

CRUISE RESULTS
NOAA Fisheries Research Vessel DELAWARE II
Cruise No. DE 07-06
Northeast Shelf Ecosystem Monitoring Late Spring Survey

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CRUISE PERIOD AND AREA

The cruise period was 22 May to 5 June 2007. The NOAA fisheries research vessel DELAWARE II sampled at a total of 131 stations. Of these, 39 were located in the Gulf of Maine, 30 were located on Georges Bank (GB), 31 were in the Southern New England (SNE) area and 31 in the Mid-Atlantic Bight (MAB). The Gulf of Maine (GOM) stations included 5 fixed stations: the Wilkinson, Jordan and Georges basins, the site of a proposed liquefied natural gas (LNG) terminal east of Boston Harbor and the Northeast Channel (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 Georges Bank and Gulf of Maine 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 and salinity. Near-surface along-track chlorophyll-*a* fluorescence, water temperature and salinity were measured while underway with the vessel's flow-through sampling system. Secondary objectives of this cruise included the following:

- Vertical CTD casts to within 5 meters of the bottom in Gulf of Maine deep basin areas 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.
- Collection of plankton samples for correlation of nitrogen, carbon and oxygen isotopes of zooplankton from the Great South Channel area with isotopes from northern right whale baleen (Nadine Lysiak samples).
- Collection of phytoplankton samples from the ship's flow-through seawater system for nitrogen isotope ratio analysis.
- Note turbidity of water column through the use of a secchi disk at selected stations.
- Calibration of flowmeters by towing them over a known distance and recording the revolutions counted.
- Note presence and volume of *Calanus finmarchicus* in samples upon return of cruise to shore.
- Collection of Acoustic Doppler Current Profiler (ADCP) data in the vicinity of the Martha's

Vineyard Coastal Observatory and GoMOOS buoy No. 107 for calibration of the ship's ADCP unit.

- Note location and abundance of marine mammals and seabirds, and make neuston tows near them.

METHODS

The survey consisted of 131 stations at which the vessel stopped to lower instruments over the side (Figure 1). All stations sampled were at randomly stratified locations except for nine stations in the GOM, one in SNE, and one in the MAB. Five of the non-random stations GOM stations were at fixed positions visited on all Ecosystem Monitoring cruises: Wilkinson Basin, Jordan Basin, Georges Basin, a proposed Liquefied Natural Gas terminal site east of Boston and the Northeast Channel. The other six non-random stations on this cruise were located at positions between randomly selected stations, and were done to improve areal coverage on transits greater than four hours.

Plankton and hydrographic sampling was conducted at all stations by making double oblique tows using the 61-cm bongo sampler and a Seabird CTD. The tows were made to approximately 5 m above the bottom, or to a maximum depth of 200 m. All plankton tows were conducted at a ship speed of 1.5 – 2.0 knots. Plankton sampling gear consisted of a 61-cm 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 (Figure 2.). A 45-kg lead weight in the shape of a flat-bottomed pear was attached by an 80-cm length of 3/8-inch diameter chain below the aluminum bongo frame to depress the sampler. The flat bottomed configuration of the depressor weight made for safer deployment and retrieval of the sampling gear when the boat was rolling in rough seas. 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 off the starboard stern quarter of the vessel using an A-frame and a Sea-Mac winch which was placed on the aft deck specifically for this operation. After retrieval, the bongo frames were carried into a covered work area on the port side of the aft deck and placed on tables for wash down of the nets to obtain the plankton samples. This work space allowed for much easier removal of the samples, particularly during inclement weather. The 61-cm bongo plankton samples were preserved in a 5% solution of formalin in seawater. The zooplankton genetics samples from the 20-cm diameter bongos were preserved in 95% ethanol, which was changed once at 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 m of the bottom was made in the Wilkinson and Jordan basins to provide hydrographic data from below the 200 m limit set for bongo tows.

Continuous monitoring of the seawater salinity, temperature and chlorophyll-*a* level, from a depth of 4.6 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 twice a day using a 1.7 liter Niskin bottle taking a water sample from 25 or more meters depth in an isohaline portion of the water column.

Calibration of the CTD salinities and chlorophyll-a from the surface flow-through system was undertaken twice daily while the ship was underway. Sample analysis for these calibrations followed the protocol outlined in the Ecosystem Monitoring Program Operations Manual.

Zooplankton genetics (zoogen) samples were collected using the 20-cm diameter bongos described above at 5 randomly designated stations in the Mid-Atlantic Bight and Southern New England regions. Six zoogen samples were collected in the Georges Bank and Gulf of Maine regions. Collecting of these samples was facilitated by the excellent weather which made deployment of the 20-cm bongos much easier than it had been on the Winter Ecosystems Monitoring Survey.

The 20-cm bongo sampler was also used to collect 9 samples for WHOI researcher Nadine Lysiak. Six of these samples were from the Mid-Atlantic Bight, two were from Southern New England, and one was collected in the Gulf of Maine in the vicinity of a pod of northern right whales. All of these samples were frozen for shore-side analysis of carbon, nitrogen, oxygen and hydrogen stable isotope ratios to correlate with the isotope ratios of these same elements within northern right whale baleen.

Nitrogen isotope samples were collected from 18 stations along the entire cruise track by filtering 600 – 1000 ml of seawater from the discharge of the ship's flow-through seawater system. The seawater was filtered through 25 mm diameter Whatman glass fiber filters (GFF) and the filters were subsequently frozen for analysis ashore.

Flowmeters were calibrated at sea south of Martha's Vineyard in the vicinity of the Martha's Vineyard Coastal Observatory. The bongo sampler was towed at normal bongo tow speeds of 1.5 – 2.0 knots, with the cod ends open for a distance of 0.333 nautical miles. After having been towed for that distance, the bongos were removed from the water, flowmeters were read, nets were hosed down to clear the meshes, and the sampler returned to the water, but now towed for the same distance and speed in the opposite direction, to offset the possible effects of any currents on the flowmeters. Two runs were made in each direction with one bongo frame, to calibrate flowmeters that has not been calibrated in 2007.

Presence and volume of *Calanus finmarchicus* was noted in the samples after completion of the cruise by measuring the settled height of the samples in mm, and then converting it to cc using the method listed in Prezioso and Kane (in prep).

Water column turbidity was measured through the use of a secchi disk at 15 stations across the entire survey area of the cruise. The white plastic disk, 31 cm in diameter, was shackled to the end of the bongo tow cable, with the 45 kg depressor weight attached below it. Secchi depth was measured using the wire out meter.

The DELAWARE II stopped near two ADCP equipped facilities to compare the vessel's ADCP data with ADCP data from the fixed station. The first stop was at the Martha's Vineyard Coastal Observatory, which has a tower just south of Martha's Vineyard at 41° 19.5' N 70° 34.0' W. The second stop was at GoMOOS buoy No. 107, located in the Northeast Channel, at 42° 19.4' N 65° 55.6' W.

Marine mammal and seabird observations were made and logged along the entire survey area by Marie-Caroline Martin and Jarrod Santora from the flying bridge of the DELAWARE II (Figures 2 and 3). Neuston tows were made in the vicinity of 4 whale and bird sightings for observer Marie Caroline Martin using a ½ x 1 meter neuston frame equipped with a 505 micron mesh net.

RESULTS

A summary of routine survey activities is presented in Table 1. Areal coverage for the cruise is shown in Figure 1. Excellent weather for almost the entire cruise period allowed all stations in all regions to be sampled, with time for an additional station in the Mid-Atlantic Bight and Southern New England regions, and 4 additional stations in the Gulf of Maine region, where transits of more than 4 hours were encountered between random stations.

The DELAWARE II sailed at 1330 hours EDT on Tuesday, 22 May 2007, under calm conditions and proceeded southeast to sample the offshore stations of the Southern New England and Mid-Atlantic Bight, taking advantage of the excellent weather. The southernmost station of the cruise was reached very early Friday morning, 25 May 2007, and with the continuation of calm conditions the vessel completed sampling the Mid-Atlantic Bight and Southern New England regions by very early Tuesday morning, 29 May. A large concentration of marine birds and several whales was sighted on Monday, 28 May, and a neuston tow was made at the request of the bird observer, to sample surface plankton in the vicinity of this sighting at 40 29.8 N 69 54.9 W.

After completing plankton sampling in the Southern New England region, the vessel proceeded to the Martha's Vineyard Coastal Observatory for ADCP data calibration, and simultaneously calibrated two flowmeters by making two east-west runs and averaging the results (Table 2). Following completion of the flowmeter calibration, the vessel stayed in the vicinity of the Coastal Observatory tower until it was time to rendezvous with a launch from the Woods Hole NEFSC, to exchange scientists for the second part of the cruise. At 0910 hours EDT, 29 May 2007, the vessels rendezvoused off of Nobska Point and scientists Joseph Kane, Courtney Schmidt and Autumn Oczkowski disembarked, while Joseph DeStefano, Tamara Holzwarth-Davis and Michael Prezioso came on board. The transfer went very smoothly under excellent weather conditions and was completed in less than 30 minutes. The vessel then steamed through the Great Round Shoal channel into the southern Gulf of Maine and on towards Georges Bank. As the vessel reached the Great South Channel a very large concentration of marine birds, dolphins and several species of baleen whales, including northern right whales was sighted. Another neuston tow was made there, and a sample was collected for Nadine Lysiak as well. A summary of the marine mammal and bird observations made is included in a report by Santora, Martin and Veit listed in Appendix A.

The DELAWARE II sampled Georges Bank in a counter-clockwise direction, starting from the southwest corner and working around to the northwest shoal area. The excellent weather conditions from the first part of the trip continued, making for rapid progress, and by Thursday, 31 May, the vessel reached GoMOOS Buoy No. 107 in the Northeast Channel. After standing by near it for 2 hours to collect comparison ADCP data, sampling continued until all Georges Bank work was completed early on 2 June, after which the vessel proceeded on into the Gulf of Maine. The stations were again sampled in a counter-clockwise manner, and again with excellent progress being made due to the continued calm sea conditions until late on 3 June when the remnants of Tropical Depression Barry increased winds and seas to a point where work was slowed, but not stopped. By that time sampling was almost completed, with only half a dozen stations remaining in the far western part of the Gulf of Maine, from Wilkinson Basin to near Boston. All sampling was completed by Monday, 4 June, after which the vessel transited the Cape Cod Canal at dawn on 5 June and docked at the NMFS dock at 1530 hours, marking the end of the DE0706 Late Spring Ecosystem Monitoring cruise.

DISPOSITION OF SAMPLES AND DATA

All samples and data, except for the zooplankton genetics samples, the WHOI isotope sample, the EPA nitrogen samples, the 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. Nadine Lysiak from WHOI picked up her frozen isotope samples and the CTD data were delivered to the Oceanography Branch of the NEFSC, Woods Hole, MA. The EPA nitrogen isotope samples were delivered to the EPA laboratory in Narragansett. The neuston samples were taken to College of Staten Island – City University of New York (CSI-CUNY) by Marie-C. Martin. 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

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Table 1. STATION OPERATION REPORT FOR CRUISE DE0706

CAST	STA.	Date(GMT)		TIME(GMT)		LAT	LONG	DEPTH	OPERATION	
		mm	did	yy	hr					min
1	1	5	22	2007	23	21	4058.6	7050.6	49	B, CO/295cc
2	2	5	23	2007	3	9	4033.6	7114.6	67	B, CO/314cc
3	3	5	23	2007	6	1	4021.5	7041.4	93	B, CO/401cc, N1
4	4	5	23	2007	8	13	4011.4	7102.7	130	B
5	5	5	23	2007	10	16	4011.3	7126.4	84	B, CO/685cc
6	6	5	23	2007	13	32	4003.6	7206.8	73	B, CO/463cc, N2
7	6	5	23	2007	13	43	4003.6	7206.4	74	W1, S1=10 m
8	7	5	23	2007	15	27	3948.5	7212.3	89	B, CO/252cc, Z1
9	8	5	23	2007	17	19	3933.8	7221.9	108	B, CO/413cc
10	9	5	23	2007	21	22	3911.4	7302.5	73	W2
11	9	5	23	2007	21	32	3911.4	7302.4	73	B, CO/271cc
12	10	5	23	2007	23	14	3856.3	7255	106	B, Z2
13	11	5	24	2007	2	0	3836.1	7310.3	750	B
14	12	5	24	2007	4	9	3824.3	7329.1	109	B
15	13	5	24	2007	5	1	3821.2	7337	125	B, CO/227cc, N3
16	14	5	24	2007	8	43	3831	7418.7	40	B
17	15	5	24	2007	13	0	3751.4	7438.7	44	B, Z3
18	16	5	24	2007	15	52	3739	7431.3	63	W3, S2=8.5 m
19	16	5	24	2007	16	3	3739.2	7431.3	63	B, CO/370cc
20	17	5	24	2007	20	10	3703.3	7437.2	314	W4
21	17	5	24	2007	20	18	3703.2	7437.2	323	B, CO/351cc
21	17	5	24	2007	20	18	3703.2	7437.2	314	B
22	18	5	25	2007	1	23	3613.9	7448.6	103	B, Z4, N4
23	19	5	25	2007	4	5	3551.3	7500.4	47	B
24	20	5	25	2007	8	47	3511.6	7518.5	30	B, Wiso1
25	21	5	25	2007	14	55	3611.4	7540.7	15	W5, S3=3 m

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE DE0706

CAST	STA.	Date(GMT)		TIME(GMT)		LAT	LONG	DEPTH	OPERATION	
		mm	did	yy	hr					min
									B=bongo W=water Z=zoogen V=vertical cast (CTD only) CO=Calanus observed/vol S=secchi / meters N=nitrogen isotope Wiso=WHOI isotope	
26	21	5	25	2007	15	3	3611.2	7540.8	15	B
27	22	5	25	2007	17	53	3616.2	7509	33	B, Z5
28	23	5	25	2007	19	46	3403.8	7508.8	28	W6
29	23	5	25	2007	19	52	3403.7	7508.7	28	B, Wiso2
30	24	5	25	2007	20	34	3638.8	7506.8	28	B
31	25	5	25	2007	21	28	3641.6	7514.7	35	B
32	26	5	26	2007	1	3	3708.2	7539.9	14	B, N5
33	27	5	26	2007	2	17	3718.9	7532.5	14	B, Wiso3
34	28	5	26	2007	3	8	3718.9	7523.1	22	B
35	29	5	26	2007	6	27	3746.2	7502.6	25	B, Wiso4
36	30	5	26	2007	10	44	3828.6	7458.4	13	B
37	31	5	26	2007	11	30	3833.6	7454.8	20	B, N6
38	32	5	26	2007	13	28	3838.6	7432.8	31	B, Wiso5
39	33	5	26	2007	14	41	3848.9	7430.8	20	B, Z6
40	34	5	26	2007	16	18	3901.3	7420.7	31	W7, S4=3.5 m
41	34	5	26	2007	16	25	3901.3	7420.7	31	B
42	35	5	26	2007	18	15	3858.8	7358.9	38	B, CO/246cc
43	36	5	26	2007	19	13	3906.3	7402.8	34	W8
44	36	5	26	2007	19	18	3906.3	7402.7	34	B
45	37	5	26	2007	21	57	3928.6	7346.8	30	B
46	38	5	26	2007	22	59	3931.1	7356.7	23	B, Wiso6
47	39	5	27	2007	0	55	3948.6	7402.6	16	B
48	40	5	27	2007	4	5	3951.2	7322.6	40	B, CO/333cc
49	41	5	27	2007	5	25	3941.4	7315.1	42	B, CO/314cc
50	42	5	27	2007	6	57	3951.3	7302.7	71	B
51	43	5	27	2007	8	3	3958.7	7256.3	50	B, CO/252cc
52	44	5	27	2007	9	32	4003.6	7240.8	58	B, CO/209cc
53	45	5	27	2007	11	45	4008.7	7306.9	43	B, Wiso7
54	46	5	27	2007	15	34	4028.7	7348.3	24	B, Z7, N7
55	47	5	27	2007	19	32	4036.2	7259.1	23	W9, S5=5 m
56	47	5	27	2007	19	40	4036.3	7259.1	22	B, Z8
57	48	5	27	2007	23	48	4043.9	7206.7	44	B
58	49	5	28	2007	1	12	4056.1	7208.1	16	B
59	50	5	28	2007	3	21	4053.6	7142.6	56	B
60	51	5	28	2007	4	23	4051.2	7130.9	59	B

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE DE0706

CAST	STA.	Date(GMT)		TIME(GMT)		LAT	LONG	DEPTH	OPERATION	
		mm	dd	yy	hr	min		m		
									B=bongo W=water Z=zoogen V=vertical cast (CTD only) CO=Calanus observed / vol S=secchi / meters N=nitrogen isotope Wiso=WHOI isotope	
61	52	5	28	2007	6	22	4108.7	7124.7	41	B, N8
62	53	5	28	2007	12	23	4033.5	7020.3	60	B, CO/190cc, Wiso8
63	54	5	28	2007	15	44	4003.9	7002.7	150	B, Z9
64	55	5	28	2007	18	5	4003.9	6935.1	105	B, CO/221cc, Z10
65	56	5	28	2007	20	32	4020.9	6952.7	78	W10, S6=9 m
66	56	5	28	2007	20	40	4020.9	6952.7	78	B, CO/562cc
67	57	5	28	2007	21	20	4021.2	6956.4	80	B, CO/537cc
68	58	5	28	2007	23	33	4036.9	6955.8	57	(Neuston 1 collected prior to sta 58) B
69	59	5	29	2007	1	19	4047.9	7008.9	36	B
70	60	5	29	2007	2	52	4058.9	7020.2	42	B
71	61	5	29	2007	4	7	4108.7	7026.7	35	(ADCP/flowmeter calibration & personnel exchange after sta 61) B
72	62	5	29	2007	18	44	4131.4	6928.7	51	W11
73	62	5	29	2007	18	53	4131.2	6928.6	50	B Neuston 2 collected after sta 62
74	63	5	29	2007	20	33	4128.7	6914.9	139	B, CO/562cc
75	64	5	29	2007	21	34	4128.8	6906.9	144	B, CO/258cc, Wiso9 Right Whales sighted
76	65	5	30	2007	1	23	4056.3	6854.8	72	B
77	66	5	30	2007	3	26	4113.8	6840.8	61	B, CO/382cc
78	67	5	30	2007	4	54	4111.1	6822.6	53	B, N9
79	68	5	30	2007	7	50	4038.7	6827.3	66	B
80	69	5	30	2007	8	47	4031.2	6822.8	92	B
81	70	5	30	2007	10	36	4016.2	6821	157	B, CO/314cc, Z11
82	71	5	30	2007	13	23	4023.8	6752.9	175	B, CO/159cc
83	72	5	30	2007	15	41	4038.8	6734.8	84	W12, S7=8 m
84	72	5	30	2007	15	51	4038.9	6734.9	84	B, Z12
85	73	5	30	2007	18	19	4056.1	6752.8	57	B
86	74	5	30	2007	19	7	4058.6	6744.9	10	W13
87	74	5	30	2007	19	11	4058.6	6744.9	58	B
88	75	5	30	2007	20	22	4106.3	6750.9	49	B
89	76	5	30	2007	22	4	4111.6	6734.5	41	B, Z13, N10
90	77	5	31	2007	0	19	4055.6	6717.7	80	B
91	78	5	31	2007	1	52	4058.7	6700.6	74	B
92	79	5	31	2007	2	34	4101.2	6658.9	70	B
93	80	5	31	2007	5	1	4118.9	6716.8	47	B
94	81	5	31	2007	5	54	4123.8	6720.9	41	B
95	82	5	31	2007	7	30	4133.5	6710.8	52	B, Z14

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE DE0706

CAST	STA.	Date(GMT)		TIME(GMT)		LAT	LONG	DEPTH	OPERATION	
		mm	did	yy	hr					min
									B=bongo W=water Z=zoogen V=vertical cast (CTD only) CO=Calanus observed / vol S=secchi / meters N=nitrogen isotope Wiso=WHOI isotope	
96	83	5	31	2007	11	8	4108.9	6636.9	88	B
97	84	5	31	2007	12	36	4121.3	6632.8	89	B, CO/333cc
98	85	5	31	2007	15	32	4146.3	6622.8	78	(Neuston 3 collected prior to sta 85) B, Z19
99	86	5	31	2007	17	18	4146.3	6558.5	100	W14, S8=6.5 m
100	86	5	31	2007	17	23	4146.3	6558.4	101	B, CO/314cc
101	87	5	31	2007	18	9	4148.7	6551	127	B, CO/190cc
102	88	5	31	2007	19	3	4153.7	6554.7	340	B, CO/110cc, N11
103	88	5	31	2007	19	42	4153.2	6544.7	400	W15
104	89	5	31	2007	7	22	4213.3	6546.1	222	V
105	89	5	31	2007	22	26	4213.5	6546.7	220	B, CO/326cc
106	90	6	1	2007	5	6	4231.1	6642.5	262	(ADCP calib prior to sta 90) V
107	90	6	1	2007	5	25	4231.1	6642.4	264	B, CO/277cc
108	91	6	1	2007	7	11	4242.8	6659.9	360	V
109	91	6	1	2007	7	39	4225	6700.3	200	B, CO/314cc
110	92	6	1	2007	10	19	4221.6	6630.6	298	V
111	92	6	1	2007	10	30	4221.6	6630.4	298	B, CO/277cc (Neuston 4 taken after sta 93)
112	93	6	1	2007	13	0	4203.9	6631	86	B, CO/884cc, Z15
113	94	6	1	2007	15	6	4201.3	6658.4	56	B
114	95	6	1	2007	15	50	4203.9	6704.8	55	B
115	95	6	1	2007	15	59	4203.7	6704.5	56	W16, S9=6.5 m
116	96	6	1	2007	17	31	4211.3	6719.2	194	B, CO/580cc, Z16, N12
117	97	6	1	2007	18	38	4203.6	6720.5	49	B
118	98	6	1	2007	19	36	4153.8	6716.8	49	W17, S10=6.8 m
119	98	6	1	2007	19	44	4153.6	6716.7	49	B
120	99	6	1	2007	22	11	4159.2	6744.8	60	B
121	100	6	2	2007	0	51	4140.6	6802.9	34	B
122	101	6	2	2007	4	38	4203.6	6844.8	157	B, CO/240cc, N13
123	102	6	2	2007	6	49	4221.4	6850.8	205	B, CO/326cc, Z17
124	103	6	2	2007	8	58	4221.3	6826.7	200	B, CO/661cc
125	104	6	2	2007	11	51	4213.8	6752.8	235	W18, S11=7 m
126	104	6	2	2007	12	11	4213.8	6752.7	236	B, CO/599cc
127	105	6	2	2007	16	49	4243.7	6716.9	212	V, S12=12 m
128	105	6	2	2007	17	3	4243.7	6716.7	211	B, CO/234cc, Z18
129	106	6	2	2007	19	31	4302.5	6705.1	210	B, CO/481cc
130	107	6	2	2007	22	16	4321.4	6653.1	208	W19

Table 1. (cont.) STATION OPERATION REPORT FOR CRUISE DE0706

CAST	STA.	Date(GMT)		TIME(GMT)		LAT	LONG	DEPTH	OPERATION	
		mm	did	yy	hr					min
131	107	6	2	2007	22	31	4321.3	6653.1	208	B, CO/289cc
132	108	6	3	2007	0	49	4341.2	6640.8	150	B, CO/265cc108
133	109	6	3	2007	3	57	4411.3	6658.9	165	B, CO/320cc, Z20
134	110	6	3	2007	7	4	4343.6	6708.6	170	B, CO/351cc
135	111	6	3	2007	8	30	4341.2	6722.7	210	B, CO/438cc
136	112	6	3	2007	10	24	4338.9	6740.7	232	W20, S13=8 m
137	112	6	3	2007	10	43	4339	6741	232	B, CO/283cc, Z21
138	113	6	3	2007	12	37	4328.8	6754.6	265	V, S14=8 m
139	113	6	3	2007	12	54	4329	6754.7	272	B, CO/444cc
140	114	6	3	2007	14	36	4324	6742.1	248	V
141	114	6	3	2007	14	36	4324.2	6742.4	248	B, CO/258cc
142	115	6	3	2007	16	26	4316.2	6758.9	230	V, S15=9 m
143	115	6	3	2007	16	40	4316.3	6759.2	229	B, CO/277cc, Z22, N15
144	116	6	3	2007	18	59	4301.3	6818.9	164	B, CO/289cc
145	117	6	3	2007	20	24	4256.2	6830.9	176	B, CO/586cc
146	118	6	3	2007	22	6	4309	6836.9	177	B, CO/345cc
147	119	6	4	2007	0	0	4323.6	6828.8	180	B, CO/475cc
148	120	6	4	2007	3	15	4345.6	6856.9	53	N16 No plankton collected due to fixed gear
149	121	6	4	2007	4	52	4333.6	6856.6	113	B
150	122	6	4	2007	7	28	4313.6	6914.7	171	B, CO/295cc
151	123	6	4	2007	9	45	4306.2	6941.6	100	W21
152	123	6	4	2007	9	58	4306.1	6941.7	99	B
153	124	6	4	2007	12	10	4258.7	7008.4	142	B, CO/518cc
154	125	6	4	2007	14	26	4251.4	7034.7	90	B, N17
155	126	6	4	2007	17	16	4240.8	7007.8	109	B
156	127	6	4	2007	20	45	4230.2	6940.1	248	V
157	127	6	4	2007	21	4	4230.3	6940.1	242	B
158	128	6	4	2007	22	37	4228.7	6952.5	206	B
159	129	6	5	2007	1	5	4226.1	7016.5	64	B
159	129	6	5	2007	1	5	4226.1	7016.5	64	B
160	130	6	5	2007	2	51	4224.9	7036.8	82	B
161	131	6	5	2007	3	29	4223.6	7042.8	48	B, N18

TOTALS: Bongo Casts = 131
 Bongo 6B3Z Samples = 130
 Bongo 6B3I Samples = 130
 Water Samples = 21
 Vertical Casts = 7
 CTD Casts = 161
 Secchi Casts = 15
 Zoogen samples = 22
 N.Lysiak WHOI isotope samples = 9
Calanus observations = 55

Nitrogen isotope samples = 18
 Neuston samples = 4

Table 2. Results of bidirectional flowmeter calibration runs near ADCP Tower,
 Martha's Vineyard 29 May 2007.

FLOWMETER/DIR	START	END	REVS	M/REV	AVG M/REV	FINAL AVG cal factor	Flowmeter#
B02684 DN	337	1735	1398	0.441144	0.3282		
B02684 UP	1735	4599	2864	0.215335		0.3215	B02684
B02684 UP	4599	7408	2809	0.219551	0.3148		
B02684 DN	7408	8912	1504	0.410053			
B09629 DN	62662	64076	1414	0.436153	0.3251		
B09629 UP	64076	66956	2880	0.214139		0.3197	B09629
B09629 DN	66956	69773	2817	0.218928	0.3142		
B09629 DN	69773	71279	1506	0.409509			

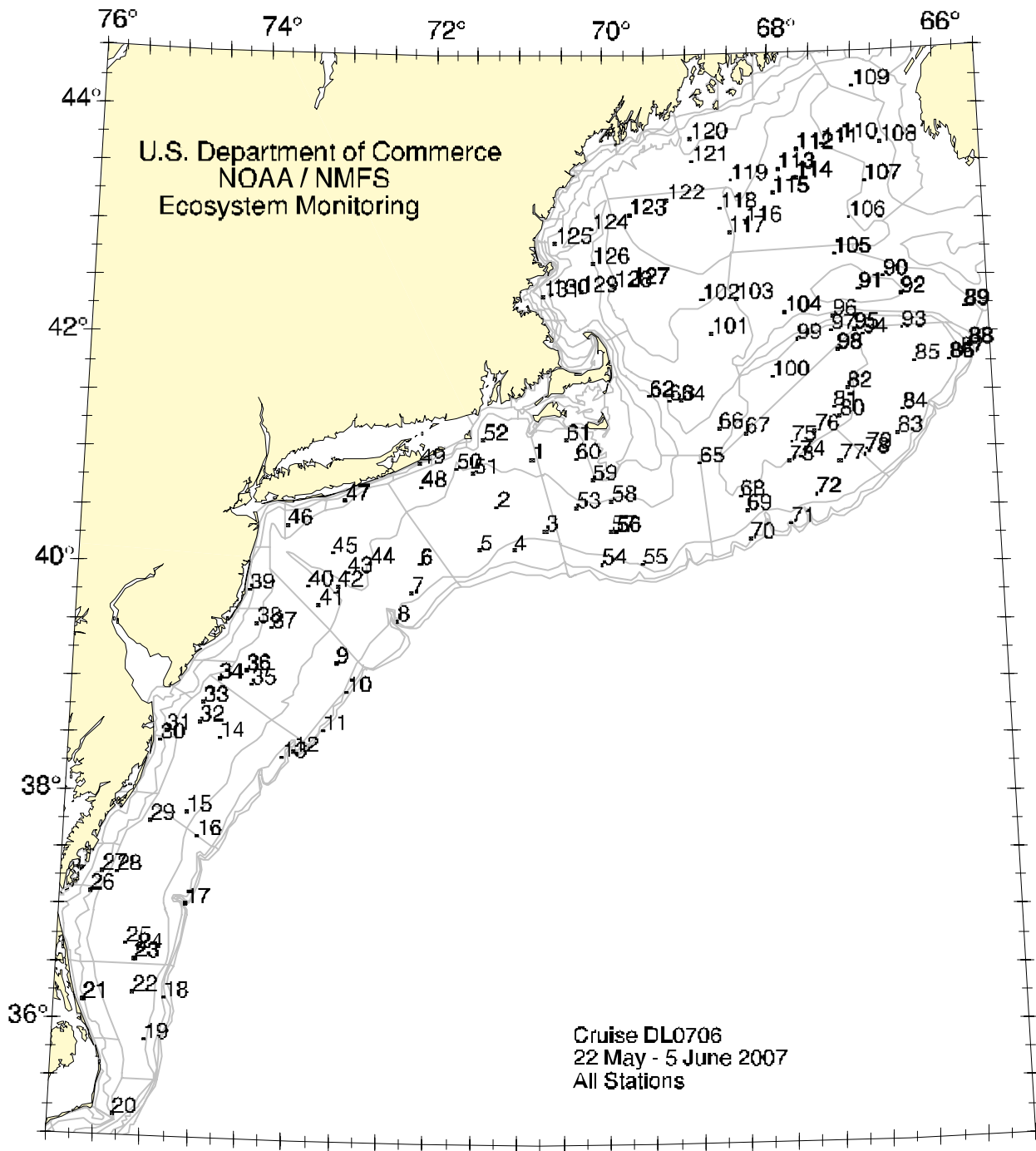


Figure 1. Station locations numbered consecutively for Late Spring Ecosystem Monitoring Cruise DE 07-06, 22 May - 5 June 2007.



Figure 2. Marie-Caroline Martin conducting seabird and marine mammal observations from DELAWARE II flying bridge.



Figure 3. Waterproof data logging station for seabird and marine mammal observations on DELAWARE II flying bridge.



Figure 4. One half by one meter neuston frame equipped with 505 micron mesh net being deployed from the aft A-frame of the R/V DELAWARE II.

Appendix A.

Distribution of seabirds and marine mammals During the 2007 May-June Ecosystems Monitoring (EcoMon) survey.

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1. Objectives

This investigation focuses on measuring the distribution of seabirds in the Northwestern Atlantic Ocean ranging from the Gulf of Maine to Cape Hatteras NC during the Ecosystems Monitoring (EcoMon) survey during 22 May to 7 June 2007. The primary objective was to map the abundance of seabirds at sea.

2. Methods

Data on seabird abundance and behavior were collected using binoculars while underway between stations during daylight hours. Surveys followed strip-transect methods (Tasker et al. 1984) and counts were made within an arc of 300m directly to one side of the ship. Observations were collected on the flying bridge of NOAA R/V Delaware II. Data were entered in a laptop computer and each record was immediately assigned a time and position directly fed by the ships navigational computer. The computer was synchronized with the ships data acquisition computer for GMT time. Individual birds or flocks of birds were assigned a behavioral code. The behaviors were: flying (with direction), sitting on water, milling, and feeding. Data recorded for mammals included distance and degrees from the ships trackline. The speed of the Delaware II during transit was 10 nmi/hr.

3. Accomplishments

We collected data on the distribution of seabirds during both legs of EcoMon. The species observed and totals for the survey are presented in Table 1. The distribution and abundance of shearwaters, storm petrels, and alcids are presented in Figures 1-3.

Table 1: Summary of Species Totals

	CODE	Name	Latin Name	SUM
1	COLO	Common Loon	<i>Gavia immer</i>	80
2	RTLO	Red-throated Loon	<i>Gavia stellata</i>	8
3	RNGR	Red-necked Grebe	<i>Podiceps grisegena</i>	1
4	NOFU	Northern Fulmar	<i>Fulmarus glacialis</i>	1263
5	GRSH	Greater Shearwater	<i>Puffinus gravis</i>	5868
6	MASH	Manx Shearwater	<i>Puffinus puffinus Puffinus</i>	23
7	SOSH	Sooty Shearwater	<i>Puffinus griseus</i>	5955
8	WISP	Wilson's Storm Petrel	<i>Oceanites oceanicus</i>	6275
9	LESP	Leach's Storm Petrel	<i>Oceanodroma leucorhea</i>	1846
10	BRSP	Band-rumped Storm Petrel	<i>Oceanodroma castro</i>	4
11	UNSP	Unknown Storm Petrel	<i>Oceanites & Oceanodroma sp.</i>	17263
12	DCCO	Double-crested Cormorant	<i>Phalacrocorax aurilus</i>	132
13	GRCO	Great Cormorant	<i>Phalacrocorax carbo</i>	4
14	NOGA	Northern Gannet	<i>Morus bassanus</i>	405
15	BLSC	Black Scoter	<i>Melanitta nigra</i>	2
16	EAWI	Eastern Willet	<i>Catoptrophorus semipalmatus</i>	1
17	REPH	Red Phalarope	<i>Phalaropus fulicaria</i>	870
18	RNPH	Red-necked Phalarope	<i>Phalaropus lobatus</i>	130
19	UNPH	Unknown Phalarope	<i>Phalaropus sp.</i>	85
20	LTJA	Long-tailed Jaeger	<i>Stercorarius longicaudus</i>	3
21	PAJA	Parasitic Jaeger	<i>Stercorarius longicaudus</i>	17
22	POJA	Pomarine Jaeger	<i>Stercorarius pomarinus</i>	8
23	SPSK	South Polar Skua	<i>Catharacta maccormicki</i>	25
24	LAGU	Laughing Gull	<i>Larus atricilla</i>	28
25	HEGU	Herring Gull	<i>Larus argentatus</i>	1646
26	LBGU	Lesser Black-backed Gull	<i>Larus fuscus</i>	1
27	BBGU	Greater Black-backed Gull	<i>Larus marinus</i>	388
28	BLKW	Black-legged Kittiwake	<i>Larus tridactyla</i>	3
29	CATE	Caspian Tern	<i>Sterna caspia</i>	21
30	COTE	Common Tern	<i>Sterna hirundo</i>	141
31	ARTE	Arctic Tern	<i>Sterna paradisaea</i>	14
32	ROTE	Roseate Tern	<i>Sterna dougallii</i>	26
33	LETE	Least Tern	<i>Sterna albifrons</i>	1
34	UNTE	Unknown Tern	<i>Sterna sp.</i>	12

35	COMU	Common Murre	<i>Uria aalge</i>	20
36	TBMU	Thick-billed Murre	<i>Uria lomvia</i>	62
37	DOVE	Dovekie	<i>Alle alle</i>	407
38	ATPU	Atlantic Puffin	<i>Fratercula arctica</i>	54
39	REVI	Red-eyed Vireo	<i>Vireo olivaceus</i>	1
40	BASW	Barn Swallow	<i>Hirundo rustica</i>	4
41	GRCA	Gray Catbird	<i>Dumetella carolinensis</i>	1
42	YEWA	Yellow Warbler	<i>Dendroica petechia</i>	1
43	BPWA	Blackpoll Warbler	<i>Dendroica striata</i>	1
44	COYE	Common Yellowthroat	<i>Geothlypis trichas</i>	1
45	RIWH	Right Whale	<i>Eubalaena glacialis</i>	10
46	FIWH	Fin Whale	<i>Balaenoptera physalus</i>	36
47	SEWH	Sei Whale	<i>Balaenoptera borealis</i>	2
48	MIWH	Minke Whale	<i>Balaenoptera acutorostrata</i>	20
49	HUWH	Humpback Whale	<i>Megaptera novaangliae</i>	55
50	SPWH	Sperm Whale	<i>Physeter macrocephalus</i>	1
51	SFPW	Short-finned Pilot Whale	<i>Globicephala macrorhynchus</i>	17
52	PIWH	Unknown Pilot Whale	<i>Globicephala sp.</i>	8
53	FKWH	False Killer Whale	<i>Pseudorca crassidens</i>	10
54	CODO	Common Dolphin	<i>Delphinus delphis</i>	380
55	BTDO	Bottle-nosed Dolphin	<i>Tursiops truncatus</i>	51
56	STDO	Striped Dolphin	<i>Stenella coeruleoalba</i>	17
57	WSDO	Atlantic White-sided Dolphin	<i>Lagenorhynchus australis</i>	94
58	RIDO	Risso's Dolphin	<i>Grampus griseus</i>	6
59	UNDO	Unknown Dolphin	<i>Stenella sp.</i>	62
60	UBWH	Unknown Beaked Whale	<i>Mesoplodon sp.</i>	1
60	UNWH	Unknown Whale	<i>Balaenoptera sp.</i>	6
61	GRSE	Gray Seal	<i>Halichoerus grypus</i>	2
62	GRTU	Green Turtle	<i>Chelonia mydas</i>	25
63	LETU	Leatherback Turtle	<i>Dermochelys coriacea</i>	2
64	BASK	Basking Shark	<i>Cetorhinus maximus</i>	15
65	MOLA	Sunfish	<i>Mola mola</i>	69

The first leg of the Ecomon cruise departed from Woods Hole (41.29 N and 70.10 W) and reached Cape Hatteras (North Carolina- 35.12 N and 75.44 W). The southbound transit surveyed water beyond the continental shelf and the northbound transit was close to shore. Summary of observation effort is presented in Table 2. Seabird density was calculated by dividing the total abundance/ kilometers surveyed for each day of

the first leg.

Table 2: Leg 1 Observation effort Summary

Survey Date	Hours Observed	Number Birds	Seabird Density/km ²	Leg I Distance (km)
23 May	13	199	0.82	241
24 May	15	654	2.35	278
25 May	12	104	0.06	223
26 May	15	174	0.62	278
27 May	14	252	0.96	260
28 May	14	3202	12.31	260
TOTAL	83	4582	2.97	1540

We observed 33 species of seabirds during Leg1. The seabird community was comprised primarily of (68%) Sooty Shearwaters, (*Puffinus griseus*) (9%) Greater Shearwaters (*Puffinus gravis*) and (7%) Wilson’s Storm Petrels (*Oceanites oceanicus*), (Figures 1-2).

Leg 2 of the EcoMon survey left from Woods Hole, MA and surveyed the waters of Georges Bank and the Gulf of Maine. Summary of observation effort is presented in Table 3. As in Leg 1, the seabird community was primarily composed of shearwaters and storm petrels. However, the density of birds recorded was much higher than in Leg 1 (Tables 2-3, and Figures 1-3). We encountered high densities of storm petrels on 1 June, which coincided with high concentrations of fish eggs found floating at the surface (Figure 2). Throughout Leg 2 we repeatedly observed surprisingly high numbers of Dovekies (*Alle alle*) and Thick-billed murrelets (*Uria lomvia*), (Figure 3).

Table 2: Leg 2 Observation effort Summary

Survey Date	Hours Observed	Number Birds	Seabird Density/km ²	Leg II Distance (km)
29 May	7	4746	36.5	130
30 May	14	1735	6.67	260
31 May	14	4478	17.22	260
1 June	13	25827	107.61	240
2 June	11	751	3.68	204
3 June	7	1214	9.33	130
TOTAL	66	38751	31.65	1224

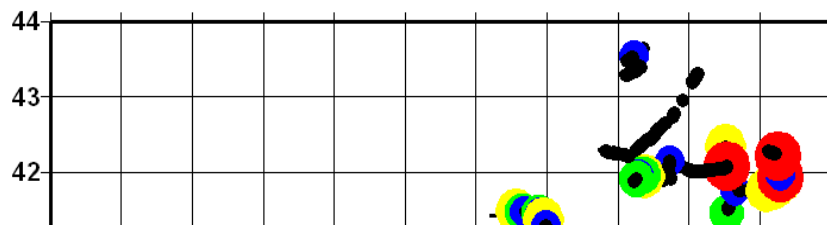


Figure 1: Distribution and abundance of (top) Greater Shearwater (*Puffinus gravis*) and (bottom) Sooty Shearwater (*Puffinus griseus*). Abundance is 0.154 km/min.



Figure 2: Distribution and abundance of (top) Leach's Storm Petrel (*Oceanodroma leucorhoa*) and (bottom) Wilson's Storm Petrel (*Oceanites oceanicus*). Abundance is 0.154 km/min.

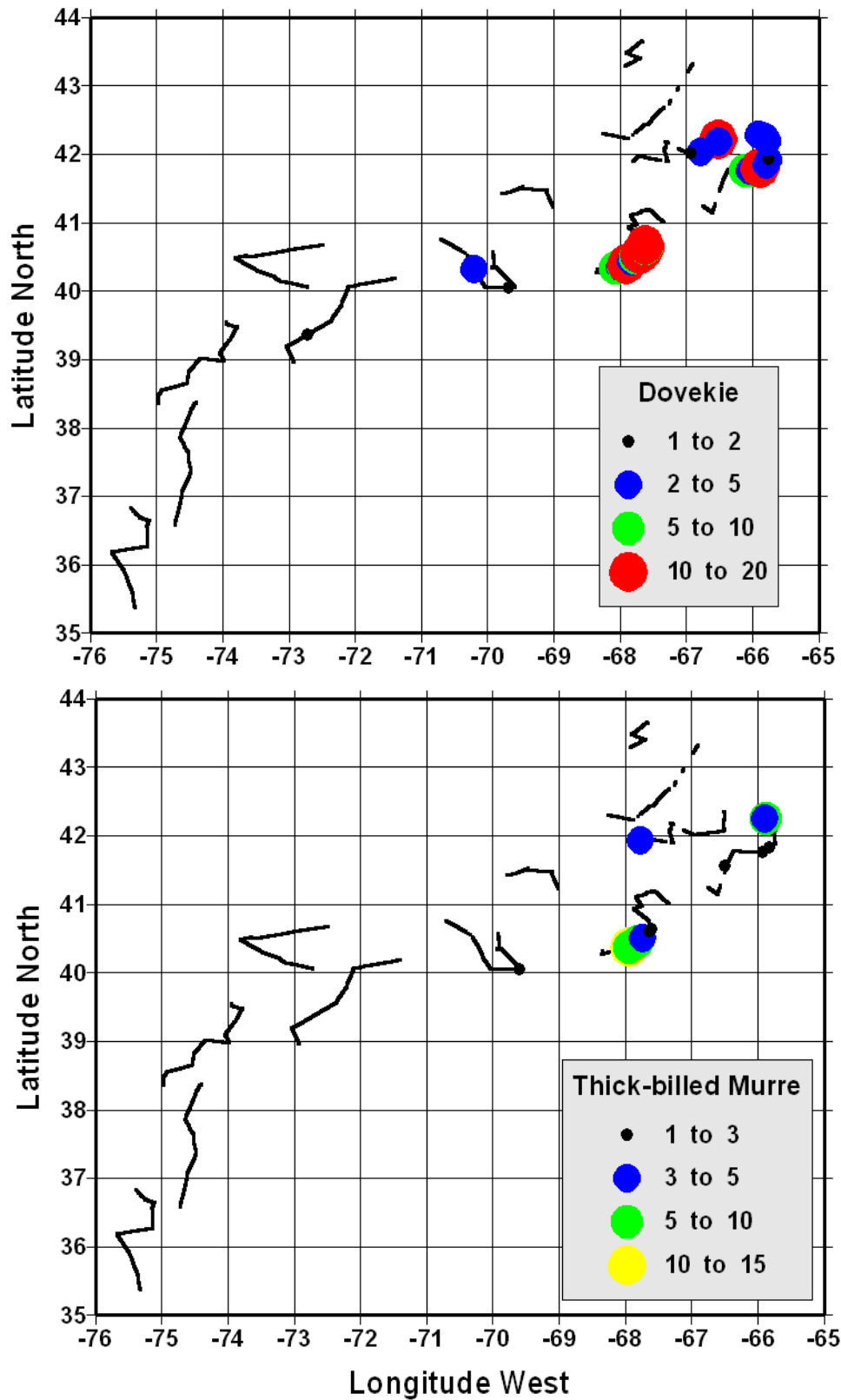


Figure 3: Distribution and abundance of (top) Dovekie (*Alle alle*) and (bottom) Thick-billed Murre (*Uria lomvia*). Abundance is 0.154 km/min.

4. Acknowledgements

We thank the officers, crew, and Chief Scientist Jerry Preciozo for their support during the Spring 2007 EcoMon survey and the Manomet Center for Conservation Sciences.

5. Reference

Tasker, M.L., P. Hope Jones, T. Dixon, and B.F. Blake. 1984. Counting seabirds at sea from ships: a review of methods employed and a suggestion for a standardized approach. *The Auk*, 101: 567-577