CRUISE RESULTS
NOAA Research Vessel GORDON GUNTER
Cruise No. GU 16-08
Spring Northeast Ecosystem Monitoring Survey

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CRUISE PERIOD AND AREA

The NOAA research vessel *GORDON GUNTER* sampled a total of 241 stations from 21 May to 20 June 2016 in 3 legs. Leg 1 covered the Mid-Atlantic Bight, Southern New England and Georges Bank. Leg 2 covered the Gulf of Maine. Leg 3 conducted specialized sampling for Bluefin tuna larvae along the northern wall of the Gulf Stream off the southeast US coast. Good weather and good support from the vessel allowed excellent coverage of all areas sampled for what turned out to be a very successful cruise.

OBJECTIVES

The principal objective of the first two legs of the survey was to assess the pelagic components of the Northeast U.S. Continental Shelf Ecosystem from water currents to plankton, pelagic fishes, marine mammals, sea turtles, and seabirds. The spatial distribution of the following parameters was quantified: water properties, phytoplankton, microzooplankton, mesozooplankton, pelagic fish and invertebrates. Both traditional and novel techniques and instruments were used.
Other operational objectives of the first two legs of this cruise were to:

! (1) collect underway data using TSG, SCS, and ADCP;

! 2) complete CTD and bongo operations at stations throughout area,

! (3) conduct acoustic surveys using the EK60,

! (4) collect samples for the Census of Marine Zooplankton (CMarZ) genetics studies.

! (5) collect samples for aging and genetic analyses of fish larvae and eggs.

! (6) collect near-surface underway data and imagery from the entire cruise track using a TSG, fluorometer, SCS, EK-60 Scientific Sounder, ADCP and an Imaging FlowCytoBot unit.

! (7) gather data on trends in ocean acidification and nutrient levels by collecting seawater samples at various depths with a rosette water sampler at predetermined fixed locations.

! (8) collect stable isotope data from phytoplankton taken at various depths with a rosette water sampler at six fixed locations.

The principal objective of the third leg of this survey was different. It was tasked with sampling for Bluefin tuna larvae along the Gulf Stream – slope water front, off the coast of the southeastern US, to provide samples to help corroborate the premise that this area is a spawning ground for Bluefin tuna. This sampling was guided by satellite sea-surface temperature data and took place as the Gordon Gunter made its' transit to the Marine Operations Center-Atlantic facility in Norfolk, VA from Davisville, RI.

METHODS

The survey consisted of 241 stations at which the vessel stopped to lower instruments over the port side of the vessel from a J-frame and two conductive-wire winches. Of these, 46 were in the Middle Atlantic Bight (MAB), 57 were in Southern New England (SNE), 37 were on Georges Bank (GB), 77 were in the Gulf of Maine (GOM) and 24 were offshore in continental slope water between New York and Virginia (Figure 1).

Plankton and hydrographic sampling was conducted with double oblique tows using the 61-cm bongo sampler and a Seabird CTD. The tows were extended 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 – 2.0 knots. Plankton sampling gear consisted of a 61-centimeter diameter aluminum bongo frame with two 335-micron nylon mesh nets equipped with analog flowmeters that recorded number of revolutions during the tow. At the 22 randomly designated Census of Marine Zooplankton (CMarZ) 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 and towed together with the large aluminum bongo frame (Figure 2). No flowmeters were used in the 20-cm bongos. A similar array, with 20 cm 335 micron mesh nets deployed above the 61 cm 335 micron mesh nets, was fished for larval fish and egg samples for NOAA researcher David Richardson at all the other plankton stations. These samples were saved for genetics and otolith analysis to be carried out at the Narragansett NEFSC Lab. A 45-kilogram bell-shaped lead weight was attached by a 20-centimeter 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. The plankton sampling gear was deployed off the port side of the vessel using a J-frame and a conducting cable winch. 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 Power Data Interface Module (PDIM) signal booster was also used to allow the data transfer at high baud rate from the Seabird 19+ CTD profiler over the great length of wire (>1600 meters) on the *GORDON* GUNTER oceanic winch. After retrieval, both the large and small bongo nets were washed down with seawater on a table set up on the deck of the sampling area to obtain the plankton samples. The 61-centimeter bongo plankton samples were preserved in a 5% solution of formalin in seawater. The CMarZ genetics samples and the genetics and otolith larval fish and egg samples from the 20-centimeter bongo nets were preserved in 95% ethanol, which was changed once, 24 hours after the initial preservation.

A different protocol was followed on the third leg of this survey, where a similar array of bongo frames, CTD and 45 kilogram depressor as described above was deployed in the slope waters between New York and Virginia to capture Bluefin tuna larvae for a David Richardson study of this area as a spawning ground. Some notable differences from his other tows on the cruise were the use of 165 micron mesh nets on the 20 cm bongo frames, the preservation of samples from all the bongo nets in 95% ethanol and a yo-yo tow profile of deploying the nets down to 25 meters and back to the surface for 5 minutes, then again for another 5 minutes, producing 2 double oblique tows for a total immersion of 10 minutes. Tow speeds were again 1.5 to 2 knots.

A Seabird 911+ CTD was deployed on a rosette frame with a carousel water sampling system (SBE32) and 11 10-liter Niskin bottles at all fixed stations. The package was deployed on vertical casts, collecting profiles of water temperature, salinity, chlorophyll-a and oxygen levels. Water samples were collected by the Niskin sampling bottles at multiple depths along the upcast to be processed ashore for nutrients, carbonate chemistry and stable isotope analysis of phytoplankton (Figure 3).

Salinity, temperature and chlorophyll-*a* levels were monitored continuously from a depth of about 3 meters along the entire cruise track using a thermosalinograph, and a fluorometer hooked up to the ship's scientific flow-through seawater system. The Scientific Computer System (SCS) recorded the output from both the thermosalinograph, and fluorometer at 10-second intervals. Records were given a time-date stamp by the GPS unit. In addition, an ImagingFlowCytobot unit was plumbed into the flow-through seawater system in the CTD lab (Figure 4**).** The device captured images of diatoms, dinoflagellates and marine ciliates on an independent computer provided by the Woods Hole Oceanographic Institution (WHOI) (Figure 5). This system was monitored daily by University of Rhode Island undergraduate Lauren Kittell-Porter on the first leg, and Chris Melrose and Tamara Holzwarth-Davis on the second and third legs of the cruise.

Another research activity carried out during this cruise involved collecting water and plankton samples to trace the path that nitrogen takes through the first steps of the marine food chain, by comparing the ratios of nitrogen 14 and 15 stable isotopes of this element in seawater, phytoplankton and zooplankton.

An educational component to this cruise was provided by an experiment where 80 Styrofoam coffee cups, decorated by third grade students from the Peacedale Elementary School, were lowered a number of times down to depths of up to 500 meters on the Niskin bottle rosette. This compressed them to a fraction of their original size, graphically demonstrating the effects of Boyle's Law of Pressure and Gas Volume when they were returned to the students (Figure 6).

Marine mammal and seabird observations and photography were conducted from the bridge and flying bridge of the *GORDON GUNTER* by Canadian Wildlife Observer John Loch (Figure 7). A Seabird Survey Report by Carina Gjerdrum of the Canadian Wildlife Service, Environment Canada summarizes John's seabird observations in Appendix A.

RESULTS

Leg 1

A summary of routine survey activities is presented in Table 1. Areal coverage for the cruise is shown in Figure 1. The NOAA vessel *GORDON GUNTER* sailed from Davisville, RI on Saturday, May 21 at 1400 hours EDT. Sampling was started just south of Narragansett Bay as the vessel proceeded south on an inshore track working and sampling under windy conditions through the Southern New England area. Improving weather off the coast of New Jersey allowed the vessel to work towards Cape Hatteras, North Carolina on an offshore track, reaching the southernmost station off of Cape Hatteras on Tuesday, May 24. While on this offshore track, sampling for hake larvae was conducted at 6 stations along the outer shelf, using the 61 cm bongos with 333 micron mesh nets and 20 cm bongos with 333 micron mesh nets mounted ½ meter above them, preserving all the samples in ethanol. The *GUNTER* then turned and looped back north, sampling inshore Mid-Atlantic Bight stations, and the offshore Southern New England stations that had been bypassed due to strong winds at the beginning of the cruise. By Sunday, May 29 the first Georges Bank station was reached, and the Gordon Gunter continued sampling there until every Georges Bank station was sampled, ending on a Great South Channel fixed station just before midnight, local time, on June 1. From there sampling was continued for the remainder of the cruise in the western Gulf of Maine area, ending off of Provincetown, MA on June 2. From this point the vessel steamed along Cape Cod to return to Davisville, RI, picking up two more stations in Southern New England prior to docking in Davisville, RI on Friday, June 3, 2016, marking the end of Leg 1.

Leg 2

The Gordon Gunter sailed from Davisville, RI on leg 2 of the GU1608 cruise on Monday, June 6, 2016, into the Gulf of Maine to complete sampling in the northern part of the survey area. With good weather, the vessel was able to sample the entire area, and complete operations at 89 stations, achieving very good coverage of the Gulf of Maine. The Gordon Gunter returned to Davisville on Thursday, June 16.

Leg 3

The Gordon Gunter sailed from Davisville, RI on leg 3 of the GU1608 cruise on Friday, June 17, 2016. The operational objective of this part of the cruise was to collect larvae of Blue fin tuna and other highly migratory species while the vessel transited south to Norfolk, VA. Plankton tows were made using an array of 61 cm bongo frames equipped with 333 micron mesh nets, and 20 cm bongo frames equipped with 165 micron mesh nets mounted ½ meter above them. These tows were NOT made following the standard Ecomon protocol of 50m/min out and 20m/min back down to a maximum depth of 200 meters, but rather were only down to 25 meters using wire out/in rates based on a 5 minute tow from the Wire Out Table. These rates were 27 m/min out and 8m/min back and then repeated once again to give a total of 10 minutes in the water as a “yo-yo” type tow, so as to best target near-surface larval and juvenile fish. Samples from all nets were preserved in 95% ethanol, which was changed once, after 24 hours
.
A total of 24 stations were sampled, with station locations being determined by the chief scientist based on sea surface temperatures and satellite imagery to locate the northern edge of the Gulf Stream where there was the greatest likelihood of finding Bluefin tuna larvae.

The Gordon Gunter arrived in Norfolk, VA on June 20, marking the end of the GU1608 Spring Ecosystem Monitoring Survey. Personnel disembarked and all gear and samples were unloaded at the Marine Operations Center-Atlantic, in Norfolk, VA, after which they traveled back in vehicles to the Northeast Fisheries Science Center laboratory in Narragansett, RI.

DISPOSITION OF SAMPLES AND DATA

All samples and data, except for the CMarZ zooplankton genetics samples, the University of Maine nutrient 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 CMarZ samples were delivered to Nancy Copley at the Woods Hole Oceanographic Institution. The nutrient samples were taken by LeeAnn Conlon to the University of Maine. The frozen stable isotope samples were sent to Jessica Lueders-Dumont at Princeton University. The CTD data were delivered to the Oceanography Branch of the NEFSC, Woods Hole, MA. Marine mammal observation data and the seabird observation data went to the Canadian Wildlife Service in Dartmouth, Nova Scotia.

SCIENTIFIC PERSONNEL

Leg 1

National Marine Fisheries Service, NEFSC, Narragansett, RI

Jerome Prezioso   Chief Scientist
Christopher Taylor

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Tamara Holzwarth-Davis

University of Rhode Island

Lauren Kittell-Porter

University of Maine

Zachary Topor

Canadian Wildlife Service

John Loch

Princeton University

Jessica Lueders-Dumont

University of Massachusetts

Bonny Clarke

Leg 2

National Marine Fisheries Service, NEFSC, Narragansett, RI

Christopher Melrose Chief Scientist

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Tamara Holzwarth-Davis

University of Maine, Orono, ME

LeeAnn Conlon
Jordan Snyder
Constantin Scherelis

Leg 3

National Marine Fisheries Service, NEFSC, Woods Hole, MA

Tamara Holzwarth-Davis Chief Scientist

National Marine Fisheries Service, NEFSC, Narragansett, RI

Lauren Carter Fisheries Biologist

Mount Holyoke College, South Hadley, MA

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Table 1. Summary of sample activities conducted at 241 stations at which the *GORDON GUNTER* stopped to lower instruments over the side during Cruise No. GU 1608. Latitude and Longitude are shown in decimal degrees.
Std BON/CTD = 61 cm bongo Standard Protocol, CTD 911 = fixed station, 2B1 P = Princeton isotope samples
2B3 D = 333 mesh 20 cm bongo Dave R. samples, 2B1 C = 165 mesh 20 cm bongo CMARZ samples, SAL=salt,
2B3 DM = Supplemental mackerel sta for Dave R., NUT=nutrients, DIC=Dissolved Inorganic Carbon
ISO=stable isotope samples, CHL=chlorophyll samples, 2B3 H=Hake , 2B1 TUNA=yo-yo non-standard tuna tow

CTD Cast	**SiteID/** STA#	**Date** GMT	**Latitude** (dd)	**Longitude** (dd)	**Bottom** Depth(m)	**Operation**
1	1	21-May 2016	41.3217	-71.2533	36	BON/CTD, 2B3 D
2	2	22-May 2016	40.9183	-71.3367	56	BON/CTD, 2B1 P
3	3	22-May 2016	40.6717	-71.6017	71	BON/CTD, 2B1 C
4	4	22-May 2016	40.9167	-71.7617	49	BON/CTD, 2B1 C
5	5	22-May 2016	40.915	-72.095	27	BON/CTD, 2B3 D
6	6	22-May 2016	40.6617	-72.3433	43	BON/CTD, 2B3 D
7	7	22-May 2016	40.665	-72.5083	38	BON/CTD, 2B1 C
8	8	22-May 2016	40.41	-72.5017	49	BON/CTD
9	9	22-May 2016	40.3317	-72.585	50	BON/CTD, 2B3 D
10	10	22-May 2016	40.415	-73.0033	38	BON/CTD, 2B3 D
11	11	22-May 2016	40.415	-73.42	30	BON/CTD, 2B3 D
12	12	22-May 2016	39.58	-73.5067	38	BON/CTD, 2B1 C
13	13	22-May 2016	39.4183	-73.42	37	BON/CTD, 2B1 P
1	14	23-May 2016	39.3633	-73.3917	49	**CTD 911, NUT, DIC, SAL, ISO**

14	15	23-May 2016	39.3317	-73.09	62	BON/CTD, 2B3 D
15	16	23-May 2016	39.2483	-72.845	83	BON/CTD, 2B3 D
2	17	23-May 2016	39.05	-72.745	203	**CTD 911, NUT, DIC, SAL, CHL**
3	18	23-May 2016	39.0133	-72.5867	1224	**CTD 911, NUT, DIC, SAL, CHL**
16	19	23-May 2016	38.87	-72.47	1850	BON/CTD, 2B3 H
17	20	23-May 2016	38.8483	-72.7767	1321	BON/CTD, 2B3 H
18	21	23-May 2016	38.8317	-73.0833	89	BON/CTD, 2B1 P
19	22	23-May 2016	38.5017	-73.3417	127	BON/CTD, 2B1 C
20	23	23-May 2016	38.415	-74.25	46	BON/CTD, 2B3 D
21	24	23-May 2016	37.9167	-74.3333	67	BON/CTD, 2B3 D
22	25	24-May 2016	37.7483	-74.335	80	BON/CTD, 2B1 P
4	26	24-May 2016	37.7017	-74.2583	112	**CTD 911, NUT, DIC, SAL, ISO, CHL**
23	27	24-May 2016	37.6117	-74.075	1369	BON/CTD, 2B3 H
24	28	24-May 2016	37.555	-74.415	97	BON/CTD, 2B3 H
25	29	24-May 2016	37.0833	-74.9117	50	BON/CTD, 2B1 C
26	30	24-May 2016	36.6633	-74.7483	86	BON/CTD, 2B1 C
5	31	24-May 2016	36.0017	-74.67	1260	**CTD 911, NUT, DIC, ISO, CHL**
27	32	24-May 2016	36.0017	-74.74	663	BON/CTD, 2B1 P
6	33	24-May 2016	36.0067	-74.7767	365	**CTD 911, NUT, DIC, ISO, CHL**
28	34	25-May 2016	35.6717	-75.4067	24	BON/CTD, 2B1 P
29	35	25-May 2016	35.9933	-75.5867	22	BON/CTD, 2B1 P
7	36	25-May 2016	35.9817	-75.5283	24	**CTD 911, NUT, DIC, SAL, ISO, CHL**
8	37	25-May 2016	36	-75.1717	34	**CTD 911, NUT, DIC, SAL, ISO, CHL**
30	38	25-May 2016	36.165	-75.1667	33	BON/CTD, 2B3 D
31	39	25-May 2016	36.415	-75.1633	32	BON/CTD, 2B1 C
32	40	25-May 2016	36.915	-75.835	13	BON/CTD, 2B3 D
33	41	25-May 2016	37.2483	-75.5817	21	**BON/CTD, 2B1 D (USED WRONG NET)**
34	42	25-May 2016	37.25	-75.0867	35	BON/CTD, 2B3 D
35	43	25-May 2016	37.33	-74.9233	40	BON/CTD, 2B3 D
36	44	25-May 2016	37.4117	-74.835	47	BON/CTD, 2B3 D
37	45	25-May 2016	37.5	-74.7517	51	BON/CTD, 2B3 D
9	46	26-May 2016	37.8433	-74.5817	54	**CTD 911, NUT, DIC, SAL, ISO, CHL**
10	47	26-May 2016	38	-74.9583	22	**CTD 911, NUT, DIC, SAL, ISO, CHL**
38	48	26-May 2016	38.3317	-74.83	18	BON/CTD, 2B1 P
39	49	26-May 2016	38.4133	-74.67	35	BON/CTD, 2B3 D
40	50	26-May 2016	38.7433	-74.6667	26	BON/CTD, 2B3 D
41	51	26-May 2016	38.915	-74.6633	15	BON/CTD, 2B3 D
42	52	26-May 2016	38.7467	-74.0033	48	BON/CTD, 2B3 D
43	53	26-May 2016	38.9133	-73.8367	40	BON/CTD, 2B3 D
44	54	26-May 2016	39.25	-73.9983	27	BON/CTD, 2B3 D
45	55	26-May 2016	39.4133	-74.165	18	BON/CTD, 2B3 D
11	56	27-May 2016	39.7083	-74.0083	22	**CTD 911, NUT, DIC, ISO, CHL**
46	57	27-May 2016	39.6617	-73.9183	26	BON/CTD, 2B1 P
47	58	27-May 2016	39.4983	-72.8333	65	BON/CTD, 2B1 C
48	59	27-May 2016	39.6633	-72.335	114	BON/CTD, 2B3 D
49	60	27-May 2016	39.6667	-72.165	124	BON/CTD, 2B1 P

50	61	27-May 2016	40.0867	-72.0817	74	BON/CTD, 2B1 C
51	62	27-May 2016	40.4117	-71.1717	83	BON/CTD, 2B3 D
52	63	27-May 2016	40.0117	-71	321	BON/CTD, 2B3 D
53	63	28-May 2016	40.0033	-71.015	343	**CTD 19/19+ WATER CAST PROFILE**
54	64	28-May 2016	39.82	-70.8167	1072	BON/CTD, 2B3 H
55	65	28-May 2016	39.655	-70.62	2216	BON/CTD, 2B3 H
12	66	28-May 2016	39.8417	-70.6267	805	**CTD 911, NUT, DIC, SAL, ISO, CHL**
13	67	28-May 2016	40.0367	-70.605	170	**CTD 911, NUT, DIC, SAL, ISO, CHL**
56	68	28-May 2016	40.2483	-70.335	100	BON/CTD, 2B1 P
57	69	28-May 2016	40.5	-70.58	71	BON/CTD, 2B3 D
58	70	28-May 2016	40.6667	-70.3317	52	BON/CTD, 2B3 D
14	71	28-May 2016	40.67	-70.6233	62	**CTD 911, NUT, DIC, SAL, ISO, CHL**
59	72	28-May 2016	40.665	-70.7517	65	BON/CTD, 2B3 D
60	73	28-May 2016	40.83	-70.9183	55	BON/CTD, 2B3 D
61	74	28-May 2016	40.9983	-70.835	50	BON/CTD, 2B3 D
15	75	28-May 2016	41.1083	-70.625	43	**CTD 911, NUT, DIC, ISO, CHL**
62	76	28-May 2016	41.165	-70.5017	37	BON/CTD, 2B1 P
63	77	29-May 2016	41.24	-70.4083	31	BON/CTD, 2B3 D
64	78	29-May 2016	40.7483	-70.0067	39	BON/CTD, 2B3 D
65	79	29-May 2016	40.3317	-69.9183	84	BON/CTD, 2B3 D
66	80	29-May 2016	40.3317	-69.7533	76	BON/CTD, 2B3 D
67	81	29-May 2016	40.08	-69	172	BON/CTD, 2B3 D
68	82	29-May 2016	40.2517	-68.6667	114	BON/CTD, 2B1 C
69	83	29-May 2016	40.4983	-68.505	91	BON/CTD, 2B3 D
70	84	29-May 2016	40.4133	-68.25	125	BON/CTD, 2B3 D
16	85	29-May 2016	40.2433	-67.695	1182	**CTD 911, NUT, DIC, SAL, ISO, CHL**
17	86	30-May 2016	40.38	-67.69	295	**CTD 911, NUT, DIC, ISO, CHL**
71	87	30-May 2016	40.58	-67.5033	106	BON/CTD, 2B1 P
72	88	30-May 2016	40.5767	-67.5883	105	BON/CTD, 2B3 D
73	89	30-May 2016	40.5917	-67.84	89	BON/CTD, 2B3 D
74	90	30-May 2016	40.665	-67.835	80	BON/CTD, 2B1 C
18	91	30-May 2016	40.93	-67.7067	65	**CTD 911, NUT, DIC, SAL, ISO, CHL**
75	92	30-May 2016	41.0083	-67.4933	67	BON/CTD, 2B3 D
76	93	30-May 2016	41.4117	-67.7533	34	BON/CTD, 2B1 P
19	94	30-May 2016	41.4667	-67.6917	35	**CTD 911, NUT, DIC, SAL, ISO, CHL**
77	95	30-May 2016	41.4967	-67.2533	47	BON/CTD, 2B3 D
78	96	30-May 2016	41.5	-67.0067	65	**NO SAMPLE-HIT BOTTOM**
79	96	30-May 2016	41.4967	-67.005	65	BON/CTD, 2B3 D
80	97	30-May 2016	41.4967	-66.6733	79	BON/CTD, 2B1 C
81	98	30-May 2016	41.08	-66.43	155	BON/CTD, 2B1 P
82	99	31-May 2016	41.495	-66.3383	90	BON/CTD, 2B3 D
83	100	31-May 2016	41.6683	-66.2517	88	BON/CTD, 2B1 C
84	101	31-May 2016	41.6667	-65.8333	159	BON/CTD, 2B3 D
20	102	31-May 2016	41.7517	-65.44	2008	**CTD 911, NUT, DIC, SAL, ISO, CHL**
85	103	31-May 2016	41.83	-65.915	113	BON/CTD, 2B1 C
86	104	31-May 2016	42.2267	-65.7633	224	BON/CTD, 2B1 P

21	104	31-May 2016	42.2267	-65.775	224	**CTD 911, NUT, DIC, SAL, ISO, CHL**
87	105	31-May 2016	42.085	-66.1683	96	BON/CTD, 2B3 D
88	106	31-May 2016	41.9167	-66.42	91	BON/CTD, 2B3 D
89	107	31-May 2016	41.8317	-66.3367	79	BON/CTD, 2B3 D
90	108	1-Jun 2016	41.7483	-66.6567	65	BON/CTD, 2B3 D
91	109	1-Jun 2016	42.165	-66.665	169	BON/CTD, 2B3 D
92	110	1-Jun 2016	41.995	-67.0883	54	BON/CTD, 2B3 D
93	111	1-Jun 2016	41.9217	-67.415	51	BON/CTD, 2B3 D
94	112	1-Jun 2016	42.0033	-67.4217	39	BON/CTD, 2B1 P
22	113	1-Jun 2016	42.01	-67.6883	67	**CTD 911, NUT, DIC, SAL, ISO, CHL**
95	114	1-Jun 2016	41.7433	-68.165	53	BON/CTD, 2B3 D
96	115	1-Jun 2016	41.245	-68.0833	44	BON/CTD, 2B3 D
97	116	1-Jun 2016	40.9983	-68.1683	44	BON/CTD, 2B3 D
98	117	1-Jun 2016	40.75	-68.3383	60	BON/CTD, 2B3 D
99	118	1-Jun 2016	40.835	-68.6683	62	BON/CTD, 2B3 D
23	119	2-Jun 2016	40.895	-69.1383	72	**CTD 911, NUT, DIC, SAL, ISO, CHL**
100	120	2-Jun 2016	40.9817	-69.055	79	BON/CTD, 2B1 P
101	121	2-Jun 2016	41.1617	-68.7533	60	BON/CTD, 2B1 C
102	122	2-Jun 2016	41.415	-69.0083	151	BON/CTD, 2B3 D
103	123	2-Jun 2016	41.665	-69.0017	159	BON/CTD, 2B3 D
104	124	2-Jun 2016	41.745	-69.0883	171	BON/CTD, 2B1 C
105	125	2-Jun 2016	42.085	-69.3383	216	BON/CTD, 2B3 D
106	126	2-Jun 2016	42.0767	-69.9233	88	BON/CTD, 2B3 D
107	127	3-Jun 2016	41.2533	-70.655	26	BON/CTD, 2B3 D
108	128	3-Jun 2016	41.265	-70.98	41	BON/CTD, 2B3 D
109	129	7-Jun 2016	42.1667	-70.5767	29	BON/CTD, 2B3 D
110	130	8-Jun 2016	42.1633	-70.3367	26	BON/CTD, 2B3 D
24	131	8-Jun 2016	42.3183	-70.2817	34	**CTD 911, NUT, DIC, CHL**
25	132	8-Jun 2016	42.3567	-70.4683	78	**CTD 911, NUT, DIC, CHL**
111	133	8-Jun 2016	42.4217	-70.605	89	BON/CTD, 2B3 D
26	133	8-Jun 2016	42.4233	-70.6133	89	**CTD 911, NUT, DIC, CHL**
27	134	8-Jun 2016	42.5317	-70.5383	58	**CTD 911, NUT**
112	135	8-Jun 2016	42.4983	-69.655	250	BON/CTD, 2B3 D
28	135	8-Jun 2016	42.5017	-69.6633	243	**CTD 911, NUT, DIC, CHL**
113	136	8-Jun 2016	42.6583	-69.325	220	BON/CTD, 2B1 C
114	137	8-Jun 2016	43.08	-69.4183	179	BON/CTD, 2B3 D
115	138	8-Jun 2016	42.995	-68.83	183	BON/CTD, 2B3 D
116	139	8-Jun 2016	43.0817	-68.335	203	BON/CTD, 2B3 D
117	140	9-Jun 2016	43.245	-68.1717	206	BON/CTD, 2B3 D
118	141	9-Jun 2016	43.0183	-67.705	175	BON/CTD, 2B3 D
29	141	9-Jun 2016	43.0283	-67.7017	184	**CTD 911, NUT, DIC, ISO, CHL**
119	142	9-Jun 2016	42.74	-67.4133	207	BON/CTD, 2B1 P
120	143	9-Jun 2016	42.3267	-67.7467	220	BON/CTD, 2B3 D
121	144	9-Jun 2016	42.325	-67.2417	295	BON/CTD, 2B3 D
122	144	9-Jun 2016	42.3283	-67.2583	295	**CTD 19/19+ WATER CAST PROFILE**
123	145	9-Jun 2016	42.37	-67.04	337	BON/CTD, 2B3 D

30	145	9-Jun 2016	42.375	-67.0517	338	**CTD 911, NUT, DIC, SAL, CHL**
124	146	9-Jun 2016	42.4967	-66.8333	291	BON/CTD, 2B1 C
125	147	9-Jun 2016	42.8217	-67.0733	206	BON/CTD, 2B3 D
126	148	10-Jun 2016	42.7483	-66.6683	169	BON/CTD, 2B3 D
127	149	10-Jun 2016	42.7483	-66.2533	63	BON/CTD, 2B3 D
128	150	10-Jun 2016	42.8267	-65.4117	131	BON/CTD, 2B3 D
31	151	10-Jun 2016	43.0267	-66.3417	128	**CTD 911, NUT, DIC, CHL**
129	152	10-Jun 2016	43.745	-66.8333	170	BON/CTD, 2B3 D
130	153	10-Jun 2016	43.8017	-66.5717	98	BON/CTD, 2B1 C
131	154	11-Jun 2016	43.995	-66.9233	164	BON/CTD, 2B1 C
132	155	11-Jun 2016	44.24	-66.7617	183	BON/CTD, 2B3 D
133	156	11-Jun 2016	44.465	-67.2217	98	BON/CTD, 2B3 D
32	156	11-Jun 2016	44.475	-67.2233	104	**CTD 911, NUT, DIC, SAL, CHL**
134	157	11-Jun 2016	44.3233	-67.4167	119	BON/CTD, 2B1 P
135	158	11-Jun 2016	44.1933	-67.7	178	BON/CTD, 2B3 D
33	158	11-Jun 2016	44.1983	-67.7067	180	**CTD 911, NUT, DIC, CHL**
136	159	11-Jun 2016	43.655	-67.495	226	BON/CTD, 2B3 D
137	159	11-Jun 2016	43.665	-67.5033	225	**CTD 19/19+ WATER CAST PROFILE**
138	160	11-Jun 2016	43.395	-67.6883	247	BON/CTD, 2B3 D
34	160	11-Jun 2016	43.3983	-67.6967	248	**CTD 911, NUT, DIC, CHL**
139	161	11-Jun 2016	43.5033	-67.88	247	BON/CTD, 2B3 D
35	161	11-Jun 2016	43.51	-67.8933	249	**CTD 911, NUT, DIC, CHL**
140	162	11-Jun 2016	43.66	-68.5817	164	BON/CTD, 2B3 D
141	163	12-Jun 2016	43.7767	-68.65	105	BON/CTD, 2B3 D
36	163	12-Jun 2016	43.7717	-68.66	114	**CTD 911, NUT, DIC, CHL**
142	164	12-Jun 2016	43.8283	-69.07	72	BON/CTD, 2B1 C
37	165	12-Jun 2016	43.7217	-69.3633	82	**CTD 911, NUT, CHL**
143	166	12-Jun 2016	43.4183	-70.2433	85	BON/CTD, 2B1 P
38	167	12-Jun 2016	43.2	-70.4267	56	**CTD 911, NUT, CHL**
144	168	12-Jun 2016	42.9917	-70.42	105	BON/CTD, 2B3 D
39	168	12-Jun 2016	43	-70.4167	107	**CTD 911, NUT, DIC, CHL**
145	169	12-Jun 2016	43.0767	-70.335	119	BON/CTD, 2B3 DM
146	170	12-Jun 2016	43.1583	-70.1617	147	BON/CTD, 2B3 DM
147	171	12-Jun 2016	43.325	-69.9933	162	BON/CTD, 2B3 DM
148	172	12-Jun 2016	43.2383	-70	112	BON/CTD, 2B3 DM
149	173	12-Jun 2016	43.075	-70.085	100	BON/CTD, 2B3 DM
150	174	12-Jun 2016	42.8283	-70.005	179	BON/CTD, 2B3 DM
151	175	12-Jun 2016	42.8267	-70.1617	107	BON/CTD, 2B3 DM
152	176	13-Jun 2016	42.9017	-70.3267	167	BON/CTD, 2B3 DM
153	177	13-Jun 2016	42.74	-70.6517	45	BON/CTD, 2B3 DM
154	178	13-Jun 2016	42.6583	-70.4933	87	BON/CTD, 2B3 DM
155	179	13-Jun 2016	42.6617	-70.42	46	BON/CTD, 2B3 DM
156	180	13-Jun 2016	42.5783	-70.5017	80	BON/CTD, 2B3 DM
157	181	13-Jun 2016	42.5783	-70.4183	127	BON/CTD, 2B3 DM
158	182	13-Jun 2016	42.4933	-70.42	80	BON/CTD, 2B3 DM
159	183	13-Jun 2016	42.495	-70.67	64	BON/CTD, 2B3 DM

160	184	13-Jun 2016	42.42	-70.8283	35	BON/CTD, 2B3 DM
161	185	13-Jun 2016	42.415	-70.7517	40	BON/CTD, 2B3 DM
162	186	13-Jun 2016	42.2467	-70.67	30	BON/CTD, 2B3 DM
163	187	13-Jun 2016	42.0717	-70.4983	48	BON/CTD, 2B3 DM
164	188	13-Jun 2016	42.1633	-70.42	65	BON/CTD, 2B3 DM
165	189	13-Jun 2016	42.2467	-70.335	59	BON/CTD, 2B3 DM
166	190	13-Jun 2016	42.3317	-70.3317	60	BON/CTD, 2B3 DM
167	191	13-Jun 2016	42.4117	-70.0833	87	BON/CTD, 2B3 DM
168	192	13-Jun 2016	42.0783	-70.0017	59	BON/CTD, 2B3 DM
169	193	13-Jun 2016	42.0783	-70.3317	61	BON/CTD, 2B3 DM
170	194	13-Jun 2016	41.9967	-70.2517	44	BON/CTD, 2B3 DM
171	195	13-Jun 2016	41.9967	-70.1717	32	BON/CTD, 2B3 DM
172	196	13-Jun 2016	41.9117	-70.1717	28	BON/CTD, 2B3 DM
173	197	14-Jun 2016	41.83	-70.415	26	BON/CTD, 2B3 DM
174	198	14-Jun 2016	41.2483	-71.0883	43	BON/CTD, 2B3 DM
175	199	14-Jun 2016	41.075	-71.0817	34	BON/CTD, 2B3 DM
176	200	14-Jun 2016	40.91	-71.0833	53	BON/CTD, 2B3 DM
177	201	14-Jun 2016	41.0817	-70.915	38	BON/CTD, 2B3 DM
178	202	14-Jun 2016	41.075	-70.4133	40	BON/CTD, 2B3 DM
179	203	14-Jun 2016	40.915	-70.17	28	BON/CTD, 2B3 DM
180	204	15-Jun 2016	40.665	-70.3317	52	BON/CTD, 2B3 DM
181	205	15-Jun 2016	40.5	-70.665	74	BON/CTD, 2B3 DM
182	206	15-Jun 2016	40.415	-71.1683	83	BON/CTD, 2B3 DM
183	207	15-Jun 2016	40.5817	-71.085	72	BON/CTD, 2B3 DM
184	208	15-Jun 2016	40.6633	-70.9183	68	BON/CTD, 2B3 DM
185	209	15-Jun 2016	40.7483	-70.755	63	BON/CTD, 2B3 DM
186	210	15-Jun 2016	40.7467	-71.2533	61	BON/CTD, 2B3 DM
187	211	15-Jun 2016	40.7483	-71.5017	63	BON/CTD, 2B3 DM
188	212	15-Jun 2016	40.6633	-71.9133	52	BON/CTD, 2B3 DM
189	213	15-Jun 2016	40.6617	-72.2533	49	BON/CTD, 2B3 DM
190	214	15-Jun 2016	40.8317	-72.0017	42	BON/CTD, 2B3 DM
191	215	15-Jun 2016	40.915	-71.5867	56	BON/CTD, 2B3 DM
192	216	15-Jun 2016	41.0783	-71.3217	42	BON/CTD, 2B3 DM
193	217	16-Jun 2016	41.165	-71.3183	43	BON/CTD, 2B3 DM
194	218	18-Jun 2016	39.6	-71.2983	2168	BON/CTD, 2B1 TUNA
195	219	18-Jun 2016	39.265	-71.2983	2681	BON/CTD, 2B1 TUNA
196	220	18-Jun 2016	38.9333	-71.3033	2800	BON/CTD, 2B1 TUNA
197	221	18-Jun 2016	38.6	-71.305	2869	BON/CTD, 2B1 TUNA
198	222	18-Jun 2016	38.46	-71.345	2917	BON/CTD, 2B1 TUNA
199	223	18-Jun 2016	38.325	-71.38	2973	BON/CTD, 2B1 TUNA
200	224	18-Jun 2016	38.18	-71.4167	3061	BON/CTD, 2B1 TUNA
201	225	18-Jun 2016	38.04	-71.4483	3168	BON/CTD, 2B1 TUNA
202	226	19-Jun 2016	37.8983	-71.505	3242	BON/CTD, 2B1 TUNA
203	227	19-Jun 2016	37.885	-71.7117	3153	BON/CTD, 2B1 TUNA
204	228	19-Jun 2016	37.86	-72.14	3200	BON/CTD, 2B1 TUNA
205	229	19-Jun 2016	37.8267	-72.5717	2911	BON/CTD, 2B1 TUNA

206	230	19-Jun 2016	37.8	-73	2739	BON/CTD, 2B1 TUNA
207	231	19-Jun 2016	37.4817	-73.1167	2916	BON/CTD, 2B1 TUNA
208	232	19-Jun 2016	37.1617	-73.24	2937	BON/CTD, 2B1 TUNA
209	233	19-Jun 2016	37.0017	-73.3017	3030	BON/CTD, 2B1 TUNA
210	234	19-Jun 2016	37	-73.5	2862	BON/CTD, 2B1 TUNA
211	235	19-Jun 2016	37.0017	-73.6983	2721	BON/CTD, 2B1 TUNA
212	236	20-Jun 2016	37.0017	-73.8983	2490	BON/CTD, 2B1 TUNA
213	237	20-Jun 2016	36.8833	-73.93	2624	BON/CTD, 2B1 TUNA
214	238	20-Jun 2016	36.7683	-73.96	2628	BON/CTD, 2B1 TUNA
215	239	20-Jun 2016	36.65	-74.1517	2353	BON/CTD, 2B1 TUNA
216	240	20-Jun 2016	36.6483	-74.3017	2037	BON/CTD, 2B1 TUNA
217	241	20-Jun 2016	36.6483	-74.4517	1723	BON/CTD, 2B1 TUNA

TOTALS:	**Std BON/CTD Casts**	**=**	**188**
	Non-std yo-yo bongo Tuna casts (6B3+2B1)	**=**	**24**
	2B3 D Bongo Casts	**=**	**89**
	Supplemental Mackerel sta’s (6B3+2B3)	**=**	**49**
	2B1 C (CMarZ) Bongo Casts	**=**	**22**
	2B1 P (Princeton Isotope) Bongo Casts	**=**	**21**
	2B3 H (Hake) Bongo Casts	**=**	**6**
	CTD PROFILE 911 Casts	**=**	**39**
	Nutrient Casts	**=**	**39**
	Stable Isotope samples	**=**	**22**
	Chlorophyll Casts	**=**	**37**
	Dissolved Inorganic Carbon Samples (DIC)	**=**	**35**
	Salinity samples	**=**	**20**

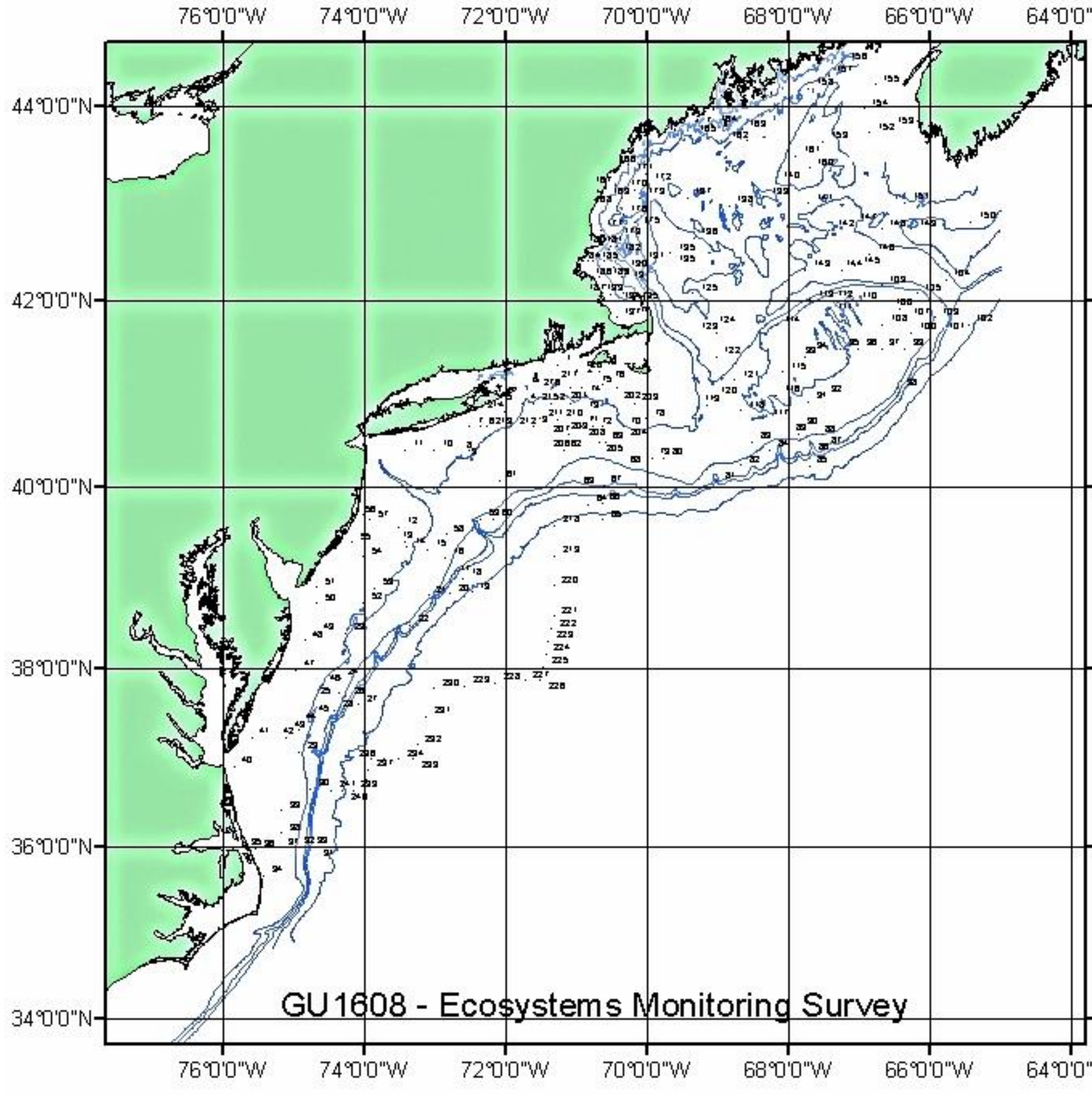

Figure 1. Station locations numbered consecutively for Spring Ecosystem Monitoring Survey GU 1608.

Figure 2. Bongo net array, showing 61 and 20 cm bongo nets being deployed from the port side of the *FSV Gordon Gunter.*

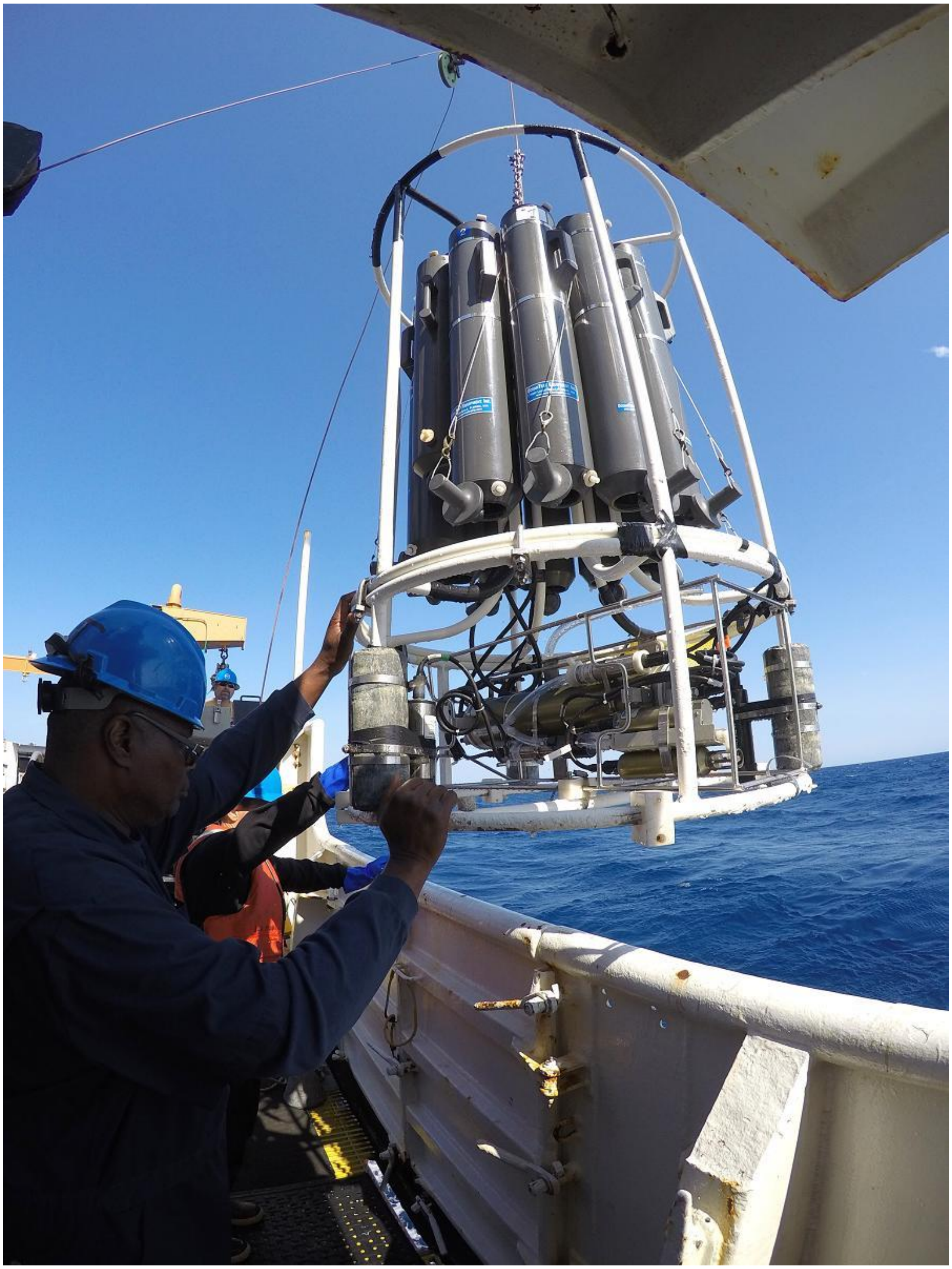

Figure 3. Niskin bottle and CTD 911 rosette being deployed aboard the FSV *Gordon Gunter.*

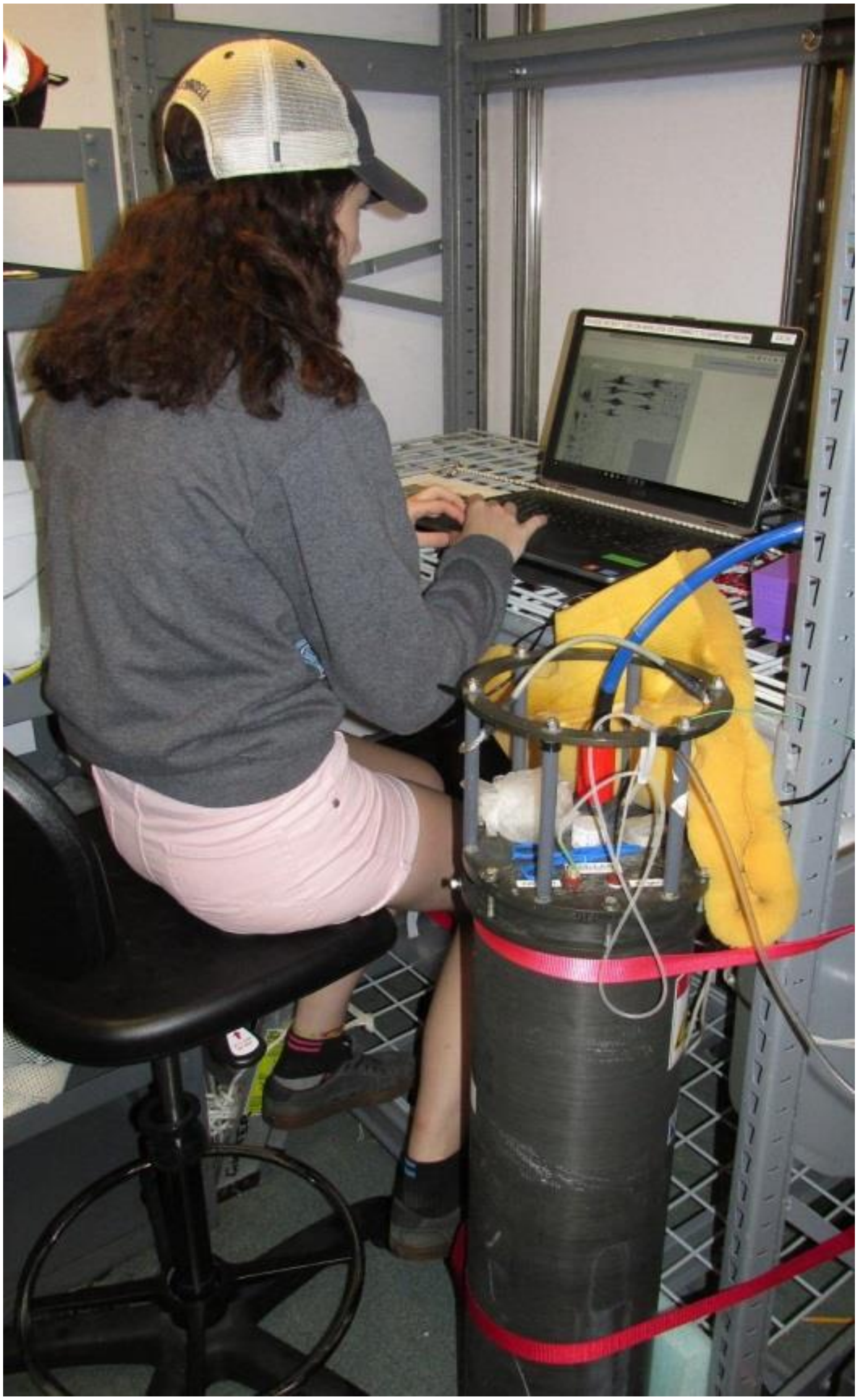

Figure 4. URI student Lauren Kittell-Porter monitoring imagery from the cylindrical ImagingFlowCytoBot on her right.

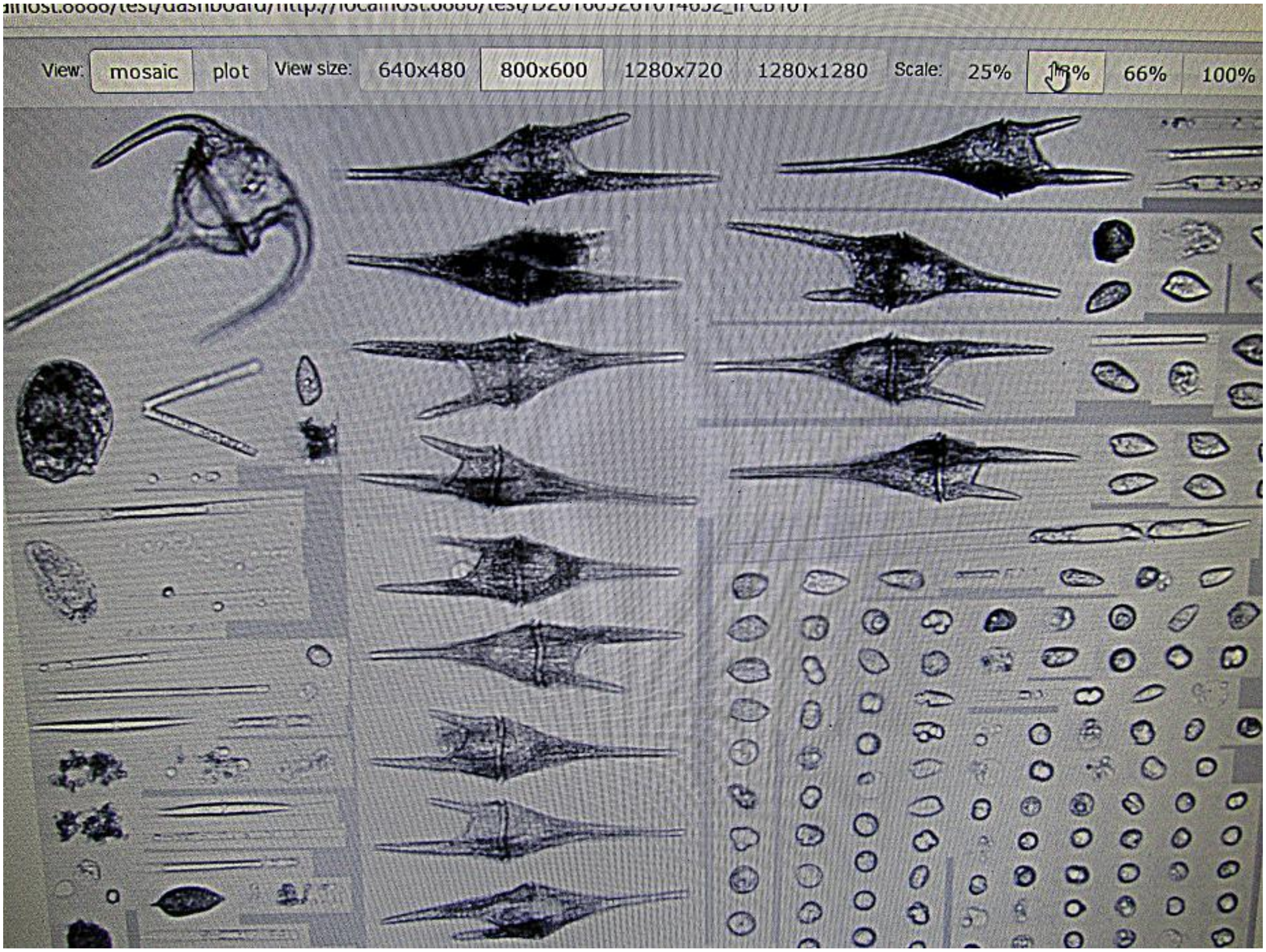

Figure 5. Images of dinoflagellates from the imaging FlowCytobot Unit.

Figure 6. Styrofoam cups, before immersion, in left photo, and after 8 submersions down to 500 meters, on right. This was a project undertaken by Peacedale Elementary school students to demonstrate the effect that water pressure has on the gas bubbles within Styrofoam.

Figure 7. Seabird and marine mammal observer John Loch on the flying bridge of the Gordon Gunter.

Appendix A.

Raw data from the Seabird Survey Report is available from Carina Gjerdrum

Seabird Survey Report
21 May - 2 June, 2016
Canadian Wildlife Service, Environment and Climate Change Canada
45 Alderney Drive, Dartmouth, Nova Scotia, Canada
Carina Gjerdrum carina.gjerdrum@canada.ca
Seabird Observer: John Loch

Background

The east coast of Canada supports millions of breeding marine birds as well as migrants from the southern hemisphere and northeastern Atlantic. In 1969, PIROP (*Programme intégré de recherches sur les oiseaux pélagiques*) was initiated based on a systematic survey technique and computer database (Brown *et al.* 1975; Brown 1986) to document the abundance and distribution of marine birds in Atlantic Canada and elsewhere. The program was operated by the Canadian Wildlife Service (CWS) of Environment Canada and supported by the large DFO (Department of Fisheries and Oceans) oceanographic fleet based in eastern Canada. Much of the data collected under PIROP are limited beyond the mid-1980s, therefore, CWS reinvigorated the pelagic seabird monitoring program in 2005 with the goal of identifying and minimizing the impacts of human activities on birds in the marine environment. Since 2005, a protocol for collecting data at sea (Gjerdrum *et al.* 2012) and a sophisticated geodatabase have been developed, relationships with industry and others to support offshore seabird observers have been established, and over 200,000 km of ocean track have been surveyed by CWS-trained observers. These data are now being used to identify and address threats to birds in their marine environment (Gjerdrum *et al.* 2008; Fifield *et al.* 2009; Lieske *et al.* 2014; Wong *et al.* 2014).

Objective

The objective of our seabird survey on board the Gordon Gunter in May-June 2016 was to collect data on the distribution and abundance of seabirds as part of our long term monitoring program for seabirds at sea in eastern Canada. We were particularly interested in surveying in the Gulf of Maine/Bay of Fundy region where we have identified a significant data gap.

Methods

Seabird surveys were conducted from the starboard side of the bridge of the Gordon Gunter during oceanographic surveys from 21 May - 2 June, 2016. Surveys were conducted while the ship was moving at speeds greater than 4 knots, looking forward and scanning a 90° arc to one side of the ship. All birds observed on the water within a 300m-wide transect were recorded, and we used the snapshot approach for flying birds (intermittent sampling based on the speed of the ship) to avoid overestimating abundance of birds flying in and out of transect. Distance sampling methods were incorporated to address the variation in bird detectability (Buckland *et al.* 2001). Marine mammal, large fish, and turtle observations were also recorded, although surveys were not specifically designed to detect marine organisms other than birds. Details of the methods used can be found in the CWS standardized protocol for pelagic seabird surveys from moving platforms (Gjerdrum *et al.* 2012).

Results and discussion

Seabird sightings

We surveyed 1394 km of ocean track from 21 May - 2 June, 2016 (Figure 1). A total of 2407 waterbirds from 8 families were observed during the surveys; 1963 of the birds sighted were counted in transect (Table 1). Overall, bird densities averaged 4.8 birds/km^2 (ranging from 0 - 832.0 birds/km^2). The highest densities of birds (>100 birds/km^2) were observed on the northwestern edge of Georges Bank (storm-petrels), just east of the Nantucket shoals (sooty shearwater), offshore near Block Canyon on the shelf edge (sooty shearwater), and over the Hudson Shelf Valley off the coast of New Jersey (herring gull, great black-backed gull, and Wilson's storm-petrel) (Figure 1).

Procellariiformes (including species from the families Procellariidae and Hydrobatidae) were the most commonly observed group of birds, accounting for 81% of the observations (Table 1). Sooty shearwaters (23% of the sightings) were observed throughout the survey area, but the highest numbers were seen in the northern sections (above 40° N). This species breeds in the southern hemisphere but travels to the NW Atlantic during the non-breeding season. Great shearwaters (20%), another visitor from the southern hemisphere, were primarily sighted on Georges Bank, while the arctic-breeding northern fulmars (19%) were common on both the Georges Bank and into the Gulf of Maine (Figure 2a). Storm-petrels were also relatively common (24% of the observations) but were highly aggregated (Figure 2b). The largest flocks observed were again on the Georges Bank.

Phalaropes (primarily red phalaropes) accounted for 8% of the sightings (Table 1) and were only seen on the northern edge of Georges Bank (Figure 2c). This is a common migratory stopover sight where phalaropes are known to feed on their way to arctic breeding locations. Gulls made up a total of 9% of the observations, the majority of which were herring and black-backed gulls (Table 1). These were observed throughout the survey area (Figure 2d).

Marine Mammal, turtle and fish sightings

Although the survey protocol (Gjerdrum et al. 2012) used for the seabird surveys was not designed for marine mammals, turtles or large fish, these observations were also recorded. A total of 148 marine organisms in addition to the birds were sighted and recorded (Table 2). Dolphin were observed in the greatest number on Georges Bank and north of Baltimore Canyon (Figure 3a). Humpback whales were sighted in the central part of the survey area, and long-finned pilot whales were sighted only on Georges Bank (Figure 3b). Also observed were 16 Turtles, 14 of which were Loggerhead Turtles observed off Chesapeake Bay (Figure 3c). Other species identified included ocean sunfish and Portuguese man-of-war (Table 2; Figure 3d).

Data Storage

All data collected on marine bird, mammal, fish and turtles from the Gordon Gunter have been imported into our main pelagic seabird survey database (MS Access), which is managed by Canadian Wildlife Service, Environment and Climate Change Canada in Dartmouth, Nova Scotia. The data are made publically available on OBIS (Ocean Biogeographic Information System), which is updated on a semi-annual basin.

Acknowledgements

The CWS monitoring program for seabirds at sea relies on the generous support of ships' crew and personnel; the surveys conducted from the Gordon Gunter would not have been possible without the kind support of Jerry Prezioso, NOAA, and we thank Jerry, the science staff, and ship's crew for giving us this valuable opportunity to accompany them on their mission.

Table 1: List of bird species sighted during seabird surveys on board the Gordon Gunter during seabird surveys from 21 May - 2 June, 2016.

Family	English	Latin	Number observed in transect	Total number observed
Gaviidae	Common Loon	*Gavia immer*	16	16
	Red-throated Loon	*Gavia stellata*	2	2
	Unidentified Loons	Gaviidae	1	1
Procellariidae	Northern Fulmar	*Fulmarus glacialis*	209	263
	Black-capped Petrel	*Pterodroma hasitata*	1	1
	Sooty Shearwater	*Ardenna griseus*	447	568
	Great Shearwater	*Ardenna gravis*	388	495
	Manx Shearwater	*Puffinus puffinus*	30	40
	Cory's Shearwater	*Calonectris diomedea*	15	20
	Audubon's Shearwater	*Puffinus lherminieri*	3	4
	Unidentified Shearwaters	Procellariidae	19	27
Hydrobatidae	Leach's Storm-Petrel	*Oceanodroma leucorhoa*	14	21
	Wilson's Storm Petrel	*Oceanites oceanicus*	78	90
	Unidentified Storm-Petrels	Hydrobatidae	378	405
Sulidae	Northern Gannet	*Morus bassanus*	10	20
	Brown Pelican	*Pelecanus occidentalis*	0	5
Anatidae	Black Scoter	*Melanitta nigra*	1	1
Scolopacidae	Red Phalarope	*Phalaropus fulicaria*	165	165
	Red-necked Phalarope	*Phalaropus lobatus*	1	1
Laridae	South Polar Skua	*Stercorarius maccormicki*	4	7
	Great Skua	*Stercorarius skua*	1	1
	Unidentified Skuas	*Stercorarius* Skuas	1	2
	Parasitic Jaeger	*Stercorarius parasiticus*	3	4
	Pomarine Jaeger	*Stercorarius pomarinus*	1	1
	Unidentified Jaegers	*Stercorarius* Jaegers	4	4
	Great Black-backed Gull	*Larus marinus*	63	90
	Herring Gull	*Larus argentatus*	70	82
	Laughing Gull	*Larus atricilla*	18	24
	Lesser Black-backed Gull	*Larus fuscus*	2	2
	Unidentified Gulls	Laridae	1	3
	Common Tern	*Sterna hirundo*	14	29
	Caspian Tern	*Hydroprogne caspia*	0	1
	Unidentified Terns	Sternidae	1	10

Alcidae	Atlantic Puffin	*Fratercula arctica*	1	1
	Common Murre	*Uria aalge*	1	1
Total			1963	2407

Table 2: List of marine wildlife (other than birds) sighted during seabird surveys on board the Gordon Gunter during oceanographic surveys from 21 May - 2 June, 2016.

English	Latin	Total number observed
Common Dolphin	*Delphinus delphis*	78
Long-finned Pilot Whale	*Globicephala melas*	14
Humpback Whale	*Megaptera novaeangliae*	5
Unidentified Cetacean	Cetacea	10
Gray Seal	*Halichoerus grypus*	2
Loggerhead Sea Turtle	*Caretta caretta*	14
Unindentified Turtle	Chelonioidea	2
Ocean Sunfish	*Mola mola*	6
Portuguese Man-Of-War	*Physalia physalia*	3
Unidentified Jellyfish	Scyphozoa	1
Total		148

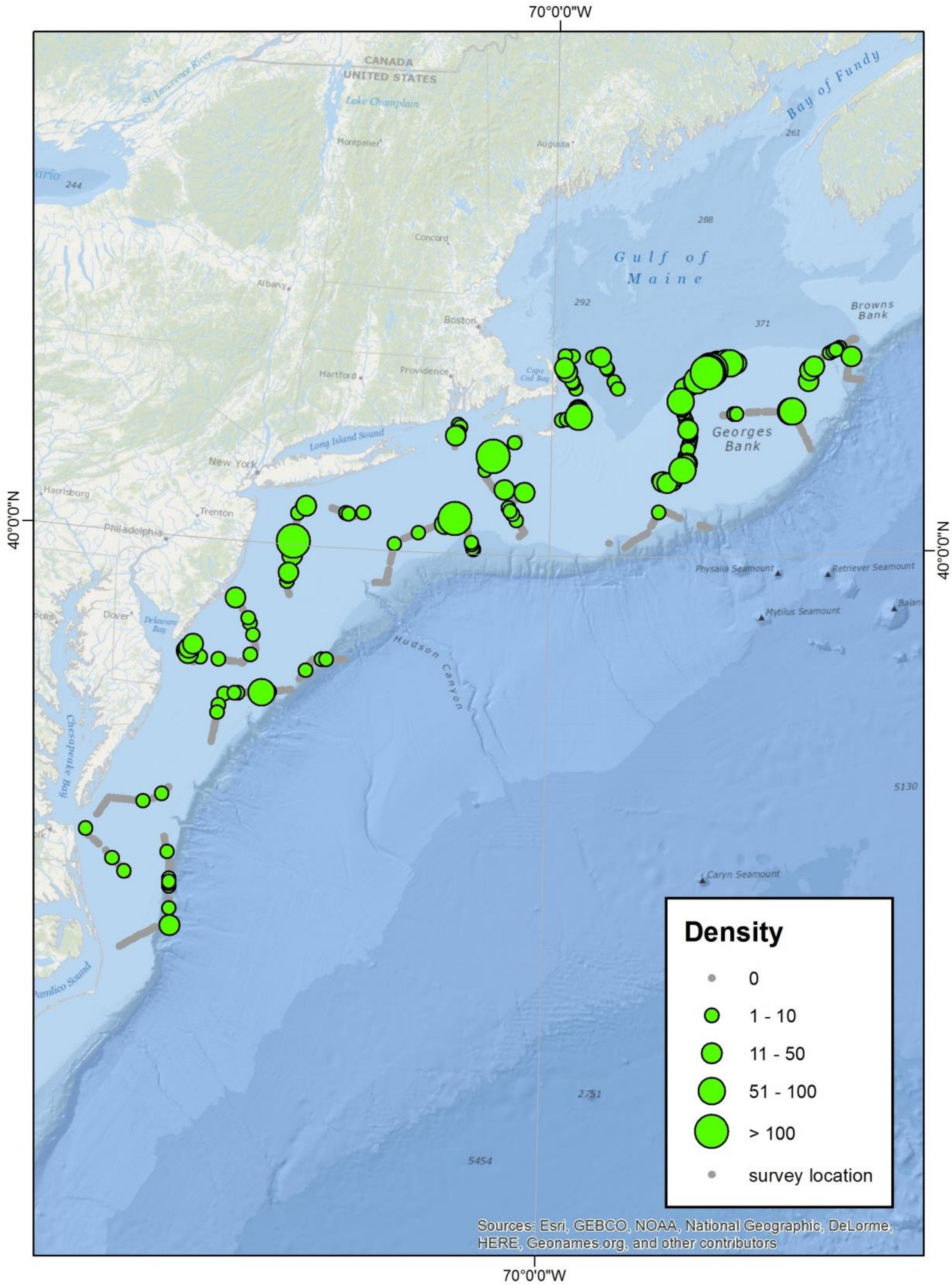

Figure 1. Density (count/km^2) of birds (all species combined) sighted during seabird surveys on board the Gordon Gunter during oceanographic surveys from 21 May – 2 June, 2016.

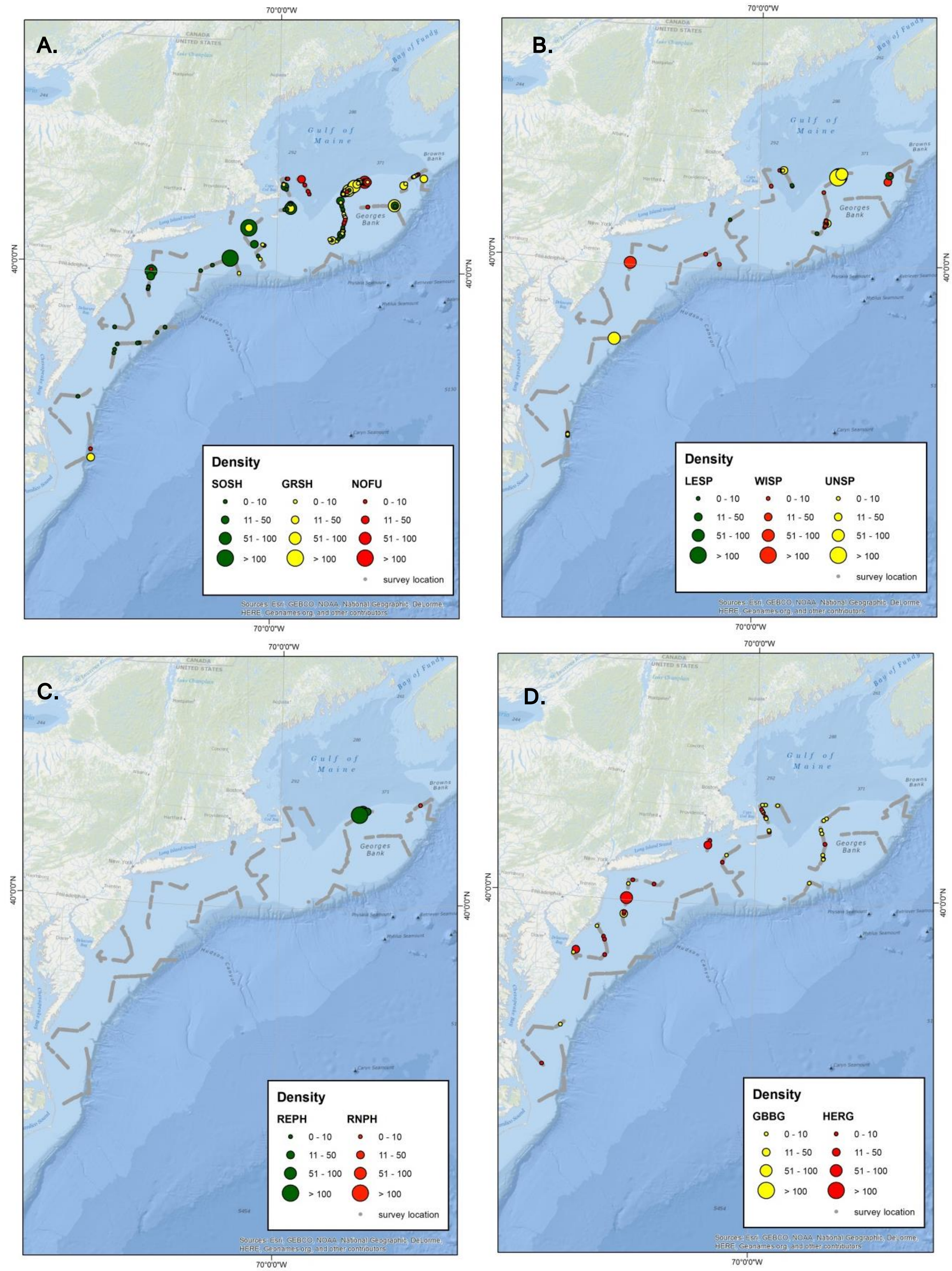

Figure 2. Density (count/km^2) of (A) shearwaters (SOSH = sooty shearwater; GRSH = great shearwater; NOFU = northern fulmar); (B) storm-petrels (LESP = Leach's storm-petrel; WISP = Wilson's storm-petrel; UNSP = unidentified storm-petrel); (C) phalaropes (REPH = red phalarope; RNPH = red-necked phalarope; and (D) gulls (GBBG = great black-backed gull; HERG = herring gull) sighted during seabird surveys on board the Gordon Gunter during oceanographic surveys from 21 May – 2 June, 2016.

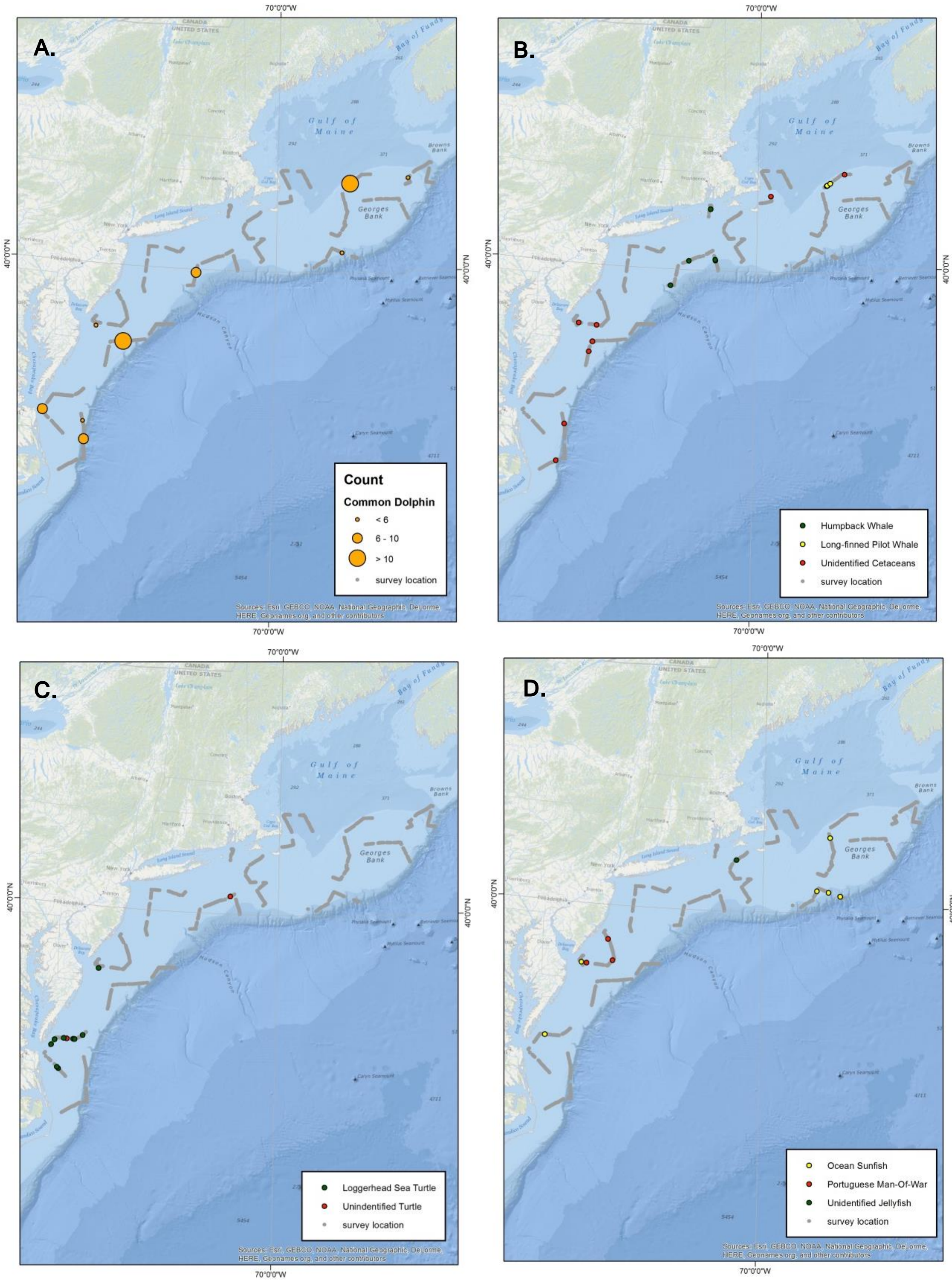

Figure 3. Location of (A) dolphins; (B) whales; (C) turtles; and (D) sunfish and jellies sighted during seabird surveys on board the Gordon Gunter during oceanographic surveys 21 May – 2 June, 2016.

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