15 September 2022

CRUISE RESULTS
NOAA Research Vessel ***HENRY BIGELOW***
Cruise No. HB 22-04
Spring Northeast Ecosystem Monitoring Survey

CRUISE PERIOD AND AREA

The NOAA research vessel *HENRY BIGELOW* sampled a total of 150 stations on the Spring Ecosystem Monitoring Survey (EcoMon). The vessel sailed from Pier 2 at the Naval Station in Newport RI on 31 May and returned on 17 June 2022, having sampled as far south as a line of stations south of Delaware Bay, so that the southernmost part of the Mid-Atlantic Bight was not covered. The truncation of the southern survey area was necessary after the ship was forced to return to port briefly due to illness, losing two days at sea. However, the modified sampling strategy enabled the survey to reach almost every station in the Southern New England, Georges Bank and the Gulf of Maine areas during the 16 sea days ultimately available for sampling. Being the last area to be sampled, the Gulf of Maine had not received complete coverage during the past several Ecosystem Monitoring cruises due to time running out at the end of the allotted cruise period, but that was rectified on this survey.

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 from the Scientific Flow-through Seawater System using TSG, SCS, a fluorometer and a Total Alkalinity Sensor.

2) Use an Imaging FlowCytoBot unit, plumbed into this same seawater system to photograph phytoplankton from the near-surface waters that the ship sailed through. Unfortunately this unit failed after 2 days of operation.

(3) Collect acoustic data using an EK60 and ADCP.

(4) Collect pteropods, (planktonic snails), from the plankton samples at various stations throughout the cruise together with simultaneous DIC samples to measure the correlation between ocean acidity and shell thickness.

(5) Gather data on trends in ocean acidification and nutrient levels by collecting seawater samples at three depths (surface, midwater and bottom) with a rosette water sampler at predetermined fixed locations for the NOAA Ocean Acidification Program.

(6) Use environmental DNA filtered from water samples taken at various depths of the water column to document the past presence of various animals.

(7) Document the presence of seabirds, marine mammals and sea turtles all along the cruise track by having two dedicated observers recording and photographing any encountered while the vessel was underway between stations.

(8) Have an outreach component with students from Cranston West High School in Rhode Island elementary school students in Rhode Island, where Styrofoam cups they decorated were shrunk at depth with our sampling gear to illustrate the effects of water pressure.

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. However on the second day of the cruise the vessel returned to Newport when one of the NOAA Corps officers showed symptoms of Covid-19, and tested positive for the virus, despite two negative tests on the previous day. The vessel remained at Pier 2 at Naval Station Newport until Friday, June 3, when a replacement officer was found, allowing the vessel to sail at 1030 and return to the survey area (Figure 1).

Plankton and hydrographic sampling was conducted with double oblique tows using the 61-cm bongo sampler and a Seabird CTD. The tows 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 15 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 and towed together with the large aluminum bongo frame (Figure 2). No flowmeters were deployed with the 20-cm bongos. At all other plankton stations, 20 cm 335 micron mesh nets were deployed above the standard CTD/61-cm Bongo sampler in order to collect larval fish and egg samples for genetics and otolith analysis at the Narragansett NEFSC Lab. These samples were preserved for genetics and otolith analysis to be carried out at the Narragansett NEFSC Lab. A 45-kilogram 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 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 provided simultaneous depth, temperature, and salinity during 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 onto 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. Note that each CMarZ sample was preserved in its own pint jar, while the 20 cm 335 micron mesh bongo samples were combined into a single pint jar.

Prior to preservation, the plankton samples from a number of stations were examined microscopically for the presence of pteropods. If any were found they were removed from the sample and placed in a drying oven, (Figure 3), while a DIC sample was taken from the flow-through scientific seawater system or from a Niskin bottle water sample if a water cast had been done at that station. Samples were preserved for later analysis by collaborators at the Bermuda Institute of Ocean Sciences with the goal of correlating pteropod shell thickness with the acidity of seawater.

A small portion of the plankton samples from a series of stations was frozen by one of our students for a project she was working on to study the carbon and nitrogen isotopes in their tissues. That same student, Catrina Nowakowski, from the URI Graduate School of Oceanography, also launched a drifter buoy near Lydonia Canyon on the outer edge of Georges Bank to test its effectiveness at measuring wave height, length and direction (Figures 4 & 5).

At all fixed stations a Seabird 911+ CTD was deployed on a rosette frame equipped with 24 10-liter Niskin bottles (Figure 6). The package was deployed from the starboard side-sampling station, using the A-frame and aft conducting cable winch. This SBE9/11+ CTD and rosette package was deployed vertically, collecting profiles of water temperature, salinity, chlorophyll-a, and oxygen concentration. Water samples were collected using the Niskin sampling bottles at multiple depths along the upcast to be processed ashore for nutrients and carbonate chemistry. Care was taken to draw a nutrient sample from the same bottle that each Dissolved Inorganic Carbon (DIC) sample had been drawn from, (surface, mid-water and bottom) to ensure the best possible correlation between the DIC and nutrient parameters. Water from several depths was also filtered for environmental DNA by two NEFSC researchers from the Milford lab, Yuan Liu and Socrates Loginidis (Figure 7). Water samples for chlorophyll-a analysis were drawn from the surface, chlorophyll-max layer and from one depth below the chlorophyll-max layer and analysis of the samples was conducted onboard the vessel in the chemistry lab, using a Turner Designs 10-AU fluorometer and a filtration setup. These were used to ground-truth the submersible fluorometer mounted on the rosette. Water was also collected from upper water column depths by Wellesley student Eve Butterworth for analysis of dissolved oxygen ashore (Figure 8).

Near-surface (~3 meters depth) salinity, temperature and pCO2 levels were monitored continuously along the entire cruise track using a thermosalinograph, and a partial pressure of carbon dioxide (pCO2) system hooked up to the ship's scientific flow-through seawater system. In addition to the pCO2 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 connected to those sensors. These independent computers also received input from the SCS system onboard. In addition, an ImagingFlowCytobot unit was plumbed into the flow-through seawater system in the CTD lab**.** This device captured images of diatoms, dinoflagellates and marine ciliates on an independent computer provided by the Woods Hole Oceanographic Institution (WHOI) (Figure 9). However the system failed after two days at sea and the science staff was unable to get it started for the remainder of the survey.

Marine mammal and seabird observations and photography were conducted from the bridge and flying bridge of the *HENRY BIGELOW* by seabird and marine mammal observers Allison Black and Nick Metheny (Figure 10).

Finally, hand decorated Styrofoam cups were attached to the CTD rosette frame as part of an outreach project involving students from Cranston West High School. The cups, which were decorated in advance of the cruise by the students were returned to them after the cruise in a much reduced size, demonstrating the effects of water pressure at depth (Figure 11).

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 Newport, RI on Tuesday, 21 May at 1400 hours EDT. Sampling started just south of Narragansett Bay as the vessel sampled at 11 stations in the Southern New England area before returning to Naval Station Newport, the following day, 1 June, when an officer developed Covid-19 symptoms and tested positive, despite having tested negative on the previous day. The vessel command located a replacement NOAA Corps officer and the vessel was able to sail at 1030 hours on Friday, 1 June. Sampling resumed that afternoon, at a station south of Block Island. From there the *Henry Bigelow* continued working its way south, and picked up all the offshore stations to north of the entrance to the Chesapeake Bay. Then the vessel turned north to pick up the inshore stations of the mid-Atlantic Bight and Southern New England areas. Twelve of the southernmost stations were bypassed in order to make up for the time lost from the personnel exchange.

Once coverage of the mid-Atlantic Bight and Southern New England areas was completed, the vessel proceeded to the Gulf of Maine which was sampled completely except for two stations far to the east, south of Nova Scotia. Georges Bank was visited next where all the stations were sampled prior to the vessel returning to Newport. On the return voyage, there was sufficient time remaining to re-sample some of the wind-energy monitoring stations, providing additional baseline data from areas designated for possible wind-turbine installations.

The *Henry Bigelow* returned to the Newport Naval Station on Friday, 17 June, having fully sampled all regions planned except the southern Middle Atlantic Bight. Notably, complete sampling coverage was achieved in the Gulf of Maine. Complete coverage for this area has only been achieved most recently on the Spring Ecosystem Monitoring Survey in 2017 and the Summer Ecosystem Survey in 2021.

DISPOSITION OF SAMPLES AND DATA

All physical plankton samples were returned to Narragansett, RI for quality control processing and further analysis (except for the CMARZ samples). The CMarZ samples and associated data will be delivered to Anne Bucklin and Peter Wiebe at the Woods Hole Oceanographic Institution. The nutrient samples were delivered to the University of Rhode Island, Graduate School of Oceanography in Narragansett, Rhode Island. The Total Alkalinity Sensor on the Scientific Seawater system was returned to the University of New Hampshire. The ImagingFlowCytoBot unit and the images and data it collected were picked up by Emily Peacock at WHOI. The frozen copepod samples were taken to the URI Graduate School of Oceanography for carbon and nitrogen stable isotope analysis. The dried pteropod samples were sent to Amy Maas at the Bermuda Institute of Ocean Sciences. The CTD data were delivered to NEFSC Oceans and Climate Branch staff in Woods Hole, MA. Marine mammal observation data and the seabird observation data went to Tim White at the Bureau of Ocean Energy Management (BOEM) in Reedsville, MD and Beth Josephson, NEFSC Protected Species Branch, Woods Hole, MA.

SCIENTIFIC PERSONNEL

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Table 1. Summary of sample activities conducted at 150 stations at which the *HENRY BIGELOW* stopped to lower instruments over the side during Cruise No. HB 2204. Latitude and Longitude are shown in degrees and minutes. BON/CTD = 61 cm bongo Standard Protocol, CTD 911+WATER= water cast at a fixed station, SAL=salinity sample, 2B3 D = 333 mesh 20 cm bongo Dave R. samples, NUT = Nutrients, CHL = Chlorophyll 2B1 C = 165 mesh 20 cm bongo CMARZ samples, DIC = Dissolved Inorganic Carbon, Net Vertical = Vertical Ring Net Tow, CTD 19/19+ WATER = Seabird 19+ Profiler+water sample, URI = URI isotope sample, DNA, PTE = Pteropod sample, O2 = Oxygen sample, LTER = Long Term Eco Research Station

CTD Cast	Site ID/ STA#	Date GMT	Latitude deg min)	Longitude (deg min)	Bottom Depth(m)	Operation
1	1	5/31/2022	4120.6	7124.8	32	BON/CTD,2B3D,URI
2	2	5/31/2022	4110.3	7110.7	40	BON/CTD,2B3D,URI
3	3	5/31/2022	4106	7109.6	35	BON/CTD,2B3D,URI
4	4	6/1/2022	4106.5	7037.8	44	BON/CTD,URI
1	4	6/1/2022	4107.1	7037.6	43	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
5	5	6/1/2022	4059.2	7029.7	45	BON/CTD,2B3D,URI
6	6	6/1/2022	4050.2	7018.8	46	BON/CTD,2B3D,URI
7	7	6/1/2022	4042.3	7003.9	43	BON/CTD,2B3D,URI
8	8	6/1/2022	4040.1	7024.8	54	BON/CTD,2B3D
9	9	6/1/2022	4040.5	7037.7	60	BON/CTD,URI,LTER
2	9	6/1/2022	4040.9	7037.7	60	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
10	10	6/1/2022	4044.4	7055	62	BON/CTD,2B3D,URI
11	11	6/1/2022	4055.6	7053	53	BON/CTD,2B3D,URI
12	12	6/3/2022	4100.4	7130.4	50	BON/CTD,2B3D,URI
13	13	6/3/2022	4045.2	7110.4	59	BON/CTD,2B3D
14	14	6/3/2022	4044.7	7120	61	BON/CTD,2B3D,URI
15	15	6/3/2022	4019.8	7145.1	73	BON/CTD,2B3D,URI,PTE
16	16	6/4/2022	4014.8	7209.6	64	BON/CTD,2B3D,URI,PTE
17	17	6/4/2022	3955.3	7229.6	65	BON/CTD,2B3D,URI,PTE
18	18	6/4/2022	3954.9	7249.3	55	BON/CTD,2B1C,URI,PTE
19	19	6/4/2022	3949.8	7304.6	65	BON/CTD,2B3D,URI,PTE
20	20	6/4/2022	3940.1	7235.7	75	BON/CTD,2B1C
21	21	6/4/2022	3930.3	7225.8	119	BON/CTD,2B3D,URI,PTE
22	22	6/4/2022	3901.1	7235.4	1013	BON/CTD,2B3D,URI,PTE
3	22	6/4/2022	3901	7236.2	1003	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
23	23	6/4/2022	3903.6	7245.1	131	BON/CTD,PTE
4	23	6/4/2022	3904.1	7245.8	127	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
24	24	6/4/2022	3905.1	7254.4	85	BON/CTD,2B3D,URI,PTE
25	25	6/4/2022	3900.3	7304.7	78	BON/CTD,2B3D,URI,PTE
26	26	6/4/2022	3855	7300.8	82	BON/CTD,2B3D,URI,PTE

Table 1. (continued)

CTD Cast	Site ID/ STA#	Date GMT	Latitude deg min)	Longitude (deg min)	Bottom Depth(m)	Operation
27	27	6/5/2022	3825.3	7325.2	116	BON/CTD,2B3D,URI,PTE
28	28	6/5/2022	3815.4	7339.3	188	BON/CTD,2B3D,URI,PTE
29	29	6/5/2022	3750.8	7434.1	54	BON/CTD,2B3D,URI,PTE
5	29	6/5/2022	3750.3	7434.1	54	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
30	30	6/5/2022	3742.3	7416.5	104	BON/CTD,2B3D,PTE
6	30	6/5/2022	3741.6	7416.4	101	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
31	31	6/5/2022	3725.5	7429.8	224	BON/CTD,2B1C,PTE
32	31	6/5/2022	3725.6	7429.6	276	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
33	32	6/5/2022	3720	7444.7	53	BON/CTD,2B3D,URI,PTE
34	33	6/5/2022	3730.5	7456.2	35	BON/CTD,2B3D,URI,PTE
35	34	6/5/2022	3759.7	7457.4	26	BON/CTD
7	34	6/5/2022	3800.2	7457.9	23	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
36	35	6/6/2022	3849.1	7449.5	16	BON/CTD,2B3D,URI,PTE
37	36	6/6/2022	3839.2	7425.8	41	BON/CTD,2B3D,URI,PTE
38	37	6/6/2022	3834.7	7415.6	46	BON/CTD,2B3D,URI,PTE
39	38	6/6/2022	3839.6	7405.7	49	BON/CTD,2B3D,URI,PTE
40	39	6/6/2022	3844.3	7409.3	46	BON/CTD,2B1C,URI,PTE
41	40	6/6/2022	3859.9	7405.8	36	BON/CTD,2B3D,URI,PTE
42	41	6/6/2022	3904.7	7345.8	39	BON/CTD,2B3D,URI,PTE
43	42	6/6/2022	3910.2	7335	45	BON/CTD,2B3D,PTE
44	43	6/6/2022	3921.3	7323.6	49	BON/CTD,PTE
8	43	6/6/2022	3921.7	7323.4	48	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
45	44	6/6/2022	3930.1	7344.5	27	BON/CTD,2B3D,URI,PTE
46	45	6/6/2022	3942.4	7359.3	22	BON/CTD,URI,PTE
9	45	6/6/2022	3942	7359	23	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
47	46	6/6/2022	3940.4	7355.4	26	BON/CTD,2B3D,URI,PTE
48	47	6/7/2022	4009.4	7354.5	21	BON/CTD,2B1C,URI,PTE
49	48	6/7/2022	4014.9	7351.1	27	BON/CTD,2B3D,URI,PTE
50	49	6/7/2022	4024.4	7340.4	26	BON/CTD,2B3D,URI,PTE
51	50	6/7/2022	4025.7	7320.2	31	BON/CTD,2B3D,URI,PTE
52	51	6/7/2022	4039.6	7225.7	44	BON/CTD,2B3D,URI,PTE
53	52	6/7/2022	4035.1	7215.6	50	BON/CTD,2B3D
54	53	6/7/2022	4010.4	7105.8	134	BON/CTD,2B3D,PTE
55	54	6/7/2022	4025.9	7100.1	84	BON/CTD,2B3D
56	55	6/7/2022	4023.1	7015.8	80	BON/CTD,2B1,PTE
57	56	6/7/2022	4019.9	7028.9	92	BON/CTD,2B3D,URI
58	57	6/7/2022	4003	7036.2	136	BON/CTD,2B3D,URI,PTE
10	57	6/7/2022	4002.6	7035.4	164	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
59	58	6/8/2022	3951	7037.1	754	BON/CTD,2B3D,URI,PTE

Table 1. (continued)

CTD Cast	Site ID/ STA#	Date GMT	Latitude deg min)	Longitude (deg min)	Bottom Depth(m)	Operation
11	58	6/8/2022	3951	7036.9	774	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
60	59	6/8/2022	3959.9	7019.9	300	BON/CTD,2B1C,URI,PTE
61	59	6/8/2022	3959.7	7019.6	292	CTD 19/19+ WATER CAST PROFILE
62	60	6/8/2022	4014.6	6945.6	84	BON/CTD,2B3D,URI,PTE
63	60	6/8/2022	4014.4	6945.1	84	BON/CTD,2B3D,URI,PTE
64	61	6/8/2022	4024.6	6905.3	82	BON/CTD,2B3D,URI
65	62	6/8/2022	4034.7	6845.8	66	BON/CTD,2B3D,URI
66	63	6/8/2022	4025.6	6825.9	98	BON/CTD,2B3D
12	64	6/8/2022	4015	6742.2	1073	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
13	65	6/8/2022	4023	6741.2	315	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
67	66	6/8/2022	4029.9	6749.9	112	BON/CTD,2B3D,URI,PTE
68	67	6/9/2022	4044.8	6815.1	63	BON/CTD,2B3D,URI
69	68	6/9/2022	4039.8	6829.3	64	BON/CTD,2B1C
70	69	6/9/2022	4049.5	6825.3	48	BON/CTD,2B3D,URI
71	70	6/9/2022	4050.2	6839.5	62	BON/CTD,2B3D,URI
72	71	6/6/2022	4054.8	6845.1	71	BON/CTD,2B3D,URI
14	72	6/9/2022	4053.9	6910	66	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
73	73	6/9/2022	4055	6915.1	60	BON/CTD,2B3D,URI
74	74	6/9/2022	4055	6919.3	42	BON/CTD,2B3D,URI
75	75	6/9/2022	4134.8	6936.4	52	BON/CTD,2B3D,URI
76	76	6/9/2022	4200.4	7015.4	46	BON/CTD,2B3D,URI
77	77	6/9/2022	4224.9	7035.9	87	BON/CTD,2B3D,URI
15	77	6/9/2022	4225.8	7036.9	88	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
78	78	6/9/2022	4221.9	7027.2	85	BON/CTD,2B3D,URI
16	78	6/10/2022	4221.6	7027.1	84	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
79	79	6/10/2022	4219.4	7016.9	35	BON/CTD,2B3D,URI
17	79	6/10/2022	4219.3	7016.8	35	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
80	80	6/10/2022	4220	6959.6	173	BON/CTD,2B3D,URI
81	81	6/10/2022	4229.9	6940.1	252	BON/CTD,2B3D,URI
18	81	6/10/2022	4230	6940.1	252	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
82	82	6/10/2022	4249.5	6925.4	156	BON/CTD,2B3D,URI
83	83	6/10/2022	4249.7	6934.5	183	BON/CTD,2B3D,PTE
19	84	6/10/2022	4259.9	7025.2	104	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
84	85	6/10/2022	4309.8	7029.8	40	BON/CTD,2B3D,URI
85	86	6/10/2022	4309.9	7015.4	124	BON/CTD,2B1C,URI
86	87	6/10/2022	4319.6	6905.7	152	BON/CTD,2B3D,URI
87	88	6/11/2022	4329.5	6825.3	168	BON/CTD,2B3D,URI
20	89	6/11/2022	4346	6840.2	118	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
21	90	6/11/2022	4411.9	6742.3	188	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
88	91	6/11/2022	4424.6	6730.2	94	BON/CTD,2B1C

Table 1. (continued)

CTD Cast	Site ID/ STA#	Date GMT	Latitude deg min)	Longitude (deg min)	Bottom Depth(m)	Operation
22	92	6/11/2022	4429.1	6713.9	81	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
89	93	6/11/2022	4419.9	6720.2	164	BON/CTD,2B3D,URI
90	94	6/11/2022	4355	6724.9	222	BON/CTD,2B3D
91	94	6/11/2022	4354.2	6724.3	218	CTD 19/19+ WATER CAST PROFILE
92	95	6/11/2022	4339.9	6720.4	210	BON/CTD,2B3D,URI,PTE
93	96	6/11/2022	4324.9	6741.8	243	BON/CTD,2B3D,URI
23	96	6/11/2022	4324.5	6741.1	249	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
94	97	6/12/2022	4259.9	6750	191	BON/CTD,2B3D,URI
24	98	6/12/2022	4242	6742.2	189	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
95	99	6/12/2022	4239.8	6759.8	188	BON/CTD,2B3D,URI,PTE
96	100	6/12/2022	4224.9	6745.2	203	BON/CTD,2B3D,URI
97	101	6/12/2022	4222	6703.2	329	BON/CTD,2B3D
25	101	6/12/2022	4222.4	6703	336	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
98	102	6/12/2022	4229.8	6650.6	286	BON/CTD,2B3D,URI,PTE
99	102	6/12/2022	4230	6650.7	281	CTD 19/19+ WATER CAST PROFILE
100	103	6/12/2022	4249.6	6645.3	218	BON/CTD,2B3D,URI,PTE
101	103	6/12/2022	4249	6645.2	220	CTD 19/19+ WATER CAST PROFILE
102	104	6/12/2022	4310.2	6650.4	162	BON/CTD,2B3D,URI,PTE
103	105	6/12/2022	4319.8	6655.1	203	BON/CTD,2B3D
104	106	6/12/2022	4329.9	6625.8	92	BON/CTD,2B1C,URI,PTE
26	107	6/13/2022	4301.9	6620.1	129	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
105	108	6/13/2022	4244.6	6610.1	61	BON/CTD,URI,PTE
106	109	6/13/2022	4214	6546.2	218	BON/CTD,2B3D,URI,PTE
27	109	6/13/2022	4214	6545.7	222	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
28	110	6/13/2022	4145.4	6526.7	2008	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
107	111	6/13/2022	4145.1	6550.1	132	BON/CTD,2B3D
108	112	6/13/2022	4140.1	6555	121	BON/CTD,2B3D
109	113	6/13/2022	4134.5	6605	102	BON/CTD,2B3D
110	114	6/13/2022	4209.4	6620.5	188	BON/CTD,2B3D,URI
111	115	6/14/2022	4200.2	6659.4	68	BON/CTD,2B3D,URI
112	116	6/14/2022	4150	6704.8	61	BON/CTD,2B1C,URI
113	117	6/14/2022	4139.8	6700.1	64	BON/CTD,2B3D,URI
114	118	6/14/2022	4134.7	6704.9	61	BON/CTD,2B3D,URI
115	119	6/14/2022	4119.7	6655.3	70	BON/CTD,URI,PTE
116	120	6/14/2022	4114.6	6650.3	73	BON/CTD,2B3D,URI

Table 1. (continued)

CTD Cast	Site ID/ STA#	Date nGMT	Latitude deg min)	Longitude (deg min)	Bottom Depth(m)	Operation
117	121	6/14/2022	4059.5	6624.8	490	BON/CTD,2B1C
118	121	6/14/2022	4059.5	6625.2	486	CTD 19/19+ WATER CAST PROFILE
119	122	6/14/2022	4100.1	6635	90	BON/CTD,2B3D
120	123	6/14/2022	4034.8	6710.1	157	BON/CTD,2B3D
121	124	6/14/2022	4054.2	6735.6	72	BON/CTD,2B3D
29	125	6/14/2022	4055.3	6742.5	66	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
122	126	6/14/2022	4059.4	6749.7	53	BON/CTD,2B3D
123	127	6/14/2022	4114.7	6759.9	50	BON/CTD,2B3D,URI
124	128	6/14/2022	4115.1	6809.7	41	BON/CTD,2B3D,URI
125	129	6/15/2022	4134.4	6759.5	35	BON/CTD,2B1C,URI
126	130	6/16/2022	4129.8	6750.2	37	BON/CTD,2B3D,URI
30	131	6/16/2022	4128.1	6741.2	43	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
127	132	6/16/2022	4148.8	6730.4	38	BON/CTD,2B3D
128	133	6/16/2022	4205.1	6725.2	64	BON/CTD,2B3D,URI
31	134	6/16/2022	4200.9	6741.3	74	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
129	135	6/16/2022	4155.1	6800.1	160	BON/CTD,2B3D,URI
130	136	6/16/2022	4204.8	6805.1	223	BON/CTD,2B3D
131	136	6/16/2022	4204.6	6805.3	224	CTD 19/19+ WATER CAST PROFILE
132	137	6/16/2022	4200.1	6820.4	184	BON/CTD,2B3D
32	137	6/16/2022	4200	6820.6	183	CTD 911+,SAL,NUT,DIC,DNA,O2,CHL
133	138	6/16/2022	4204.7	6834.7	175	BON/CTD,2B3D,URI
134	139	6/16/2022	4219.4	6849.3	207	BON/CTD,2B3D,URI
135	140	6/16/2022	4229.6	6859.8	222	BON/CTD,2B1C,URI.PTE
136	140	6/16/2022	4229.8	6859.9	223	CTD PROFILE 19/19+
137	141	6/16/2022	4157	6852.7	137	BON/CTD,2B3D,URI
138	142	6/16/2022	4129.7	6845.2	149	BON/CTD,2B3D
139	143	6/16/2022	4041.4	6908.9	66	BON/CTD,2B3D,URI
140	144	6/16/2022	4044.2	6950.1	46	BON/CTD,2B3D,URI
141	145	6/16/2022	4041.6	7003.4	45	BON/CTD,2B3D,URI
142	146	6/16/2022	4104	7005.3	26	BON/CTD,2B1C
143	146	6/16/2022	4104.2	7005.8	25	CTD 19/19+ WATER CAST PROFILE
144	147	6/16/2022	4050.6	7017.8	45	BON/CTD,2B3D,URI
145	148	6/16/2022	4058.6	7029.8	46	BON/CTD2B3D,URI
146	149	6/17/2022	4055.9	7052	53	BON/CTD2B3D,URI
147	150	6/17/2022	4105.4	7109.4	37	BON/CTD,2B3D

TOTALS:	Std BON/CTD Casts	=	147
	2B3 D Bongo Casts	=	105
	2B1 C (CMarZ) Bongo Casts	=	15
	CTD PROFILE 911 Casts	=	32
	Nutrient Casts	=	32
	Chlorophyll Casts	=	32
	Dissolved Inorganic Carbon casts (DIC)	=	32
	Salinity Sample Casts	=	32
	Environmental DNA Casts	=	32
	Pteropod Samples	=	48
	URI Isotope Samples	=	99

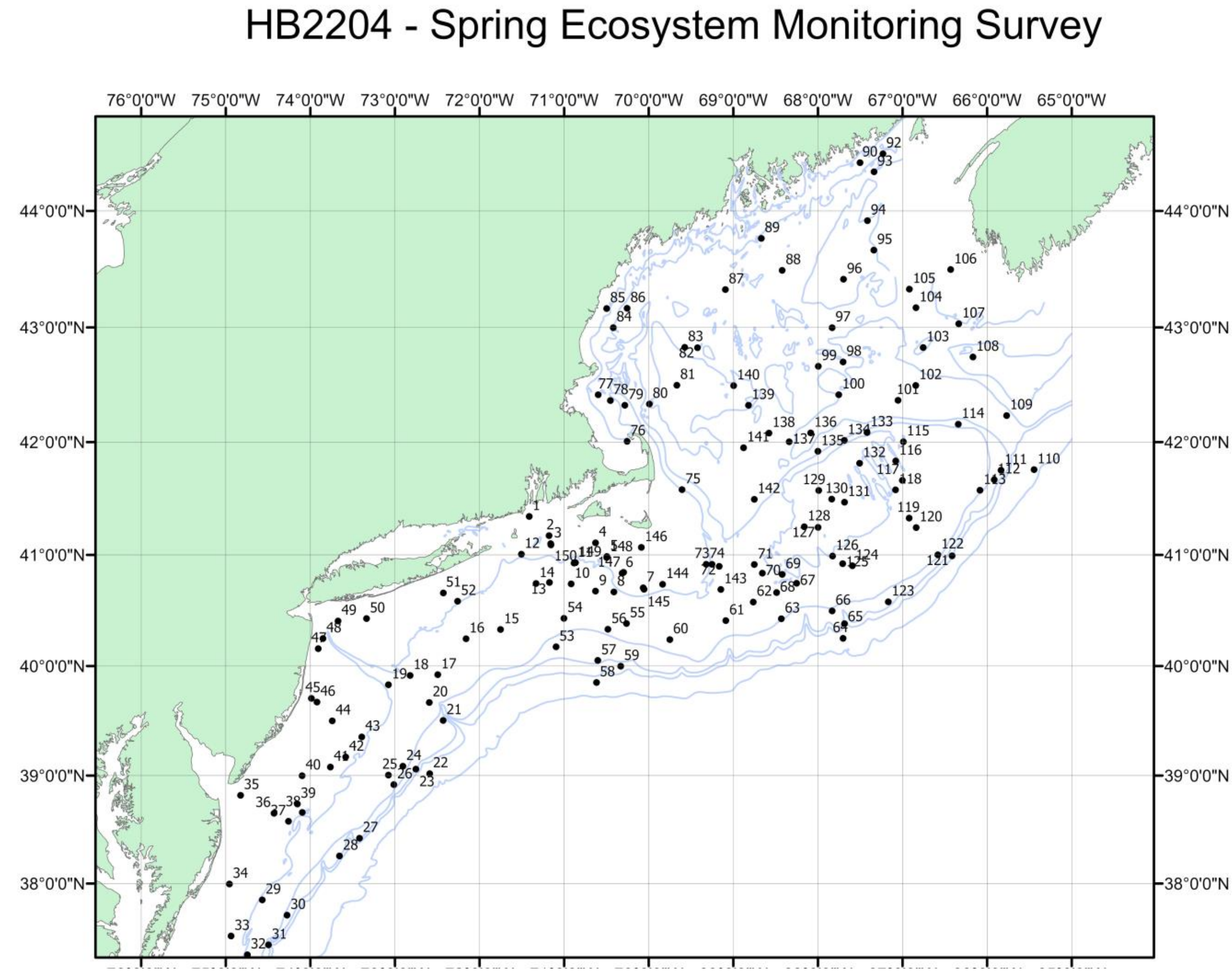

Figure 1. Station locations numbered consecutively for Spring Ecosystem Monitoring Survey HB 2204, 31 May – 17 June 2022 .

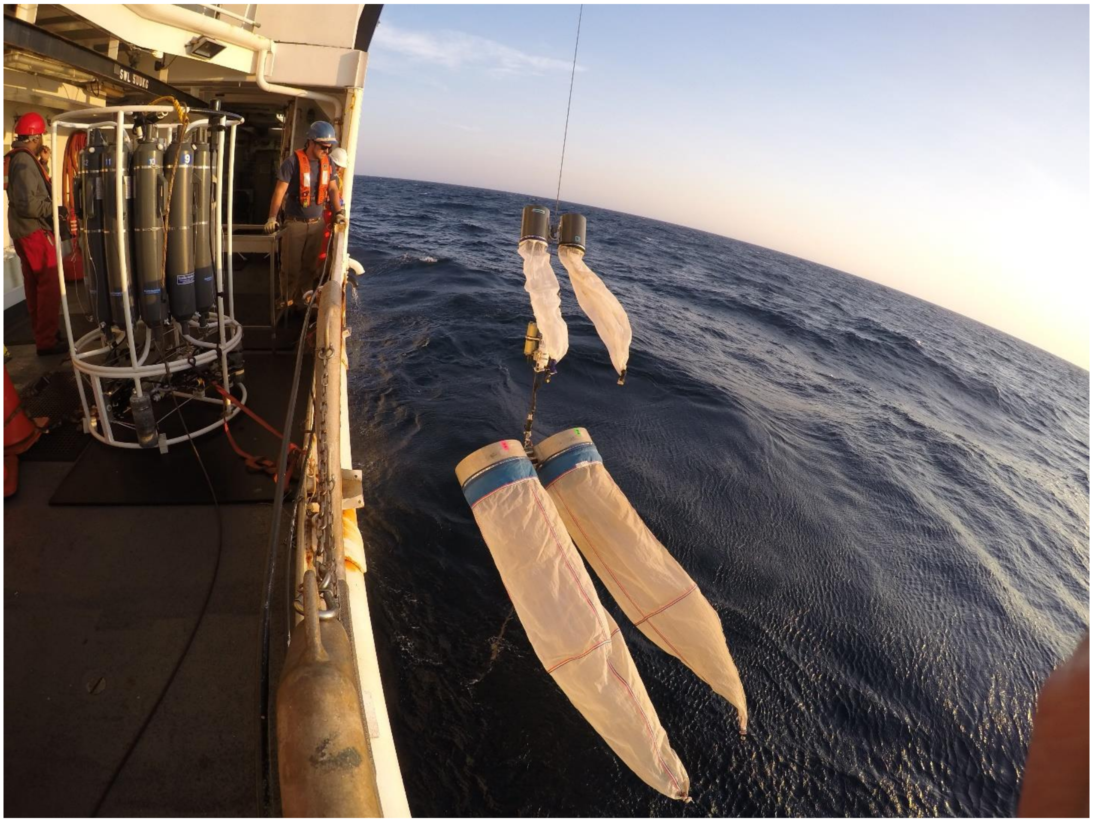

Figure 2. Bongo net array showing 61 and 20 cm bongo nets being deployed from the side sampling station on the *Henry Bigelow*.

Figure 3. Biologist Katey Marancik places a sample of pteropods in the drying oven.

Figure 4. **Graduate student Catrina Nowakowski prepares to launch drifter buoy at Lydonia Canyon on the southeastern edge of Georges Bank.**

Figure 5. **Data output from the drifter buoy launched by Catrina Nowakowski.**

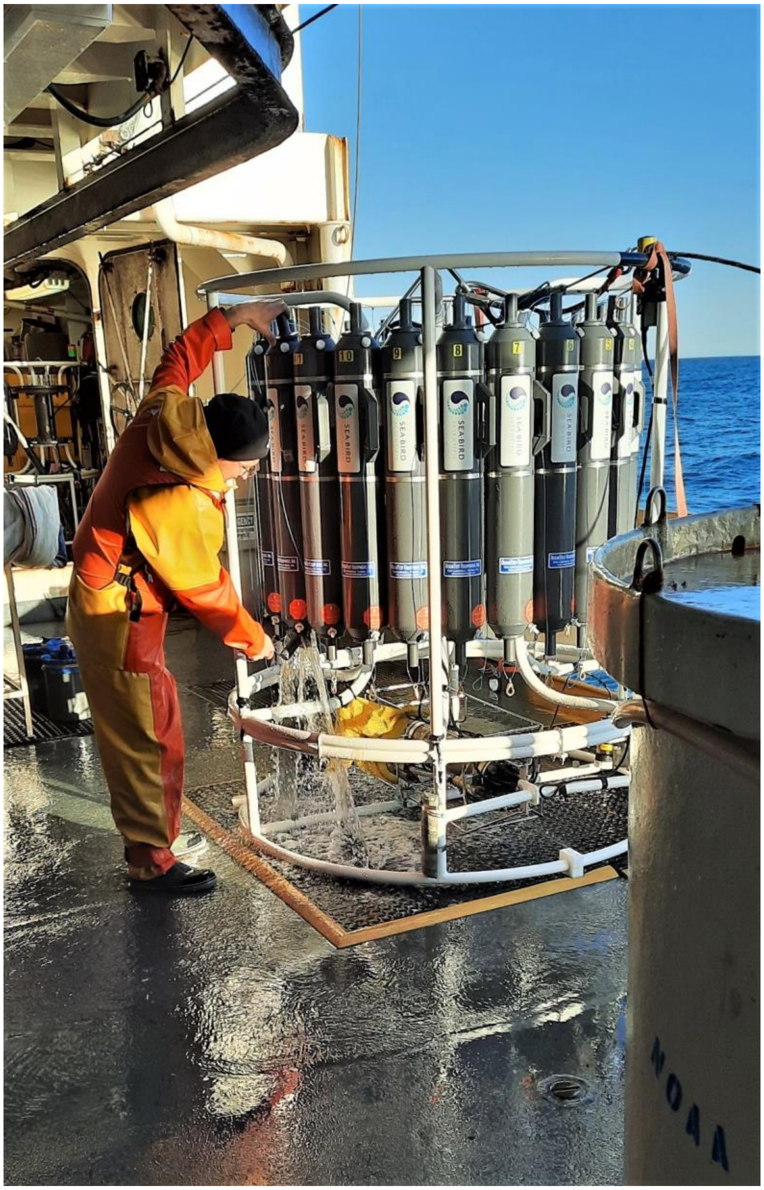

Figure 6. Chris Taylor empties water from the 24 bottle rosette water sampler.

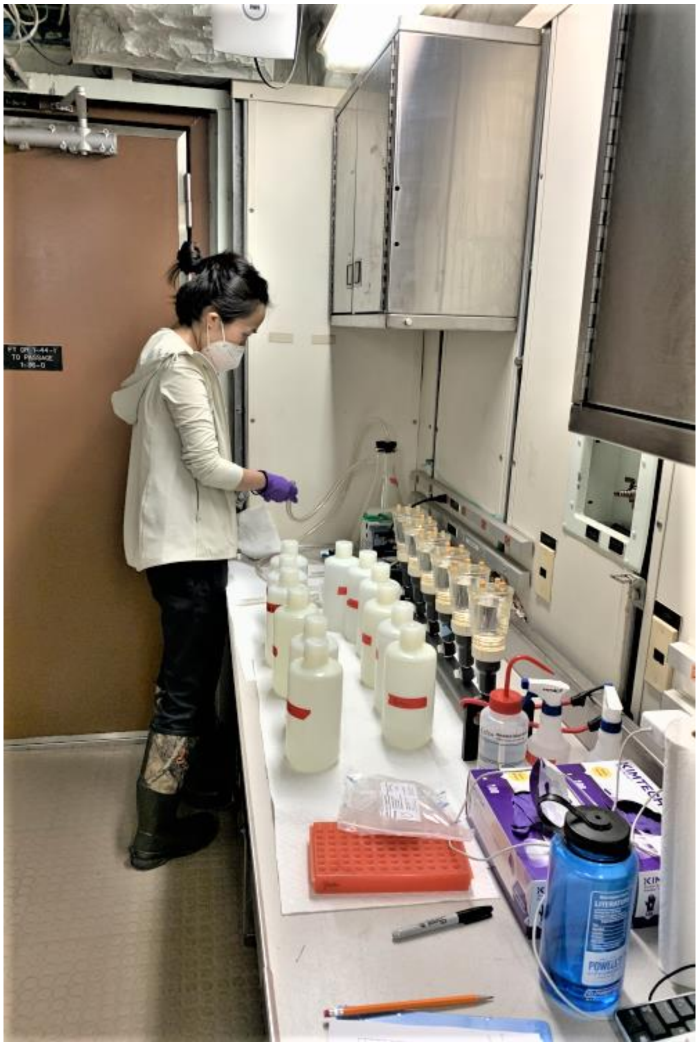

Figure 7. Yuan Liu filtering seawater sollected from several depths to find environmental DNA of organisms living in the water column that was sampled.

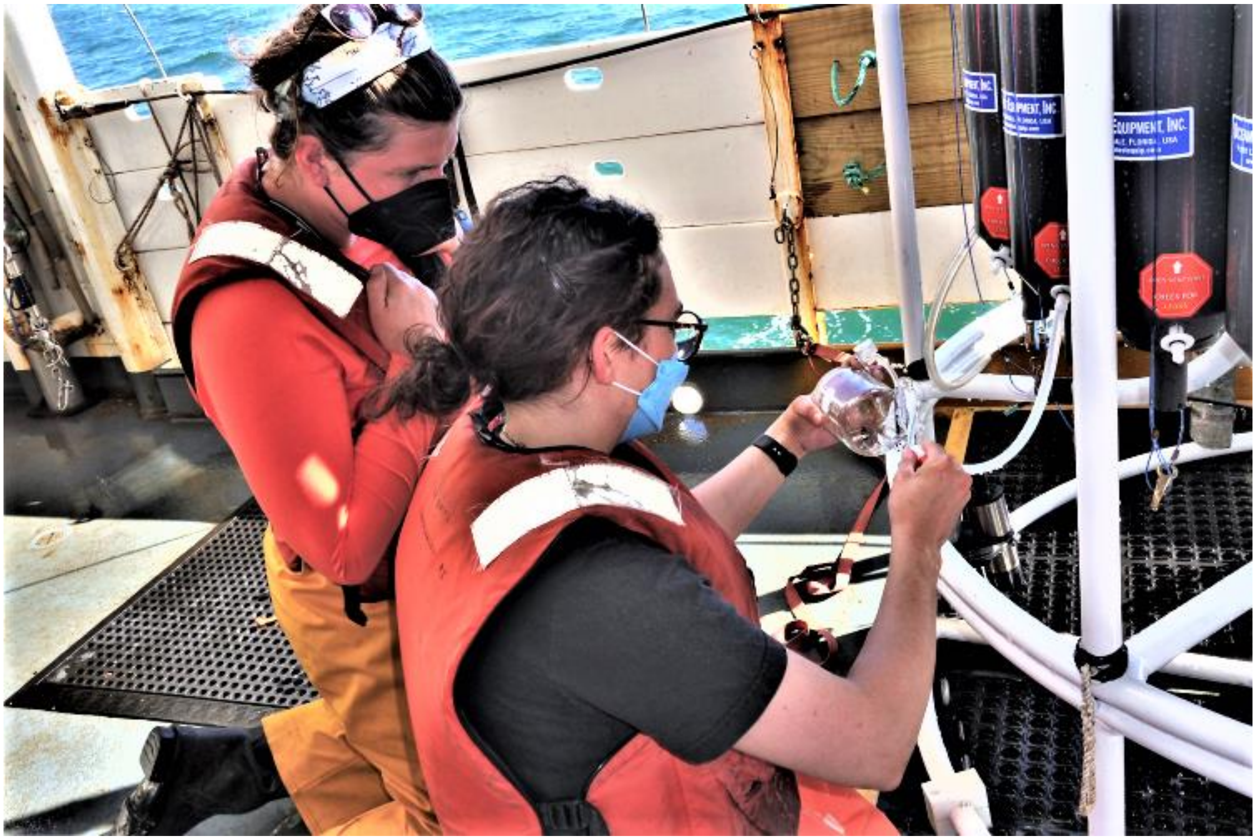

Figure 8. Eve Butterworth shows Catrina Nowakowski how to collect a water sample for oxygen analysis.

Figure 9. Emily Peacock from WHOI sets up an ImagingFlowCytobot aboard the *Henry Bigelow*.

Figure 10. Seabird observers Allison Black and Nick Metheny aboard the *Henry Bigelow*.

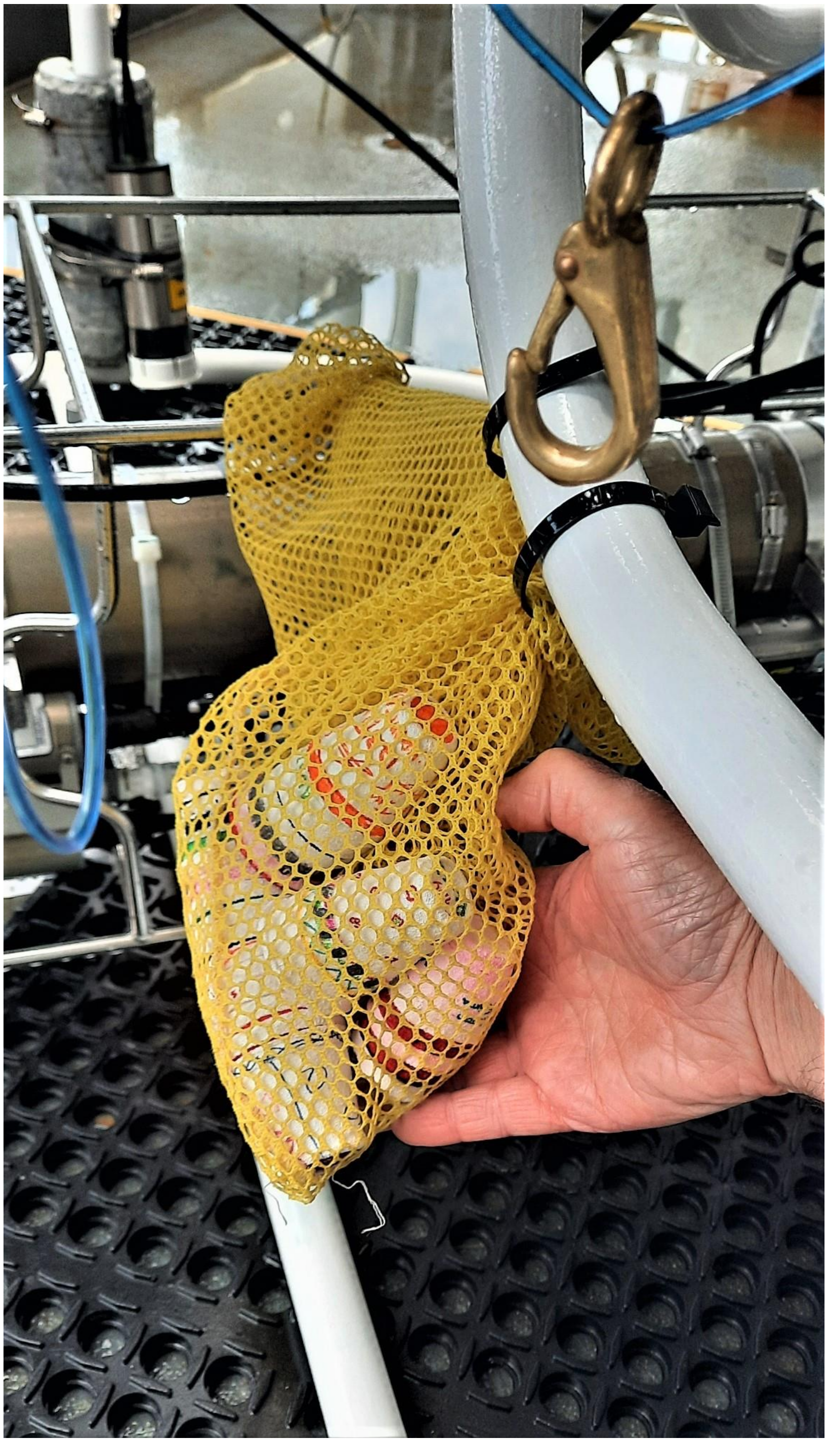

Figure 11. Styrofoam cups decorated by Cranston West High School students are in a mesh bag attached to the Niskin bottle water sampler. They have shrunk considerably from their original size after repeated submersions, some to as deep as 500 meters.