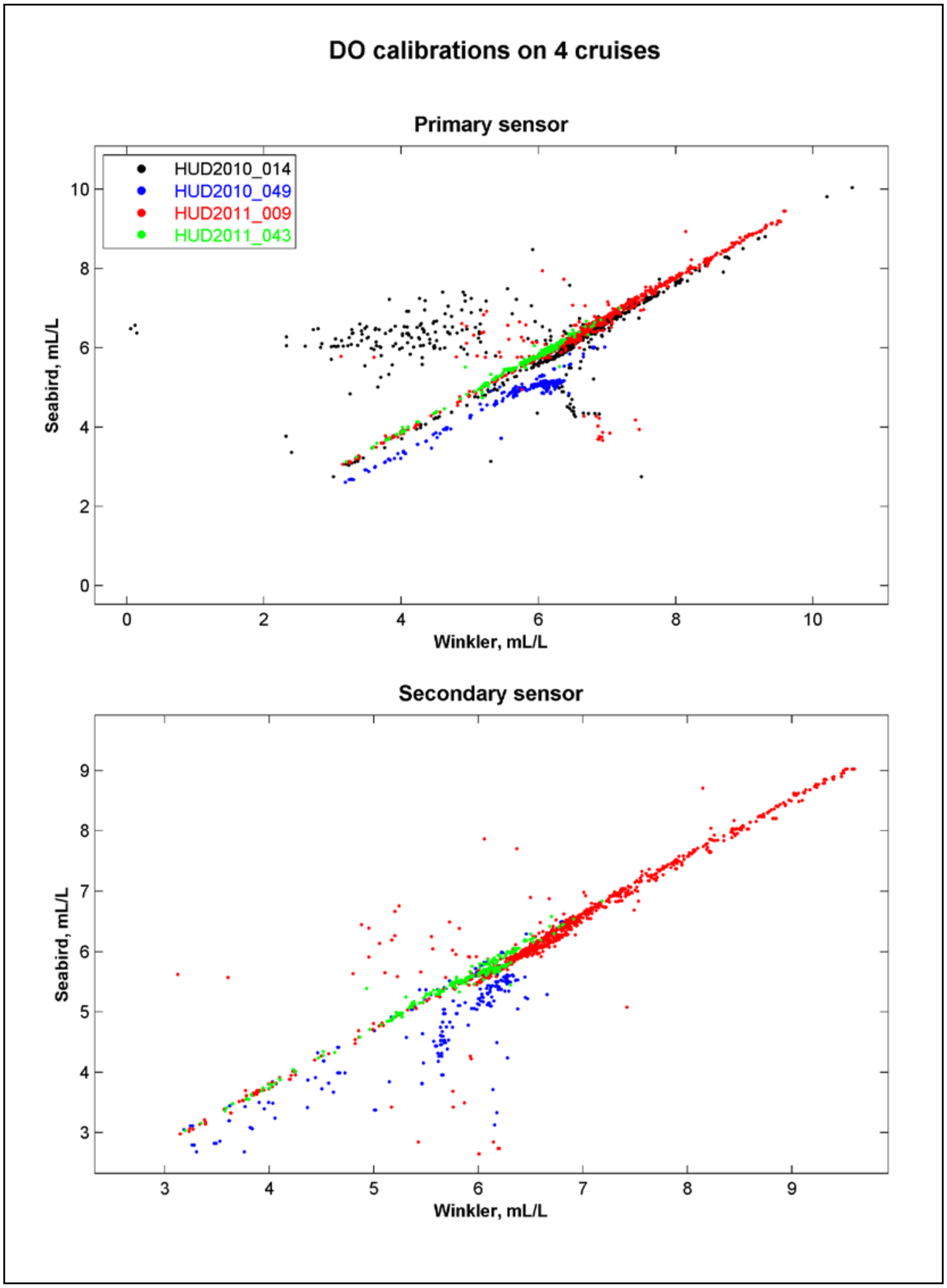

Figure 2. Scatter plot of Sea – Bird vs Winkler DO concentrations from four Hudson cruises.

Inspection of Figure 4 allows us to identify two cruises with apparent problems: 2010049 (the Sea-Bird values are offset by about 0.5) and 2010014 (the Sea-Bird values are offset by about 0.1 and a great number of outliers). See the corresponding cruise reports for details.

5. Conclusions

We have summarized the procedures for and results of sampling, measuring and calibrating the DO concentrations on the Hudson cruise in the fall of 2011. Table 2 summarizes the Sea-Bird - Winkler correlation coefficients derived on 4 cruises and suggests an apparent improvement in our sampling and titration techniques over the last year.

Cruise	Primary Sea-Bird sensor	Secondary Sea-Bird sensor
2010-014	0.46	N/A
2010-049	0.97	0.87
2011-009	0.93	0.94
2011-043	0.99	0.99

Table 2. Correlation coefficients between Winkler- and Sea-Bird-derived values of DO concentration.

On the other hand, it should be noted that we are still not successful in solving the problem of pressure-dependent Sea-Bird values (see the right panels in Figure 1). As mentioned, the Sea-Bird calibration equation needs to be corrected. The CTD data should then be re-processed, and the correlations re-computed.

APPENDIX D

Determinations of salinity with the Autosal Salinometer - Richard Boyce

a. Description of Equipment and Technique

For Leg 1, 97 salinity samples were analyzed using a Guildline Autosal 8400B salinometer, serial number 69780 on the first leg of the mission. Samples were drawn into 200 ml bottles. Once the sample bottle was rinsed three times and filled to the shoulder, the neck and threads of the bottle were dried using paper towel and a new dry cap was installed. Once the bottles reached room temperature, the caps were retightened. The drying of the neck of the bottle and installation of a dry cap has been a technique used since the HUD2000009 cruise and prevents salt crystals from forming under the cap if samples are left for a long period of time before analysis.

The samples were placed in a constant temperature water bath set to 23.5º C with the Autosal running at 24ºC. The cell of the salinometer was filled and rinsed three times with sample water. A fourth sample was introduced into the cell and readings were averaged over a 10 to 15 second interval until the operator was satisfied that the correct value was attained. If there was any doubt in this value, subsequent refills were performed and readings averaged as above. Once satisfied, a sample ID number and Conductivity Ratio was recorded onto the Salinity Log Sheet. Periodically, the room's temperature was recorded.

b. Laboratory and Sample Temperatures

Full cases of samples were taken from the Winch Room to the Drawing Office. Cases of 24 salinity bottles were placed into water baths set at 23.5º C and allowed to equilibrate before analyzing. During this particular Mission, the room temperature in this area ranged remained quite stable hovering near 24 ºC. The Autosal bath temperature was set to 24ºC for all samples.

c. Standards Used

The salinometer was standardized during the mission using IAPSO standard water, Batch P152 with a "use by" date of May 5/13 having a K15 value of 0.99981, salinity of 34.993. Typically, standardization checks were performed at the beginning and end of a run.

d. Performance of the Autosal salinometer

Overall, the Autosal salinometer worked well during the first leg of the mission. The introduction of water baths to bring the samples close to the temperature of the Autosal bath has made the analysis much better. The instrument spends very little time in bringing the sample to the temperature of the bath thus reducing bath fluctuations. The lab temperature was stable during all runs which is an important factor when trying to optimize the performance of the instrument. Historically the Autosal was setup in the General Purpose (GP) lab onboard Hudson. Air temperature was difficult to control in this area. For this mission the Autosal was installed in the Drawing Office where the operator could control the ambient air temperature much better than in the GP lab.

APPENDIX E

Acoustic monitoring of Scotian Shelf northern bottlenose whales (Hyperoodon ampullatus) and underwater noise within the Gully MPA – Hilary Moors

Purpose of Activity

To retrieve and deploy autonomous underwater acoustic recorders in the Gully MPA on behalf of the Oceans and Coastal Management Division to record northern bottlenose whale vocalizations, vocalizations of other whale species and ambient background noise for acoustic monitoring purposes throughout summer 2011-winter 2012.

Report on Activities

An Autonomous Multi-channel Acoustic Recorder (AMAR; developed by JASCO Applied Sciences) mooring was deployed in Zone 1 of the Gully MPA on May 27th 2011 at 43^{o}52.162'N and 58^{o}55.943'W, at a depth of approximately 1700 meters. To retrieve the system, an acoustic signal is sent to an acoustic release unit attached to a ballast weight that moors the system to the seafloor. This signal triggers the acoustic release to detach from the ballast weight, allowing all components of the mooring (minus the ballast weight) to float to the surface. Retrieval of this system was attempted on October 10th 2011. However, communication with the acoustic release unit could not be established despite numerous attempts over several hours, from different angles and positions around the co-ordinates where the system was dropped off in May. The release command was sent to the system several times, but the system did not surface. The mooring system was therefore not retrieved and was left on the Gully floor. A second retrieval attempt has been scheduled for November 18th 2011.

A second AMAR system was successfully deployed on October 10th at 14:10 UTC in Zone 1 of Gully at a position approximately two kilometers south of the first system that could not be retrieved. The deployment coordinates of this second system were at 43°50.9445'N and 58°55.2843'W, at a depth of about 1725 meters. The second system will be retrieved during the spring AZMP cruise onboard CCGS Hudson in April 2012.

Potential Environmental Impacts
The AMAR deployment has the potential to disturb the benthic environment through contact with the ocean bottom. These systems generally sit on the ocean bottom for a period of about six months; however, the ballast weights attached to the systems are left on the ocean bottom permanently. The ballast weights are relatively small and probably each affect an area < 1 m^2.

Should the first system not be retrieved even after a second retrieval attempt, then greater environmental impacts are expected. The entire mooring system, including 40 meters of cable extending up into the water column, could potentially remain on bottom permanently. If the second retrieval attempt fails, the position of the lost mooring should be considered in future mooring deployment proposals.

APPENDIX F

Multi-frequency Acoustics HUDSON 2011-043 – N. Cochrane

Objective - To opportunistically record 12 & 200 kHz acoustic backscatter on AZMP transects and sampling stations. The principal application of this data will be the delineation of macrozooplankton concentrations. The 200 kHz channel is reasonably well calibrated while the 12 kHz channel is used primarily in distinguishing backscattering layers or depth ranges dominated by larger zooplankton from those dominated by fish.

Equipment - Two DataSonics DFT-210 scientific echosounders are used, one operating at 200 kHz and coupled to a 200 kHz FURUNO 200-B transducer deployed in HUDSON's GP lab stand-pipe, the other operating at 12 kHz and coupled to a 12 kHz AIRMAR transducer mounted on HUDSON's main RAM. A custom 12 bit digitizer acquires demodulated signals from the two sounders and in turn feeds its digital output to a logging PC where the data stream is merged with navigation.

Procedure - The equipment operates continuously and virtually autonomously throughout the cruise, excepting short shut-downs to prevent the acoustics from interfering with other high priority acoustic operations. Acoustic data was sampled and logged at 5 kHz/channel over a 818 ms post-transmission interval (610 m water column penetration accounting for transducer draft) at a ping rate of 1/10s. Pulse lengths of 2 and 5 ms are used at 12 at 200 kHz respectively, the latter pulse being relatively long to maximize the signal-to-noise ratios from weakly scattering deep zooplankton layers. A sounder receive-only noise level signal is recorded in-port alongside to assist the separation of true backscatter signals from internally generated equipment noise during subsequent data processing operations.

Results - Acquired data were of variable quality. Interference possibly from the shipboard ADCP was frequently experienced on the 200 kHz channel. A brief navigation dropout occurred in the middle of file # 16 however, this was the only navigation problem encountered - in contrast to the extensive navigation outages experience on the immediately preceding spring 2011 AZMP cruise. Part of File # 17, especially 12 kHz, was degraded by an apparent high sea state.

Data Disposition - Data in the acquisition format will be immediately archived to BIO's Mass Storage Machine (MSM) and later will be converted to standard HAC interchange format by way of a NADA initiative.

Table. Data collected on HUDSON 2011-043.

FILE #	TIME (ADT)	LOCATION
1	16:13 Sept. 22 – 16:18 Sept. 22	44 40.90 63 36.83
		Noise Sample acquired alongside at BIO
2	16:47 Sept. 22 – 14:42 Sept. 23	To: 44 20.89 N 63 18.46 W
		Alongside at BIO – Halifax Line 1 (HL1) then turn east
3	15:33 Sept. 23 – 15:41 Sept. 23	To: 44 18.92 N 63 15.64 W
		Just east of HL2
4	18:37 Sept. 23 – 07:08 Sept. 24	To: 42 51.08 N 61 39.02 W
		Just east of HL2A to HL2 then pass SW of HL3 to HL6 then just east
5	18:38 Sept. 24 – 08:49 Sept. 25	To: 42 09.80 N 61 04.54 W
		New Halifax Line 8 (nHL8) south to just beyond nHL9
6	18:56 Sept. 25 – 12:58 Sept. 26	To: 42 23.71 N 61 15.72 W
		Just east of nHL8 irregularly SSE near nHL10 to nHL11
7	19:28 Sept. 26 – 10:32 Sept. 27	To: 42 09.78 N 61 04.29 W
		HL7 to just NW of HL7 then SW near nHL8 to beyond nHL9
8	07:16 Sept. 28 – 07:16 Sept. 29	To: 42 51.04 N 61 40.60 W
		Between nHL11 and nHL12 – nHL8 – HL7 – HL6
9	07:16 Sept. 29 – 08:25 Sept. 29	To: 42 50.76 N 61 37.66 W
		Just east of HL6
10	15:50 Sept. 29 – 15:50 Sept. 30	To: 44 40.91 N 63 36.82 W
		SW of HL6, jog to east – HL5 then north on Halifax Line to BIO
11	15:50 Sept. 30 – 15:57 Sept. 30	44 40.91 N 63 36.82 W
		Alongside at BIO
12	15:58 Sept. 30 – 15:58 Oct. 01	44 40.88 N 63 36.85 W
		Alongside at BIO to departure from wharf
13	15:58 Oct. 01 – 15:58 Oct. 02	To: 42 54.82 N 66 00.58 W
		Bedford Basin – HL1 SW to RL1 – BBL1 – BBL2 then to WSW
14	15:58 Oct. 02 – 15:58 Oct. 03	To: 42 17.66 N 65 42.32 W
		WSW of BBL2 - Fundian Channel (PS1 – 10) then NE toward BBL4
15	15:58 Oct. 03 – 15:58 Oct. 04	To: 42 19.16 N 63 52.28 W
		SW of BBL4 – BBL4 then south to BBL7, then ENE to RL6
16	15:58 Oct. 04 – 15:58 Oct. 05	To: 45 03.86 N 61 00.61 W
		RL6 – RL5 then NE to just south of HL2 then east to off Cape Canso

17	15:58 Oct. 05 – 15:58 Oct. 06	To: 46 37.69 N 60 15.23 W
		South of Cape Canso – LL2 – to near end of Cabot Strait Line (CSL)
18	15:58 Oct. 06 – 15:58 Oct. 07	To: 47 06.66 N 59 57.99 W
		SSW of CSL irregularly to CSL1 – CSL3
19	15:58 Oct. 07 – 15:58 Oct. 08	To: 45 59.92 N 59 31.70 W
		CSL3 NE to CSL6 then SSE crossing Laurentian Ch, SW to NE of LL1
20	15:58 Oct. 08 – 15:58 Oct. 09	To: 43 47.41 N 57 50.21 W
		To Louisbourg Line 1 (LL1) then south along LL to LL8
21	15:58 Oct. 09 – 09:26 Oct. 10	To: 43 52.10 N 58 55.79 W
		LL8 – LL9 then NW to just north of GULD4
22	14:09 Oct. 10 – 14:09 Oct. 11	To: 42 12.10 N 59 49.73 W
		GULD3 SE then WSW to GULD4 – SG28 then SW to south of SIB8
23	14:09 Oct. 11 – 07:56 Oct. 12	To: 42 09.33 N 61 04.01 W
		South of SIB8 to nHL south of nHL12 then NNW to near nHL9
24	08:50 Oct. 14 – 16:15 Oct. 14	To: 44 40.90 N 63 36.83 W
		HL3 to BIO

Acquisition format file names: HA1143xx.dat
Data format: Header + 2 ch x 4090 pts/ch @ 5 kHz/ch

APPENDIX G

Fall AZMP Cruise report: Leg 1, September 23, 2011 – September 30, 2011
Dartmouth, N.S. to Dartmouth, N.S.

Observer: Sarah Wong
snpwong@dal.ca

General overview

Seabird and marine mammal observations were made from the bridge of the CCGS Hudson during the first part of the fall AZMP cruise from September 23 to September 30, 2011 beginning and ending at the Bedford Institute of Oceanography in Dartmouth, N.S. Seabird surveys followed the standardized protocol for pelagic seabird surveys from moving platforms and stationary platforms for the Eastern Canada Seabirds at Sea program (ECSAS). The Hudson steamed southeast along the Halifax Line, off the Scotia Shelf. The primary purpose of the cruise was to retrieve and deploy moorings during the day and conduct oceanographic sampling (CTDs, net tows) at night. For the majority of the day, the ship was stopped at mooring stations with brief transits (less than 45 minutes) between stations. Fog for the first three days of the cruise reduced survey opportunity and resulted in some transects being conducted with strip widths less than 300m. A total of 239 five-minute transects were completed, resulting in nearly 20 hours of observations and a total of 386 km surveyed. An additional 11 stationary surveys were conducted when we spent most of the day at one mooring station. Two of these stationary surveys were opportunistic sightings of pilot whales (September 26 at 22:13 UTC and September 28 at 17:45 UTC). Another seabird observer (Sue Abbott, seee Appendix H) conducted surveys for the second part of the fall AZMP cruise.

Seabird sightings

From Dartmouth, N.S. to Dartmouth, N.S, along the “Halifax Line”, 294 birds from 4 different families were counted in transect (this does not include birds outside of the 300m wide transect, birds following the ship or birds in flight that were not captured during the instantaneous snapshots)(Table 1). Northern fulmars, Cory’s shearwaters and Greater shearwaters dominated the sightings. Sightings on the shelf consisted mainly of gulls, Greater shearwaters and northern fulmars. The number of seabird sightings increased near the shelf edge. Cory’s shearwaters were sighted upon leaving the shelf edge and were sighted more often than Greater shearwaters in the deep water. Leach’s storm-petrels and Cory’s shearwaters dominated the deep water sightings. Phalaropes and jaegers were sighted in the deep water.

Marine mammal sightings

A total of 70 marine mammals (plus one dead and largely decomposed one) were sighted from Dartmouth, N.S. to Dartmouth, N.S. (Table 2). The sightings were dominated by Long-finned pilot whales that were mainly seen in the deep water or just off the shelf edge. Finback whales were sighted on the shelf.

Large fish sightings

Large predatory fish were also sighted during the cruise (Table 2). A basking shark was sighted September 24, 11:25 UTC just off the shelf edge (42.806 and -61.605). Tuna were also sighted twice in the deep water and included 2 individuals chasing small fish and one breaching individual.

Table 1: List of seabird species observed during the seabird survey from Dartmouth, N.S. to Dartmouth, N.S., September 23-30, 2011, as part of the fall AZMP cruise. Total numbers include only those birds considered “in” transect. They do not include birds following the ship, birds outside 300m and flying birds not captured during the “snapshot”. Additional species sighted that were not considered “in transect” include: Northern gannets (*Morus bassanus*) and a Red-necked phalarope (*Phalaropus lobatus*).

Family	Species	Latin Name	Number Observed
Hydrobatidae	Wilson Storm-Petrel	*Oceanites oceanicus*	13
	Leach’s Storm-Petrel	*Oceanodroma leucorha*	39
	Unknown Storm-Petrel	*Oceanodroma* or *Oceanites*	16
Laridae	Herring Gull	*Larus argentatus*	12
	Great Black-backed Gull	*Larus marinus*	5
	Unknown gull	*Larus* spp.	3
	Pomarine Jaeger	*Stercorarius pomarinus*	1
	Parasitic Jaeger	*Stercorarius parasiticus*	1
	South Polar Skua	*Stercorarius maccormicki*	1
Procellariidae	Northern Fulmar	*Fulmarus glacialis*	73
	Cory’s Shearwater	*Calonectris diomedea*	63
	Greater Shearwater	*Puffinus gravis*	56
	Unknown shearwater	*Puffinus* or *Calonectris*	2
Scolopacidae	Red Phalarope	*Phalaropus fulicaria*	9

Table 2: List of marine mammals and large fish recorded during surveys from Dartmouth, N.S. to Dartmouth, N.S. during part of the fall AZMP cruise, September 23-30, 2011.

Species	Latin Name	Number observed
Long-fined Pilot whale	*Globicephala melas*	64
Finback whale	*Balaenoptera physalus*	2
Unknown dolphin		4
Unknown whale	Possibly Long-finned pilot whale	1
Tuna species		3
Basking shark	*Cetorhinus maximus*	1

APPENDIX H

Fall AZMP Cruise report: Leg 2, 1 October 2011 – 14 October 2011
Dartmouth, N.S. to Dartmouth, N.S.

Observer: Sue Abbott
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General overview

Seabird and marine mammal observations were made from the bridge of the CCGS Hudson during the second part of the fall AZMP cruise from 2 October to 14 October, 2011 beginning and ending at the Bedford Institute of Oceanography in Dartmouth, N.S. Seabird surveys followed the standardized protocol for pelagic seabird surveys from moving platforms and stationary platforms for the Eastern Canada Seabirds at Sea program (ECSAS). The primary purpose of the cruise was to conduct oceanographic sampling (CTDs, net tows). Weather conditions were favourable for surveys with the exception of 6 Oct and the morning of 7 Oct during a significant low pressure system. A total of 653 five-minute transects were completed, resulting in over 54 hours of observations. An additional 32 stationary surveys were conducted while the ship was conducting oceanographic sampling. Marine mammal sightings were collected during seabird surveys and also noted by CCGS Hudson crew. As part of DFO's effort to identify individual Bottlenose whales, photographs were taken, whenever possible, of Bottlenose whale dorsal fins using DFO's high-powered Nikon camera.

Seabird sightings

In total, 695 birds from 8 different families were counted in transect (this does not include birds outside of the 300m wide transect or birds in flight that were not captured during the instantaneous snapshots) (Table 1). Overall, Greater Shearwaters was the dominant species observed. Flocks of Greater and Cory's shearwaters were observed off the Western Scotian shelf between the Halifax and Roseway lines. In the Fundian Channel north of George's Bank, concentrations of Sargassum weed were abundant and several flocks of phalaropes were observed as well as storm-petrels and Greater Shearwater. Northern Gannets were frequently observed along the Eastern Shore, and were seen with Black-legged Kittiwakes in Cabot Strait. Jaegers were often associated with Greater Shearwaters and one failed kleptoparasitism attempt by a Parastic Jaeger on a shearwater was observed. Few alcids (and no Dovekies) were observed during surveys. Among the rarer sightings included seabirds usually associated with warmer waters: an albatross (unknown species) observed off southwestern NS, and two Audubon's Shearwaters observed in deep water off the shelf slope.

Landbird sightings

From Dartmouth, N.S. to Dartmouth, N.S, ten birds from six different families were counted in transect (this does not include birds outside of the 300m wide transect or birds in flight that were not captured during the instantaneous snapshots) (Table 1). The unusual sighting of two Dickcissel on 4 Oct coincided with a 'fallout' of landbirds on the NS mainland in advance of a large low pressure system, which produced high winds and seas during 5-7 Oct. A flock of five White-throated Sparrows landed on the ship on 11 Oct and remained until we arrived at BIO on 14 Oct.

Marine mammal sightings

A total of 106 marine mammals (including a dead bottlenose whale) were sighted from Dartmouth, N.S. to Dartmouth, N.S. (Table 2). The sightings were dominated by Long-finned pilot whales and Bottlenose whales. The dead Bottlenose whale was observed during a seabird survey north of The Gully on 9 Oct.

Large fish sightings

Large predatory fish were also sighted during the cruise (Table 2). One small shark was observed on 12 Oct while ship was on station. A group of tuna ten was observed on 8 Oct.

Table 1: List of seabird species observed during the seabird survey from Dartmouth, N.S. to Dartmouth, N.S., 2-14 October 2011, as part of the fall AZMP cruise. Total numbers include only those birds considered "in" transect. They do not include birds outside 300m and flying birds not captured during the "snapshot".

Family	Species	Latin Name	Number Observed
Hydrobatidae	Wilson Storm-Petrel	*Oceanites oceanicus*	2
	Leach's Storm-Petrel	*Oceanodroma leucorha*	64
	Unknown Storm-Petrel	*Oceanodroma* or *Oceanites* sp.	3
Laridae	Herring Gull	*Larus argentatus*	24
	Great Black-backed Gull	*Larus marinus*	12
	Iceland Gull	*Larus glaucoides*	1
	Ring-billed Gull	*Larus delawarensis*	2
	Black-legged Kittiwake	*Rissa tridactyla*	43
	Long-tailed Jaeger	*Stercorarius longicaudus*	1
	Pomarine Jaeger	*Stercorarius pomarinus*	3
	Parasitic Jaeger	*Stercorarius parasiticus*	6
	Unknown jaeger	*Stercorarius* Jaegers	3
	Great Skua	*Stercorarius skua*	2
	South Polar Skua	*Stercorarius maccormicki*	4
Pelecanidae	Northern Gannet	*Morus bassanus*	51
Procellariidae	Northern Fulmar	*Fulmarus glacialis*	77
	Cory's Shearwater	*Calonectris diomedea*	68
	Greater Shearwater	*Puffinus gravis*	235
	Manx Shearwater	*Puffinus puffinus*	1

	Audubon's Shearwater	*Puffinus lherminieri*	2
Diomedeidae	Unknown albatross	*Thalassarche* sp.	1
Alcidae	Common Murre	*Uria algae*	2
	Unknown alcid	*Uria, Cepphus or Fratercula* sp.	1
Scolopacidae	Red Phalarope	*Phalaropus fulicaria*	3
	Red-necked Phalarope	*Phalaropus*	7
	Unknown phalarope	*Phalaropus* sp.	75
Anatidae	Black Scoter	*Melanitta nigra*	1
	Surf Scoter	*Melanita perspicillata*	1
Falconidae	Peregrine Falcon	*Falco peregrinus*	1
Regulidae	Ruby-crowned Kinglet	*Regulus calendula*	1
Motacillidae	American Pipit	*Anthus rubescens*	1
Parulidae	Magnolia Warbler	*Dendroica magnolia*	1
	Ovenbird	*Seiurus aurocapillus*	1
	Mourning Warbler	*Oporornis Philadelphia*	1
Emberizidae	White-throated Sparrow	*Zonotrichia atricapilla*	2
	Dark-eyed Junco	*Junco hyemalis*	1
Fringillidae	Pine Siskin	*Carduelis pinus*	1

Table 2: List of marine mammals and large fish recorded during surveys from Dartmouth, N.S. to Dartmouth, N.S. during the second part of the fall AZMP cruise, 2-14 October 2011.

Species	Latin Name	Number observed
Long-fined pilot whale	*Globicephala melas*	22
Bottlenose whale	*Hyperoodon ampullatus*	21 (including one dead)
Humpback whale	*Megaptera novaeangliae*	1
Common dolphin	*Delphinus* sp.	56
Unknown whale		5
Unknown seal		1
Unknown shark		1
Unknown tuna	*Thunnus sp.*	10

APPENDIX I

Collection of samples for determination of carbon dioxide concentration - Shaun Gelati

Outline
A total of 357 water samples were collected on the transects listed below. These samples will be used to measure CO_2 concentration by Helmuth Thomas's research group in the Department of Oceanography at Dalhousie University.

Halifax Line (121 samples)
HL1: s, 10, 20, 30, 40, 50, 60, b
HL2(1): s, 10, 20, 30, 40, 50, 60, 80, 100, b
HL2(2): depths were not on CTD sheet, 10 samples were collected
HL3: depths were not on CTD sheet, 11 samples were collected
HL4: s, 10, 20, 30, 40, 50, 60, b
HL5: s, 10, 20, 30, 40, 50, 60, 80, b
HL6: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 750, b
HL6.3: s, b
HL7: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 1000, 1500, 2000, 2500, b
HL8: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 1000, 1500, 2000, 2500, b
HL9: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 1000, 1500, 2000, 2500, 3000, 3500, b

Browns Bank Line (70 samples)
BBL1: s, 10, 20, 30, 40, b
BBL2: s, 10, 20, 30, 40, 50, 60, 80, b
BBL3: s, 10, 20, 30, 40, 50, 60, 80, b
BBL4: s, 10, 20, 30, 40, 50, 60, 80, b
BBL5: s, 10, 20, 30, 40, 50, 60, 80, 100, 150, b
BBL6: 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 750, b
BBL7: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 750, 1000, b

Cabot Strait Line (69 samples)
CSL1: s, 10, 20, 30, 40, 50, 60, b
CLS2: s, 10, 20, 30, 40, 50, 60, 80, 100, 150, b
CLS3: s, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200, b
CLS4: s, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200, 300, b
CLS5: s, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200, 300, b
CLS6: s, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200, b

Louisbourg Line (97 samples)
LL1: s, 10, 20, 30, 40, 50, 60, 80, b
LL2: s, 10, 20, 30, 40, 50, 60, 80, 100, b
LL3: s, 10, 20, 30, 40, 50, 60, 80, 100, b
LL4: s, 10, 20, 30, 40, 50, 60, 80, b
LL5: s, 10, 20, 30, 40, 50, 60, 80, 100, b

LL6: s, 10, 20, 30, 40, 50, b
LL7: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, b
LL8: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 1000, 1500, 2000, b
LL9: s, 10, 20, 30, 40, 50, 60, 80, 100, 250, 500, 1000, 1500, 2000, b

N.B. All depths are nominal and in meters. Letters s and b stand for surface and bottom, respectively.

The author of report was a volunteer during the cruise and is a graduate student in the Department of Oceanography, Dalhousie University. Future enquiries should be addressed to helmuth.thomas@dal.ca.