C270D Cruise Report
Williams-Mystic Spring 2017 Offshore Seminar

SSV *Corwith Cramer*

San Juan, Puerto Rico – St. Croix, U.S. Virgin Islands
29 January – 8 February, 2017

Sea Education Association
Woods Hole, Massachusetts

Cover photo caption:
The Williams-Mystic students gathered to celebrate a birthday underway.

This document should be cited as:

Lane, M. K. 2017. Final report for S.E.A. Cruise C270D. Sea Education Association, Woods Hole, MA 02543. www.sea.edu.

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Introduction

This report documents the scientific activities of the *SSV Corwith Cramer* during the Williams-Mystic Spring 2017 Offshore Seminar (29 January – 8 February, 2017.) This cruise was the offshore sea seminar of the Williams-Mystic Maritime Studies' Spring semester. Sampling was conducted during our ~400 nm cruise track in the waters north of Puerto Rico, north of Culebra, in the British Virgin Islands, U.S. Virgin Islands, and in the Caribbean Sea. Students examined the physical, chemical and biological oceanography of this region through the various sampling methods. The ship had to return to San Juan, Puerto Rico, for a medical evaluation and later made a planned stop in Francis Bay, St. John so the students could snorkel and see the national park.

While onboard, the students served as full, working members of the scientific team and sailing crew. They deployed oceanographic sampling equipment, learned how to operate the vessel, and collected data for their scientific research projects. They presented a brief summary of their research before departing the ship in St. Croix. The students will use the concepts learned onboard to continue their coursework throughout the Williams-Mystic Maritime Studies semester.

C270D, Williams-Mystic S17, was an excellent cruise, with some lovely sailing weather, some exciting science, and a great ship's company. A special thanks to Professor Lisa Gilbert, who brings so much experience to the program and has made the SEA and Williams-Mystic collaboration so strong; Professor Mike Nishizaki, who brings his zooplankton expertise; Captain Sarah Herard, who keeps the ship running and provides the students and staff so many opportunities to learn; and of course, the amazing staff, who bring endless passion and energy to all they do. The Williams-Mystic program truly captures a semester of learning in just ten days, and I love to see what these students can accomplish.

The brief summary of C270D data contained in this report is not intended to represent final data interpretation and should not be excerpted or cited without written permission from SEA.

Kelsey Lane
SEA Scientist, C270D

Data Description

This section provides a record of data collected aboard the SSV *Corwith Cramer* Cruise C270D, from San Juan, Puerto Rico to St. Croix, U.S. Virgin Islands (Figure 1).

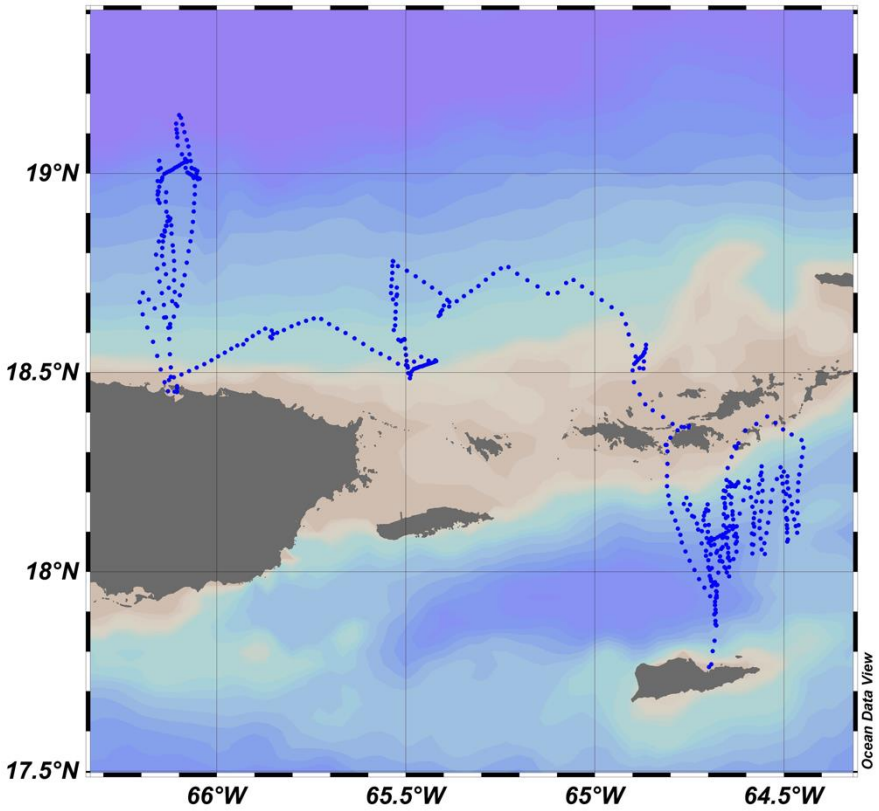


Figure 1. Hourly positions along the C270D cruise track.

During the 10-day cruise, we collected oceanographic samples and deployed scientific gear at ten discrete stations (Table 1). Chemical analyses were made of eighteen surface water samples, collected every six hours. Many of these were timed with hydrocast and biological sampling (neuston net and phytoplankton net) stations (Table 2). We continuously sampled using two acoustic tranducers: water depth and sub-bottom profiles (CHIRP system), ADCP current data to 600m (Acoustic Doppler Current Profiler system.) Additionally, a flow-through system continuously sampled sea surface temperature, salinity, colored dissolved organic matter (CDOM), and transmittance (seawater flow-through system, Figure 2 – temperature, salinity, fluorescence.) Discrete CTD measurements of vertical temperature, salinity, and density profiles were collected at five stations, three of which were hydrocasts with a rosette of twelve Niskin bottles. Additional instrumentation on the hydrocast allowed profiling of dissolved oxygen, chlorophyll-*a* fluorescence, and photosynthetically active radiation (PAR.) Summaries of sea surface and water column physical, chemical and biological properties are given in Tables 3-6. Results of sediment analyses of two shipek grab samples are given in Table 7. Certain large datasets, namely CTD, CHIRP, ADCP and flow-through data, are not fully presented here due to their size but are available by request. All unpublished data can be made available by arrangement with the SEA data archivist (contact information, p. 2.)

Table 1. C270D oceanographic sampling stations. **X** indicates type of station. (NT = Neuston Tow, PN = Phytoplankton Net, HC = Hydrocast with 12 Niskin bottles, CTD, fluorometer, and optical instrumentation, CTD = Free CTD, SG = Shipek Grab, SD = Secchi Disk, SS = Surface Station.) See additional footnote at bottom of table.[1]

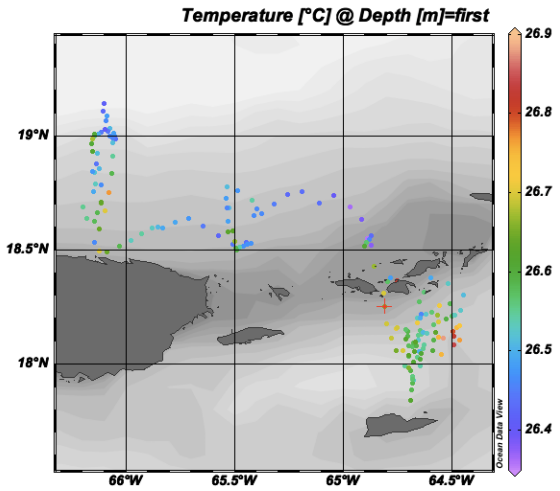
Station Name	Date	Time (Local)	Latitude (N)	Longitude (W)	General Locale	NT	PN	HC[1]	CTD[1]	SG[1]	SD[1]	Associated Surface Station
C270D-001	30-Jan-17	10:21	18°27.1	066°06.4	San Juan Harbor		X	X (8m)			X (2m)	SS-001
C270D-002	31-Jan-17	00:00	19°06.6	066°06.3	Puerto Rico Trench	X						SS-003
C270D-003	31-Jan-17	08:09	19°01.5	066°05.9	Puerto Rico Trench	X	X	X (1002m)			X (28m)	SS-005
C270D-004	1-Feb-17	00:00	18°52.0	066°07.0	Puerto Rico Slope	X						SS-007
C270D-005	1-Feb-17	23:54	18°36.3	065°51.1	Puerto Rico Slope	X						SS-010
C270D-006	2-Feb-17	07:52	18°31.8	065°25.3	Puerto Rico Slope	X	X	X (470m)		X (465m)	X (21m)	SS-012
C270D-007	3-Feb-17	00:13	18°40.6	065°24.0	N of Culebra	X						SS-014
C270D-008	3-Feb-17	13:12	18°32.6	064°52.4	Barracuda Bank	X	X	X (32m)		X (38m)	X (26m)	SS-016
C270D-009	4-Feb-17	23:57	18°09.3	064°42.6	S of St. John	X						SS-018
C270D-010	5-Feb-17	09:00	18°05.5	064°40.3	Caribbean Sea				X (1998m)			

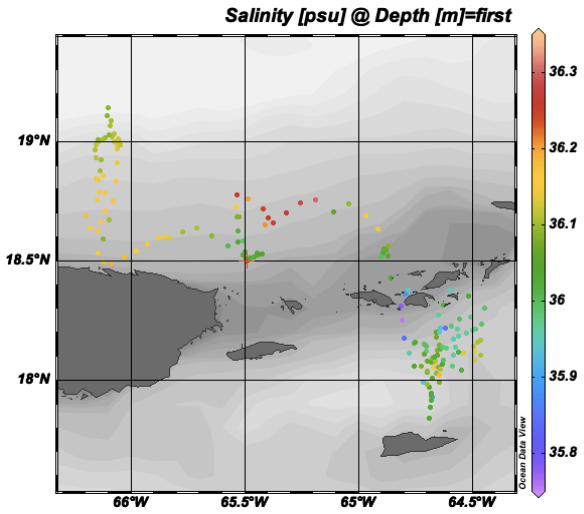
[1] Maximum wire-out depths are given, in parentheses, for the HC, CTD, SG, and SD wire deployments.

Table 2. C270D Surface Sampling (SS) Station Data. See footnote at bottom of table[1].

Station Name	Date	Time (Local)	Latitude (N)	Longitude (W)	General Locale	Temp (°C)	Salinity (psu)	Chl-α (μg/L)	PO_4 (μm)
SS-001	30-Jan-17	10:45	18°27.1' N	66°6.4' W	San Juan Harbor	27.0	33.500	2.805	1.126
SS-002	30-Jan-17	18:20	18°51.5' N	66°3.8' W	Puerto Rico Slope	26.6	36.143	0.000	0.644
SS-003	31-Jan-17	00:22	19°6.0' N	66°6.3' W	Puerto Rico Trench	26.4	36.088	0.095	0.669
SS-004	31-Jan-17	06:05	18°59.9' N	66°4.5' W	Puerto Rico Trench	26.5	36.123	0.058	0.586
SS-005	31-Jan-17	10:21	19°0.2' N	66°8.0' W	Puerto Rico Trench	26.5	36.107	0.036	0.636
SS-006	31-Jan-17	18:00	18°50.5' N	66°8.6' W	Puerto Rico Slope	26.5	36.141	0.040	0.810
SS-007	1-Feb-17	00:20	18°51.8' N	66°8.5' W	Puerto Rico Slope	26.5	36.148	0.054	0.146
SS-008	1-Feb-17	07:41	18°28.6' N	66°7.7' W	Puerto Rico Slope	26.8	35.876	0.174	0.437
SS-009	1-Feb-17	19:04	18°29.4' N	66°5.2' W	Puerto Rico Slope	26.6	36.180	0.256	0.213
SS-010	2-Feb-17	00:18	18°35.6' N	65°51.4' W	Puerto Rico Slope	26.5	36.140	0.064	0.370
SS-011	2-Feb-17	05:55	18°32.0' N	65°31.1' W	Puerto Rico Slope	26.5	36.031	0.121	0.213
SS-012	2-Feb-17	12:00	18°30.2' N	65°29.2' W	Puerto Rico Slope	26.6	36.120	0.288	0.204
SS-013	2-Feb-17	18:13	18°41.7' N	65°31.4' W	Puerto Rico Slope	26.5	36.090	0.064	0.387
SS-014	3-Feb-17	00:31	18°40.1' N	65°24.2' W	N of Culebra	26.5	36.249	0.083	0.420
SS-015	3-Feb-17	06:10	18°42.7' N	65°6.2' W	NE of Culebra	26.4	36.058	0.130	0.337
SS-016	3-Feb-17	14:50	18°31.3' N	64°54.0' W	Barracuda Bank	26.6	36.001	0.174	0.362
SS-017	3-Feb-17	17:55	18°21.7' N	64°45.1' W	N of St John	26.4	35.978	0.471	0.312
SS-018	4-Feb-17	00:14	18°8.8' N	64°42.7' W	S of St John	26.6	36.000	Not collected	Not collected

[1] Water temperature and salinity determined from samples collected by a flow through seawater sampling system. Extracted chlorophyll-α and phosphate (PO_4) sea water samples were collected from a bucket thrown over the side. Phosphate (PO4) was assessed with colorimetric spectrophotometry. Extracted chlorophyll-α samples were filtered through 0.45 μm filters and measured with a Turner Designs 10-AU fluorometer. Each surface station also included a sample for microplastics, which will be analyzed at Williams-Mystic.





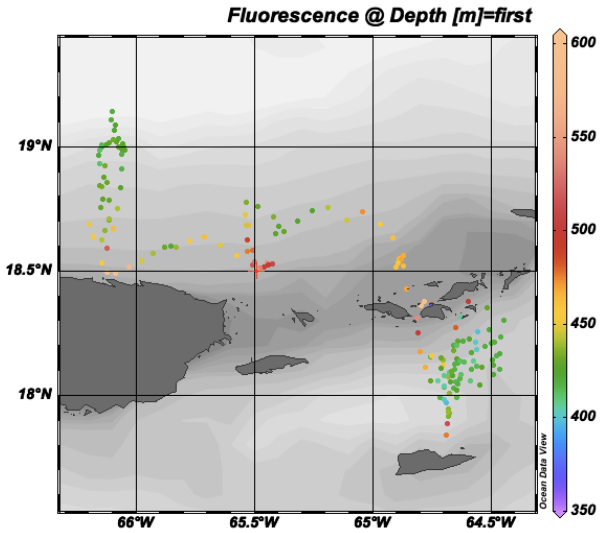


Figure 2a, b. C270D Hourly surface temperature (top left figure) and surface salinity measurement (top right figure) from the continuous flow-through collected from SeaBird Thermosalinography (S/N 0022) data logger.

Figure 2c. C270D Hourly surface chlorophyll-α fluorescence from the continuous flow-through collected from Seapoint Fluorometer (SCF 2740.)

Table 3. C270D hydrocast (HC) bottle data. Station locations and general locales are given in Table 1. Oceanographic data from associated surface stations are given in Table 2. Analyses conducted as given in footnote below.[1]

Station	Bottle #	Depth (m)	Temp (ºC)	Salinity (PSU)	Density (kg/m3)	PO4 (µg)	Chl-a (µg/L)	Associated Surface Station
C270D-003-HC	12	10	26.3778	36.0749	1023.7718	0.379	0.033	SS-005
	11	20	26.3741	36.0747	1023.8127	0.121	0.025	
	10	40	26.3615	36.0731	1023.8977	0.619	0.039	
	9	60	26.3343	36.317	1024.175	0.694	0.097	
	8	75	26.4312	36.5473	1024.3815	0.536	0.128	
	7	85	26.3738	36.7729	1024.6097	0.171	0.183	
	6	100	25.6862	36.9572	1025.0312	0.404	0.223	
	5	150	23.2988	37.1598	1026.1241	0.736	0.068	
	4	250	18.8254	36.6541	1027.4094			
	3	500	13.2432	35.7407	1029.1191			
	2	750	8.1699	35.0643	1030.6808	3.391	0	
	1	1000	6.1127	34.9887	1031.879	3.366	0	
C270D-006-HC	12	10	26.3621	35.9875	1023.7107	0.57	0.266	SS-012
	11	25	26.3488	35.9884	1023.7788			
	10	45	26.4028	36.2502	1024.0407			
	9	55	26.3956	36.2566	1024.0917		0.104	
	8	75	26.4161	36.5028	1024.3544	0.993	0.211	
	7	100	25.9145	37.0814	1025.0511	0.312	0.237	
	6	150	23.0388	37.183	1026.2178	0.835	0.002	
	5	200	20.8077	37.0042	1026.9282	1.018	0	
	4	250	18.3869	36.6062	1027.4825	0.736	0	
	3	300	17.3084	36.4253	1027.8373	1.001	0	
	2	400	14.7266	35.9903	1028.5507	1.54	0	
	1	500	14.0932	35.9049	1028.7692	1.897	0	
C270D-008-HC	12	5	26.5002	35.9713	1023.6319	0.13	0.139	SS-016
	11	5	26.4951	35.971	1023.6367			
	10	10	26.4734	35.965	1023.6567	0.644	0.091	
	9	10	26.4886	35.9693	1023.6558			
	8	15	26.3895	35.9624	1023.7031	0.163	0.093	
	7	15	26.3893	35.9639	1023.7053			
	6	20	26.3823	35.9704	1023.7362	0.561	0.141	
	5	25	26.3961	36.0193	1023.7859	0.196	0.148	
	4	25	26.3927	36.0213	1023.7882			
	3	30	26.3842	36.0245	1023.7992	0.702	0.186	
	2	35	26.3842	36.0247	1023.801			
	1	50	26.3849	36.0265	1023.8023			

[1]Temperature, salinity, and density data were determined from a SeaBird 19Plus V2 CTD. Phosphate (PO4) was assessed with colorimetric spectrophotometry. Extracted chlorophyll-α samples were filtered through 0.45 μm filters and measured with a Turner Designs 10-AU fluorometer. A blank indicates no sample was collected for analysis from that bottle.

Table 4. C270D neuston net tow (NT) data. Station locations and general locales are given in Table 1. Oceanographic data from associated surface stations are given in Table 2. 100-count data of zooplankton samples are available from SEA. Explanatory footnotes are given below.[1,2]

Station	Time (Local)	Zoop. Biomass (mL)	Zoop. Density (ml/m^2)	Lepto-cephali (#)	Mycto-phids (#)	Cepha-lopods (#)	Other Nekton >2cm (#)	Total Nekton (#)	Total Nekton (mL)	*Sarga-ssum* (g)	Plastic Pellets (#)	Plastic Pieces (#)	Tar Pieces (#)	Halo-bates (#)	Gelatinous Organisms >2cm (#)	Gelatinous Organisms >2cm (mL)	Associated Surface Station
C270D-002-NT	0:00	7	0.0041	0	1	0	0	1	0.2	89	0	0	0	3	0	0	SS-003
C270D-003-NT	11:18	1.5	0.0008	0	0	0	0	0	0	19	0	2	0	1	0	0	SS-005
C270D-004-NT	0:00	15	0.0066	3	8	0	1	12	2.4	144.4	0	3	0	0	3	0.5	SS-007
C270D-005-NT	23:54	4.5	0.002	157	4	0	0	161	39.2	200.2	0	0	0	1	2	4.3	SS-010
C270D-006-NT	11:50	3.5	0.0021	0	0	0	0	0	0	52	0	0	0	2	0	0	SS-012
C270D-007-NT	13:00	7	0.0038	8	3	0	3	14	3.4	18.6	0	3	0	2	0	0	SS-014
C270D-008-NT	11:59	9.2	0.0067	0	0	0	0	0	0	2	0	0	0	0	0	0	SS-016
C270D-009-NT	23:57	5	0.0033		3	0	1	4	0.5	5	0	0	0	1	0	0	SS-018

[1] Tow area calculations using distance (meters) between successive minutes' GPS positions. Neuston net opening is 1.0m wide by 0.5m tall, with a 333 μm mesh net. Zooplankton density ml/m2) is recorded as a wet volume displacement of zooplankton biomass per tow area (ml/m^2.)

[2] Eel larvae (Leptocephali), Lantern fish (Myctophids), and Cephalopods removed from net contents and counted separately. Micronekton and gelatinous micronekton removed using a 1cm mesh sieve; biovolume (mL) recorded. Qualitative description of micronekton removed from zooplankton are available from SEA. *Sargassum* removed from net contents and weighed with spring balance scale. Floating plastic, tar, and marine water striders (Halobates) removed from net contents, sorted and recorded as numbers collected per tow.

Table 5. C270D phytoplankton net (PN) data. Station locations are given in Table 1. Oceanographic data from associated surface stations are given in Table 2. Explanatory footnotes are given below. [1,2]

Station	Time (Local)	Sea Surface Temp (℃)[2]	Chl-a Fluorescence (volts)[2]	Salinity (PSU)[2]	General Locale	Diatoms (%)[1]	Dino-flagellates (%)[1]	Associated Surface Station
C270D-001-PN	10:25	27.1	n/a	33.5	San Juan Harbor	47.50%	52.50%	SS-001
C270D-003-PN	9:50	26.5	420.3	36.11	Puerto Rico Trench	62.00%	38.00%	SS-005
C270D-006-PN	10:10	26.5	534.8	36.02	Puerto Rico Slope	93.00%	7.00%	SS-012
C270D-008-PN	14:27	26.6	463.7	36	Barracuda Bank	79.00%	21.00%	SS-016

[1] Calculated from 100-count under a compound microscope. [2] Sea surface temperature, chlorophyll-a fluorescence, and salinity measurements from water samples collected in lab flow-through system while drifted surface phytoplankton net was deployed.

Table 6. C270D Secchi disk (SD) data. Station locations and general locales are given in Table 1. Oceanographic data from associated surface stations are given in Table 2.

Station	Time (Local)	Cloud Cover (%)	Wave Height (ft)	Wind Speed (BF)[1]	Secchi Depth (m)	Calculated Depth of 1% Light Level	Associated Surface Station
C270D-001-SD	10:21	80%	0	2	2	5	SS-001
C270D-003-SD	8:09	20%	3	4	28	74	SS-005
C270D-006-SD	7:52	10%	3	4	20	52	SS-012
C270D-008-SD	13:36	10%	4	5	25	67	SS-016

[1] BF = Beaufort Force

Table 7. C270D shipek grab (SG) sediment data. Station locations are given in Table 1. Oceanographic data from associated surface stations are given in Table 2.

Station	Time	Water Depth (m)	General Locale	Sediment Size Analysis (%)									Qualitative Description	Associated Surface Station
				>4 mm	3 - 4 mm	2 - 3 mm	1 - 2 mm	0.5 -1 mm	0.25 -0.5 mm	0.125mm -0.25mm	0.63mm -0.125mm	<0.63mm		
C270D-006-SG	8:08	345	Puerto Rico Slope	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	99	Grayish-orange, silty clay. Shape too small to tell, has some carbonate.	SS-012
C270D-008-SGA/B	13:12	35.1	Barracuda Bank	10	0	20	5	45	10	5	5	0	Grayish yellow, sandy sediment, with shells. Sediments angular.	SS-016