CRUISE RESULTS NOAA Fisheries Research Vessel ALBATROSS IV Cruise No. AL 05-09 Late Autumn Ecosystem Monitoring SurveyHabitat

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CRUISE PERIOD AND AREA

The cruise period was 5 to 18 November 2005. The NOAA fisheries research vessel ALBATROSS IV sampled 108 stratified random ecosystem monitoring stations located in the Mid-Atlantic Bight, Southern New England, Georges Bank and Gulf of Maine, plus 3 non-random stations in Southern New England, 4 non-random stations in the Gulf of Maine, and 5 fixed stations in the Gulf of Maine region. The fixed stations were in the Wilkinson, Jordan and Georges basins, in the Northeast Channel and east of Boston Harbor, at the site of a proposed liquefied natural gas (LNG) terminal (Figure 1).

OBJECTIVES

The primary objective of the cruise was to assess changing biological and physical properties which influence the sustainable productivity of the living marine resources of the Mid-Atlantic Bight, Southern New England, Gulf of Maine and Georges Bank portions of the northeast continental shelf ecosystem. Key parameters measured for the Ecosystem Monitoring Program included ichthyoplankton and zooplankton composition, abundance and distribution, plus water column temperature, salinity, and chlorophyll-a fluorescence. Secondary objectives of this cruise involved the following:

- Vertical CTD casts to within 5 meters of the bottom in Gulf of Maine deep basin areas and the Northeast Channel to provide hydrographic data detailing the incursion of Labrador Current water into this region.
- Sampling at the site of a proposed liquefied natural gas (LNG) terminal east of Boston Harbor, to collect baseline data.
- Collection of samples for zooplankton genetics (genome) studies.
- Examination of plankton samples for concentrations of <u>Calanus finmarchicus</u> to correlate with right whale sightings.
- Collection of neuston samples for a study of larval squid distribution.
- Collection of phytoplankton samples from the ship's flow-through seawater system for nitrogen stable isotope ratio analysis.

METHODS

The survey consisted of 120 stations at which the vessel stopped to lower instruments over the side. Ninety randomly stratified stations were planned for the cruise, with 30 in the Mid-Atlantic Bight, 30 in Southern New England and 30 on Georges Bank Three additional non-random stations were completed in the Southern New England region to improve geographic coverage. With too little time left in the schedule for sampling the entire Gulf of Maine, priority was given to deeper stations to document the incursion of Labrador Current water into this region. Accordingly, three deep basins (Jordan, Georges and Wilkinson) were sampled with the bongo nets and CTD, the Northeast Channel was sampled with the CTD unit, and a fifth station east of Boston Harbor provided baseline environmental data at the site of a proposed offshore LNG terminal. Stations between these points were also sampled, bringing the total number of Gulf of Maine stations sampled to 28, with the majority of these stations being from the southern half of this region.

Zooplankton genetics (zoogen) samples were collected at 5 randomly designated stations in the Mid-Atlantic Bight region, 4 in the Southern New England region, 4 in the Georges Bank region and 5 in the Gulf of Maine region, yielding a total of 18 samples.

Double oblique tows using the 61-cm bongo sampler and a Seabird CTD with a fluorometer were made at 94 stations (one station was a CTD-cast-only). The tows were made to approximately 5 meters above the bottom, or to a maximum depth of 200 meters. All plankton tows were conducted at a ship speed of 1.5 knots. Plankton sampling gear consisted of a 61-centimeter diameter aluminum bongo frame with two 335-micron nylon mesh nets. At the randomly designated zoogen stations a 20-cm diameter PVC bongo frame fitted with paired 165-micron nylon mesh nets was put on the towing wire one half meter above the Seabird CTD with a wire stop. A 45-kilogram lead ball was attached by an 80-centimeter length of 3/8inch diameter chain below the aluminum bongo frame to depress the sampler. A digital flowmeter was suspended within the mouth of each sampler to determine the amount of water filtered by each net. No flowmeters were used in the 20-cm bongos. The plankton sampling gear was deployed over the port side of the vessel by means of a power boom. Upon retrieval, the bongo frame was placed in the checker, a wooden table used to hold the fish catch from trawl surveys. The checker allowed for easier wash-down of the large sampling nets, and when a 20 cm bongo frame was deployed, it was carried forward to the sheltered work area so both sampling arrays could be washed down simultaneously after retrieval by placing the large frame in the checker and the small frame in the protected work area. The 61-centimeter bongo plankton samples were preserved in a 5 % solution of formalin in seawater. The zooplankton genetics samples were preserved in 95 % ethanol, which was changed once 24 hours after the initial preservation. Tow depth was monitored in real time with a Seabird CTD profiler. The Seabird CTD profiler was hard-wired to the conductive towing cable, providing simultaneous depth, temperature, and salinity for each plankton tow. A CTD cast to within 5 meters of the bottom was made in Wilkinson, Jordan, and Georges basins and near the northern wall of the Northeast Channel.

A 10 minute neuston tow using a ½ by 1 meter neuston frame equipped with a 500 micron mesh net was made at 8 stations for William Macy, a researcher at the URI Graduate School of Oceanography. These tows were made from the same power boom used for deploying the bongo net plankton sampler. Neuston tows were conducted after completion of the bongo tow at the same speed and heading that the bongo tow was taken at. The purpose of these tows was to locate distributions of larval squid. Six of these stations were in the Mid-Atlantic Bight region and 2 were from the Southern New England region.

During the cruise, settled plankton heights were measured to determine the volume of zooplankton

present. Stations with large amounts of <u>Calanus finmarchicus</u> were noted and the volumes (Table 1.) for these stations were forwarded to Tim Cole, of the NEFSC Protected Species Branch, Large Whale Group.

Continuous monitoring of the seawater salinity, temperature and chlorophyll-a level, from a depth of 2.1 meters along the entire cruise track was done by means of a thermosalinograph, and a flow-through fluorometer hooked up to the ship's flow-through seawater system. The Scientific Computer System (SCS) recorded the output from both the thermosalinograph, and the fluorometer at 10-second intervals. The data records were given a time-date stamp by the GPS unit.

Samples for Seabird CTD salinity data calibration were obtained on the 12-6 watch using a 1.7 liter Niskin bottle taking a water sample from 30 or more meters depth at an isohaline portion of the water column. Calibration of the CTD salinities and chlorophyll-a from the surface flow-through system was undertaken on the 6-12 watch. Sample analysis for these calibrations followed the protocol outlined in the Ecosystem Monitoring Program Operations Manual.

Nitrogen isotope samples for the US EPA Atlantic Ecology Laboratory were taken at 18 sites along the cruise track. Seven were from the Mid-Atlantic Bight, 3 were from Southern New England, 4 were from Georges Bank and 4 were from the Gulf of Maine. These samples were collected from the discharge water of the near-surface flow-through system. Samples of 800 to 1000 milliliters of seawater were prefiltered through a 300 micron mesh nitex gauze to remove most zooplankton, then filtered through a Whatman glass-fiber filter (GFF) and flash frozen for analysis ashore.

Three extra bongo tows were made using the 61 cm bongo sampler to provide samples for testing a bench-mounted video plankton recorder. These samples were taken from Georges Bank and the Gulf of Maine. They were not part of the Ecosystem Monitoring Program.

RESULTS

A summary of routine survey activities is presented in Table 1. Areal coverage for the cruise is shown in Figure 1. The ALBATROSS IV sailed at 1000 hours on Saturday, 5 November 2005, and started work in the southernmost part of the Southern New England area, then continued on into the Mid-Atlantic Bight. It had been decided to drop the Gulf of Maine (GOM) region because of a loss of cruise time when the previous cruise, the fall trawl survey, was extended due to weather problems. With light winds and favorable weather, rapid progress was made, and by Thursday, 10 November the ALBATROSS IV had completed sampling the Mid-Atlantic Bight region, and part of the Southern New England region, and returned to Woods Hole to exchange scientific personnel and take on fuel. On the way in, the scientists and crew aboard the ALBATROSS IV were filmed lowering a CTD and bucket thermometer over the side. The filming was done by a crew from the TV program NOVA, located aboard the Delaware II, and the purpose of this footage was to provide a scene representing the span of progress in the technology of sampling seawater temperature.

After a brief 2 ½ hour port call, the ALBATROSS IV returned to sea. Sampling was completed in the Southern New England area by Sunday, 13 November, after which the vessel crossed the Great South Channel and proceeded to work its way eastward across Georges Bank. Good weather allowed sampling to continue at a brisk pace, and by Tuesday, 15 November, almost all stations on Georges Bank had been sampled, and the ALBATROSS IV headed into the Gulf of Maine. From group discussions made prior to the cruise, sampling in the Gulf of Maine was focused primarily on the deep Basin areas, since it had been anticipated that there would not be enough time to obtain representative coverage of the entire region. Accordingly, the ALBATROSS IV sampled the Northeast Channel, the Jordan, Georges, and

Wilkinson basins, and the proposed LNG terminal site east of Boston Harbor, plus random stations encountered as the vessel steamed between these points. The vessel traveled in a counterclockwise loop from the Northeast Channel to Jordan Basin and back to the northern edge of Georges Bank before heading west towards Wilkinson Basin and the LNG site.

Sampling operations were completed east of Boston late Thursday night. After sampling operations were completed the vessel returned to Woods Hole via the Cape Cod Canal. It tied up at the NMFS dock in Woods Hole at 0730 on Friday, 18 November 2005, marking the end of the Late Autumn Ecosystem Monitoring Cruise AL0509.

DISPOSITION OF SAMPLES AND DATA

All samples and data, except for the zooplankton genetics samples, the EPA nitrogen isotope samples and the University of Rhode Island/Graduate School of Oceanography (URI/GSO) neuston samples and the Seabird CTD data, were delivered to the Ecosystem Monitoring Group of the NEFSC, Narragansett, RI, for quality control processing and further analysis. The zooplankton genetics samples were taken from the vessel by Nancy Copley of the Woods Hole Oceanographic Institute. The EPA samples were taken to the US Environmental Protection Agency, Atlantic Ecology Division, located in Narragansett, Rhode Island. The neuston samples were delivered to the URI/GSO lab in Narragansett. The CTD data were delivered to the Oceanography Branch of the NEFSC, Woods Hole, MA. Copies of the CTD logs were retained by the Ecosystems Monitoring Group in Narragansett. Calanus volume information was forwarded to Tim Cole after the cruise report was completed.

SCIENTIFIC PERSONNEL

National Marine Fisheries Service, NEFSC, Narragansett, RI

Jerome Prezioso^{1,2} Chief Scientist Joseph Kane^{1,2} Carolyn Griswold² Jacquelyn Anderson²

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Maureen Taylor¹ Tamara Holzworth-Davis¹

Table 1. STATION OPERATION REPORT FOR CRUISE AL0509

B=bongo W=water Z=zoogen V=vertical cast (CTD only) D=deep tow CO=Calanus observed/vol NEU=neuston N=nitrogen isotope

m

mm did yy hr min

1	1	11	6	2005	4	45	3932.4	7211.9	150	В
2	2	11	6	2005	8	48	3921.4	7256.2	72	В
3	2	11	6	2005	8	58	3921.3	7256.5	72	W
4	3	11	6	2005	10	33	3909	7246.7	109	B, NEU 1, N 1
5	4	11	6	2005	12	13	3909.1	7303.7	71	B, Z 1
6	5	11	6	2005	14	50	3841.6	7304.3	280	B, N 2
7	6	11	6	2005	18	55	3843.8	7352.4	45	В
8	7	11	6	2005	19	52	3839.1	7344.6	57	В
9	7	11	6	2005	20	5	3838.7	7344.8	57	W
10	8	11	7	2005	0	42	3803.9	7430.3	45	В
11	9	11	7	2005	1	6	3803.5	7429.1	41	В
12	10	11	7	2005	3	32	3754.5	7405.3	147	В
13	11	11	7	2005	9	48	3701.1	7448.3	60	B, NEU 2, N 3
14	11	11	7	2005	10	11	3701.7	7449.2	58	W
15	12	11	7	2005	12	27	3641.8	7502.4	29	B, Z 2
16	13	11	7	2005	16	29	3558.9	7452.7	89	B, N 4
17	14	11	7	2005	20	33	3521.3	7520.5	25	B, NEU 3, N 5
18	14	11	7	2005	20	57	3521.5	7519.5	26	W
19	15	11	7	2005	23	48	3548.1	7511.7	36	В
20	16	11	8	2005	0	9	3550.3	7511	33	B, Z 3
21	17	11	8	2005	4	1	3621	7538.5	21	В
22	18	11	8	2005	8	8	3658.9	7550.4	12	B, NEU 4, N 6
23	18	11	8	2005	8	32	3659.6	7549.7	13	W
24	19	11	8	2005	10	13	3714.6	7541.5	11	В
25	20	11	8	2005	12	35	3726.4	7517.3	27	B, Z 4
26	21	11	8	2005	14	46	3741.4	7458.9	30	В
27	22	11	8	2005	15	39	3746.4	7452.6	32	В
28	23	11	8	2005	16	45	3748.3	7504.1	27	В
29	24	11	8	2005	20	16	3823.8	7453.5	18	В
30	24	11	8	2005	20	34	3824.1	7453.8	19	W
31	25	11	8	2005	23	46	3843.3	7418.9	35	B, Z 5, NEU 5
32	26	11	9	2005	2	26	3903.7	7432.4	14	B, N 7
33	27	11	9	2005	6	32	3908.7	7338.7	38	В
34	27	11	9	2005	6	40	3908.6	7338.3	39	W
35	28	11	9	2005	8	3	3916.3	7352.6	35	В
36	29	11	9	2005	9	49	3930.9	7401.2	23	В
37	30	11	9	2005	11	32	3945.9	7402.7	14	В
38	31	11	9	2005	12	38	3938.8	7352.8	26	В
39	32	11	9	2005	14	13	3936.1	7334.9	35	B, NEU 6
40	33	11	9	2005	15	48	3943.5	7323	36	В
41	34	11	9	2005	21	22	4015.6	7224.6	56	В
42	34	11	9	2005	21	34	4015.3	7224.5	56	W
43	35	11	10	2005	0	50	4033.5	7150.9	62	В
44	36	11	10	2005	20	8	4121.5	7104.8	25	В
45	36	11	10	2005	20	20	4121.9	7105.1	26	W

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE AL0509

mm dd yy hr min

B=bongo W=water Z=zoogen V=vertical cast (CTD only) D=deep tow CO=Calanus observed/vol NEU=neuston N=nitrogen isotope

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65 53 11 12 2005 12 23 4011.6 7013 102 B, Z 8 66 54 11 12 2005 14 30 4030.9 7014.8 61 B, CO/122cc 67 55 11 12 2005 17 48 4051.6 7050.3 52 B 68 55 11 12 2005 18 3 4051.6 7050.5 53 W 69 56 11 12 2005 20 36 4111.4 7025 31 B 70 57 11 12 2005 22 34 4109.1 6958.9 13 B 71 58 11 13 2005 1 17 4050.5 6948.9 33 B 72 59 11 13 2005 5 24038.7 6937.3 51 B, Z 9 73 60 11 </td <td>63</td> <td>51</td> <td>11</td> <td>12</td> <td>2005</td> <td>8</td> <td>53</td> <td>4026.4</td> <td>7043.2</td> <td>81</td> <td>В</td>	63	51	11	12	2005	8	53	4026.4	7043.2	81	В
66 54 11 12 2005 14 30 4030.9 7014.8 61 B, CO/122cc 67 55 11 12 2005 17 48 4051.6 7050.3 52 B 68 55 11 12 2005 18 3 4051.6 7050.5 53 W 69 56 11 12 2005 20 36 4111.4 7025 31 B 70 57 11 12 2005 22 34 4109.1 6958.9 13 B 71 58 11 13 2005 2 52 4038.7 6937.3 51 B, Z 9 73 60 11 13 2005 5 22 4035.1 6912.8 67 B 74 60 11 13 2005 5 24 4035.1 6912.8 67 W 75 61	64	52	11	12	2005	10	42	4014.3	7030.8	111	В
67 55 11 12 2005 17 48 4051.6 7050.3 52 B 68 55 11 12 2005 18 3 4051.6 7050.5 53 W 69 56 11 12 2005 20 36 4111.4 7025 31 B 70 57 11 12 2005 22 34 4109.1 6958.9 13 B 71 58 11 13 2005 1 17 4050.5 6948.9 33 B 72 59 11 13 2005 2 52 4038.7 6937.3 51 B, Z9 73 60 11 13 2005 5 3 4034 6912.8 67 B 74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 <td>65</td> <td>53</td> <td>11</td> <td>12</td> <td>2005</td> <td>12</td> <td>23</td> <td>4011.6</td> <td>7013</td> <td>102</td> <td>B, Z 8</td>	65	53	11	12	2005	12	23	4011.6	7013	102	B, Z 8
68 55 11 12 2005 18 3 4051.6 7050.5 53 W 69 56 11 12 2005 20 36 4111.4 7025 31 B 70 57 11 12 2005 22 34 4109.1 6958.9 13 B 71 58 11 13 2005 1 17 4050.5 6948.9 33 B 72 59 11 13 2005 2 52 4038.7 6937.3 51 B, Z9 73 60 11 13 2005 5 3 4034 6912.8 67 B 74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 13 2005 7 38 4051.4 6911 66 B 76 62 11	66	54	11	12	2005	14	30	4030.9	7014.8	61	B, CO/122cc
69 56 11 12 2005 20 36 4111.4 7025 31 B 70 57 11 12 2005 22 34 4109.1 6958.9 13 B 71 58 11 13 2005 1 17 4050.5 6948.9 33 B 72 59 11 13 2005 2 52 4038.7 6937.3 51 B, Z 9 73 60 11 13 2005 5 3 4034 6912.8 67 B 74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 13 2005 6 59 4048.8 6905 72 B 76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11	67	55	11	12	2005	17	48	4051.6	7050.3	52	В
70 57 11 12 2005 22 34 4109.1 6958.9 13 B 71 58 11 13 2005 1 17 4050.5 6948.9 33 B 72 59 11 13 2005 2 52 4038.7 6937.3 51 B, Z9 73 60 11 13 2005 5 3 4034 6912.8 67 B 74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 13 2005 6 59 4048.8 6905 72 B 76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11 13 2005 13 3408.6 6917.2 40 B 78 64 11 13	68	55	11	12	2005	18	3	4051.6	7050.5	53	W
71 58 11 13 2005 1 17 4050.5 6948.9 33 B 72 59 11 13 2005 2 52 4038.7 6937.3 51 B, Z 9 73 60 11 13 2005 5 3 4034 6912.8 67 B 74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 13 2005 6 59 4048.8 6905 72 B 76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11 13 2005 8 35 4058.6 6917.2 40 B 78 64 11 13 2005 13 8 4104.2 6829.3 52 B 80 66 11	69	56	11	12	2005	20	36	4111.4	7025	31	В
72 59 11 13 2005 2 52 4038.7 6937.3 51 B, Z 9 73 60 11 13 2005 5 3 4034 6912.8 67 B 74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 13 2005 6 59 4048.8 6905 72 B 76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11 13 2005 8 35 4058.6 6917.2 40 B 78 64 11 13 2005 12 13 4108.5 6829.3 52 B 79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11	70	57	11	12	2005	22	34	4109.1	6958.9	13	В
73 60 11 13 2005 5 3 4034 6912.8 67 B 74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 13 2005 6 59 4048.8 6905 72 B 76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11 13 2005 8 35 4058.6 6917.2 40 B 78 64 11 13 2005 12 13 4108.5 6829.3 52 B 79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11	71	58	11	13	2005	1	17	4050.5	6948.9	33	В
74 60 11 13 2005 5 22 4035.1 6913.2 67 W 75 61 11 13 2005 6 59 4048.8 6905 72 B 76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11 13 2005 8 35 4058.6 6917.2 40 B 78 64 11 13 2005 12 13 4108.5 6829.3 52 B 79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11 13 2005 17 10 4031.4 6832.3 81 B 82 68 11	72	59	11	13	2005	2	52	4038.7	6937.3	51	B, Z 9
75 61 11 13 2005 6 59 4048.8 6905 72 B 76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11 13 2005 8 35 4058.6 6917.2 40 B 78 64 11 13 2005 12 13 4108.5 6829.3 52 B 79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11 13 2005 14 49 4053.6 6816.5 47 B 82 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11	73	60	11	13	2005	5	3	4034	6912.8	67	В
76 62 11 13 2005 7 38 4051.4 6911 66 B 77 63 11 13 2005 8 35 4058.6 6917.2 40 B 78 64 11 13 2005 12 13 4108.5 6829.3 52 B 79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11 13 2005 14 49 4053.6 6816.5 47 B 82 68 11 13 2005 17 10 4031.4 6832.3 81 B 83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 </td <td>74</td> <td>60</td> <td>11</td> <td>13</td> <td>2005</td> <td>5</td> <td>22</td> <td>4035.1</td> <td>6913.2</td> <td>67</td> <td>W</td>	74	60	11	13	2005	5	22	4035.1	6913.2	67	W
77 63 11 13 2005 8 35 4058.6 6917.2 40 B 78 64 11 13 2005 12 13 4108.5 6829.3 52 B 79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11 13 2005 14 49 4053.6 6816.5 47 B 82 68 11 13 2005 17 10 4031.4 6832.3 81 B 83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11<	75	61	11	13	2005	6	59	4048.8	6905	72	В
78 64 11 13 2005 12 13 4108.5 6829.3 52 B 79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11 13 2005 14 49 4053.6 6816.5 47 B 82 68 11 13 2005 17 10 4031.4 6832.3 81 B 83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 1	76	62	11	13	2005	7	38	4051.4	6911	66	В
79 65 11 13 2005 13 8 4104.2 6822.4 34 B 80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11 13 2005 14 49 4053.6 6816.5 47 B 82 68 11 13 2005 17 10 4031.4 6832.3 81 B 83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72	77	63	11	13	2005	8	35	4058.6	6917.2	40	В
80 66 11 13 2005 13 57 4101.4 6814.6 38 B 81 67 11 13 2005 14 49 4053.6 6816.5 47 B 82 68 11 13 2005 17 10 4031.4 6832.3 81 B 83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73	78	64	11	13	2005	12	13	4108.5	6829.3	52	В
81 67 11 13 2005 14 49 4053.6 6816.5 47 B 82 68 11 13 2005 17 10 4031.4 6832.3 81 B 83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74	79	65	11	13	2005	13	8	4104.2	6822.4	34	В
82 68 11 13 2005 17 10 4031.4 6832.3 81 B 83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	80	66	11	13	2005	13	57	4101.4	6814.6	38	В
83 68 11 13 2005 17 24 4030.7 6832.5 83 W 84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	81	67	11	13	2005	14	49	4053.6	6816.5	47	В
84 69 11 13 2005 18 57 4021 6838.5 94 B 85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	82	68	11	13	2005	17	10	4031.4	6832.3	81	В
85 70 11 13 2005 20 26 4024.2 6823.4 106 B 86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	83	68	11	13	2005	17	24	4030.7	6832.5	83	W
86 71 11 13 2005 22 22 4021.3 6805.9 210 B 87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	84	69	11	13	2005	18	57	4021	6838.5	94	В
87 72 11 14 2005 1 18 4040.9 6744.9 76 B, Z10 88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	85	70	11	13	2005	20	26	4024.2	6823.4	106	В
88 73 11 14 2005 3 26 4043.3 6718.9 95 B 89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	86	71	11	13	2005	22	22	4021.3	6805.9	210	В
89 74 11 14 2005 5 11 4043.4 6659.4 119 B, N11	87	72	11	14	2005	1	18	4040.9	6744.9	76	B, Z10
	88	73	11	14	2005		26	4043.3	6718.9	95	В
90 74 11 14 2005 5 24 4043.4 6659.4 119 W	89	74	11	14	2005		11	4043.4	6659.4	119	B, N11
	90	74	11	14	2005	5	24	4043.4	6659.4	119	W

CAST STA. Date(GMT) TIME(GMT) LAT LONG DEPTH

OPERATION B=bongo W=water Z=zoogen
V=vertical cast (CTD only)
D=deep tow CO=Calanus observed/vol
NEU=neuston N=nitrogen isotope

mm dd hr min уу

91											
93 77 11 14 2005 11 2 4123.9 6646.4 75 B 94 78 11 14 2005 12 12 4116.3 6651.9 71 B 95 79 11 14 2005 13 52 4108.8 6708.7 65 B 96 80 11 14 2005 14 52 4108.8 6708.7 65 B 97 81 11 14 2005 16 32 4108.3 6732.2 54 B,211 98 82 11 14 2005 19 28 4133.8 6731.9 38 B 99 82 11 14 2005 19 38 4133.7 6732.5 35 W 100 82 11 14 2005 19 38 4133.7 6732.5 35 W 100 82 11 14 2005 21 8 4136.5 6701.1 60 B,N12 101 83 11 14 2005 22 18 4136.5 6701.1 60 B,N12 102 84 11 14 2005 23 34 4143.9 6716.4 57 B 103 85 11 15 2005 1 21 4200.5 6709.2 55 B 104 86 11 15 2005 1 21 4200.5 6709.2 55 B 105 87 11 15 2005 1 24 4208.8 6636.2 97 B 107 88 11 15 2005 5 12 4208.8 6636.2 97 B 108 89 11 15 2005 7 13 4165.3 6612.6 82 B 109 90 11 15 2005 7 13 4165.3 6612.6 82 B 109 90 11 15 2005 10 2 4147.8 6643.3 348 B,N13 111 91 11 15 2005 10 23 4148.1 6643.3 385 V 110 91 11 15 2005 10 23 4148.1 6643.2 355 V 111 92 11 15 2005 10 24 4147.9 6546.1 148 B 110 91 11 15 2005 10 23 4148.1 6643.2 355 V 111 99 11 15 2005 10 23 4148.1 6643.2 355 V 112 92 11 15 2005 10 23 4148.1 6643.2 355 V 113 93 11 15 2005 10 23 4148.1 6643.2 355 V 114 99 11 15 2005 10 23 4148.1 6643.2 355 V 115 94 11 15 2005 15 29 4213.8 6601.6 42 B 119 96 11 15 2005 10 23 4148.1 6640.8 251 B 119 96 11 15 2005 15 29 4213.8 6601.8 22 B 119 99 11 16 2005 17 36 4224.7 6547.4 113 W 111 91 11 15 2005 10 23 448.1 6640.8 251 B 119 96 11 15 2005 17 30 4225.8 6549.1 116 B 110 94 11 15 2005 10 23 4438.5 6614.6 49 B 110 99 11 16 2005 19 15 8428.2 6616.6 242 V 119 98 11 16 2005 19 15 84226.2 6616.6 242 B 119 96 11 16 2005 6 43 438.9 6704.6 203 B,Z14,CO/85cc 123 100 11 16 2005 17 30 4224.7 6547.4 113 B,N16,CO/296cc 124 100 11 16 2005 17 30 4225.7 6615.8 242 V 119 98 11 16 2005 19 18 4328.7 6714.1 209 W 125 101 11 16 2005 17 12 4225.7 6615.8 242 V 129 91 11 16 2005 17 30 4224.7 6547.4 113 B,N16,CO/296cc 128 103 11 16 2005 17 34 4225.7 6615.8 242 V 144 100 11 16 2005 17 24 4225.7 6700.1 360 B 130 104 11 16 2005 17 24 4225.7 6700.1 360 B 131 105 11 16 2005 17 24 4225.7 6700.1 360 B 132 106 11 16 2005 17 24 4225.7 6700.1 360	91	75	11	14	2005	7	37	4058.7	6638.9	86	В
94	92	76	11	14	2005	10	28	4126.4	6643.4	79	В
95	93	77	11	14	2005	11	2	4123.9	6646.4	75	В
96 80 11 14 2005 14 52 4103.7 6716.5 65 B 97 81 11 14 2005 19 28 4103.8 6732.2 54 B, Z11 98 82 11 14 2005 19 28 4133.8 6731.9 38 B 99 82 11 14 2005 19 38 4133.7 6732.5 35 W 100 82 11 14 2005 21 8 4136.5 6701.1 60 B, N12 101 83 11 14 2005 22 18 4136.5 6701.1 60 B, N12 102 84 11 14 2005 23 34 4143.9 6716.4 57 B 103 85 11 15 2005 0 23 4151.5 6713.3 55 B 104 86 11 15 2005 1 21 4200.5 6709.2 55 B 105 87 11 15 2005 2 49 4151.6 668.5 70 B, Z12 106 88 11 15 2005 5 12 4208.8 6636.2 97 B 107 88 11 15 2005 5 12 4208.8 6636.2 97 B 108 89 11 15 2005 7 13 4156.3 6612.6 82 B 109 90 11 15 2005 7 13 4156.3 6612.6 82 B 110 91 11 15 2005 10 23 4147.9 6546.1 148 B 110 91 11 15 2005 10 23 4147.9 6546.1 148 B 110 91 11 15 2005 13 4 413.7 6646.1 148 B 110 91 11 15 2005 13 4 413.8 6604.8 251 B 114 93 11 15 2005 13 4 4213.7 6546.1 148 B 115 94 11 15 2005 17 10 4225.8 6646.1 244 V, N14 113 93 11 15 2005 17 10 4225.8 6641. 148 B 116 94 11 15 2005 17 10 4225.8 6641. 148 B 117 95 11 15 2005 17 10 4225.8 6641. 148 B 118 95 11 15 2005 17 10 4225.8 6641. 148 B 119 96 11 15 2005 17 10 4225.8 6641. 148 B 110 97 11 15 2005 17 4243.8 6604.8 251 B 111 99 11 15 2005 17 4243.8 6604.8 251 B 114 93 11 15 2005 17 4243.8 6604.8 251 B 115 94 11 15 2005 17 42428.8 6641. 148 B 116 94 11 15 2005 17 42428.8 6641. 148 B 117 95 11 15 2005 17 42428.8 6641. 148 B 119 96 11 15 2005 17 4425.8 6641. 148 B 110 97 11 16 2005 18 4213.7 6646.1 224 V, N14 117 95 11 15 2005 17 42428.8 6641. 148 B 119 96 11 15 2005 17 10 4225.8 6641. 148 B 110 97 11 16 2005 18 4248.5 6614.6 49 B 120 97 11 16 2005 19 58 4228.6 6640.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 19 58 4226.2 6616.6 242 B 122 99 11 16 2005 17 10 4225.7 6615.8 242 V 124 100 11 16 2005 17 10 4225.7 6615.8 242 V 125 101 11 16 2005 17 14 425.7 6615.8 242 V 127 102 11 16 2005 17 14 425.7 6615.8 242 V 128 100 11 16 2005 17 14 425.7 6615.8 242 V 129 104 11 16 2005 17 14 425.7 6615.8 242 V 120 104 11 16 2005 17 14 425.7 6615.8 242 V 121 14 16 2005 17 14 425.7 6615.8 242 V 122 12 14 14 16 2005 17 14 425.7 6615.8 242 V 12	94	78	11	14	2005	12	12	4116.3	6651.9	71	В
97 81 11 14 2005 16 32 4108.3 6732.2 54 B, Z11 98 82 11 14 2005 19 28 4133.8 6731.9 38 B 99 82 11 14 2005 19 38 4133.7 6732.5 35 W 100 82 11 14 2005 22 18 4136.5 6701.1 60 B, N12 101 83 11 14 2005 22 18 4136.5 6701.1 60 B, N12 102 84 11 15 2005 12 4151.5 6713.3 55 B 103 85 11 15 2005 1 21 4200.5 6709.2 55 B 104 86 11 15 2005 1 21 4200.5 6709.2 55 B 105 87 11 15 2005 1 24 4208.8 6636.5 70 B, Z12 106 88 11 15 2005 5 12 4208.8 6636.2 97 B 107 88 11 15 2005 5 7 13 4156.3 6612.6 82 B 109 90 11 15 2005 5 27 4208.8 6636.3 96 W 108 89 11 15 2005 9 26 4147.9 6546.1 148 B 110 91 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 13 4 4213.7 6546.1 224 V, N14 113 93 11 15 2005 15 29 4213.8 6603.6 248 V 116 94 11 15 2005 17 10 4225.8 6549.1 116 B 117 95 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 17 36 4224.7 6547.4 113 W 118 95 11 15 2005 20 2 49 439.8 6638.5 960.8 V 119 96 11 15 2005 15 29 4213.8 6603.6 248 V 119 97 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 119 96 11 15 2005 19 58 4226.2 6616.6 242 B 119 96 11 16 2005 20 21 4225.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 120 97 11 16 2005 19 58 4226.2 6616.6 242 B 120 97 11 16 2005 19 58 4226.2 6616.6 242 B 120 97 11 16 2005 19 58 4238.5 6614.6 49 B 120 97 11 16 2005 19 18 4328.7 6714.7 211 B, N16, CO/209cc 123 100 11 16 2005 17 44 225.8 6613.8 242 V 124 100 11 16 2005 17 44 225.8 6613.8 242 V 125 101 11 16 2005 19 18 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 17 44 4225.2 6700.5 360 W 125 101 11 16 2005 17 44 4225.2 6700.5 360 W 126 101 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 133 106 11 16 2005 20 21 48 4211.3 6724.8 221 V 134 1	95	79	11	14	2005	13	52	4108.8	6708.7	65	
98 82 11 14 2005 19 28 4133.8 6731.9 38 B 99 82 11 14 2005 19 38 4133.7 6732.5 35 W 100 82 11 14 2005 19 45 4133.7 6732.5 37 W 101 83 11 14 2005 22 18 4136.5 6701.1 60 B, N12 102 84 11 14 2005 23 34 4143.9 6716.4 57 B 103 85 11 15 2005 0 23 4151.5 6713.3 55 B 104 86 11 15 2005 1 21 4200.5 6709.2 55 B 105 87 11 15 2005 1 2 49 4151.6 6658.5 70 B, Z12 106 88 11 15 2005 5 12 4208.8 6636.2 97 B 107 88 11 15 2005 5 12 4208.8 6636.2 97 B 108 89 11 15 2005 5 12 4208.8 6635.3 96 W 108 89 11 15 2005 5 12 4208.8 6635.3 96 W 108 89 11 15 2005 9 26 4147.9 6546.1 148 B 110 91 11 15 2005 10 2 4147.8 6543.3 348 B, N13 111 91 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 14 59 4213.8 6604.8 251 B 114 93 11 15 2005 17 10 4225.8 6549.1 116 B 116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 17 36 4224.7 6547.4 113 W 118 95 11 15 2005 2 2 49 4309 6638.5 125 B, CO/85cc 123 100 11 16 2005 2 49 4309 6638.5 125 B, CO/73cc 124 100 11 16 2005 9 15 439 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 9 15 434 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 9 15 434 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 58 4213.9 6703.6 25 B, CO/85cc 126 101 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 17	96	80	11	14	2005	14	52	4103.7	6716.5	65	В
99	97	81	11	14	2005	16	32	4108.3	6732.2		B, Z11
100	98	82	11	14	2005	19	28	4133.8	6731.9	38	В
101	99	82	11	14	2005	19	38	4133.7	6732.5	35	
102	100	82	11	14	2005		45	4133.7	6732.5	37	W
103	101	83	11	14	2005		18	4136.5	6701.1	60	B, N12
104	102	84	11	14	2005	23	34	4143.9	6716.4	57	В
105	103	85	11	15	2005	0	23	4151.5	6713.3	55	В
106	104	86	11	15	2005		21	4200.5	6709.2	55	В
107 88 11 15 2005 5 27 4208.8 6635.3 96 W 108 89 11 15 2005 7 13 4156.3 6612.6 82 B 109 90 11 15 2005 9 26 4147.9 6546.1 148 B 110 91 11 15 2005 10 2 4147.8 6543.3 348 B, N13 111 91 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 13 4 4213.8 6604.8 251 B B 114 93 11 15 2005 15 29 4213.8 6604.8 251 B B 114 93 11 15 2005 17 10 4225.8 6549.1 116 B 11 <td>105</td> <td>87</td> <td>11</td> <td>15</td> <td>2005</td> <td>2</td> <td>49</td> <td>4151.6</td> <td>6658.5</td> <td>70</td> <td>B, Z12</td>	105	87	11	15	2005	2	49	4151.6	6658.5	70	B, Z12
108 89 11 15 2005 7 13 4156.3 6612.6 82 B 109 90 11 15 2005 9 26 4147.9 6546.1 148 B 110 91 11 15 2005 10 2 4147.8 6543.3 348 B, N13 111 91 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 13 4 4213.7 6546.1 224 V, N14 113 93 11 15 2005 14 59 4213.8 6604.8 251 B 114 93 11 15 2005 15 29 4213.8 6603.6 248 V 115 94 11 15 2005 17 10 4225.8 6549.1 116 B 116 <	106	88	11	15	2005		12	4208.8	6636.2	97	В
109 90 11 15 2005 9 26 4147.9 6546.1 148 B 110 91 11 15 2005 10 2 4147.8 6543.3 348 B, N13 111 91 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 13 4 4213.7 6546.1 224 V, N14 113 93 11 15 2005 14 59 4213.8 6604.8 251 B 114 93 11 15 2005 17 29 4213.8 6604.8 251 B 114 93 11 15 2005 17 10 4225.8 6549.1 116 B 115 94 11 15 2005 17 10 4225.8 6549.1 116 B 116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B, CO/73cc 122 99 11 16 2005 6 43 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 6 43 4324.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 6 43 4324.8 6741.6 244 B, CO/258cc 126 101 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 21 4225.7 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.8 221 V 134 107 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, Video test sample	107	88	11	15	2005		27	4208.8	6635.3	96	W
110 91 11 15 2005 10 2 4147.8 6543.3 348 B, N13 111 91 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 13 4 4213.7 6546.1 224 V, N14 113 93 11 15 2005 14 59 4213.8 6604.8 251 B 114 93 11 15 2005 17 10 4225.8 6649.1 116 B 115 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 22 45 4248.5 6614.6 49 B 120	108	89	11	15	2005	7	13	4156.3	6612.6	82	В
111 91 11 15 2005 10 23 4148.1 6543.2 355 V 112 92 11 15 2005 13 4 4213.7 6546.1 224 V, N14 113 93 11 15 2005 14 59 4213.8 6604.8 251 B 114 93 11 15 2005 15 29 4213.8 6604.8 251 B 115 94 11 15 2005 17 10 4225.8 6549.1 116 B 116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 <t< td=""><td>109</td><td>90</td><td>11</td><td>15</td><td>2005</td><td>9</td><td>26</td><td>4147.9</td><td>6546.1</td><td>148</td><td>В</td></t<>	109	90	11	15	2005	9	26	4147.9	6546.1	148	В
112 92 11 15 2005 13 4 4213.7 6546.1 224 V, N14 113 93 11 15 2005 14 59 4213.8 6604.8 251 B 114 93 11 15 2005 15 29 4213.8 6604.8 251 B 115 94 11 15 2005 17 10 4225.8 6549.1 116 B 116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 </td <td>110</td> <td>91</td> <td>11</td> <td>15</td> <td>2005</td> <td>10</td> <td>2</td> <td>4147.8</td> <td>6543.3</td> <td>348</td> <td>B, N13</td>	110	91	11	15	2005	10	2	4147.8	6543.3	348	B, N13
113 93 11 15 2005 14 59 4213.8 6604.8 251 B 114 93 11 15 2005 15 29 4213 6603.6 248 V 115 94 11 15 2005 17 10 4225.8 6549.1 116 B 116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 16 2005 2 9 4309 6638.5 125 B, CO/73cc 121	111	91	11	15	2005	10	23	4148.1	6543.2	355	V
114 93 11 15 2005 15 29 4213 6603.6 248 V 115 94 11 15 2005 17 10 4225.8 6549.1 116 B 116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B,CO/73cc 122 <td>112</td> <td>92</td> <td>11</td> <td>15</td> <td>2005</td> <td>13</td> <td>4</td> <td>4213.7</td> <td>6546.1</td> <td>224</td> <td>V, N14</td>	112	92	11	15	2005	13	4	4213.7	6546.1	224	V, N14
115 94 11 15 2005 17 10 4225.8 6549.1 116 B 116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B, CO/73cc 122 99 11 16 2005 6 19 4328.7 6714.7 211 B, N16, CO/290cc	113	93	11	15	2005	14	59	4213.8	6604.8	251	
116 94 11 15 2005 17 36 4224.7 6547.4 113 W 117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B,CO/73cc 122 99 11 16 2005 4 34 4318.9 6704.6 203 B,Z14,CO/85cc 123 100 11 16 2005 6 19 4328.7 6714.7 211 B,N16,CO/209cc	114	93	11	15	2005	15	29	4213	6603.6	248	V
117 95 11 15 2005 19 58 4226.2 6616.6 242 B 118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B,CO/73cc 122 99 11 16 2005 4 34 4318.9 6704.6 203 B,Z14,CO/85cc 123 100 11 16 2005 6 19 4328.7 6714.7 211 B,N16,CO/209cc 124 100 11 16 2005 8 49 4324 6741.6 244 B,CO/258cc <	115	94	11	15	2005	17	10	4225.8	6549.1	116	В
118 95 11 15 2005 20 21 4225.7 6615.8 242 V 119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B, CO/73cc 122 99 11 16 2005 4 34 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 6 19 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 6 43 4324.8 6714.1 209 W 125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc	116	94	11	15	2005	17	36	4224.7	6547.4	113	W
119 96 11 15 2005 22 45 4248.5 6614.6 49 B 120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B, CO/73cc 122 99 11 16 2005 4 34 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 6 19 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 6 43 4327.8 6714.1 209 W 125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc 126 101 11 16 2005 11 31 4304.3 6750.3 194 B, Z1	117	95	11	15	2005	19	58	4226.2	6616.6	242	
120 97 11 15 2005 23 47 4256 6610.9 112 B,N15,Z13,CO/141cc 121 98 11 16 2005 2 9 4309 6638.5 125 B, CO/73cc 122 99 11 16 2005 4 34 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 6 19 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 6 43 4327.8 6714.1 209 W 125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc 126 101 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 11 31 4304.3 6750.3 194 B, C	118	95	11	15	2005	20	21	4225.7	6615.8	242	V
121 98 11 16 2005 2 9 4309 6638.5 125 B, CO/73cc 122 99 11 16 2005 4 34 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 6 19 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 6 43 4327.8 6714.1 209 W 125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc 126 101 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 17 21 4225.7 6700.1 360 B </td <td>119</td> <td>96</td> <td>11</td> <td>15</td> <td>2005</td> <td>22</td> <td>45</td> <td>4248.5</td> <td>6614.6</td> <td>49</td> <td>В</td>	119	96	11	15	2005	22	45	4248.5	6614.6	49	В
122 99 11 16 2005 4 34 4318.9 6704.6 203 B, Z14, CO/85cc 123 100 11 16 2005 6 19 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 6 43 4327.8 6714.1 209 W 125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc 126 101 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 14 30 4244.1 6725.8 202 B, CO/54cc 129 104 11 16 2005 17 21 4225.7 6700.1 360 <t< td=""><td>120</td><td>97</td><td>11</td><td>15</td><td>2005</td><td>23</td><td>47</td><td>4256</td><td>6610.9</td><td>112</td><td>B,N15,Z13,CO/141cc</td></t<>	120	97	11	15	2005	23	47	4256	6610.9	112	B,N15,Z13,CO/141cc
123 100 11 16 2005 6 19 4328.7 6714.7 211 B, N16, CO/209cc 124 100 11 16 2005 6 43 4327.8 6714.1 209 W 125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc 126 101 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 14 30 4244.1 6725.8 202 B, CO/54cc 129 104 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 44 4225.2 6700.5 360 W	121	98	11	16	2005	2	9		6638.5	125	B, CO/73cc
124 100 11 16 2005 6 43 4327.8 6714.1 209 W 125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc 126 101 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 14 30 4244.1 6725.8 202 B, CO/54cc 129 104 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc <td>122</td> <td>99</td> <td>11</td> <td>16</td> <td>2005</td> <td>4</td> <td>34</td> <td>4318.9</td> <td>6704.6</td> <td>203</td> <td>B, Z14, CO/85cc</td>	122	99	11	16	2005	4	34	4318.9	6704.6	203	B, Z14, CO/85cc
125 101 11 16 2005 8 49 4324 6741.6 244 B, CO/258cc 126 101 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 14 30 4244.1 6725.8 202 B, CO/54cc 129 104 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc <td>123</td> <td>100</td> <td>11</td> <td>16</td> <td>2005</td> <td>6</td> <td>19</td> <td>4328.7</td> <td>6714.7</td> <td>211</td> <td>B, N16, CO/209cc</td>	123	100	11	16	2005	6	19	4328.7	6714.7	211	B, N16, CO/209cc
126 101 11 16 2005 9 15 4323.3 6741.9 245 V 127 102 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 14 30 4244.1 6725.8 202 B, CO/54cc 129 104 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc 133 106 11 16 2005 21 18 4211 6724.8 221 V <td>124</td> <td>100</td> <td>11</td> <td>16</td> <td>2005</td> <td>6</td> <td>43</td> <td>4327.8</td> <td>6714.1</td> <td>209</td> <td>W</td>	124	100	11	16	2005	6	43	4327.8	6714.1	209	W
127 102 11 16 2005 11 31 4304.3 6750.3 194 B, Z15, CO/190cc 128 103 11 16 2005 14 30 4244.1 6725.8 202 B, CO/54cc 129 104 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc 133 106 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test s	125	101	11	16	2005	8	49	4324	6741.6	244	B, CO/258cc
128 103 11 16 2005 14 30 4244.1 6725.8 202 B, CO/54cc 129 104 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc 133 106 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test sample	126	101	11	16	2005	9	15	4323.3	6741.9	245	V
129 104 11 16 2005 17 21 4225.7 6700.1 360 B 130 104 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc 133 106 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test sample	127	102	11	16	2005	11	31	4304.3	6750.3	194	B, Z15, CO/190cc
130 104 11 16 2005 17 44 4225.2 6700.5 360 W 131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc 133 106 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test sample	128	103	11	16	2005	14	30	4244.1	6725.8	202	B, CO/54cc
131 105 11 16 2005 19 28 4213.9 6710.3 210 B, CO/29cc 132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc 133 106 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test sample	129	104	11	16	2005	17	21	4225.7	6700.1	360	В
132 106 11 16 2005 20 59 4211.3 6724.6 225 B, CO/85cc 133 106 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test sample	130	104	11	16	2005	17	44	4225.2	6700.5	360	W
133 106 11 16 2005 21 18 4211 6724.8 221 V 134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test sample	131	105	11	16	2005	19	28	4213.9	6710.3	210	B, CO/29cc
134 107 11 16 2005 23 2 4200.2 6736.7 49 B, video test sample	132	106	11	16	2005	20	59	4211.3	6724.6	225	B, CO/85cc
	133	106	11	16	2005	21	18	4211	6724.8	221	V
	134	107	11	16	2005	23	2	4200.2	6736.7	49	B, video test sample
135 108 11 17 2005 0 48 4149.2 6748.5 36 B, Z16	135	108	11	17	2005	0	48	4149.2	6748.5	36	B, Z16

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE AL0509

CAST STA. Date(GMT) TIME(GMT) LAT LONG DEPTH OPERATION

B=bongo W=water Z=zoogen V=vertical cast (CTD only) D=deep tow CO=Calanus observed/vol NEU=neuston N=nitrogen isotope

mm dd yy hr min

136	109	11	17	2005	3	25	4153.3	6820.5	203	B, CO/221cc	
137	110	11	17	2005	6	22	4158.4	6852.8	132	В	
138	110	11	17	2005	6	37	4157.9	6853	131	W	
139	111	11	17	2005	7	55	4208.8	6856.8	148	B, CO/147cc	
140	112	11	17	2005	9	11	4215.9	6902.1	190	B, CO/147cc	
141	113	11	17	2005	11	44	4200	6924.3	208	B, CO/438cc	
142	114	11	17	2005	14	16	4159.8	6955.4	53	В	
143	114	11	17	2005	14	32	4200.4	6955.7	56	B. video test sample	
144	115	11	17	2005	16	32	4218.6	6950.6	226	B, Z17, CO/203cc	
145	115	11	17	2005	16	54	4219.3	6950.6	227	W	
146	116	11	17	2005	18	18	4224	6935.3	243	B, CO/234cc	
147	116	11	17	2005	18	39	4224.3	6935.2	243	V	
148	117	11	17	2005	19	34	4229.7	6939.9	250	B, N17, CO/277cc	
149	117	11	17	2005	20	0	4230.5	6939.8	239	V	
150	118	11	17	2005	22	2	4238.8	7000.6	126	В	
151	119	11	17	2005	23	2	4241	7009.7	97	В	
152	119	11	17	2005	23	25	4241.6	7010.1	104	B,Z18, video test sample	
153	120	11	18	2005	2	6	4225.2	7035.4	86	B, N18	
154	121	11	18	2005	3	14	4221.2	7045.7	28	В	

TOTALS:	Bongo Casts	=	120
	Bongo 6B3Z Samples	=	119
	Bongo 6B3I Samples	=	119
	Water Samples	=	23
	Vertical Casts	=	7
	CTD Casts	=	154
	Zoogen samples	=	18
	Neuston samples	=	8
	Nitrogen isotope samples	=	18
	<u>Calanus</u> observations	=	18
	Video test samples	=	3

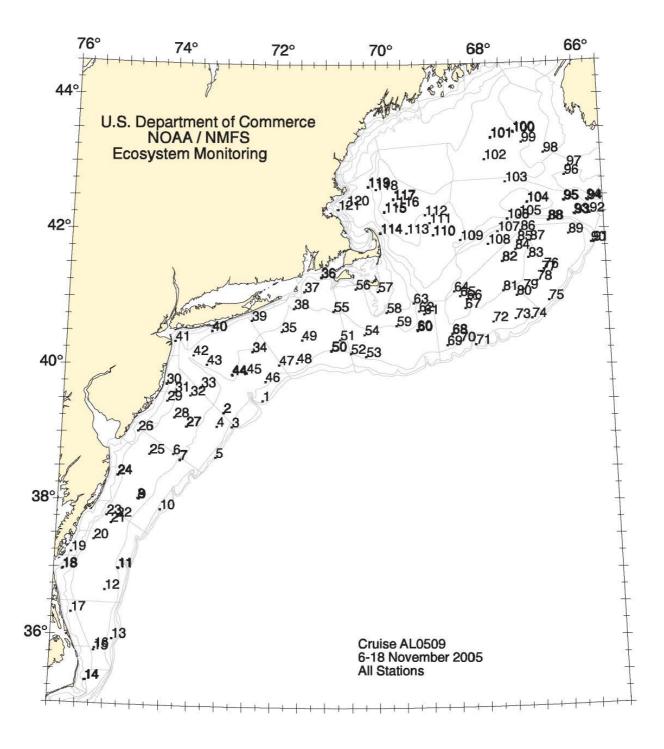


Figure 1. Station locations numbered consecutively for Late Summer Ecosystem Monitoring Cruise AL0509, 5 - 18 November 2005.