CRUISE RESULTS
NOAA Research Vessel HENRY BIGELOW
Cruise No. HB 17-01
Winter Northeast Ecosystem Monitoring Survey

For further information, contact
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Date: 20 March 2017

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CRUISE PERIOD AND AREA

The NOAA research vessel *HENRY BIGELOW* sampled a total of 115 stations from 11 to 23 February 2017. The cruise departure, originally set for Friday, February 10, was delayed by one day when a blizzard prevented scientists from Newfoundland and New Hampshire from reaching the vessel on the day before sailing. A thermosalinograph shipped from Miami and due to be installed in the scientific seawater flow-through system was also delayed. The scientists and equipment arrived on February 10 and departure took place on Saturday, February 11. The delayed departure not only made it possible for personnel and gear to reach the vessel, but also provided time for the storm's winds and seas to diminish, allowing the vessel to start working soon after leaving Narragansett Bay.

OBJECTIVES

The principal objective of this 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 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.

METHODS

The survey originally consisted of 155 stations at which the vessel planned to stop and lower instruments over the port side of the vessel from an A-frame and two conductive-wire winches. Due to time constraints imposed by vessel availability and weather, only a total of 115 stations were sampled. Of these, 29 were in the Middle Atlantic Bight (MAB), 33 were in Southern New England (SNE), 37 were on Georges Bank (GB), and 16 were in the Gulf of Maine (GOM). (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 the number of revolutions during the tow. At the 24 randomly designated Census of Marine Zooplankton (CMarZ) stations a 20-cm diameter PVC bongo frame fitted with paired 165-micron nylon mesh nets was added to 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 bell-shaped 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 starboard side of the vessel at the side-sampling station using an A-frame and the forward 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 used to facilitate data transfer at high baud rates over more than 1600 meters of conducting wire spooled on the 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 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 (Figure 3). The package was deployed from the starboard side-sampling station, using the A-frame and aft conducting cable winch. This CTD and rosette 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 and carbonate chemistry. Analysis for chlorophyll-a levels from these water samples was conducted on board the vessel in the chemistry lab, using a Turner Designs 10-AU fluorometer and a filtration setup (Figure 4). Water samples for the chlorophyll-a analysis were drawn from the surface, chlorophyll-max layer and from one depth below the chlorophyll-max layer. These were taken as a check for the submersible fluorometer mounted on the rosette. Care was taken to draw a nutrient sample from the same bottle that each Dissolved Inorganic Carbon (DIC) sample had been drawn from, to ensure the best possible correlation between the DIC and nutrient parameters.

Near-surface (~ 3 meters depth) salinity, temperature and pCO_2 levels were monitored continuously along the entire cruise track using a thermosalinograph, and a partial pressure of carbon dioxide (pCO_2) system hooked up to the ship's scientific flow-through seawater system. In addition to the pCO_2 system, UNH scientists added a sensor to the flow-through scientific seawater plumbing to measure Total Alkalinity (TA). The Scientific Computer System (SCS) recorded the output from the thermosalinograph at 10-second intervals. Records were given a time-date stamp by the GPS unit. Data from the pCO2 and TA systems were logged independently on dedicated computers hooked up to those sensors. These dedicated, independent computers for pCO_2 and TA did receive correlated data from the SCS system on board. In addition, an ImagingFlowCytobot unit was plumbed into the flow-through seawater system in the CTD lab (Figure 5**).** The device captured images of diatoms, dinoflagellates and marine ciliates on an independent computer provided by the Woods Hole Oceanographic Institution (WHOI) (Figure 6). This system was monitored daily by EPA volunteer Joseph Bishop.

Marine mammal and seabird observations and photography were conducted from the bridge and flying bridge of the *HENRY BIGELOW* by Canadian Wildlife Observer Holly Hogan (Figure 7). A Seabird Survey Report by Carina Gjerdrum of the Canadian Wildlife Service, Environment Canada summarizes seabird observations in Appendix A.

RESULTS

A summary of routine survey activities is presented in Table 1. Areal coverage for the cruise is shown in Figure 1. The NOAA vessel *HENRY BIGELOW* sailed from Davisville, RI on Saturday, February 11 at 1000 hours EST. Sampling started just south of Narragansett Bay as the vessel headed south and offshore across the Southern New England shelf. Improving weather allowed the vessel to sample at 9 offshore stations before a decision was made to head inshore toward stations off the coast of southern New Jersey as another front was approaching. After completing 18 stations the vessel steamed slowly south to what was decided to be the southernmost station at the mouth of the Chesapeake Bay. While this would leave a dozen stations unsampled south towards Cape Hatteras, the decision was made in the interest of devoting more of the remaining cruise to sampling the northern areas. Weather continued to hamper sampling as the vessel headed toward the north, particularly at offshore stations. In order to continue working in marginal conditions the sampling was scaled back at a couple of stations to include only the larger 61 cm bongos, removing the 20 cm bongos which make the full array with four nets difficult to deploy in heavy weather.

By February 16, sampling from Chesapeake Bay through the Southern New England area had been completed. At this critical juncture the long-range weather forecast showed improving conditions on Georges Bank, so the remainder of the cruise period was spent sampling every designated Georges Bank station, and 16 in the southern Gulf of Maine, including the Northeast Channel, Georges Basin and Wilkinson Basin. After completing those stations the Henry Bigelow returned to Newport, RI via the Cape Cod Canal, and docked there on February 23, Thursday morning, to end the 2017 Winter Ecosystem Monitoring Survey, HB1701.

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 sent by overnight UPS to Maura Thomas at the University of Maine, School of Marine Sciences 5706 Aubert Hall, Orono, ME. The Total Alkalinity Sensor on the Scientific Seawater system remained in place for the next cruise on board the Henry Bigelow, but all data collected during the Ecomon cruise were taken to the University of New Hampshire by Shawn Shellito. The ImagingFlowCytoBot unit and the imagery and data it collected were delivered to Emily Peacock at WHOI. 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

<u>National Marine Fisheries Service, NEFSC, Narragansett, RI</u>

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Christopher Taylor

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Table 1. Summary of sample activities conducted at 115 stations at which the *HENRY BIGELOW* stopped to lower

instruments over the side during Cruise No. HB 1701. Latitude and Longitude are shown in decimal degrees.
Std BON/CTD = 61 cm bongo Standard Protocol, CTD 911 = fixed station, SAL=salt
2B3 D = 333 mesh 20 cm bongo Dave R. samples, 2B1 C = 165 mesh 20 cm bongo CMARZ samples, ,
DIC = Dissolved Inorganic Carbon, NUT = nutrients, CHL = Chlorophyll

CTD Cast	**SiteID/** STA#	**Date** GMT	**Latitude** (dd)	**Longitude** (dd)	**Bottom** Depth(m)	**Operation**
1	1	11 Feb 2017	41.2517	-71.1733	41	BON/CTD, 2B3 D
2	2	11 Feb 2017	41.085	-71.2517	37	BON/CTD, 2B3 D
3	3	11 Feb 2017	40.6667	-71.1783	63	BON/CTD, 2B3 D
4	4	11 Feb 2017	40.665	-71.4167	63	BON/CTD, 2B1 C
5	5	12 Feb 2017	40.2533	-71.67	86	BON/CTD, 2B3 D
6	6	12 Feb 2017	40.0817	-71.5033	93	BON/CTD, 2B3 D
7	7	12 Feb 2017	39.9983	-71.4233	120	BON/CTD, 2B3 D
8	8	12 Feb 2017	39.7383	-71.9167	206	BON/CTD, 2B3 D
9	9	12 Feb 2017	39.5867	-72.9233	62	BON/CTD, 2B1 C
1	10	12 Feb 2017	39.3633	-73.4	54	CTD 911 - SAL,DIC,CHL,NUT
10	11	12 Feb 2017	39	-73.8333	37	BON/CTD, 2B3 D
11	12	12 Feb 2017	39.25	-74	28	BON/CTD, 2B3 D
12	12	12 Feb 2017	39.2517	-73.9983	27.7	BON/CTD – no baby bongo
13	13	12 Feb 2017	39.2533	-74.3417	19	BON/CTD, 2B1 C
14	14	12 Feb 2017	39.01	-74.6617	13	BON/CTD, 2B3 D
15	15	13 Feb 2017	38.9117	-74.4333	26	BON/CTD, 2B3 D
16	16	13 Feb 2017	38.2467	-75.0083	22	BON/CTD, 2B3 D
2	17	13 Feb 2017	37.9967	-74.9567	26	CTD 911 - DIC,CHL,NUT
3	18	13 Feb 2017	37.8367	-74.58	55	CTD 911 - SAL,DIC,CHL,NUT
17	19	13 Feb 2017	37.1617	-75.6633	14	BON/CTD, 2B1 C
18	20	13 Feb 2017	37.1583	-75.2483	32	BON/CTD, 2B3 D
19	21	13 Feb 2017	37.4967	-75.5017	15	BON/CTD, 2B1 C
20	22	14 Feb 2017	37.75	-74.8383	35	BON/CTD, 2B3 D
21	23	14 Feb 2017	37.5817	-74.6733	58	BON/CTD, 2B1 C
4	24	14 Feb 2017	37.6917	-74.26	117	CTD 911 - SAL,DIC,CHL,NUT
22	25	14 Feb 2017	38.2467	-73.8417	146	BON/CTD, 2B1 C
23	26	14 Feb 2017	38.4133	-73.925	63	BON/CTD, 2B3 D
24	27	14 Feb 2017	38.4967	-73.9217	54	BON/CTD, 2B3 D
25	28	14 Feb 2017	38.4983	-74.08	62	BON/CTD, 2B3 D
26	29	14 Feb 2017	38.66	-73.9983	52	BON/CTD, 2B1 C
27	30	14 Feb 2017	38.7417	-73.8333	48	BON/CTD, 2B3 D
28	31	14 Feb 2017	38.5817	-73.335	99	BON/CTD, 2B3 D
29	32	14 Feb 2017	38.8233	-73.345	78	BON/CTD, 2B3 D
30	33	15 Feb 2017	38.995	-72.9133	98	BON/CTD, 2B3 D
5	34	15 Feb 2017	39.0117	-72.58	946	CTD 911 - DIC,CHL,NUT
6	35	15 Feb 2017	39.0583	-72.7417	196	CTD 911 - DIC,CHL,NUT
31	36	15 Feb 2017	39.3317	-72.7483	89	BON/CTD, 2B3 D
32	37	15 Feb 2017	39.4933	-73.33	37	BON/CTD, 2B3 D

7	38	15 Feb 2017	39.71	-73.985	24	CTD 911 - SAL,DIC,CHL,NUT
33	39	15 Feb 2017	39.8317	-73.5867	38	BON/CTD, 2B1 C
34	40	15 Feb 2017	40.16	-73.8317	29	BON/CTD, 2B3 D
35	41	15 Feb 2017	40.4133	-73.4983	27	BON/CTD, 2B1 C
36	42	15 Feb 2017	40.1667	-72.925	49	BON/CTD, 2B3 D
37	43	15 Feb 2017	40	-72.9983	53	BON/CTD, 2B3 D
38	44	15 Feb 2017	39.9983	-72.915	55	BON/CTD, 2B3 D
39	45	16 Feb 2017	39.8283	-72.9233	70	BON/CTD, 2B1 C
40	46	16 Feb 2017	40.2533	-72.0833	64	BON/CTD – no baby bongo
41	47	16 Feb 2017	40.66	-72.2467	50	BON/CTD – no baby bongo
42	48	16 Feb 2017	40.9833	-71.9183	22	BON/CTD, 2B3 D
43	49	16 Feb 2017	40.83	-71.585	63	BON/CTD, 2B3 D
8	50	16 Feb 2017	41.1067	-70.6183	44	CTD 911 - SAL,DIC,CHL,NUT
44	51	16 Feb 2017	41.2483	-70.5067	32	BON/CTD, 2B3 D
45	52	16 Feb 2017	41.065	-70.175	27	BON/CTD, 2B3 D
46	53	17 Feb 2017	40.7333	-69.79	47.1	BON/CTD, 2B3 D
47	54	17 Feb 2017	40.6633	-70.1617	48	BON/CTD – no baby bongo
48	55	17 Feb 2017	40.6633	-70.5833	62	BON/CTD – no baby bongo
9	56	17 Feb 2017	40.6617	-70.605	62	CTD 911 - SAL,DIC,CHL,NUT
10	57	17 Feb 2017	40.0383	-70.6067	170	CTD 911 - DIC,CHL,NUT
11	58	17 Feb 2017	39.8333	-70.625	940	CTD 911 - SAL,DIC,CHL,NUT
49	59	17 Feb 2017	40.0817	-70.085	158	BON/CTD, 2B3 D
50	60	17 Feb 2017	40.2467	-69.67	83	BON/CTD, 2B3 D
51	61	18 Feb 2017	40.0783	-69.5	106	BON/CTD, 2B3 D
52	61	18 Feb 2017	40.0783	-69.5083	107	BON/CTD, 2B3 D
53	62	18 Feb 2017	40.3283	-68.9217	95	BON/CTD, 2B3 D
54	63	18 Feb 2017	40.33	-68.4167	126	BON/CTD, 2B3 D
55	64	18 Feb 2017	40.33	-68.1783	183	BON/CTD, 2B1 C
12	65	18 Feb 2017	40.2417	-67.6933	1192	CTD 911 - SAL,DIC,CHL,NUT
13	66	18 Feb 2017	40.38	-67.6933	261	CTD 911 - DIC,CHL,NUT
56	67	18 Feb 2017	40.745	-67.9183	77	BON/CTD, 2B1 C
57	68	18 Feb 2017	41.0867	-68.3333	46	BON/CTD, 2B3 D
58	68	18 Feb 2017	41.0833	-68.3367	41	BON/CTD – no baby bongo
59	69	18 Feb 2017	41	-68.585	55	BON/CTD, 2B3 D
60	70	18 Feb 2017	40.8467	-68.4233	53	BON/CTD, 2B3 D
61	71	18 Feb 2017	40.6633	-68.5	66	BON/CTD, 2B3 D
62	72	19 Feb 2017	40.825	-68.665	61	BON/CTD, 2B3 D
63	73	19 Feb 2017	40.7517	-68.9967	73	BON/CTD, 2B1 C
14	74	19 Feb 2017	40.9133	-69.1483	68	CTD 911 - DIC,CHL,NUT
64	75	19 Feb 2017	41.1667	-69	104	BON/CTD, 2B3 D
65	76	19 Feb 2017	41.4133	-68.7517	132	BON/CTD, 2B1 C
66	77	19 Feb 2017	41.6617	-68.4233	39	BON/CTD, 2B1 C
67	78	19 Feb 2017	41.465	-68.3933	64	BON/CTD, 2B3 D
68	79	19 Feb 2017	41.3167	-68.1883	53	BON/CTD, 2B1 C
69	80	19 Feb 2017	41.3267	-67.8433	43	BON/CTD, 2B3 D
15	81	19 Feb 2017	41.4717	-67.6933	42	CTD 911 - SAL,DIC,CHL,NUT

70	82	19 Feb 2017	41.165	-67.505	53	BON/CTD, 2B3 D
71	83	19 Feb 2017	40.99	-67.4983	70	BON/CTD, 2B3 D
16	84	19 Feb 2017	40.9283	-67.7033	68	CTD 911 - DIC,CHL,NUT
72	85	19 Feb 2017	40.8267	-67.5117	83	BON/CTD, 2B3 D
73	86	20 Feb 2017	40.9117	-67.255	86	BON/CTD, 2B3 D
74	87	20 Feb 2017	40.7467	-67.0867	104	BON/CTD, 2B3 D
75	88	20 Feb 2017	40.9967	-66.6717	88	BON/CTD, 2B3 D
76	89	20 Feb 2017	41.0817	-66.6717	83	BON/CTD, 2B1 C
77	90	20 Feb 2017	41.2467	-67.0067	68	BON/CTD, 2B3 D
78	91	20 Feb 2017	41.5017	-66.76	75	BON/CTD, 2B1 C
79	92	20 Feb 2017	41.7467	-66.345	79	BON/CTD, 2B3 D
80	93	20 Feb 2017	41.58	-66.09	101	BON/CTD, 2B3 D
81	94	20 Feb 2017	41.6633	-65.8417	156	BON/CTD, 2B1 C
17	95	20 Feb 2017	41.7483	-65.4333	1977	CTD 911 - DIC,CHL,NUT
82	96	20 Feb 2017	41.9083	-65.745	226	BON/CTD, 2B3 D
83	96	20 Feb 2017	41.91	-65.765	190	CTD 19/19+ WATER
84	97	21 Feb 2017	42.2183	-65.7617	229	BON/CTD, 2B3 D
18	97	21 Feb 2017	42.225	-65.7633	231	CTD 911 -DIC,CHL,NUT
85	98	21 Feb 2017	42.335	-66.3367	254	BON/CTD, 2B1 C
86	98	21 Feb 2017	42.3217	-66.3367	252	CTD 19/19+ WATER
87	99	21 Feb 2017	41.9983	-66.5067	87	BON/CTD, 2B3 D
88	100	21 Feb 2017	42.005	-66.5883	78	BON/CTD, 2B3 D
89	101	21 Feb 2017	42.25	-66.7483	269	BON/CTD, 2B1 C
90	101	21 Feb 2017	42.25	-66.75	265	CTD 19/19+ WATER
91	102	21 Feb 2017	42.3683	-67.0417	346	BON/CTD, 2B1 C
19	102	21 Feb 2017	42.38	-67.0417	345	CTD 911 - SAL,DIC,CHL,NUT
20	103	21 Feb 2017	42.0067	-67.6917	64	CTD 911 - DIC,CHL,NUT
92	104	21 Feb 2017	41.9983	-67.755	83	BON/CTD, 2B3 D
93	105	21 Feb 2017	42	-68.005	201	BON/CTD, 2B3 D
94	106	21 Feb 2017	41.7567	-68.0917	39	BON/CTD, 2B3 D
95	107	21 Feb 2017	41.915	-68.4083	210	BON/CTD, 2B3 D
96	108	22 Feb 2017	42.1617	-68.8317	182	BON/CTD, 2B1 C
97	109	22 Feb 2017	42.2533	-69.665	247	BON/CTD, 2B3 D
98	109	22 Feb 2017	42.2467	-69.6583	248	CTD 19/19+ WATER
99	110	22 Feb 2017	42.5117	-69.6533	260	BON/CTD, 2B3 D
21	110	22 Feb 2017	42.505	-69.655	260	CTD 911 - SAL,DIC,CHL,NUT
22	111	22 Feb 2017	42.315	-70.2783	37	CTD 911 - SAL,DIC,CHL,NUT
100	112	22 Feb 2017	42.3383	-70.3283	47	BON/CTD, 2B3 D
23	113	22 Feb 2017	42.3567	-70.465	78	CTD 911 - DIC,CHL,NUT
24	114	22 Feb 2017	42.4167	-70.605	88	CTD 911 - SAL,DIC,CHL,NUT
101	114	22 Feb 2017	42.425	-70.61	89	BON/CTD, 2B3 D
102	115	22 Feb 2017	42.0833	-70.5033	45	BON/CTD – no baby bongo

TOTALS:	**Std BON/CTD Casts**	**=**	**98**
	2B3 D Bongo Casts	**=**	**66**
	2B1 C (CMarZ) Bongo Casts	**=**	**24**
	CTD PROFILE 911 Casts	**=**	**24**
	Nutrient Casts	**=**	**24**
	Chlorophyll Casts	**=**	**24**
	Dissolved Inorganic Carbon casts (DIC)	**=**	**24**
	Salinity sample casts	**=**	**13**

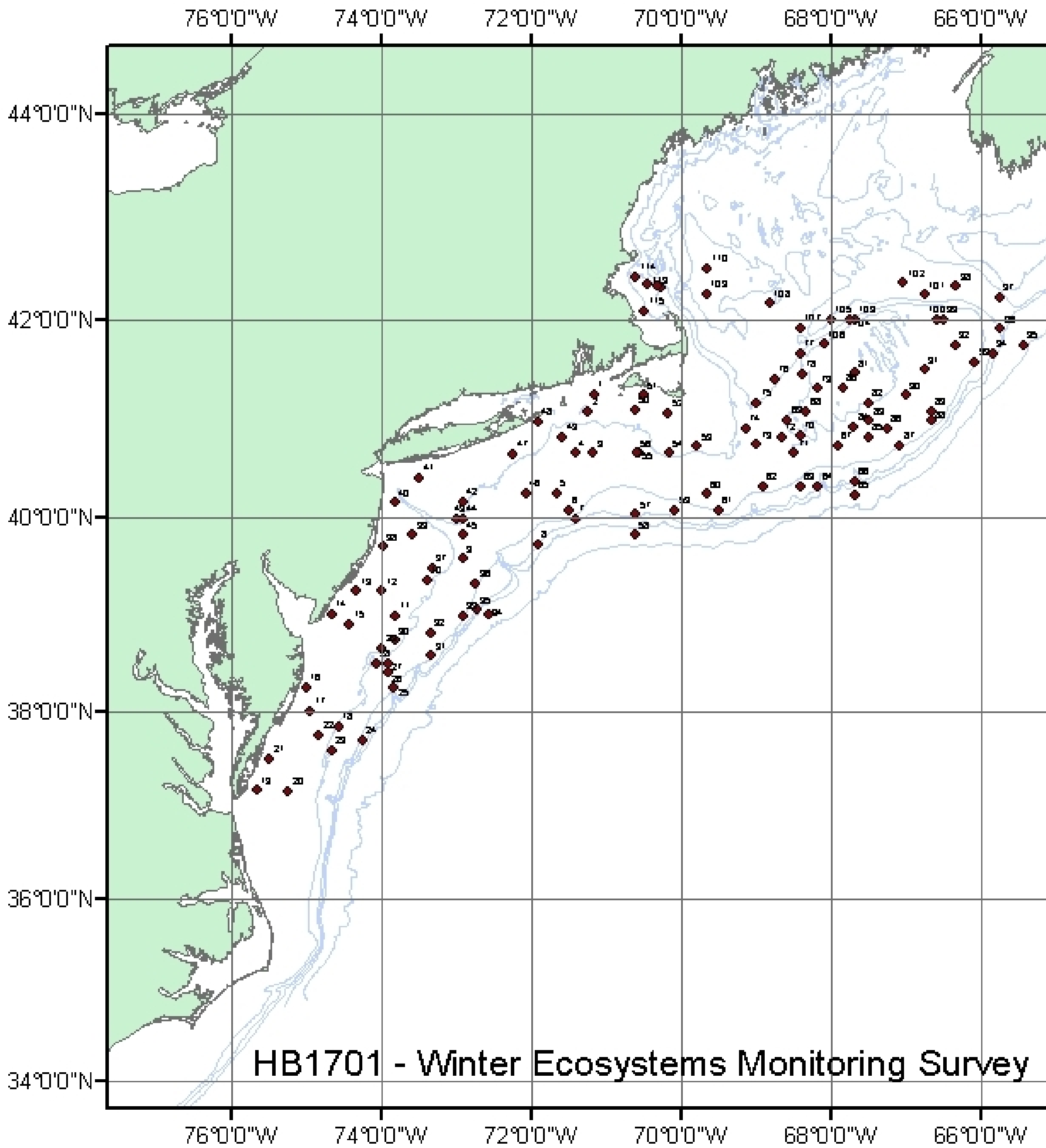


Figure 1. **Station locations numbered consecutively for Spring Ecosystem Monitoring Survey HB 1701, 11 – 23 February 2017.**

Figure 2. Bongo net array, showing 61 cm bongo nets being deployed from the port side of the *FSV Henry Bigelow.*

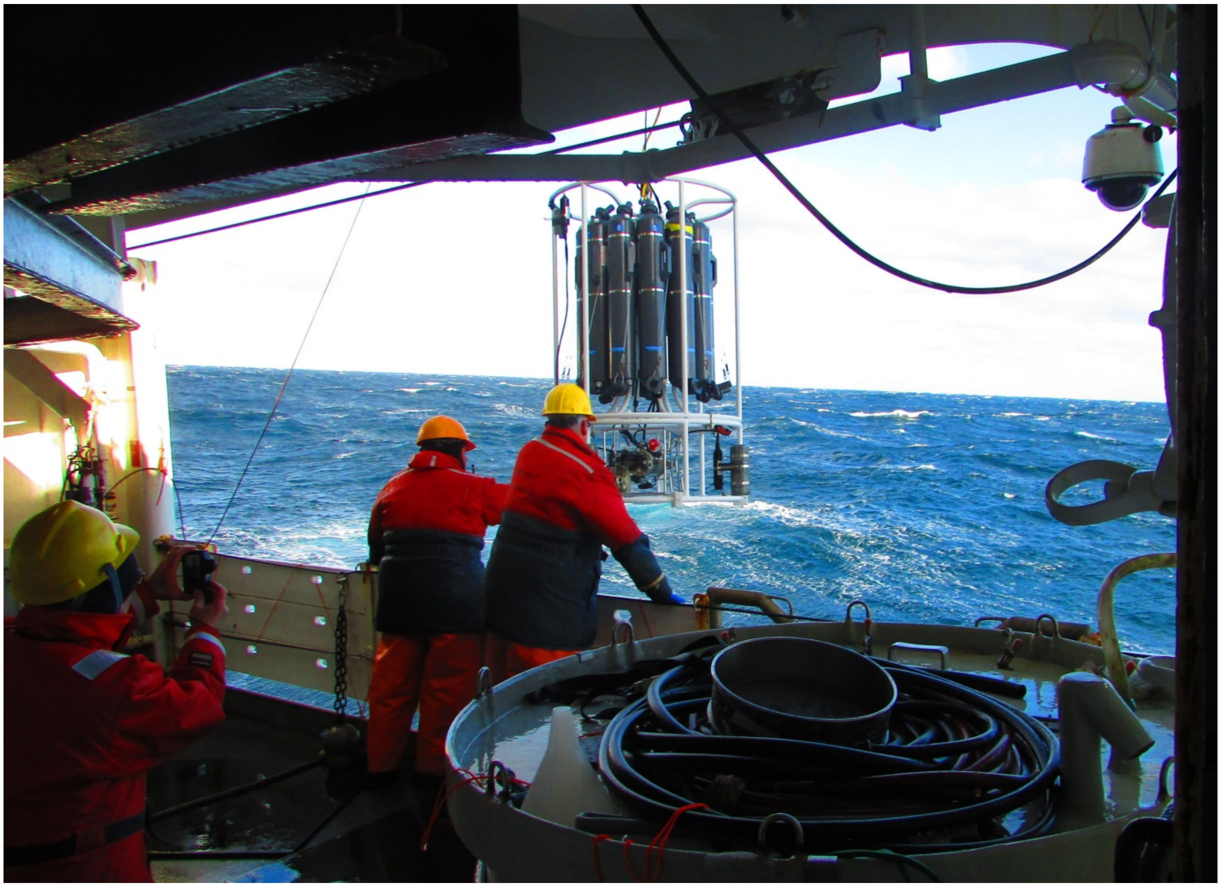


Figure 3. Niskin bottle and CTD 911 rosette being deployed aboard the FSV *Henry Bigelow.*

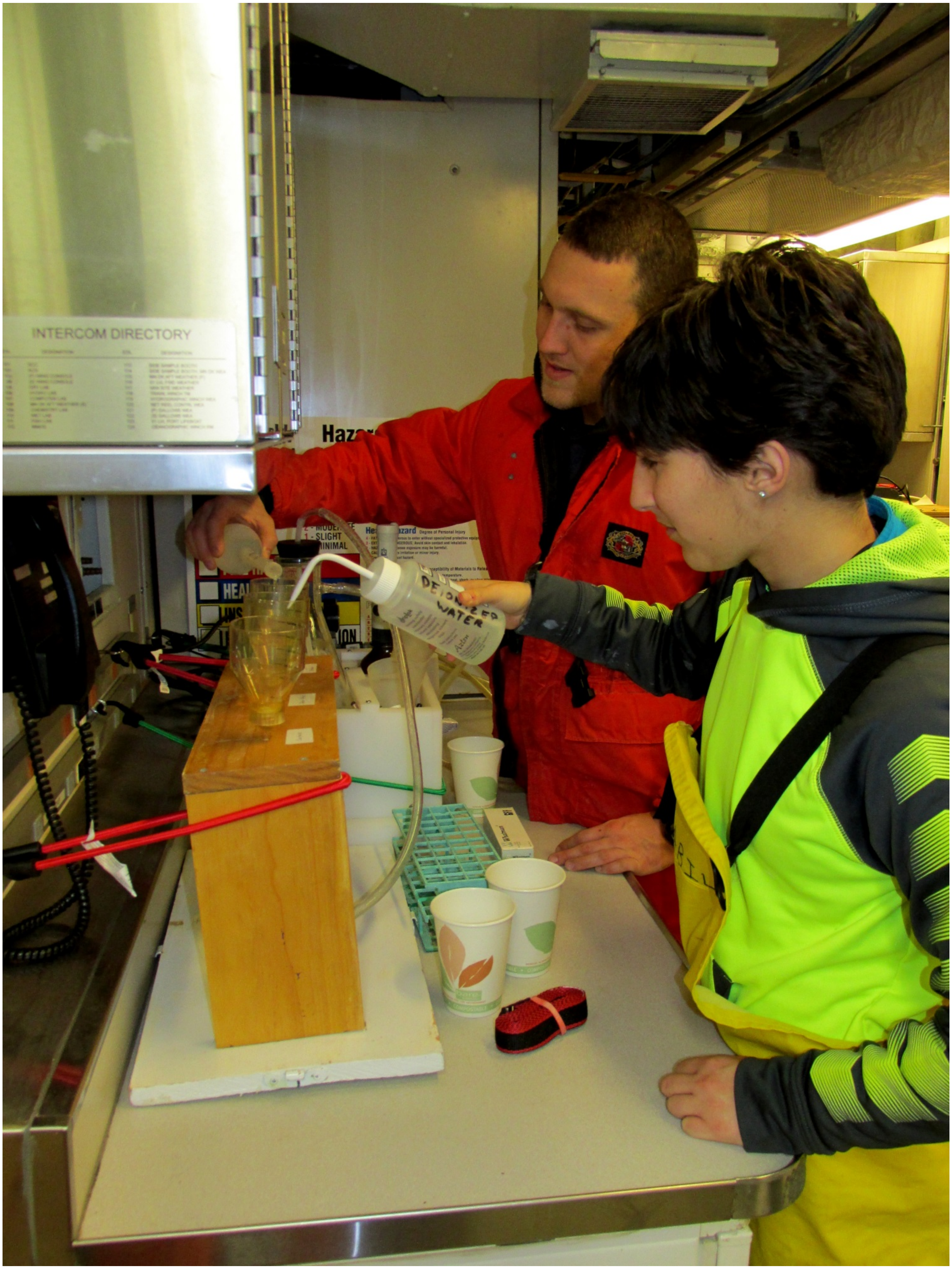


Figure 4. Filtration setup used for chlorophyll-a analysis in the chemistry lab of the Henry Bigelow during the HB1701 Winter Ecomon Cruise.

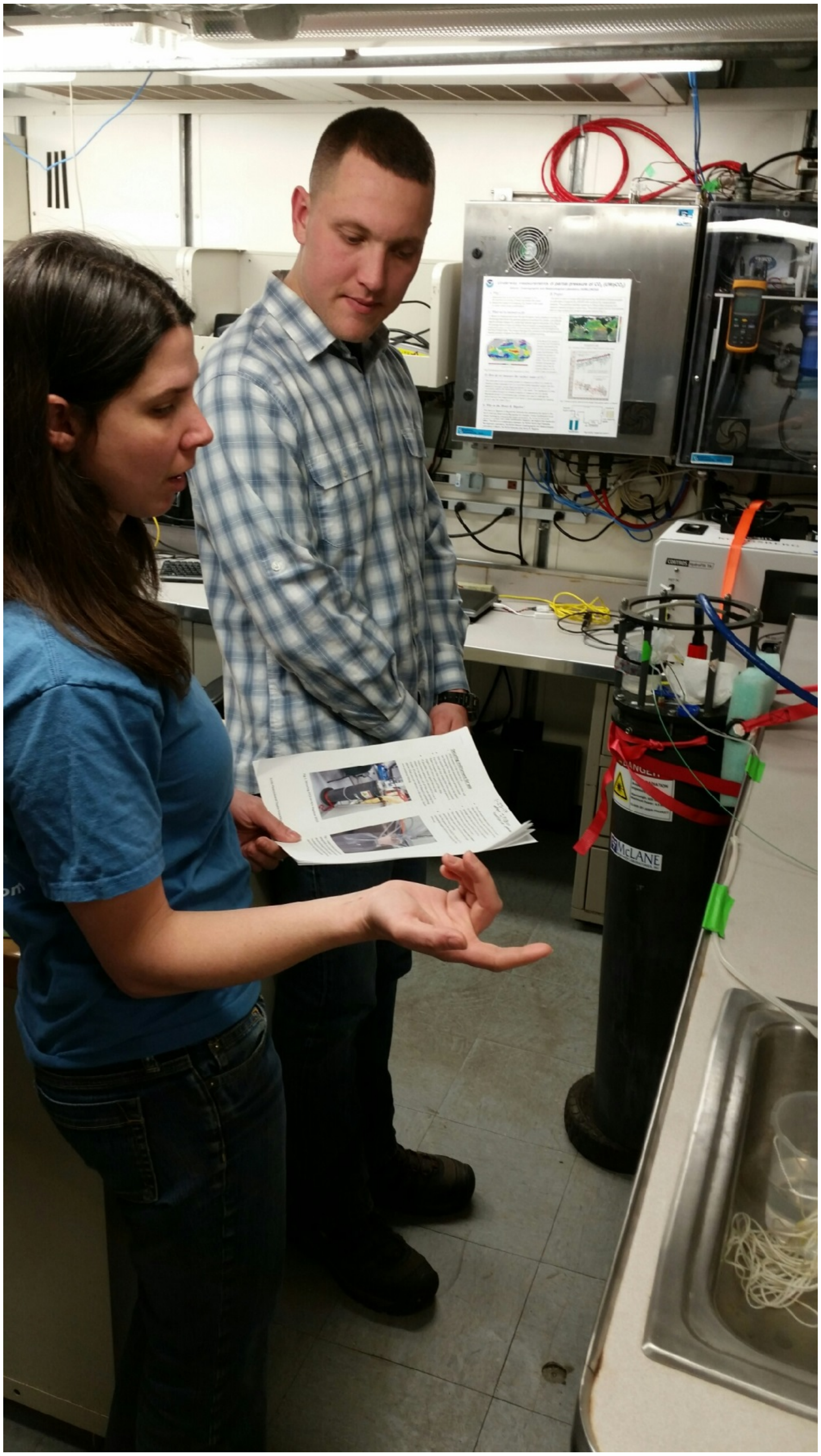


Figure 5. WHOI researcher Emily Peacock instructing EPA volunteer Joseph Bishop on running the Imaging FlowCytoBot (vertical black cylinder in photo).

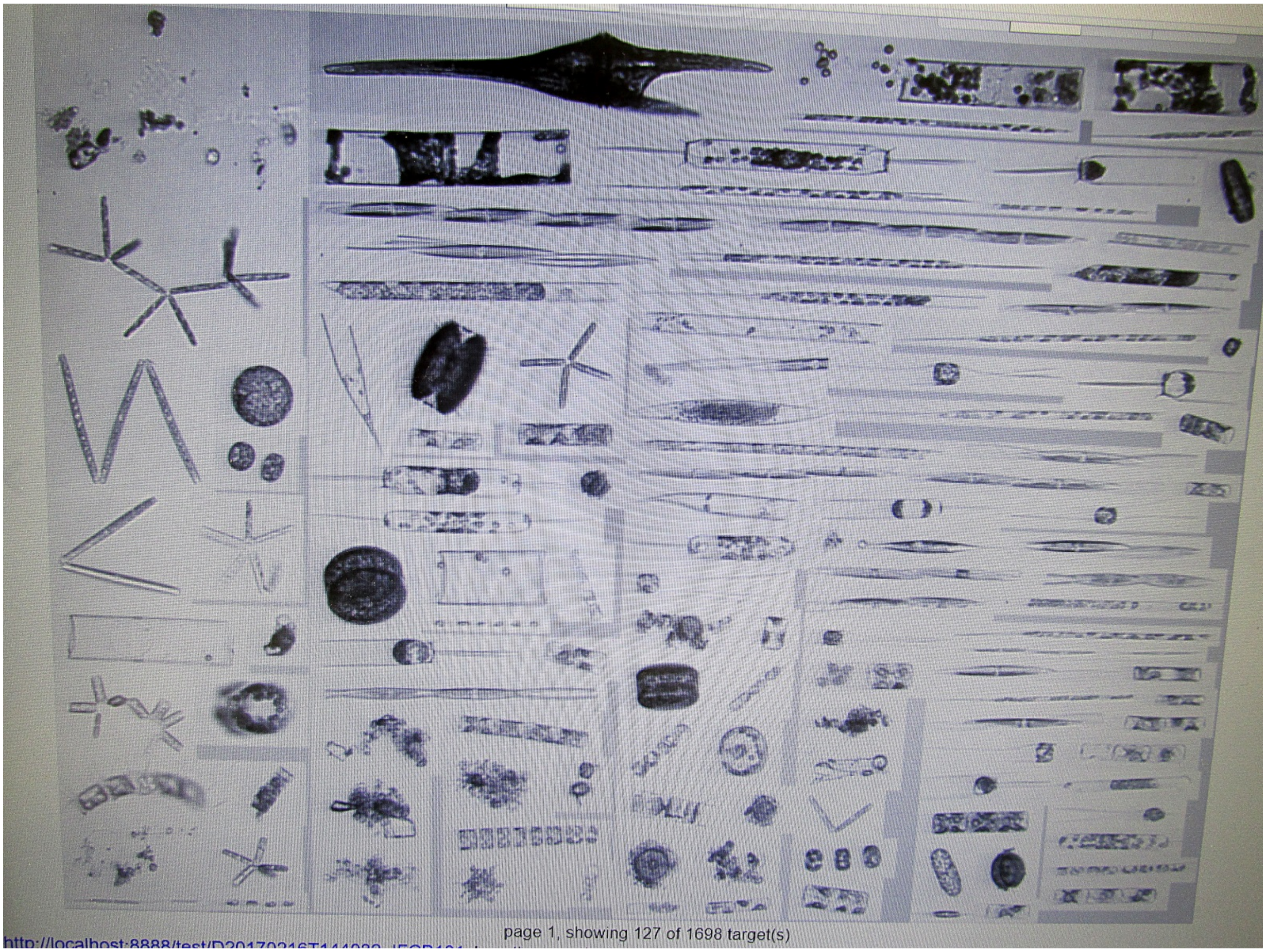


Figure 6. Images of diatoms & dinoflagellates from the imaging FlowCytobot Unit.

Figure 7. Seabird and marine mammal observer Holly Hogan at her observation post on the port side of the bridge of the Henry Bigelow.

Appendix A.

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

Seabird Survey Report
11-22 February 2017
Canadian Wildlife Service, Environment and Climate Change Canada
45 Alderney Drive, Dartmouth, Nova Scotia, Canada
Carina Gjerdrum carina.gjerdrum@canada.ca
Seabird Observer: Holly Hogan

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 Henry Bigelow in February 2017 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 port side of the bridge of the Henry Bigelow during oceanographic surveys from 11-22 February, 2017. 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

Seabird sightings

We surveyed 1223 km of ocean track from 11-22 February, 2017 (Figure 1). A total of 1184 waterbirds from 6 families were observed during the surveys; 694 of the birds sighted were counted in transect (Table 1). Overall, bird densities averaged 1.8 birds/km^2 (ranging from 0 - 276.3 birds/km^2). The highest densities of birds (>50 birds/km^2) were observed on the northern edge of George's Bank, eastern Nantucket shoals, and just northwest of Delaware Bay (Figure 1).

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 78 marine organisms in addition to the birds were sighted and recorded, 87% of which were common dolphin (Table 2).

Data Storage

All data collected on marine bird, mammal, fish and turtles 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 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.

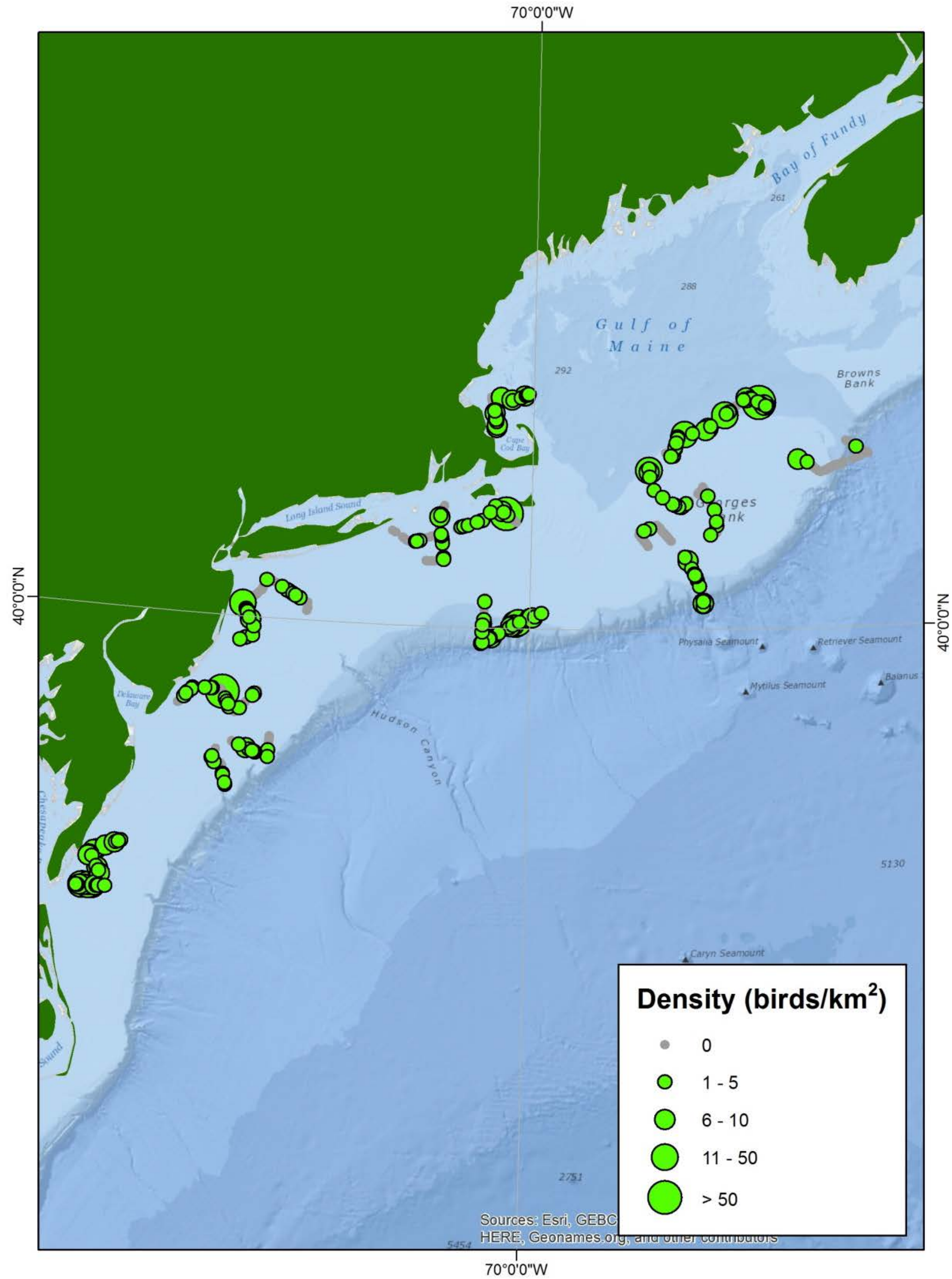
Table 1: List of bird species sighted during seabird surveys on board the Henry Bigelow during oceanographic surveys from 11-22 February, 2017.

Family	**Species**	**Latin**	**Number observed in transect**	**total number observed**
Gaviidae	Common Loon	*Gavia immer*	4	13
	Red-throated Loon	*Gavia stellata*	1	1
Procellariidae	Northern Fulmar	*Fulmarus glacialis*	101	121
Sulidae	Northern Gannet	*Morus bassanus*	160	402
Anatidae	White-winged Scoter	*Melanitta fusca*	155	184
	Black Scoter	*Melanitta nigra*	0	1
	Long-tailed Duck	*Clangula hyemalis*	3	3
Laridae	Herring Gull	*Larus argentatus*	39	96
	Great Black-backed Gull	*Larus marinus*	28	79
	Black-legged Kittiwake	*Rissa tridactyla*	11	22
	Ring-billed Gull	*Larus delawarensis*	0	1
	Great Skua	*Stercorarius skua*	1	1
	Unidentified gull	*Larus*	0	5
Alcidae	Common Murre	*Uria aalge*	107	126
	Thick-billed Murre	*Uria lomvia*	4	4
	Unidentified Murres	*Uria*	3	8
	Dovekie	*Alle alle*	47	60
	Atlantic Puffin	*Fratercula arctica*	9	21
	Razorbill	*Alca torda*	6	6
	Murre or Razorbill	*Uria* or *Alca*	4	6
	Unidentified Alcid	*Alcidae*	11	24
Total			**694**	**1184**

Table 2: List of marine wildlife (other than birds) sighted during seabird surveys from the Henry Bigelow during oceanographic surveys from 11-22 February, 2017.

English	**Latin**	**Total number observed**
Common Dolphin	*Delphinus delphis*	68
Fin Whale	*Balaenoptera physalus*	4
Gray Seal	*Halichoerus grypus*	2
Sei Whale	*Balaenoptera borealis*	1
Minke Whale	*Balaenoptera acutorostrata*	1
Humpback Whale	*Megaptera novaeangliae*	1
Unidentified cetaceans	Cetacea	1
Total		**78**

Figure 1. Density (count/km^2) of birds (all species combined) sighted during seabird surveys on board the the Henry Bigelow during oceanographic surveys from 11-22 February, 2017.



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