

INTRODUCTION

In 2018, the Oyster Recovery Partnership (ORP) was contracted by the Maryland Department of Natural Resources (DNR) to plant spat-on-shell (SOS) on selected oyster reefs in the Severn River sanctuary. To enhance the project, ORP and the Severn River Association (SRA) created a Build-a-Reef campaign designed to improve public awareness and expand the capacity of the DNR project through additional fundraising. The selected reefs were part of an approximately 13-acre complex constructed by the U.S. Army Corps of Engineers (USACE) in 2009, using a combination of alternate substrate materials including stone/granite, concrete, and steel slag. Some reefs were topped with an oyster shell veneer. The reefs were constructed to enhance four historic Yates oyster bars: Traces Hollow, Peach Orchard, Weems Upper, and Wade located between the U.S. 50 and Route 450 bridges (Figure 1). Some reefs within the USACE reef complex have received SOS deployments since construction in 2009 (Table 1).



Figure 1. Reefs constructed by USACE in 2009 in the Severn River. Individual reefs have been planted with spat on shell since 2010. Reefs outlined in blue (Upper Weems, Peach Orchard 1, and Peach Orchard 2) were planted during summer 2018.

Table 1. Materials used by the USACE to construct each reef in the twelve reef complex and historic SOS deployments by Oyster Recovery Partnership and Horn Point hatchery. The Traces Hollow 1B site has received is the location where oysters grown by Marylanders Grow Oysters (MGO) volunteer are deployed annually.

Oyster Bar/Site	Concrete volume (yd ³)	Steel slag volume (yd ³)	Stone/granite volume (yd ³)	Shell veneer volume (yd ³)	Spat planted (in millions)			
					Not planted	2010	2012	2013
Peach Orchard #1			1018			5.66		
Peach Orchard #2			4861					18.49
Peach Orchard #3		1290						
Traces Hollow #1A			4185		X			
Traces Hollow #1B	214		337		X			
Traces Hollow #2A			3352		MGO site			
Wade	1560	725	996	1018		16.71		
Weems Upper			5743	1530		38.16		25.94

The entire Severn River was designated as an oyster sanctuary area in 2009, although public health concerns have restricted oyster harvest in the Severn for many years. The river bottom in this region consists of sandy and muddy-sand channel edges which slope down to the muddy main channel. All substrate planted by the USACE was located at 8 feet or deeper than mean lower low water (MLLW) level, with mounds rising 1 to 4 feet above the river bottom.

Three of the constructed reefs were chosen for SOS enhancement in 2018. These sites were selected based on historic plantings and preference by the DNR. Bathymetric data provided by the NOAA Chesapeake Bay Office and NOAA charts were used to delineate areas within each reef where SOS was deployed (Figure 2). A total of 10.87 acres received 45.14 million spat-on-shell in the Severn River in July and August (Table 2).

In April 2019, ORP staff returned to the Severn River restoration area to monitor the reefs that had received SOS the previous summer. The main objective of the survey was to assess the status of spat from the 2018 plantings.

Table 2. Reef site characteristics and planting details for three reef sites planted with spat-on-shell in the Severn River sanctuary in July and August 2018.

Reef Site Characteristics				Plantings Details	
Site name	Planting date	Site acreage	Range of planting depth (ft.)	Amount of spat deployed (millions)	Density of spat/acre
Weems upper	7/23/2018	6	6 to 12	11.06	1.84
	7/26/2018			9.96	1.66
	8/8/2018			7.28	1.21
Peach Orchard #2	8/7/2018	2.3	10 to 19	10.78	4.69
Peach Orchard #1	8/14/2018	2.6	10 to 19	6.06	2.33
Total		10.9		45.14	
DNR contract requirements				40	
BUILD-A-REEF contribution				5.14	

2019 MONITORING

Samples sites, as shown by purple polygons in Figure 2, were chosen in the fringing areas around the alternative substrate reefs where patent tongs could be used. The *F/V Baby Boy* was contracted to conduct a patent tong survey at Upper Weems and Peach Orchard bars on the morning of April 2, 2019. The dimensions of the patent tong gear were 1.23m x 1.52m (1.87 m²).

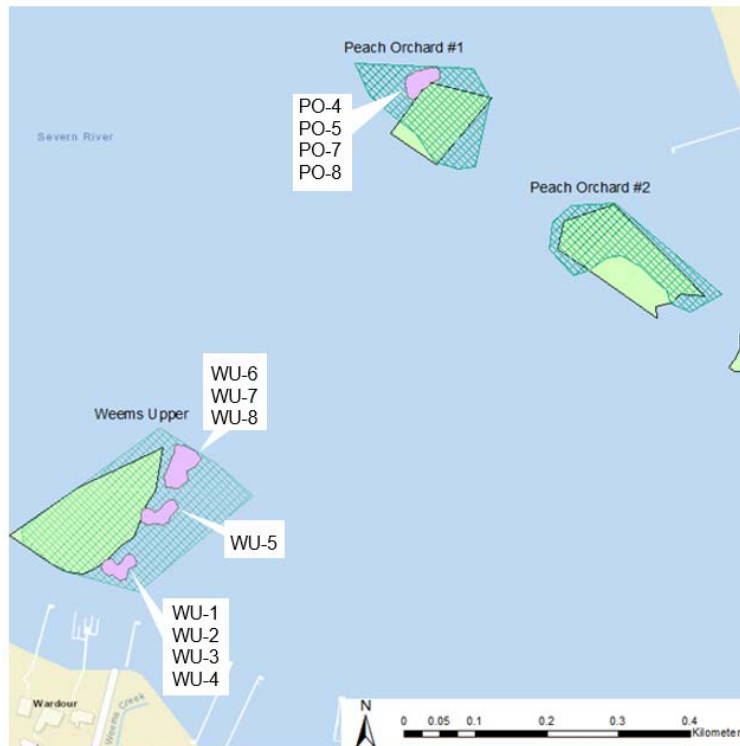


Figure 2. Oyster reef sites sampled in the Severn River by ORP in April 2019. Purple polygons denote locations where multiple patent tong samples were collected to assess the status of 2018 spat-on-shell plantings. Hatched polygons show the extent of SOS plantings over top of USACE constructed reefs: Weems Upper, Peach Orchard 1, and Peach Orchard 2.

GPS was used to navigate to the sampling locations, and the patent tong was deployed on or in close proximity to each target sampling location. Samples were processed by separating spat from substrate and from older oysters present from previous planting activities. Measurements of spat height were done for a subset of spat in each sample and all spat were counted. The number of live and dead spat was documented in each sample. The number of large oysters was estimated for each sample. Mortality associated with all oysters collected in each sample was estimated by comparing the number of boxes (dead oysters) to number of living oysters in a sample. Observed spat mortality was calculated using recorded totals of live and dead spat. Representative pictures of all samples were taken before the contents of the sample was returned to the water.

RESULTS and DISCUSSION

ORP staff were concerned that low salinity caused by heavy rainfalls experienced in 2018 would have negative impacts on the spat planted in Severn River (Figure 3). The results were quite encouraging, as live spat from the 2018 planting and live large oysters were observed at both sites (Figures 4 and 5; Table 3). Total observed mortality was between 10-15% over most of the restored areas. At many of the sampling locations, the primary substrate types were loose shell, mud, and living oysters. On Peach Orchard 1 bar, the average shell height of spat measured was 18mm, while the average spat measured on Weems Upper was slightly larger at 18.9mm (Figure 6). Some dead spat were observed, but the majority of observed spat were alive (Figure 7). On both sites, the average size of measured spat boxes (dead oysters with articulated valves) was 30.7mm. Spat mortality ranged from 5-20% over the sampling locations (Table 3).

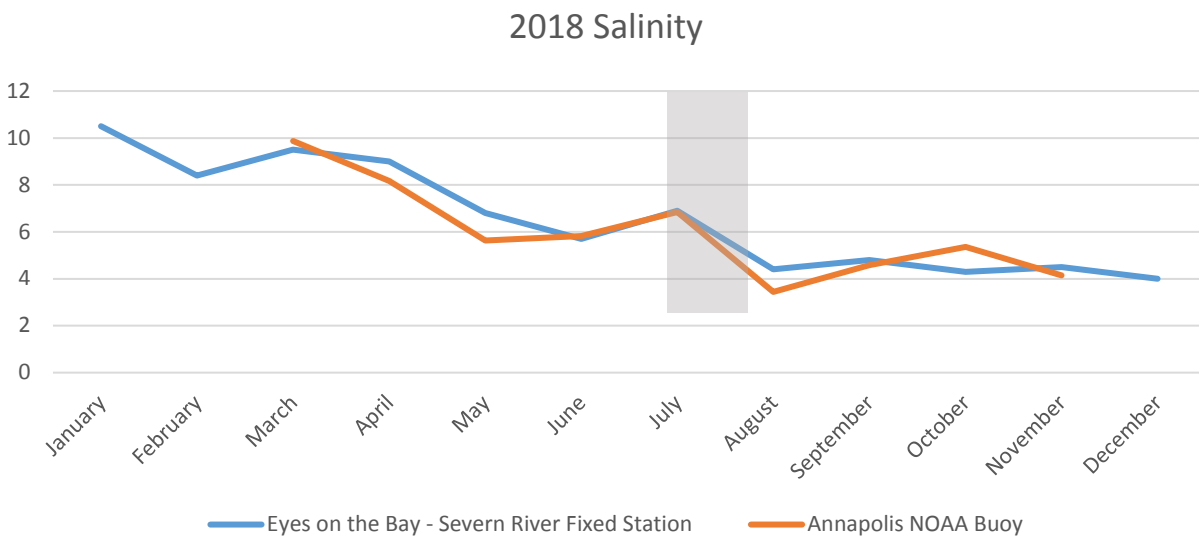


Figure 3. Average monthly salinity for two water quality stations near the restored reef sites. Severn River fixed station is located just north of the Route 50 bridge. Annapolis buoy is located at the mouth of the Severn River. Gray shaded region indicates when SOS was planted between July 23 and August 14, 2018.

Table 3. Characteristics of 2018 planted oyster spat and other observations from samples collected at Weems Upper and Peach Orchard 1 reefs on April 2, 2019.

Bar Name	Sample Site	Primary substrate	# of spat	Avg. spat height (mm)	Avg. density (spat/m ²)	Estimated # of large oysters
Weems Upper	WU-8	Mud	29	18.50	-	-
Weems Upper	WU-5	Oysters	3	21.30	-	50
Weems Upper	WU-1	Loose shell	17	17.76	9.09	-
Weems Upper	WU-4	Oysters	10	19.10	-	25
Weems Upper	WU-2	Loose shell	6	23.00	3.21	-
Weems Upper	WU-3	Oysters	0	NA	-	30
Weems Upper	WU-5	Oysters	0	NA	-	50
Weems Upper	WU-6	Oysters	70	20.00	37.44	40
Weems Upper	WU-7	Oysters	8	16.00	4.28	50
Peach Orchard	PO-4	Loose shell	12	17.33	6.42	-
Peach Orchard	PO-5	Loose shell	37	18.11	19.79	10
Peach Orchard	PO-7	Loose shell	18	20.40	9.63	-
Peach Orchard	PO-8	Mud	7	17.00	3.74	-

While the main purpose of the survey was to assess the status of spat planted in 2018, the patent tong survey also revealed the presence of large, older oysters; the largest measured was 150 mm. These individuals were likely from plantings that took place in 2010 and 2013. Staff also observed multiple clumps of five or more live oysters, growing upright from the benthos (Figure 9).



Figure 4. Live spat observed on cultch shell sampled with patent tongs on Weems Upper bar, April 2, 2019.



Figure 5. Larger live oysters collected with patent tongs, April 2, 2019.

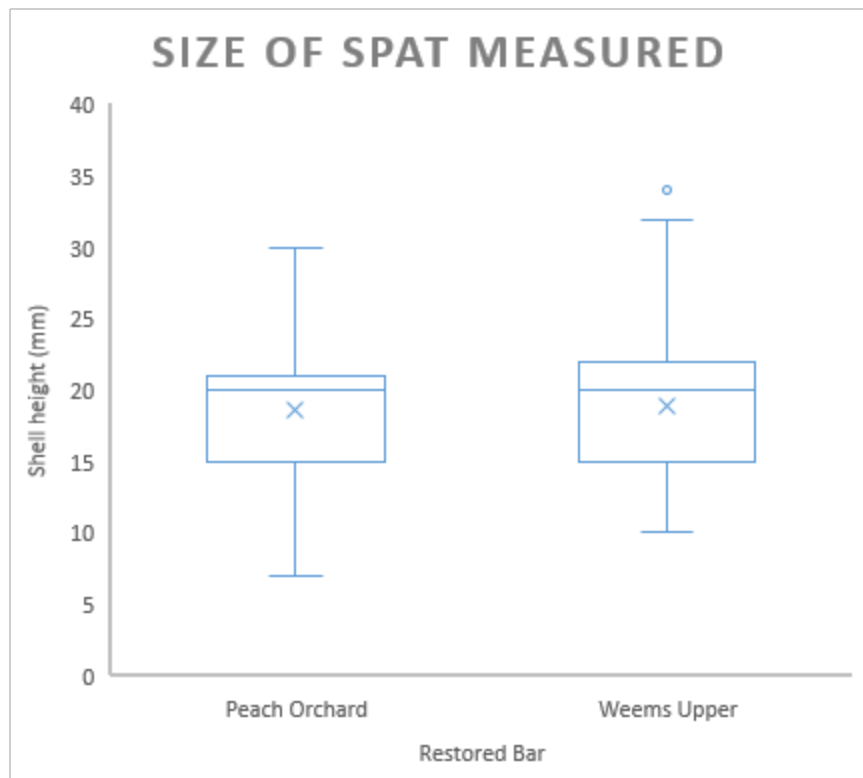


Figure 6. Boxplot of average size of spat measured on restored reefs in Severn River.



Figure 7. Clump of oysters collected with patent tongs on April 2, 2019. Arrow pointing to dead, gaping spat.



Figure 9. Clumps of live oysters collected with patent tongs on April 2, 2019.