Frenchman's Bay Water Quality Monitoring

2011-12 Cruise Ship Season

Submitted to:

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Submitted by:

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1.0 INTRODUCTION

In 2011 the Town of Bar Harbor entered into a contract with Moody Mountain Environmental (MME) to conduct water quality monitoring of Frenchman's Bay during the 2011 cruise ship season. This monitoring effort was associated with *An Act to Protect Maine's Coastal Waters* (2004), which prohibits large vessels from discharging untreated gray water or an untreated mixture of gray and blackwater into Maine's coastal waters. The goal of the project was to determine whether cruise ships are in compliance with this legislation. The Town recognized that the cruise industry is individually regulated with respect to disposal of waste water and solid waste. In addition the Town acknowledges and appreciates the innovative strides the cruise industry has made with respect to improved design and treatment of such waste. In 2004 The MDI Water Quality Coalition, a non-profit organization based on Mount Desert Island, conducted a similar monitoring effort and issued a subsequent report. This project was intended to provide an update to this previous study.

2.0 METHODS

Sampling Frequency

MME sampled 14 cruise ship visits, 3 in September 2011, 5 in October 2011, and 3 each in May and June 2012.

Field Sampling

Sampling in the field was done from the harbormaster's vessel or the town float. MME coordinated with the Bar Harbor Harbormaster to facilitate sampling and communication with cruise ship captains. Permission was needed from each cruise ship to enter the 100 yard exclusion zone in order to sample close the ships.

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The following parameters were sampled on the water during the 2011-2012 cruise ship season:

- date and time
- weather, including clouds, temperature, wind speed and direction, pressure, precipitation
- sea state including tide, current, wave height and direction, boat traffic
- water temperature
- water transparency
- turbidity
- salinity
- dissolved oxygen
- chlorine (total residual, free, combined)

The following parameters were analyzed in the laboratory (see below):

- biological oxygen demand
- nitrogen (nitrate, nitrite)
- enterococci bacteria
- phytoplankton

Field data was taken in an all weather field book for input later into a project database. Field parameters and methodologies are shown below:

- **Water temperature** was read digitally using a YSI dissolved oxygen meter
- **Water transparency** was determined using a standard secchi disk and Hydroscope viewtube. Methods followed the Volunteer Lake Monitor published protocol.
- **Turbidity** was measured using a HACH Model 2100P Turbidimeter. Methods followed the Volunteer Estuary Monitoring: A Methods Manual March 2006 EPA-842-B-06-003
- **Salinity** was measured using an Extech RF20 Salinity Refractometer. Methods followed the Volunteer Estuary Monitoring: A Methods Manual (EPA-842-B-06-003).

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- **Dissolved Oxygen** was measured using an YSI meter. The pologrаphic probe was lowered to approximately 1 meter below the surface and "jigged", gently raised and lowered, to create a slight current. Readings, in mg/l were taken after the instrument stabilized.
- **Chlorine** was measured using a LaMotte Colorimeter. Measurements followed the method found in Mount Desert Island Water Quality Coalition, 2004.

Laboratory Analysis

The remaining parameters were collected and analyzed a state of Maine certified laboratory. No NELAC or Maine certification exists for analysis of phytoplankton. Phytoplankton was analyzed at MME's laboratory in Searsmont Maine. A description of the parameters is presented below:

- **Biological Oxygen Demand** (BOD5) is the measure of the amount of oxygen consumed by microorganisms in the water over a 5-day period. It is an indicator of organic matter in the water that could be a result of gray water or black water discharges. BOD levels above 2 ppm indicate that water may be polluted with organic matter. Samples are collected in sample bottles (to prevent photosynthetic dissolved oxygen production) and taken to the lab. Standard Method 5210 B will be used to determine the 5 day oxygen demand (dissolved oxygen amount, mg/l subtracted from initial instantaneous amount).
- **Nitrogen,** when introduced into the ocean in large amounts, can lead to algae blooms. Nitrogen is difficult to eliminate from sewage treatment plants**.** Standard Methods 4500 will be used to determine the amount of nitrogen in the water.
- **Enterococci bacteria** are found in the guts of all warm-blooded organisms and are a common indicator organism of fecal contamination. The Idexx Enterolert methodology was used similar to the Mount Desert Island Water Quality Coalition, 2004 methods. Samples were collected in sterile jars supplied by the lab; water was collected from a depth of 8-14 inches below the surface. Samples were stored at less than 10ºC for transport within 24 hours to the lab
- **Phytoplankton** was sampled for two reasons: to characterize the endemic community and check for blooms of harmful algae; and, to determine if non-native species have been

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transported in ballast water and released. Methodologies followed those of Mount Desert Island Water Quality Coalition, 2004. Two (2) samples, one in each sampling season, were collected and analyzed.

Samples requiring transport to laboratory were preserved according to the appropriate method and either hand delivered or shipped as needed. Chain of Custody forms and procedures were followed throughout the process including signatures and attesting to sample condition upon arrival.

3.0 RESULTS

Results are shown in Table 1. A total of fourteen (14) sampling events occurred during the study, eight (8) in the fall of 2011 and six (6) in the spring of 2012. Three (3) locations were sampled, Anchorages A and B and the town float (Map 1). Anchorage B was sampled exclusively in 2011 as that location had not previously been tested. No ships were scheduled for Anchorage B in the spring of 2012 so Anchorage A and the Town float were tested. Control data was collected twice at Anchorage B in 2011 and once each at Anchorage A and the float in 2012. Eight (8) cruise ships were sampled during the study, six individual ships in 2011 and the Maasdam and Independence twice each in the spring of 2012.

In general the results indicated good water quality in Frenchman's Bay. Transparency (or water clarity) was good and turbidity levels were low. Dissolved oxygen levels stayed above 7 parts per million (ppm), and BOD (biological oxygen demand) was 2ppm or below.

Nitrogen levels were low throughout the study. Problems with the Nitrate laboratory procedure caused the 2011 results to be discarded. Using a different method in 2012 showed nitrate levels to be low, below the detection limit. Similarly nitrite levels were below 0.01 ppm.

Enterococci bacteria levels were below the detection limit for all samples except the first control sampling at Anchorage B (Sept. 22, 2011, 31 colonies) and at the float when the Independence was tied up (May 28, 2012, 40 colonies). Enterococci bacteria are found in the guts of all warm-blooded organisms and are a common indicator organism of fecal contamination. The U.S. EPA single sample threshold for issuing swimming advisories is 104 colonies. The sample taken on May 28, 2012 was taken shortly after an observed overboard discharge (OBD) of gray water from the Independence (See Appendix A-Email from D. Reed Bar Harbor Town Manager).

Map 1. Sampling locations in Frenchman's Bay of Anchorage A, B, and the Town float in 2011 and 2012.

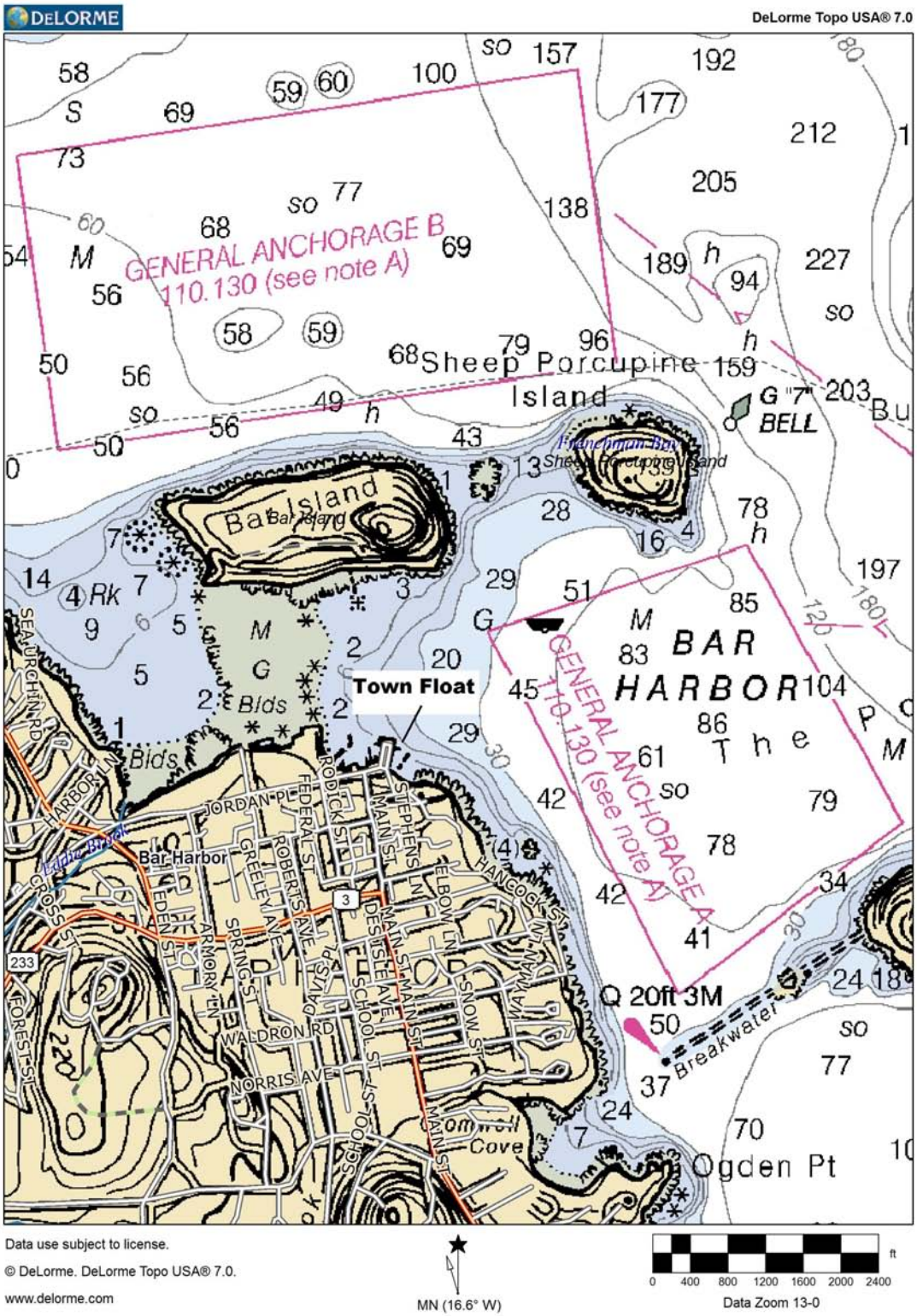

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Table 2. Water quality results around selected cruise ships visiting Bar Harbor in 2011 and 2012.

Date	Location	Vessel	Time	Clds	AirT	Windsp	Wnddir	Bar Press	Precip 24	Tide	Current	Wv.ht	Wv dir	Boat act
9/22/11	Anc-B	None	1134	overcast	--	lt		--	y	low	<1 fps	<1'	ne	no
9/27/11	Anc-B	Eurodam	930	clr	18.0	lt	n	--	n	fld	<1 fps	<0.5'	n	lob/ tenders
9/30/11	Anc-B	Aurora	938	clr	20.4	lt	s	--	y	fld	<1 fps	<0.5'	s	lob/ tenders
10/3/11	Anc-B	Seabourne Sojourn	1001	cldy	16.0	calm	na	29.79	y	fld	<1 fps	swls 1.5'	e	Lob /tenders
10/4/11	Anc-B	Caribbean Princess	930	cldy	13.3	5	ne	29.74	y	low	<1 fps	swls/chp <1'	ne	lob/ tenders
10/12/11	Anc-B	None	1005	ovrcst	13.7	7	se	30.04	n	fld	<1 fps	<1'	se	n
10/19/11	Anc-B	Crown Princess	1300	rn	11.1	8	s	29.8	y	fld	<1 fps	<1'	se	y tenders
10/24/11	Anc-B	Jewel of the Seas	900	pcldy	12.7	3	n	29.87	n	low	<2 fps	<0.5'	e	Y tenders
05/24/12	Anc-A	None	1030	cldy	15.0	9	sse	30.02	n	fld	<1fps	<1'	s	n
05/24/12	Dock	None	1045	cldy	13.9	9	sse	30.02	n	fld	<1fps	<1'	s	y
05/28/12	Dock	Independence	745	cldy	12.8	4	n	29.75	n	ebb	<1fps	<1	n	n
06/18/12	Anc-A	Maasdam	935	clr	14.4	11	se	29.96	n	fld	<1	<1	e	y
06/18/12	Dock	Independence	1030	clr	13.3	14	se	29.96	n	slack	<1	<1	e	y
06/29/12	Anc-A	Maasdam	930	ovrcst	15.0	4	n	29.59	n	ebb	<1	<1	ene	y

Date	Location	Vessel	W. Temp	Trans	Turb	D.O.	Chlorine (All)	Salinity	NITRATE (mg/l)	NITRITE (mg/l)	Enterococc (MPN/100ml)	BOD5 (mg/l)	Dominant Phytoplankton Tot.Cells
9/22/11	Anc-B	None	13.8	4.40	1.82	9.65	0	34	*	<0.01	**31**	<2	
9/27/11	Anc-B	Eurodam	13.8	4.50	1.06	8.60	0	34	*	<0.01	<10	<2	
9/30/11	Anc-B	Aurora	13.5	5.80	0.93	8.35	0	35	*	0.01	<10	<2	
10/3/11	Anc-B	Seabourne Sojourn	14.4	6.80	0.94	7.92	0	33	*	0.01	<10	<2	
10/4/11	Anc-B	Caribbean Princess	13.8	7.70	1.88	7.69	0	33	*	<0.01	<10	<2	
10/12/11	Anc-B	None	12.6	6.65	0.77	7.32	0	35	*	0.01	<10	<2	
10/19/11	Anc-B	Crown Princess	12.7	7.22	1.05	7.92	0	33	*	0.01	<10	<2	
10/24/11	Anc-B	Jewel of the Seas	12.3	6.27	0.85	7.96	0	33	*	0.01	<10	<2	Coscinodiscus-35
05/24/12	Anc-A	None	11.5	4.62	1.4	9.92	0	34	<0.01	<0.01	<10	<2	
05/24/12	Dock	None	11.7	4.11	2.4	9.37	0	33	<0.01	<0.01	<10	**2**	
05/28/12	Dock	Independence	12.9	4.4	1.4	9.46	0	32	<0.01	<0.01	**40**	<2	
06/18/12	Anc-A	Maasdam	12.4	4.95	1.5	9.46	0	32	<0.01	<0.01	<10	<2	Coscinodiscus-5
06/18/12	Dock	Independence	11.9	6.55	1	9.97	0	34	<0.01	<0.01	<10	<2	
06/29/12	Anc-A	Maasdam	13.9	5.45	1.6	9.37	0	32	<0.01	<0.01	<10	<2	

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4.0 DISCUSSION

As mentioned above in general the results indicate good water quality at the cruise ship anchorages. Furthermore the cruise ship captains reported that they were not discharging while in port and no evidence of discharges were observed while sampling. However, it should be noted that this study sampled a small proportion of the total number of cruise ship visits (over 88 in 2011).

Bacteria testing revealed positive results during control sampling and during sampling of the Independence at the Town float. Enterococci bacteria are found in the guts of all warm-blooded organisms and are a common indicator organism of fecal contamination. In addition enterococci bacteria are known to "clump" in natural systems; that is the bacteria are not uniformly distributed in the water. The levels reported are relatively low and if reported from a swim beach would not trigger a swim advisory. The positive result during control sampling may well have been from fecal matter from seabirds, waterfowl, or ocean mammals.

The positive test next to the Independence could also have been from natural causes; however, taken with the report of an OBD of gray water from the ship minutes before sampling, the origin of the bacteria could well have originated in the ship. It is important to note that sampling took place during an ebb tide and the sampler did not notice any soapy water in the harbor.

As mentioned above in general the results indicate good water quality at the cruise ship anchorages. These results mirrored the results from 2004 (MDI Water Quality Coalition) Furthermore the cruise ship captains reported that they were not discharging while in port and no evidence of discharges were observed while sampling. However, it should be noted that this study sampled a small proportion of the total number of cruise ship visits (over 88 in 2011). The cost of sampling most likely precludes the Town of Bar Harbor from testing all cruise ships during a season. In addition, single sampling for minutes during a 12 or 24 hour stay cannot ensure no OBDs during the rest of the stay. It is my recommendation that any future sampling be done with the goal of characterizing the water quality of Frenchman's Bay and documenting any long-term trends.

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References

Ohrel, R. L. Jr. and K.M. Register. 2006. Voluntary Estuary Monitoring: A Methods Manual. EPA-842-B-06-003. 2nd Ed. USEPA & Ocean Conservancy. 396 pgs.

The MDI Water Quality Coalition. 2004. Cruise Ship Water Quality Report, Bar Harbor, Maine May - November 2004. MDI Water Quality Coalition P.O. Box 911 Mount Desert, ME 04660. 22 pgs.

Appendix A

Email from D. Reed, Town Manager, Bar Harbor to P. Leeper, Moody Mtn Env. and others on June 4, 2012:

As you may be aware, on Memorial Day, May 28, the cruise ship Independence, a 100 passenger American Cruise Lines (ACL) vessel, was observed discharging soapy water overboard while docked at the Town Pier, an event that was reported by a local citizen, as well as recorded on one of the Town's surveillance cameras.

After an internal review, Captain John Ayer, ACL Operations Supervisor, indicated to Harbor Master Charlie Phippen on Wednesday that an overboard discharge (OBD) valve to the forward washing machines was inadvertently left open and effluent from the washing machines was discharged, although the on board procedures for docking in Bar Harbor include securing all OBD valves. Obviously, this was a mistake on the part of the crew. The discharge was gray water only, so there was no chance for black water to discharge from this particular valve. The type of detergent used in the washing machines is biodegradable and meets EPA Standards. He apologized and said that this will not happen again.

On Friday, I received a phone message from Mr. Charles Robertson, ACL President & CEO. I returned his call today and was pleased to hear that he accepted full responsibility for the event and indicated their policy is to allow no OBDs in Bar Harbor. He clearly understands our concerns, is quite anxious to prevent future OBDs and even offered to come to Bar Harbor to make a public apology, if I thought that would help. I indicated that wouldn't be necessary and thanked him for his concern. He also indicated that they have changed their operating procedures to prohibit clothes washing while in Bar Harbor, to further assure that they have no further incidents.

We have not heard back from our water quality tester, Paul Leeper of Moody Environmental, regarding the results of the lab tests on his samples collected around the Independence the morning prior to the OBD.

Just FYI,
Dana

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Note: Samples were collected on June 28th, after the reported OBD.