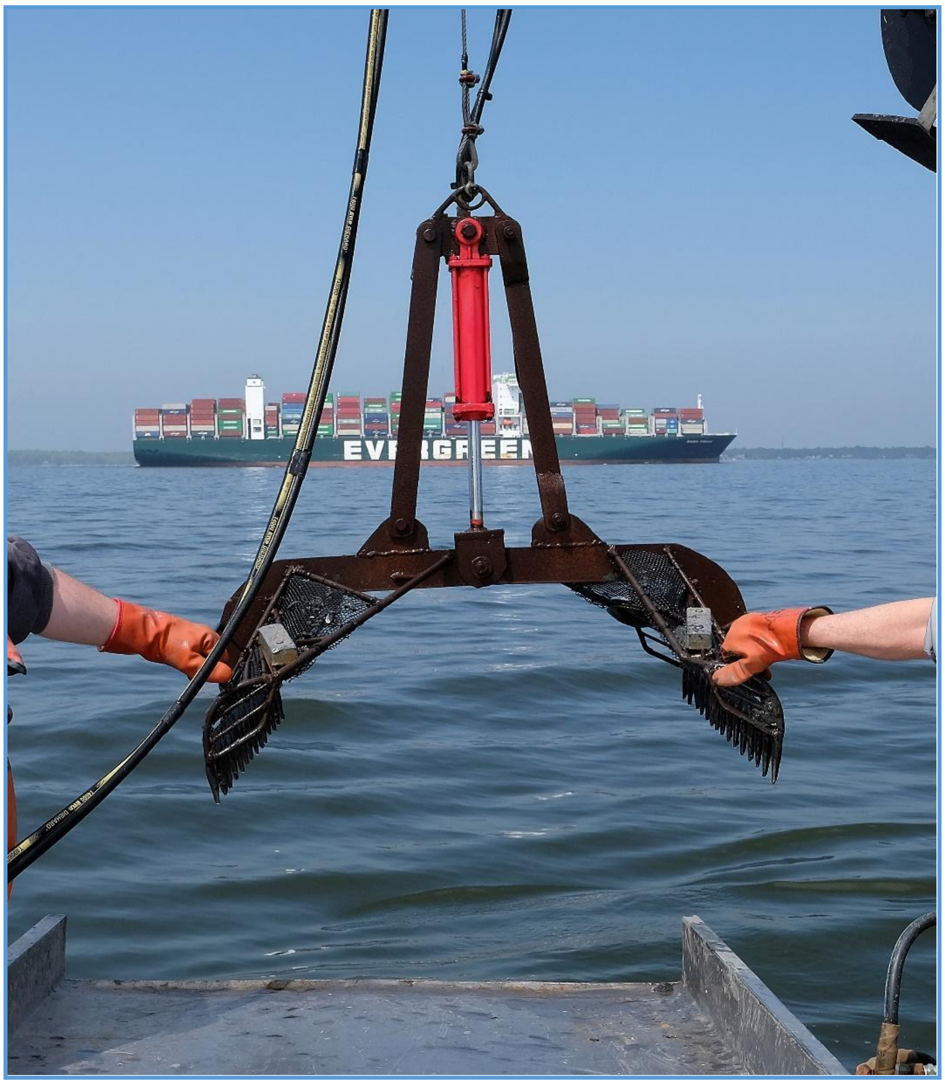
Survey of Potential Impacts on Oyster Populations from the Grounding of the M/V *Ever Forward* on Natural Oyster Bar 4-2



Shellfish Division

Maryland Depart of Natural Resources

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Survey of Potential Impacts from the Grounding of the M/V *Ever Forward* on Natural Oyster Bar 4-2

Introduction

On 13 March 2022 the M/V *Ever Forward*, leaving the Port of Baltimore, exited Craighill Channel and ran fast aground in the mud inside the edge of Natural Oyster Bar (NOB) 4-2. The bow of the ship, which draws 40 ft. of water, was at a depth of 18 ft. After a month of intensive dredging around the ship, two failed attempts to free her with tugboats, and the removal of about 500 containers, the *Ever Forward* was finally extracted from the oyster bar on 17 April 2022.

Because the grounding and subsequent activity to free the vessel were within the legal boundaries of a designated Natural Oyster Bar, there was a twofold concern over the potential impacts to the oyster population and shell habitat, as well as associated epibenthic organisms:

1. What was the impact to the immediate area around the grounding?

2. What was the far-field impact of the activity to free the vessel on oyster bars within NOB 4-2?

A survey was designed and conducted by the MDNR Shellfish Division to address these questions. The results are presented herein, along with background information on the area and the findings of previous oyster surveys at nearby locations.

Description of the Area

To better understand what the potential impacts might be, a description of the area is instructive, as aptly provided in the Fourth Report of the ShellFish Commission of Maryland (Grave 1912):

The oyster ground known as the "Lumps," although covering a very large area, has in reality a comparatively small area of oyster producing bottom. It is lumpy throughout, the lumps (patches of oysters) varying in size from a few square yards to about fifteen acres. Between the lumps large areas of very soft barren mud are found. The total area of oyster-bearing bottom on the "Lumps" probably does not exceed 400 acres, and this is being gradually diminished by the deposit of a finely divided ooze from the debris dredged from the Craighill Channel and dumped over the eastern section of the lumps. During the survey empty shells and mud boxes were brought up at several of the examination stations from several inches below the surface of the bottom, the oysters having recently been smothered by the deposited material.

The "Lumps" referred to in this passage are formally named "Lumps East of Craighill Channel", a historic Yates bar located within the larger NOB 4-2. Based on surveys and observations including those conducted this year, the general characteristics of the bar remain the same today, although another century of siltation has probably further reduced the oyster habitat. It is interesting to note that during the early twentieth century the dredge material from channel dredging was dumped on the oyster bar, whereas the dredge material from the *Ever Forward* dredging was loaded onto barges and removed for island restoration in another part of the bay (Dredging Today 2022).

In addition to the natural structure of the oyster bars in this area, salinity is a key factor that determines the status of oysters in this region. Salinity affects oyster reproduction and recruitment, disease, and mortality. The upper bay (the region north of the Bay Bridge) oyster population is strongly influenced by the proximity of the Susquehanna River, the largest source of freshwater discharge into the bay. The oyster bars in this region are characterized by low and sporadic recruitment which is often supplemented by seed oyster plantings. Disease-related mortality is extremely low, but populations have periodically been subjected to killing freshets (Tarnowski 2012).

Fall Oyster Survey (Table 1)

Since 1939, the Maryland Department of Natural Resources and its predecessor agencies have conducted annual dredge-based surveys of oyster bars. These oyster population assessments have provided information on spatfall intensity, observed mortality, and more recently on parasitic infections and habitat in the Maryland waters of Chesapeake Bay. Details on the methodology and results of the surveys can be found in the most recent annual report (Tarnowski 2022).

Two Fall Survey stations are located within NOB 4-2 (Figure 1). Both are on Belvedere Shoal, which extends into the Yates bar Lumps East of Craighill Channel, downstream from the grounding site. Belvedere Lump "A" (BLA) is approximately 1,320 m south southeast from where the bow of the ship was situated, and Belvedere East Lump (BEL) is further east, approximately 1,780 m from the bow. The Fall Survey results provide baseline information about these oyster bars for the five years prior to the grounding (Table 1).

Oyster densities have been low in these areas in recent years, due in part to an extended period of high freshwater input in 2011, including spring freshets, a tropical storm, and a hurricane. Consequently, observed oyster mortalities in 2011 were severely elevated on many bars in this region, including BLA (25%) and BEL (33%). These values are likely underestimated as mortalities may have continued due to persistent low salinities after the survey was conducted. Over the past five years, densities averaged 14.0 oysters/bushel of cultch (shells and oysters) on BLA and 21.2 oysters/bushel on BEL. In contrast, a highly productive area such as Broad Creek averaged 291.0 adult oysters/bushel in 2021. No spat was observed on either Belvedere site during the past five years. However, a small number of sublegal (< 76 mm shell height) oysters were found most years, indicating a slight trickle of recruitment taking place on these sites. The last reported seed oyster planting was in 2003.

Post-Grounding Survey

Methods

The survey was conducted on 2 May 2022 using hydraulic patent tongs (see cover photo), which sampled 1 m^2 of bottom. Patent tongs provide spatially-explicit estimates of oyster density, thus affording a sound statistical basis for quantitative sampling, and are considered 100% efficient (Chai et al. 1992). They are the gear of choice for smaller-scale surveys such as this.

To address the dual concerns of proximal impacts and far-field effects on NOB 4-2, two sampling schemes were used (Figure 1). In the immediate vicinity of the grounding site but outside the footprint of the ship and dredging activity, stations were randomly selected within a 305 m radius from the ship and exclusively inside NOB 4-2. For the second sampling scheme to look at potential impacts on nearby oyster habitat, two transects were established. One ran in a generally north-south direction east of the grounding site on the Yates bar “Lumps East of Craighill Channel” (LECC). The second transect was also located in LECC, southeast of the grounding in an east-west direction between the two Fall Survey stations, BLA and BEL.

For all stations, depth and substrate type were recorded. Samples with oyster habitat were photographed before processing, then the total volume of shell and oysters was measured and the proportion of brown surface shell and gray subsurface shell was determined. All live and dead (shells still articulated) oysters were removed from the sample, classified by size as either markets (legals ≥ 76 mm) or smalls (sublegals), and measured to the nearest millimeter along the height axis (longest distance from umbo to ventral margin). Dead oysters were also categorized according to the length of time they had been dead, ranging from Gaper (meat still inside) to Stage 3 - old (interior of shells largely covered with fouling organisms or discolored from sediment). Volumes were obtained for both live and dead oysters. Siltation impacts on viable oyster habitat were ascertained by noting the presence of live epibenthic animals commonly associated with oyster bars. These included recurved mussels (*Ischadium recurvum*), dark false mussels (*Mytilopsis leucophaeata*), white anemones (*Diadumene leucolena*), barnacles (*Balanus sp*.), and mud crabs (Xanthidae).

Results: Grounding Site (Table 2)

A total of 25 samples were taken at random around the footprint of the grounding. In addition, a duplicate sample was taken at Sta. 1, the only station where oyster habitat was found and the only one within the Yates bar LECC. Furthermore, two supplemental samples were opportunistically taken at a location where shell was observed on the sonar unit.

No oysters were found in any of the samples. Oyster habitat was absent for the most part except for modest amounts of surface shell at two sites: Sta. 1 and supplemental samples A and B. These were also the shallowest sites, ranging between 5.9 m and 6.1 m. A variety of epibenthic organisms were observed on the surface shell, including recurved mussels, barnacles, anemones, dark false mussels, and xanthid mud crabs. The substrate at all of the stations was either mud, clay, or a mixture of both.

Results: East-West Transect (BEL to BLA) (Table 3)

The East-West Transect was 1,000 m in length running between the two Fall Survey sites on Belvedere Shoal. The transect was approximately between 1,320 m and 1,780 m southeast of the grounding site. Depths ranged from 4.2 m on the shoals to 7.7 m off the shoals. Samples were taken every 25 m for a total of 41 stations, apportioned as follows: 21 on BLA, 12 on BEL, and eight in deeper water off the two Fall Survey shoals. The substrate at all of the stations was mud, although several samples on BLA had sand and shell grit mixed in.

Of the three areas surveyed, the E-W Transect had the most live oysters, albeit in extremely low numbers. A total of nine live oysters and one dead oyster was found, for an average density of 0.25 live oysters/m^2 on oyster habitat. Oyster densities were almost identical on BLA and BEL.

No spat were observed but there were three small oysters, indicating a very low level of recruitment occurring at these sites. The average shell height was 88.9 mm, with the sizes of small oysters ranging from 42 mm to 56 mm and market oysters from 84 mm to 146 mm. The dead oyster was categorized as Stage 3 (old) at 88 mm shell height. All of the samples had modest amounts of shell habitat, averaging 3.96 L/m^2 on BLA and 5.09 L/m^2 on BEL. The oyster habitat was rich with epibenthic animals, including recurved mussels, barnacles, anemones, dark false mussels, and xanthid mud crabs.

Results: North-South Transect (LECC) (Table 4)
The North-South Transect was situated approximately 750 m due east of the grounding site. It was 870 m in length, anchored on a shoal at the north end. Samples were taken at 30 m intervals, for a total of 35 samples, including three sets of triplicate samples on the north end shoal. Depths ranged from 5.7 m on the shoal to 7.2 m. The substrate was primarily mud with occasional traces of long-buried gray shell.

One live market oyster and no dead oysters were found. The only oyster habitat was on the shoal, averaging 3.0 liters of surface shell per m^2. Epibenthic animals were only observed in the shoal samples containing surface shell, and included recurved mussels, barnacles, anemones, dark false mussels, and xanthid mud crabs.

Discussion

Aside from the deep footprint of the ship and dredging, the survey found no discernable impacts on oyster populations from the grounding of the M/V *Ever Forward* and subsequent activities to free the ship on NOB 4-2. Note that the grounding site was outside of the historic Yates bar, which at its closest point was about 250 m to the east. The immediate area surrounding the grounding site was almost exclusively natural mud with little if any oyster habitat. The actual oyster habitat was in or near the historic Yates bar (LECC). Based on the presence of live epibenthic animals in the samples with surface shells, this habitat area did not appear to be affected by the grounding.

Even within the Yates bar, most of the bottom consisted of mud. Only the shallower shoals or “lumps” contained limited amounts of shell habitat. The oyster population was found to be extremely sparse, averaging 0.25 live oysters/m^2 at the Fall Survey monitoring sites. For reference, a restored oyster bar is considered to have a minimum of 15 live oysters/m^2 of multiple year classes (Oyster Metrics Workgroup 2011). Recruitment on NOB 4-2 is poor and sporadic; the last observed spatset was in 2010, although a small number of sublegal oysters have been found in recent years.

Whatever oysters or surface shells were present did not appear to be silted over. This was confirmed by the diverse variety and numbers of epibenthic animals living on the shells. Anemones in particular are sensitive indicators and their widespread presence suggests siltation was not an issue on these shell areas.

Summary

The M/V *Ever Forward* grounded in legal charted oyster bar NOB 4-2. Whether mitigation occurs for this intrusion is to be determined by the various agencies involved.

Oyster population was not present within the immediate grounding/dredging site, as this was natural mud bottom which pre-existed the grounding. Oysters and viable habitat were found to the east and southeast inside the Yates Bar LECC. There did not appear to be a far-field impact on this habitat from the activity to free the vessel, as indicated by the presence of numerous epibenthic animals living on the viable shell habitat.

References

Chai, A., M. L. Homer, C. Tsai and P. Goulletquer. 1992. Evaluation of oyster sampling efficiency of patent tongs and an oyster dredge. North American Journal of Fisheries Management 12: 825-832.

Dredging Today, 2022. https://www.dredgingtoday.com/2022/03/23/the-ever-forward-dredge-ops-in-full-swing./

Grave, C. ed. 1912. Fourth Report of the ShellFish Commission of Maryland. Baltimore, Md. 377 pp.

Oyster Metrics Workgroup. 2011. Restoration Goals, Quantitative Metrics and Assessment Protocols for Evaluating Success on Restored Oyster Reef Sanctuaries. Report to the Sustainable Fisheries Goal Implementation Team of the Chesapeake Bay Program. Annapolis, Md. 32 pp.

Tarnowski, M. 2012. Maryland Oyster Population Status Report – 2011 Fall Survey. MDNR Publ. No. 17-8152012-598. Annapolis, Md. 47 pp. https://dnr.maryland.gov/fisheries/documents/2011FSreport.pdf

Tarnowski, M. 2022. Maryland Oyster Population Status Report – 2020 Fall Survey. MDNR Publ. No. 17-062521-282. Annapolis, Md. 88 pp. https://dnr.maryland.gov/fisheries/Documents/oysters/2020RptFinal.pdf

Figure 1. Map depicting the location of the M/V *Ever Forward* grounding site relative to Natural Oyster Bar 4-2 and the sampling schemes for the post-grounding patent-tong survey.

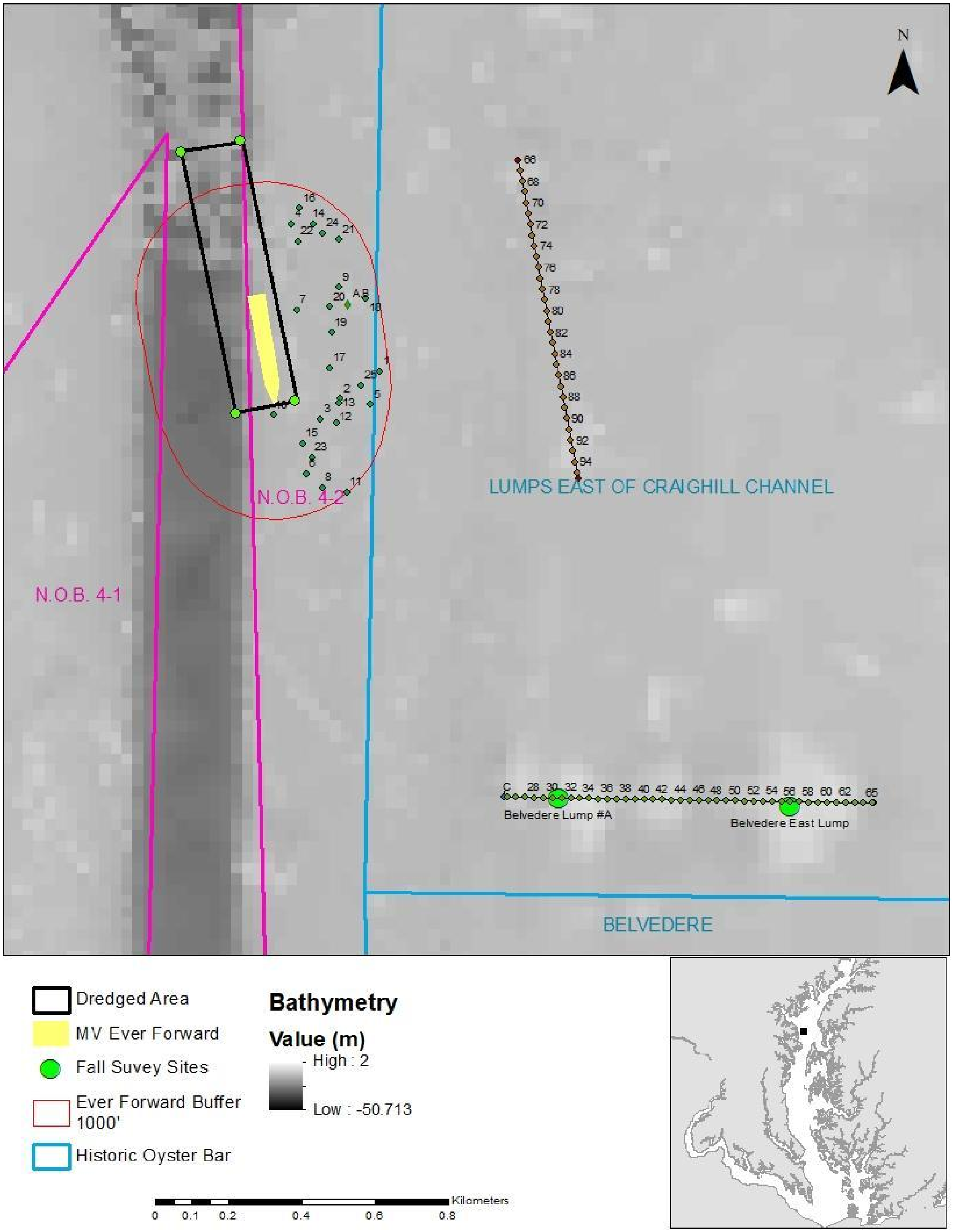

Table 1. Fall Oyster Survey results from the last five years on Belvedere Lump "A" and Belvedere East Lump. Markets are legal-size oysters $\geq 76\ mm$.

Belvedere Lump "A" 39°06.022'N 76°22.954'W 3.8 m

Latitude Longitude Avg. Depth

Date	Live Oysters per Bu			Dead Oysters per Bu		Total Observed Mortality, %
	Markets	Smalls	Spat	Markets	Smalls	
11/13/2017	14	2	0	0	0	0.0
11/08/2018	30	2	0	0	0	0.0
11/11/2019	4	0	0	4	0	50.0
11/09/2020	12	0	0	0	0	0.0
11/11/2021	4	2	0	0	0	0.0
5-yr Avg	12.80	1.20	0.00	0.80	0.00	5.41

Belvedere East Lump 39°06.015'N 76°22.515'W 4.1 m

Latitude Longitude Avg. Depth

Date	Live Oysters per Bu			Dead Oysters per Bu		Total Observed Mortality, %
	Markets	Smalls	Spat	Markets	Smalls	
11/13/2017	20	6	0	0	0	0.0
11/08/2018	20	10	0	0	0	0.0
11/11/2019	12	2	0	0	0	0.0
11/09/2020	16	8	0	0	0	0.0
11/11/2021	12	0	0	0	0	0.0
5-yr Avg	16.00	5.20	0.00	0.00	0.00	0.00

Table 2. Results from the patent-tong survey immediately around the grounding site within NOB 4-2. Samples A and B are duplicate supplemental samples.

Region	Oyster Bar	Date		Temp °C	Sal ppt
Ever Forward Grounding	**NOB 4-2**	**2 May 2022**	Surface	15.5	6

			Live Oysters/m^2				Dead Oysters/m^2			Blank Shell		Total				
	Depth	Bottom	Number			Volume	Number		Volume	Volume (liters)		Sample			Associated	
Sta. #	(ft.)	Type	Spat	Small	Market	Total (L)	Small	Market	Total (L)	Surface	Gray	Vol (L)	Latitude	Longitude	Organisms	Photo #
1	19.6	m	0	0	0	0	0	0	0	2	6	8.00	39.11079	-76.38843	rmu,dfm,bar,ane	8199
1a	19.5	m	0	0	0	0	0	0	0	3	6	9.00	39.11079	-76.38843	rmu,xan	9165
2	22.9	m	0	0	0	0	0	0	0	0	0	0.00	39.11010	-76.38967		
3	23.3	m/c	0	0	0	0	0	0	0	0	0.05	0.05	39.10959	-76.39028		
4	23.8	m	0	0	0	0	0	0	0	0	0	0.00	39.11440	-76.39129		
5	22.3	m/c	0	0	0	0	0	0	0	0	0.05	0.05	39.10998	-76.38871		
6	23.9	m/c	0	0	0	0	0	0	0	0	2	2.00	39.10824	-76.39071		
7	24.2	c	0	0	0	0	0	0	0	0	0	0.00	39.11228	-76.39108		
8	23.2	m	0	0	0	0	0	0	0	0	1	1.00	39.10791	-76.39019		
9	23.5	m	0	0	0	0	0	0	0	0	0	0.00	39.11285	-76.38974		
10	26.2	c	0	0	0	0	0	0	0	0	0	0.00	39.10968	-76.39175		
11	22.9	m	0	0	0	0	0	0	0	0	0	0.00	39.10780	-76.38942		8194-95
12	22.7	m	0	0	0	0	0	0	0	0	0.05	0.05	39.10952	-76.38978		
13	23.1	m	0	0	0	0	0	0	0	0	0	0.00	39.11000	-76.38969		
14	22.8	m/c	0	0	0	0	0	0	0	0	0.05	0.05	39.11441	-76.39059		
15	24.0	m/c	0	0	0	0	0	0	0	0.05	5	5.05	39.10900	-76.39083		8196-98
16	23.1	m/c	0	0	0	0	0	0	0	0.05	0.05	1.00	39.11479	-76.39103		
17	22.7	m/c	0	0	0	0	0	0	0	0	0.05	0.05	39.11086	-76.39001		
18	22.9	m/c	0	0	0	0	0	0	0	0	0.05	0.05	39.11259	-76.38890		
19	22.9	m/c	0	0	0	0	0	0	0	0	0.05	0.05	39.11174	-76.38997		
20	23.0	m/c	0	0	0	0	0	0	0	0	0	0.00	39.11237	-76.39004		
21	22.6	m	0	0	0	0	0	0	0	0	0	0.00	39.11403	-76.38976		
22	23.4	m/c	0	0	0	0	0	0	0	0	0	0.00	39.11396	-76.39107		
23	23.5	m/c	0	0	0	0	0	0	0	0	1	1.00	39.10865	-76.39053		
24	22.8	m/c	0	0	0	0	0	0	0	0	0	0.00	39.11419	-76.39030		
25	22.3	m	0	0	0	0	0	0	0	0	0	0.00	39.11045	-76.38901		
A	20.1	m/s	0	0	0	0	0	0	0	1	4	5.00	39.11244	-76.38947	rmu,bar	8200
B	20.1	m/s	0	0	0	0	0	0	0	3.5	0.5	4.00	39.11244	-76.38947	rmu,bar	8201
		avg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.93	1.30				

m=mud, c=clay, s=sand
Dominant type listed first

rmu=recurved mussels
dfm= dark false mussels
bar=barnacles
ane=anemones
xan=xanthid mud crabs

Table 3. Results from the patent tong survey along an east-west transect between two Fall Survey sites within NOB 4-2. Stations C-45 were on Belvedere Lump "A" and stations 52-63 were on Belvedere East Lump. Markets are legal-size oysters $\geq 76\ mm$.

Region	Oyster Bar	Date		Temp °C	Sal ppt
Ever Forward Grounding	**Belvedere Shoal**	**2 May 2022**	Surface	15.5	6
	E-W Transect				
	Sta. C-45=Belvedere Lump "A"	Sta. 52-63=Belvedere East Lump			

			Live Oysters/m^2				Dead Oysters/m^2			Blank Shell		Total				
	Depth	Bottom	Number			Volume	Number		Volume	Volume (liters)		Sample			Associated	
Sta. #	(ft.)	Type	Spat	Small	Market	Total (L)	Small	Market	Total (L)	Surface	Gray	Vol (L)	Latitude	Longitude	Organisms	Photo #
C	18.9	m	0	0	0	0	0	1	0.25	1.50	16.50	18.25	39.10036	-76.38421	rmu,dfm,bar,xan	8152-54
26	15.5	m	0	0	1	0.25	0	0	0	7.75	2.00	10.00	39.10036	-76.38392	rmu,dfm,bar,xan	8150-51
27	14.6	m	0	1	0	0.25	0	0	0	3.25	0.50	4.00	39.10036	-76.38363	rmu,dfm,bar,xan	8149
28	18.9	m	0	0	0	0	0	0	0	4.00	16.00	20.00	39.10036	-76.38334	rmu,ane,bar,xan	8146-48
29	20.4	m	0	0	0	0	0	0	0	2.00	8.00	10.00	39.10036	-76.38305	rmu,ane,bar,xan	8144-45
30	15.7	m/s	0	0	0	0	0	0	0	5.00	2.00	7.00	39.10036	-76.38276	rmu,ane,bar,xan,dfm	8143
31	14.6	m/s	0	0	1	0.25	0	0	0	5.25	0.50	6.00	39.10036	-76.38247	rmu,ane,bar,xan,dfm	8142
32	13.7	m/s	0	0	0	0	0	0	0	4.25	0.75	5.00	39.10036	-76.38218	rmu,bar,xan	8141
33	13.9	m/sg	0	1	0	0.1	0	0	0	6.90	1.00	8.00	39.10036	-76.38189	rmu,ane,bar,xan	8140
34	13.9	m	0	0	1	0.25	0	0	0	1.65	0.10	2.00	39.10036	-76.38160	rmu,dfm,bar,xan	8139
35	14.9	m	0	0	0	0	0	0	0	3.90	0.10	4.00	39.10036	-76.38131	rmu,dfm,bar,xan	8138
36	16.5	m	0	0	1	0.25	0	0	0	4.25	1.50	6.00	39.10036	-76.38103	rmu,dfm,bar,xan	8136-37
37	21.3	m	0	0	0	0	0	0	0	4.50	6.00	10.50	39.10036	-76.38074	rmu,ane,bar,xan,dfm	8135
38	22.2	m/s	0	0	0	0	0	0	0	3.00	5.00	8.00	39.10036	-76.38045	rmu,ane,bar,xan,dfm	8134
39	17.6	m/s	0	0	0	0	0	0	0	2.90	0.10	3.00	39.10036	-76.38016	rmu,bar,dfm	8133
40	16.0	m/s	0	0	0	0	0	0	0	3.00	0.50	3.50	39.10036	-76.37987	rmu,bar,xan	8132
41	17.0	m	0	0	0	0	0	0	0	3.50	1.50	5.00	39.10035	-76.37958	rmu,dfm,bar,xan	8131
42	15.8	m/s	0	0	0	0	0	0	0	4.50	0.50	5.00	39.10035	-76.37929	rmu,dfm,bar,xan	8129-30
43	15.7	m/sg	0	0	0	0	0	0	0	6.50	0.50	7.00	39.10035	-76.37900	rmu,dfm,bar,xan	8128
44	15.9	m	0	0	0	0	0	0	0	2.50	1.00	3.50	39.10035	-76.37871	rmu,ane,bar,xan,dfm	
45	21.4	m	0	0	0	0	0	0	0	3.00	4.00	7.00	39.10035	-76.37842	rmu,ane,bar,xan,dfm	8127
46	24.2	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10035	-76.37813		
47	23.8	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10035	-76.37785		
48	23.7	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10035	-76.37756		
49	23.6	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10035	-76.37727		
50	24.2	m	0	0	0	0	0	0	0	0.00	2.00	2.00	39.10035	-76.37698		8121-22
51	22.4	m	0	0	0	0	0	0	0	0.10	8.90	9.00	39.10035	-76.37669	rmu	8119-20
52	14.7	m	0	0	0	0	0	0	0	2.90	0.10	3.00	39.10035	-76.37640	rmu,dfm,bar,xan	8118
53	15.0	m	0	0	0	0	0	0	0	7.90	0.10	8.00	39.10035	-76.37611	rmu,ane,bar,xan,dfm	8116-17
54	15.1	m	0	0	0	0	0	0	0	9.00	2.00	11.00	39.10035	-76.37582	rmu,ane,bar,xan,dfm	8114-15
55	14.9	m	0	0	0	0	0	0	0	5.75	0.25	6.00	39.10035	-76.37553	rmu,dfm,bar,xan	8113
56	14.8	m	0	0	0	0	0	0	0	7.25	0.25	7.50	39.10035	-76.37524	rmu,dfm,bar,xan	8112
57	15.0	m	0	0	1	0.1	0	0	0	2.05	0.10	2.25	39.10035	-76.37496	rmu,bar,dfm	8109
58	14.9	m	0	0	1	0.1	0	0	0	8.30	0.10	8.50	39.10035	-76.37467	rmu,bar,dfm	8106-08
59	14.3	m	0	0	0	0	0	0	0	4.90	0.10	5.00	39.10035	-76.37438	rmu,dfm,bar,xan	8105
60	13.8	m	0	0	0	0	0	0	0	3.40	0.10	3.50	39.10035	-76.37409	rmu,dfm,bar,xan	8104
61	14.0	m	0	0	0	0	0	0	0	3.50	0.50	4.00	39.10035	-76.37380	rmu,dfm,bar,xan	8103
62	14.6	m	0	1	0	0.1	0	0	0	2.15	0.25	2.50	39.10035	-76.37351	rmu,bar,dfm	8102
63	19.4	m	0	0	0	0	0	0	0	4.00	5.00	9.00	39.10035	-76.37322		8101
64	25.3	m	0	0	0	0	0	0	0	0.00	1.00	1.00	39.10036	-76.37293		
65	23.5	m	0	0	0	0	0	0	0	0.00	2.00	2.00	39.10036	-76.37264		
		avg	0.00	0.07	0.15	0.04	0.00	0.02	0.01	3.52	2.21	5.78				

m=mud, c=clay, s=sand, sg=shell grit
Dominant type listed first

rmu=recurved mussels
dfm=dark false mussels
bar=barnacles
ane=anemones
xan=xanthid mud crabs

Table 4. Results from the patent tong survey along a north-south transect on Lumps East of Craighill Channel bar within NOB 4-2. Triplicate samples were taken at stations 66-68 on the shoal at the north end of the transect.

Region	Oyster Bar	Date		Temp °C	Sal ppt
Ever Forward Grounding	**Lumps East of Craighill Channel N-S Transect**	**2 May 2022**	Surface	15.5	6

			Live Oysters/m^2				Dead Oysters/m^2			Blank Shell Volume (liters)		Total Sample				
	Depth	Bottom	Number			Volume	Number		Volume						Associated	
Sta. #	(ft.)	Type	Spat	Small	Market	Total (L)	Small	Market	Total (L)	Surface	Gray	Vol (L)	Latitude	Longitude	Organisms	Photo #
66	22.5	m	0	0	0	0	0	0	0	2.50	2.50	5.00	39.11580	-76.38408	rmu,ane,bar	8174
66a	22.3	m	0	0	0	0	0	0	0	1.50	3.50	5.00	39.11580	-76.38408	rmu,ane,bar,xan,dfm	8175
66b	22.1	m/sg	0	0	1	0.25	0	0	0	3.00	4.00	7.25	39.11580	-76.38408	rmu,ane,bar,xan	8185-89
67	19.9	m/s	0	0	0	0	0	0	0	2.00	4.00	6.00	39.11553	-76.38401	rmu,dfm,bar,xan	8172-73
67a	20.2	m	0	0	0	0	0	0	0	2.50	5.50	8.00	39.11553	-76.38401	rmu,ane,bar,xan,dfm	8176
67b	20.6	m	0	0	0	0	0	0	0	4.00	5.50	9.50	39.11553	-76.38401	rmu,ane,bar,xan	8180-84
68	18.8	m/s	0	0	0	0	0	0	0	3.00	1.00	4.00	39.11527	-76.38394	rmu,ane,bar,xan,dfm	8171
68a	19.4	m	0	0	0	0	0	0	0	5.00	2.50	7.50	39.11527	-76.38394	rmu,ane,bar,dfm	8177-78
68b	20.5	m	0	0	0	0	0	0	0	3.50	1.50	5.00	39.11527	-76.38394	rmu,ane,bar,xan	8179
69	23.6	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11500	-76.38388		8165-70
70	22.8	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11474	-76.38381		
71	22.8	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11447	-76.38374		
72	22.4	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11421	-76.38367		
73	22.1	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11395	-76.38360		
74	22.2	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11368	-76.38353		
75	22.3	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11342	-76.38346		
76	22.3	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11315	-76.38339		
77	22.4	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11289	-76.38332		
78	22.2	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11262	-76.38325		
79	22.0	m	0	0	0	0	0	0	0	0.00	0.10	0.10	39.11236	-76.38319		
80	21.8	m	0	0	0	0	0	0	0	0.00	0.10	0.10	39.11209	-76.38312		
81	21.9	m	0	0	0	0	0	0	0	0.00	0.10	0.10	39.11183	-76.38305		
82	21.8	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11156	-76.38298		
83	21.8	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11130	-76.38291		
84	21.8	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11103	-76.38284		
85	21.9	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11077	-76.38277		
86	21.7	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11050	-76.38270		
87	21.9	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.11024	-76.38263		
88	22.0	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10997	-76.38256		
89	22.0	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10971	-76.38250		
90	21.9	m	0	0	0	0	0	0	0	0.00	0.10	0.10	39.10944	-76.38243		
91	21.8	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10918	-76.38236		
92	21.9	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10891	-76.38229		
93	21.9	m	0	0	0	0	0	0	0	0.00	0.10	0.10	39.10865	-76.38222		
94	22.3	m	0	0	0	0	0	0	0	0.00	0.00	0.00	39.10838	-76.38215		
		avg.	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.77	0.87	1.65				

m=mud, c=clay, s=sand, sg=shell grit
Dominant type listed first

rmu=recurved mussels
dfm= dark false mussels
bar=barnacles
ane=anemones
xan=xanthid mud crabs

Blue Crab Potential Impact Assessment for the M/V Ever Forward Grounding Event

Prepared by Maryland Department of Natural Resources
Fishing and Boating Services
Blue Crab Program

July 2022

Blue Crab Potential Impact Assessment for the M/V Ever Forward Grounding Event

Background

On March 13, 2022 the M/V Ever Forward was traveling at nearly 13 knots when it exited the Craighill shipping channel and ran aground as it departed the Port of Baltimore. The refloating required lightening the ship, dredging of the surrounding bottom, and large salvage tugs from which the environmental impact remains unclear. The location of the grounding and subsequent dredging needed to free the M/V Ever Forward is favorable habitat for the overwintering of blue crabs and is located where the channel coming east out of Baltimore takes a turn to the south toward the William Preston Lane Jr. Memorial Bay Bridge. As winter approaches, most blue crabs will migrate to deeper water and bury themselves in the mud along channel edges to emerge when temperatures rise in the spring (Rothschild et al., 1992; Zhang and Ault, 1995). This assessment aims to investigate the impact from the M/V Ever Forward's grounding on the overwintering blue crab population utilizing data from the long standing blue crab winter dredge survey.

Survey Description

The blue crab winter dredge survey is conducted annually from December to March by the Maryland Department of Natural Resources in cooperation with the Virginia Institute of Marine Science to estimate the size of the Chesapeake Bay's blue crab population, and is a critical component of blue crab management. Since 1994, the survey has been conducted according to a stratified random design (Rothschild and Sharov, 1997). The bay is divided into three regions or strata: Lower Bay (the mouth of the Chesapeake to Windmill Point, VA), Middle Bay (Windmill Point, VA to Cove Point, MD) and the Upper Bay/Tributaries (Cove Point to Pooles Island and all of the Bay's tributaries). The Upper Bay/Tributaries stratum represents mostly shallow waters with low salinity (0–10 ppt), where the winter population is dominated by young-of-year blue crabs and adult males. The Lower Bay stratum has higher levels of salinity (25–35 ppt), deeper waters and is inhabited primarily by mature females in winter. The Middle Bay stratum is an intermediate area. Each year, a total of 1500 sites in waters deeper than 5 feet are randomly selected with the number of sites in each geographic stratum being proportional to the area of that stratum.

A six-foot-wide Virginia crab dredge fitted with a half-inch nylon mesh liner is towed at each site along the bottom for one minute at a speed of three knots. Latitude and longitude, measured with a Differential Global Positioning System (GPS), is recorded at the beginning and end of each tow to determine distance covered. This distance is multiplied by the dredge's width to calculate the area covered. Beginning and ending depth, surface water temperature, and salinity are recorded at each site. All crabs collected are measured point to point across the top shell or carapace to the nearest mm and weighed to the nearest 0.1g. The sex of each crab is determined and the maturity of females is noted.

The 2022 blue crab winter dredge survey for the area in question was completed prior to the grounding of the M/V Ever Forward. The survey is conducted annually from December to March while crabs are dormant, which allows for a more precise estimate of crab density because the crabs do not move around and therefore can not be counted twice. No follow up sampling has been conducted post the event because comparable samples can not be obtained once blue crabs begin to emerge from their dormant state.

Analysis

The analysis described here was conducted to estimate the number of blue crabs overwintering in the mud where the M/V Ever Forward grounding and dredging occurred. Therefore, an estimate of crab density for this particular area was calculated and then applied to the estimated area of impact for a total number of blue crabs likely to have been overwintering in this area at the time of the grounding and dredging.

To calculate crab density for the grounding and dredging area, winter dredge survey sites that were within 2 nautical miles of where the ship grounded in all directions for the last 5 years, 2018-2022 were utilized (i.e. sites that fit within a 16 square nautical mile perimeter around the vessel grounding location). Geometric means of crabs caught per square meter for each year were calculated and then converted to crabs per acre so they could be applied to an estimated area impacted. Since a final determination of the area of the bottom impacted by the grounding and dredging is not available at this time, an impact area of 10 acres was assumed. The estimated number of blue crabs overwintering in this habitat was then converted to bushels to better understand the scale of the impact, assuming one bushel holds 84 legal sized crabs.

Blue crab densities as geometric mean crabs per acre were also calculated for all sites in the Upper Bay/Tributary stratum that were located above the William Preston Lane Jr. Memorial Bay Bridge (Upper Bay) and for all sites from all strata throughout the entire Chesapeake Bay (Baywide) for comparison purposes.

It should be noted that the impact estimates provided by this analysis assume blue crabs are evenly dispersed throughout the habitat, which is unlikely to be the case. However, this is the best estimate given the information available.

Results

Table 1 shows the densities of blue crabs per acre (all sexes and sizes) for the grounding site, Upper Bay and Baywide areas. The highest crab density per acre was observed for the grounding site in 2022, for the Upper Bay in 2018, and Baywide in 2019. The lowest crab densities were observed for the grounding site and the Upper Bay in 2019, and in 2022 Baywide.

The estimated number of blue crabs impacted in 2022 was 423 crabs, which is slightly more than 5 bushels of crabs, assuming a 10 acre impact area. Utilizing data from 2018, 2020, and 2021, the estimated numbers of blue crabs impacted would have been 123, 99, and 110 crabs, roughly converting to less than 1.5 bushels. It is estimated that 0 crabs would have been affected by the M/V Ever Forward grounding site in 2019. In the last 5 years, 2018-2022, the average number of blue crabs estimated to be impacted per 10 acres was 151 crabs equating to 1.8 bushels. Table 2 summarizes the number and bushels of blue crabs estimated to be utilizing the grounding site from 2018-2022.

Table 1.

Geometric Mean Total Crabs per Acre			
Year	**M/V Ever Forward**	**Upper Bay**	**Baywide**
2018	12.3	19.7	42
2019	0	9.7	57
2020	9.9	9.9	47
2021	11	18.9	27.8
2022	42.3	17.9	27

Table 2.

Year	Estimated Number of Crabs Impacted	Bushels
2018	123	1.46
2019	0	0.00
2020	99	1.18
2021	110	1.31
2022	423	5.04

Discussion

The varying densities of blue crabs by year and area shows the heterogeneity of overwintering blue crab distribution throughout the Chesapeake Bay, which is driven by many environmental factors. Therefore, the 2022 estimate is the preferred estimate for assessing the impact to the blue crab resource from the grounding event. This estimate is believed to be the most appropriate, given that the winter dredge survey sampled the grounding site habitat just prior to the grounding event during a time of year when crabs are dormant. Additionally, 2022 overwintering blue crab abundance was relatively high for the Upper Bay, and the type of habitat (i.e. channel edge) where the grounding occurred is a preferred overwintering habitat further supporting use of this estimate. Anecdotally, the area near the Craighill Channel is known to be a productive area for harvesting crabs in the springtime when crabs emerge from the mud and recent information from the blue crab fishery implies that the bulk of the Chesapeake Bay blue crab population is utilizing more northern bay habitats in 2022, which is consistent with this analysis.

Overall, it is estimated that 423 crabs were impacted by the grounding and dredging, amounting to roughly 5 bushels of crabs. In 2022, the winter dredge survey estimated the total Chesapeake Bay blue crab population to be 227 million crabs and the average baywide harvest of blue crabs from 2018-2021 was 1.3 million bushels. Therefore, the impact of the grounding event to the resource at the baywide scale is very small. On the local scale, the grounding site is a higher density site for the Upper Bay and there are likely to be longer lasting effects from the habitat alteration that deters crabs from bedding down in this location until the bottom returns to its earlier formation. This impact is likely to redistribute crabs to other locations for overwintering and may displace local fishing effort.

Summary

In summary, the M/V Ever Forward grounded in a favorable habitat for overwintering of blue crabs, in a year where the total population of blue crabs is very low and crab distribution appears to be skewed towards the northern bay. The impact to the resource on a baywide scale is estimated to be small, but there are likely to be longer lasting effects on the local scale redistributing crabs and fishing effort until the bottom returns to its earlier formation.

References

Rothschild, B. J. R., J. Ault, E. Patrick, S. Smith, H. Li, T. Maurer, B. Daugherty, G. Davis, C. Zhang and R. McGarvey. 1992. Assessment of the Chesapeake Bay blue crab stock. University of Maryland, Chesapeake Biological Laboratory. Final report to Maryland DNR, CB92-003-036, CEES 07-303307, Solomons, Maryland. 201 p.

Rothschild, B. J. R., and A. F. Sharov. 1997. Abundance estimation and population dynamics of the blue crab in Chesapeake Bay. Final report to the Maryland DNR, Univ. Massachusetts, Center for Marine Science and Technology, 285 Old Westport Road, North Dartmouth, Massachusetts. 81 p.

Zhang, C. I., and J. S. Ault. 1995. Abundance estimation of the Chesapeake Bay Blue Crab, Callinectes sapidus. Bull. Korean Fish. Soc. 28 (6): 708–719.