Fixed Station Bivalve TRANSPORT (FSBT-12) Cruise Report

November 11, 2013

Jacob Goodwin and Elizabeth North

Project title: Integrating field methods and numerical models to quantify the links between oyster larval transport, connectivity, and population dynamics

Cruise dates: July 10-14, 2012

Research Vessel*: R/V Hugh R. Sharp* (Captain: Sean McNulty)

Scientists:

Chief Scientists: Jacob Goodwin and Tom Wazniak
Scientific crew: Jason Spires, Johanna Thalmann, Ian Mitchell, Maggie Chaney, Carolina Mandez, Caroline Rodriguez, Gabriel Ng, Rebecca Saunders, and Katherine Liu.

Sampling Area:

Choptank River at two locations station 1 (38.6476, -76.3151) and station 2 (38.6460, -76.2104).

Cruise Report Contents

I. Activities

Our objective of the cruise was to enhance our understanding of physical and biological factors that influence bivalve larval transport and their distribution. Data was collected to help identify factors that influence vertical distribution of bivalve larvae. Salinity, temperature, dissolved oxygen, current velocities, turbulence and food concentrations (phytoplankton) are all factors that may influence vertical distributions.

This 96-hr cruise was the second of two cruises for this endeavor (summer 2011 and 2012). On this cruise, one station near the Choptank River mouth and one further up river were occupied (Fig. 1), one with stratified conditions and one with well mixed conditions. At each station bivalve larvae were sampled while the ship was at anchor. Depth-specific plankton samples were obtained during day and night and on ebb and flood tides with accompanying physical measurements to characterize larval distributions and the physical and biological factors that could cue larval swimming behavior.

The ship was loaded at the Sailwinds dock in Cambridge, MD, on 10-July, and departed that evening under partly sunny and warm conditions. Two stations were occupied during this cruise. Operations for station 1 began around 21:30 on July 10, 2012 with the deployment of an Acoustic Doppler Current Profiler (ADCP,TRDI Workhorse sentinel 1200 KHz, with mode 12 (high ping rate). One hour after the ADCP deployment, CTD casts and plankton sample collections commenced and were made every 1.5 hr. On July 12 at approximately 19:00, the ADCP was deployed at station 2, with CTD casts and plankton samples starting shortly thereafter. We returned to port and unloaded the ship at 19:00 on July 14, 2012. The consecutive station log for the cruise is in Appendix A.

Upon arrival at each station, a CTD cast was conducted to determine if the water column was stratified or well mixed. A second CTD cast was made to pump water for an oblique plankton sample which was inspected immediately to confirm the presence of bivalve larvae. Next, the 1200 KHz ADCP was moored in close proximity to the station to measure turbulence and current velocity profiles. In addition, the ADCP in the hull of the *R/V Hugh R. Sharp* (RDI Workhorse 600 KHz) was used to collect current velocity information. After the moored ADCP was deployed, a time series of plankton samples commenced. Before each plankton sample, the *R/V Hugh R. Sharp*'s CTD, which was equipped with a hose attached to the frame, was lowered to measure profiles of temperature, salinity, fluorescence, and dissolved oxygen on the down-cast. Water for plankton samples was pumped up to the deck of the ship with a Bellows pump using the hose attached to the CTD frame as the CTD was raised up through the water column. Approximately 200 liters of seawater, per interval, was filtered by pumping water for ~ 3 min through a 64 micron plankton net immersed in a bucket (Fig. 2). Four to 5 depth intervals were sampled, depending upon the station (Tables 1 and 2). For each depth interval, the CTD started at the bottom of the interval and was moved upwards to one or more target depths every 30 or 60 s depending on the height of the interval (Tables 1 and 2) to ensure consistent collections within each depth interval over time. The CTD cast and plankton sample collections occurred every 90 min at each station. All pumped samples were filtered and stored in 4% Sodium borate buffered formaldehyde.

Station 1 was 10 m deep and had well mixed conditions initially. Station 1 was occupied for 40 hours; 32 CTD casts were made and 160 plankton samples were collected. Station 2 was 10 m deep and had stratified conditions initially. Station 2 was occupied for 41.5 hr; 31 CTD casts were made and 147 plankton samples were collected.

Water samples from nine CTD casts were collected and used for total suspended solids (TSS) and chlorophyll (Chl) analysis. Samples for TSS were filtered through pre-processed 934-AH Whatman 2.5 cm filters from 200 ml of seawater. The chlorophyll samples were taken from 20 ml of seawater filtered through 25-mm diameter GF/F filters. All TSS and Chl samples were processed by the Horn Point laboratory analytical services using their standard protocols.

In addition, graduate student Katherine Liu Slater conducted a gelatinous zooplankton study using vertical tows with two kinds of zooplankton nets as well as Niskin bottles on the CTD. Samples with nets and Niskin bottles were taken from three sampling depths (above pycnocline, pycnocline and below pycnocline) and were chosen according to the CTD cast results. Vertical tows were applied with a gel-net from the three layers, and up to ten ctenophores

were preserved with 5% formaldehyde in 250 ml glass jars. Repeated vertical tows from the same three depths were conducted with a 64 micron-meshed zooplankton net. The water samples from each water layers were sorted and counted for ctenophore larvae and hydromedusa with a dissecting microscope. Water samples with Niskin bottles were also collected from the three depths and preserved with 10% acid Lugol's Solution. Ctenophores captured with the gel-net from the layer above pycnocline, were kept in a bucket, aerated and fed with *Artemia salina*, which was hatched in a carboy with salty water of 25-45psu.

II. Weather

The high temperatures fluctuated around the mid-80s during the entire cruise. Barometric pressure increased as a high pressure system moved through the region although on July 14th pressure dropped and during our ADCP recovery we experienced and isolated rain event. During most plankton sampling wind speeds were generally less than 10 mph with some isolated gusts to 20 mph.

III. Contact Information

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Table 1. Depth intervals at station 1 as well as the target depths which were used to guide the CTD up through the interval during the 2-min sample collection.

	Interval (m)	CTD depths (m)
Bottom	9.0-7.2	9.0, 8.1,7.2
Middle Bottom	7.2-5.4	7.2,6.3,5.4
Middle	5.4-3.6	5.4, 4.5, 3.6
Mid-Surface	3.6-1.8	3.6, 2.7, 1.8
Surface	1.8-0	1.8, 0.9, 0

Table 2. Depth intervals at station 2 as well as the target depths which were used to guide the CTD up through the interval during the 2-min sample collection.

	Interval (m)	Target depths (m)
Bottom	8.5-6.8	8.5, 7.4, 6.8
Mid-Bottom	6.8-5.1	6.8, 5.7, 5.1
Middle	5.1-3.4	5.1, 4.0, 3.4
Mid-Surface	3.4-1.7	3.4, 2.3, 1.7
Surface	1.7-0	1.7, 0.6, 0

Fig. 1. Location of station 1 and station 2 in the Choptank River, a tributary of Chesapeake Bay.

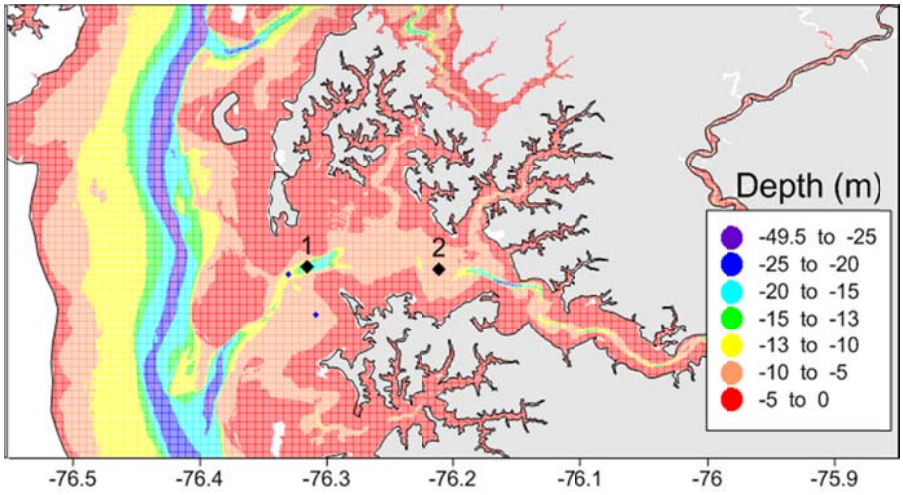

Fig. 2. Jake Goodwin directing hose into plankton net which was suspended inside a 50 gallon drum filled with water (¾ full) to ensure the plankton were cushioned and not forced through the mesh by the high-volume pump. A series of small holes above the duct tape allowed water to drain out and maintain the drum ¾ full.

Appendix A. Consecutive Station Log.

Station	Date	Time (GMT)	Time (EDT)	Latitude	Longitude	Station depth (m)	Surface salinity	Surface Temp (C)	CTD cast #	TSS sample #s	Secchi depth (m)	Pycnocline type	Notes
1	7/10/2012	3:35	11:35	3838.38	7619.90	11.2	13.07	28.53	001	-		Surface pycnocline	Test Cast. Testing pump and observing pycnocline (20L/6s)
2	7/10/2012	3:50	11:50	3838.38	7619.90	11.2	13.07	28.53	002			Middle pycnocline	First cast
3	7/11/2012	5:20	1:20	3838.37	7619.90	11	13.07	28.51	004			Middle pycnocline	fired 3 Niskon bottles for Katherine
4	7/11/2012	6:51	2:51	3838.37	7619.90	11	13.03	28.56	004	JG2		Bottom pycnocline	TSS/CHL
5	7/11/2012	8:20	4:20	3838.37	7619.90	10.9	12.5	28.99	005			Bottom pycnocline	First shift change
6	7/11/2012	9:50	5:50	3838.37	7619.90	11	12.54	28.87	006			Bottom pycnocline	
7	7/11/2012	11:20	7:20	3838.37	7619.90	11	13.45	28.56	007		1.1	Bottom pycnocline	First Secchi
8	7/11/2012	13:50	8:50	3838.36	7619.89	11.2	12.9	28.03	008		1.1	Middle pycnocline	
9	7/11/2012	14:25	10:25	3838.38	7619.90	11.1	13.05	27.71	009		1.4	Middle pycnocline	
10	7/11/2012	16:07	11:00	3838.37	7619.90	11.1	13.04	28.54	010		1.6	Middle pycnocline	Pump check 20L/6s
11	7/11/2012	17:37	13:37	3838.37	7619.90	10.9	13.28	28.14	011		1.4	Middle pycnocline	
12	7/11/2012	19:05	15:05	3838.37	7619.90	10.8	12.54	29.2	012	JG3	1.0	Middle pycnocline	TSS/CHL
13	7/11/2012	20:28	16:28	3838.37	7619.90	10.8	12.58	29.08	013		1.2	Middle pycnocline	
14	7/11/2012	22:09	18:09	3838.39	7619.90	10.9	12.52	29.17	014		1.2	No pycnocline	No pycnocline for the first time
15	7/11/2012	23:34	19:34	3838.39	7619.90	11.1	12.73	28.94	015		1.1	Bottom/mid pycnocline	
16	7/11/2012	0:59	20:59	3838.39	7619.90	11.2	12.96	28.57	016			Bottom pycnocline	Pump check 20L/6s
17	7/11/2012	2:28	22:28	3838.39	7619.90	11.3	13.25	28.44	017	JG4		Bottom pycnocline	TSS/CHL
18	7/11/2012	3:53	23:53	3838.39	7619.90	11.2	13.28	28.22	018	JG5		Middle pycnocline	TSS/CHL
19	7/11/2012	5:25	1:25	3838.38	7619.90	11.1	13.32	28.14	019			upper/mid pycnocline	
20	7/12/2012	6:50	2:50	3838.37	7619.90	11	13.42	27.86	020	JG6		Middle pycnocline	TSS/CHL
21	7/12/2012	8:20	4:20	3838.37	7619.90	11.1	13.01	27.93	021			low/mid pycnocline	
22	7/12/2012	9:50	5:50	3838.38	7619.90	10.9	12.86	27.99	022	JG7		No pycnocline	No pycnocline, TSS/CHL
23	7/12/2012	11:20	7:20	3838.38	7619.90	11	12.87	27.84	023		1.2	Bottom pycnocline	First Secchi of day
24	7/12/2012	12:50:00	8:50	3838.37	7619.90	11.1	12.75	27.97	024		1.2	Bottom pycnocline	Pumped longer on final interval. Will result in more volume for surface interval
25	7/12/2012	13:23	9:23	3838.37	7619.90	11.2	12.73	27.71	025			Bottom pycnocline	Test cast for O2 sensor. Moved intake hose outward so flow doesn't interupt WQ readings
26	7/12/2012	14:20	10:20	3838.36	7619.90	11.1	12.88	27.56	026	JG8	1.2	Bottom/mid pycnocline	TSS/CHL
27	7/12/2012	14:50	10:50	3838.36	7619.90	11.2	13.08	27.66	027			Middle pycnocline	Oblique sample taken (all intervals so 1000 L of water in sample)
28	7/12/2012	16:05	12:05	3838.37	7619.90	11.2	12.98	28.05	028		1.4	Middle pycnocline	
29	7/12/2012	17:34	13:35	3838.37	7619.90	11	13.06	28.58	029	JG10	1.6	Middle pycnocline	
30	7/12/2012	19:03	15:03	3838.37	7619.90	10.9	12.91	28.57	030		1.4	Middle pycnocline	
31	7/12/2012	20:34	16:34	3838.37	7619.90	10.8	12.76	28.68	031		1.2	Middle pycnocline	
32	7/12/2012	21:54	17:54	3838.37	7619.90	10.8	12.8	28.78	032		1	Middle pycnocline	Last station for this position (Last cast for STATION 1)
33	7/12/2012	0:16	20:16	3838.40	7611.73	10.5	12.56	28.47	033			slight pycnocline	Test cast to decide station 2
34	7/12/2012	0:34	20:34	3838.69	7611.99	10.4	12.47	28.53	034			slight pycnocline	Test cast to decide station 2
35	7/12/2012	1:04	21:04	3838.72	7611.92	10.4	12.48	28.51	035			slight pycnocline at bottom	1st cast at station 2 (pump rate measured 20L/6s
36	7/12/2012	2:30	22:30	3838.71	7611.94	10.5	12.5	28.38	036			slight mid pycnocline	Added 2nd JED measures!!!
37	7/13/2012	4:00	0:00	3838.72	7611.94	10.4	12.48	28.34	037			slight mid pycnocline	
38	7/13/2012	5:30	1:30	3838.71	7611.94	10.5	12.51	28.3	038	JG11		Middle pycnocline	TSS/CHL
39	7/13/2012	7:00	3:00	3838.70	7611.95	10.3	12.51	28.2	039			Middle pycnocline	TSS/CHL
40	7/13/2012	8:30	4:30	3838.70	7611.95	10.2	12.42	28.19	040		1.3	well mixed	Missed intervals MS and S
41	7/13/2012	10:00	6:00	3838.70	7611.95	10.2	12.57	27.76	041	JG12	1.3	well mixed	Ths is for intervals MS and S for previous cast
42	7/13/2012	11:30	7:30	3838.70	7611.95	10	12.57	27.76	042		1.2	Middle pycnocline	
43	7/13/2012	11:40	7:40	3838.70	7611.95	10	12.57	27.76	043		1.1	weak middle pycnocline	
44	7/13/2012	13:00	9:00	3838.70	7611.94	10.3	12.57	27.82	044		1	weak middle pycnocline	
45	7/13/2012	14:30	10:30	3838.71	7611.94	10.4	12.51	28.01	045	JG13	1.3	weak middle pycnocline	last station for this position (Last cast for STATION 1)
46	7/13/2012	16:13	12:13	3838.71	7611.94	10.3	12.49	28.21	046		1.4	weak middle pycnocline	
47	7/13/2012	17:43	13:43	3838.69	7611.90	10.4	12.55	28.51	047		1.2	mixed	
48	7/13/2012	19:14	15:14	3838.69	7611.93	10.1	12.575	28.384	048	JG15	1.1	mixed	TSS/CHL
49	7/13/2012	20:44	16:44	3838.70	7611.90	10	12.59	28.71	049		1	mixed	
50	7/13/2012	22:12	18:12	3838.71	7611.91	10	12.59	28.64	050		1.2	mixed	TSS/CHL
51	7/13/2012	23:43	19:43	3838.72	7611.91	10	12.61	28.44	051		1.1	mixed	
52	7/13/2012	1:03	21:03	3838.72	7611.92	10.2	12.64	28.46	052			weak middle pycnocline	TSS/CHL a sample
53	7/13/2012	2:29	22:29	3838.70	7611.90	10.3	12.51	28.58	053			mixed	Night light reading (PAR)
54	7/14/2012	4:00	0:00	3838.70	7611.91	10.4	12.52	28.43	054			weak middle pycnocline	
55	7/14/2012	5:30	1:30	3838.71	7611.94	10.4	12.57	28.27	055			weak middle pycnocline	
56	7/14/2012	7:00	3:00	3838.72	7611.94	10.4	12.56	28.22	056			mixed	
57	7/14/2012	8:30	4:30	3838.72	7611.97	10.3	12.65	28.17	057			mixed	
58	7/14/2012	10:00	6:00	3838.72	7611.97	10.1	12.65	28.07	058	JG		mixed	
59	7/14/2012	11:30	7:30	3838.72	7611.97	10.1	12.68	28.07	059			mixed	TSS/chl (missed on previous cast, No sample jarS)
60	7/14/2012	11:30	7:30	3838.72	7611.97	10.2	12.74	27.99	060			mixed	
61	7/14/2012	13:00	9:00	3838.73	7611.96	10.2	12.72	28.01	061			mixed	Overcast light drizzle
62	7/14/2012	14:30	10:30	3838.69	7611.97	10.2	12.5	27.89	062			slight mid pycno	
63	7/14/2012	16:00	12:00	3838.69	7611.97	10.3	12.66	28.67	063	7		mixed	
64	7/14/2012	17:30	13:30	3838.72	7611.97	10.3	12.61	28.23	064			mixed	
65	7/14/2012	19:00	15:00	3838.71	7611.97	10.3	12.67	28.67	065			mixed	Last cast!