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Expanding Virginia's oyster industry while minimizing user conflict

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Expanding Virginia's oyster industry while minimizing user conflict

Interim report (Year 1 of 3) submitted to Virginia Coastal Zone
Management Program

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Introduction

Historically, commercial fishing, especially the oyster fishery, dominated coastal activity throughout the tidal areas of the Bay. For decades, communities developed along shorelines to take advantage of productive public and private (leased) oyster grounds, and to harvest other economically important species. With the introduction of oyster diseases in the late 1950s, oyster harvests began to collapse and continued to decline through several consecutive decades.

Efforts to increase oyster populations and oyster production on both public and private grounds has remained a bay-wide focus of federal, state and local entities. Revitalization of the public fishery through shell replenishment programs, that is the addition of oyster shell to a region to serve as a substrate for oyster recruitment from the larval to the attached benthic form, have attempted to restore shell budgets on public Baylor grounds to a level that can sustain recruitment and thus the fishery. Note that recruitment is often also referred to as “spat set”. Over the past decade there has been a substantial improvement in oyster production on both public and private grounds. This can primarily be attributed to increased gear efficiency among the dredge fishery on both public and private grounds as well as the expansion of intensive aquaculture practices (intensive aquaculture involves the use of containers, such as cages, floats etc. for grow-out). Figure 1 illustrates the rise in oyster harvest on both public and private grounds in Virginia since 2000. About 70% of the harvest occurring on private grounds is attributed to opportunistic fishing practices and the rise beginning around 2009 is associated with more efficient dredges used on both public and private grounds. On private grounds, aquaculture accounts for just under 30% of the harvest.

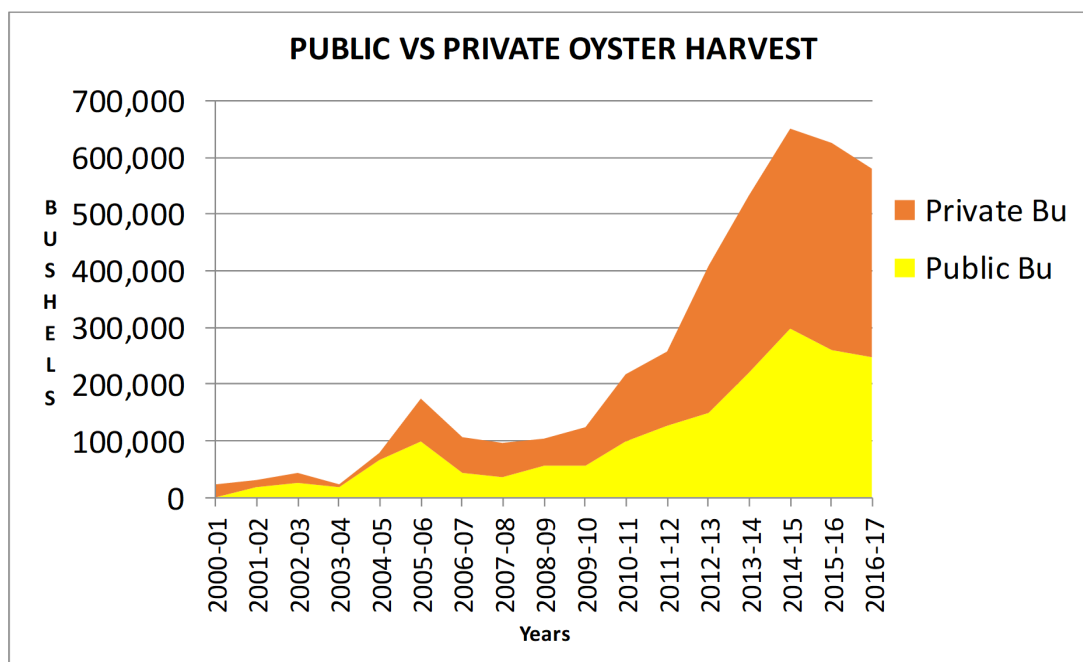


Figure 1. Harvest trends in public and private oyster fishery (2000-2017)

This study seeks to assess the sustainability of the public oyster fishery and the expansion of hatchery dependent oyster aquaculture in the Virginia portion of the Chesapeake Bay. Previous analyses have suggested that limitations in available shell resources will ultimately drive the future of the public fishery. The expansion of intensive aquaculture, already apparent in the Bay, suggests sustainability will be contingent upon the availability of bottom space and/or a shift in practices that minimize user conflict in leased areas.

Statement of the Problem

Status of the shell resources on the public reefs can be summarized as follows:

- Within public Baylor grounds, intensive and ongoing monitoring of the shell budget on oyster reefs indicates that replenishment efforts provide short term increases in the shell budget.
- Monitoring data indicate that reef systems slowly revert to pre-replenishment conditions since the oyster growth, associated shell production rate and eventual addition of shell to the reef structure through oyster mortality cannot keep pace with breakdown and/or burial of the shell material (Mann and Powell 2007, Mann et al. 2009a, 2009b).
- Predictions for the future based on this evidence suggests that despite replenishment efforts on public Baylor ground, available shell to sustain the wild oyster fishery will be an ever declining resource.

With support from the Chesapeake Bay Trust investigators Mann, Southworth and Wesson are nearing completion of a census of shell abundance and productivity on currently exploited Baylor grounds in the Virginia Bay and subestuaries. For reporting the study area has been generally divided into 11 areas: Tangier Sound, Pocomoke Sound, Rappahannock harvest areas 1-5 as a single unit, Rappahannock harvest area 6, Great Wicomico River natural (VMRC monitored) reefs), Piankatank River, York River and Mobjack Bay as a single unit, and the James as three units these being Upper James (upper Burwell Bay), Middle James (lower Burwell Bay) and Lower James (downriver of Burwell Bay), and the Chesapeake Bay mainstem (essentially from the mouth of the Rappahannock to the Piankatank). For convenience, shell abundance data in absolute numbers of bushels (one VA bushel ~ 50L) present in the entire sampling area is summarized for all areas except Rappahannock harvest area 6 and Chesapeake Bay in Figure 2 for the 2006-2016 period. Note the vertical axes are not to the same scale. The total is subdivided into live oysters, brown shell that is present above the sediment water interface, and black shell that is buried within the sediment. Note the general stability of abundance values in most of the regions. Notable increases in shell abundance are associated with single replenishment events (e.g., York River and Mobjack Bay 2008-2011). Also notable are general modest declines some 2-3 years later as the year class resulting from replenishment, grows and is subsequently harvested. Figure 2 provides data in absolute volumes, but a cautionary note on shell abundance, that is as bushels per unit area or density, is pertinent. Consider that 10 Lm^{-2} is essentially a one shell thick layer when spread uniformly on the bottom. Most of the regions in Figure 2 have standing stocks of shell at or below this critical density value,

the most stable systems NOT requiring regular replenishment (James River) have notably the highest shell per unit area density. Thus while absolute numbers of bushels present show constancy, mostly due to feedback processes that reduce shell loss rates when density is low, a desired end point would be gradual increase in recruitment to sustained higher levels that will, in turn sustain higher densities. This gradual increment is not observed in any of the described areas. Thus this deficit is backfilled by replenishment.

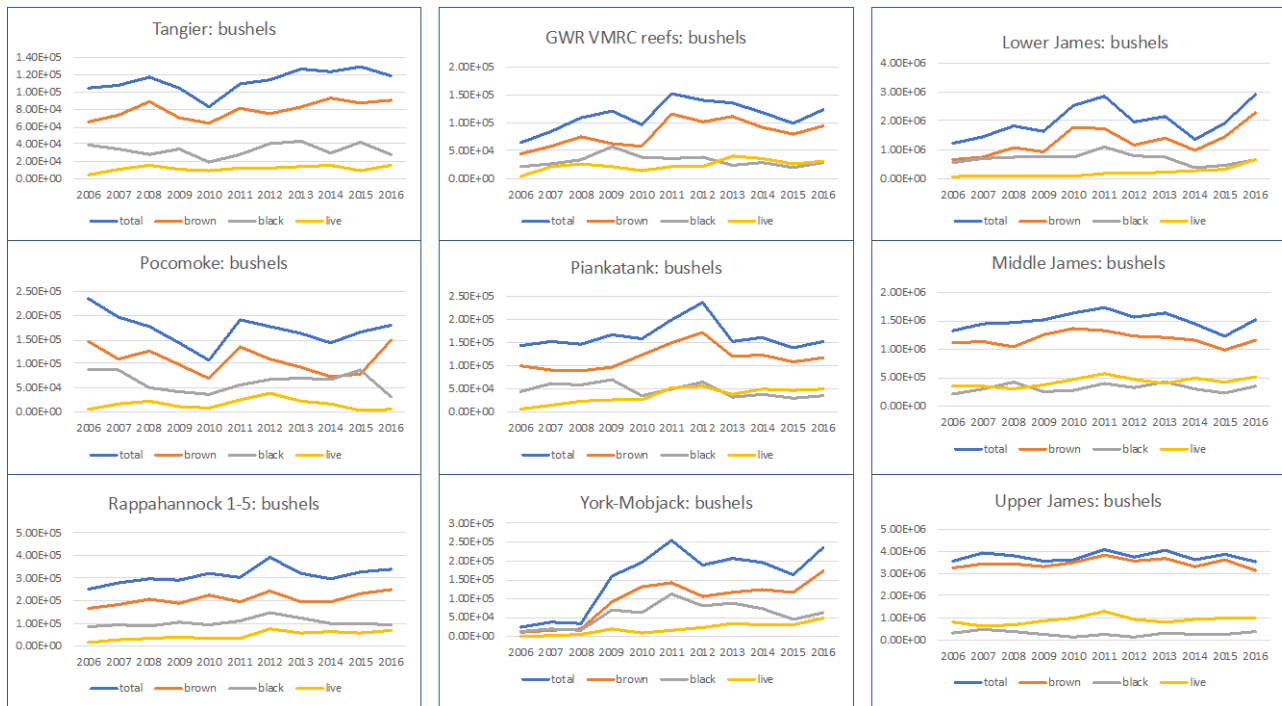


Figure 2. Standing stocks of shell (bushels) in selected regions of Baylor ground: 2006-2016

A general summary of the status of the wild oyster resource on Baylor grounds in the Virginia bay can be found at the Virginia Oyster Stock Assessment and Replenishment Archive website at: <http://cmap2.vims.edu/VOSARA/viewer/VOSARA.html>

Best practices for replenishment in support of the wild fishery should be to geographically target selected areas within Baylor bottom with the highest opportunity for success. This study developed a protocol to identify where subaqueous bottom within Baylor has the potential to support future oyster populations, and where replenishment efforts in the future should be directed.

A decline in the public fishery stimulates a likely shift in oyster production to aquaculture. Such a shift has already been documented through the expansion of the aquaculture industry in Virginia on private grounds. This study reviews and identifies opportunities and conflicts for the growing contribution aquaculture has had on oyster production on private grounds; with the most rapid expansion being hatchery-based production of cage-cultured oysters on private grounds in shallow water. A review of current regulation within public and private subaqueous bottom use reveals that existing policy confines the

expansion of this well supported industry into the future. This study quantifies the impact that broadening the use of the public resource for aquaculture could have at stimulating the industry and its growth without adversely affecting the public fishery.

Expansion of intensive aquaculture, as it is typically practiced in Virginia, is expected to be limited primarily by available space in the shallow water nearshore, where most of the production occurs today. Along with this increase is an expanding list of conflicts in this zone. Most notable are ecological conflicts associated with submerged aquatic vegetation and user conflicts associated with multiple uses by constituents with widely varying commercial, recreational and cultural interests. Nearshore properties, historically associated with commercial fishing long ago, have transitioned to a user group made up largely of single family, residential home owners. Conflicts ranging from view scape disputes to navigation impingement have ensued in the past decade.

Assessment of Productivity on Public Grounds

A geospatial analysis of data indicative of suitable bottom for oyster growth and restoration was undertaken. Four datasets were ultimately evaluated and used in the analysis. The analysis is restricted to production and restoration potential within the public Baylor Grounds. The boundaries for these grounds were provided by the Virginia Marine Resources Commission (VMRC), and data which extended beyond these boundaries were clipped appropriately. Conditions of productivity were determined by 1) the known presence of productive bottom replenished through various state restoration efforts, and 2) suitable substrate material which include oyster rock, shell, and shell mixed with sand.

Sources for determining productive bottom came from three primary databases: the VMRC's Conservation and Replenishment Department (CRD), the Virginia Institute of Marine Science's Virginia Oyster Stock Assessment and Replenishment Archive (VOSARA) <http://cmap2.vims.edu/VOSARA/viewer/VOSARA.html>, and the Haven et al. (1981) sub-aqueous bottom survey.

VMRC's CRD tracks replenishment activity, and provides data on sanctuary reefs through the Virginia portion of the Chesapeake Bay. Additional data provided from VMRC for 3-dimensional oyster reefs built from 1993 to 2006 were also used. VOSARA, as noted earlier, reports annual monitoring and status of oyster stock in the sub-estuaries of the Virginia portion of Chesapeake Bay. Collectively these describe large scale, restoration and monitoring efforts in the Virginia portion of the Chesapeake Bay on public Baylor grounds. Haven et al. (1981) surveyed the subaqueous bottom between 1978 and 1981 and classified bottom type material. The original dataset was updated through field probes over the last several decades to add quality control and currency to the original dataset. In 2001, the dataset was digitized by the VIMS Comprehensive Coastal Inventory Program in ArcInfo®, and later converted into a shapefile in ArcGIS®.

Future productivity was determined to be based on the presence or absence of any of these three primary data attributes within Baylor grounds: a VMRC shell replenishment site, a VOSARA reef site, and substrate with composition verified through sediment probes to be oyster rock, shell, or shell-sand mixture. VMRC also provided data on 3-dimensional oyster reefs built from 1993 to 2006. These reefs were also identified as a future productive site. ArcGIS was used to map and classify presence/absence. If features were present, the area was classified as “suitable for restoration”. If features were not present, the area was classified as “not suitable for restoration”.

Results

Public Baylor grounds in the Chesapeake Bay account for 178,915 acres of state owned subaqueous bottom. Following the criteria above, the assessment yielded 39,117 acres suitable for restoration and 139,608 acres not suitable for restoration. Regional differences in restoration potential can be useful to further target specific areas for future shell replenishment. These differences are summarized in 10 different waterbody delineations that generally align with public oyster harvest regulations used by the VMRC (Table 1). Detailed descriptions of each area are given below. Figure 3 illustrates the distribution of suitable areas versus not suitable areas throughout the Virginia portion of the Chesapeake Bay.

Table 1: Restoration potential by waterbody delineation.

Location	Suitable for Restoration (acres)	Additional Suitable bottom set aside by VMRC (acres)	Not Suitable for restoration (acres)	Total Acres	% Suitable of Total
Chesapeake Bay Lower West and Poquoson	785	0	8,124	8,909	8.8
Chesapeake Bay Upper West and Fleets Bay	721	11	35,608	36,341	2.0
Great Wicomico River	455	1	2,238	2,694	16.9
James River and Tributaries	17,977	110	12,960	31,047	57.9
Lynnhaven Bay	0	48	19	67	0.0
Piankatank River and Milford Haven	915	12	7,450	8,377	10.9
Pocomoke/Tangier Sounds and Chesapeake Bay Upper East	5,862	6	26,779	32,647	18.0
Potomac River Tributaries	704	1	2,563	3,268	21.5
Rappahannock River and Tributaries	9,953	0	33,467	43,420	22.9
York River and Mobjack Bay (with tributaries)	1,745	0	10,400	12,145	14.4
Chesapeake Bay Total	39,117	189	139,608	178,915	21.97

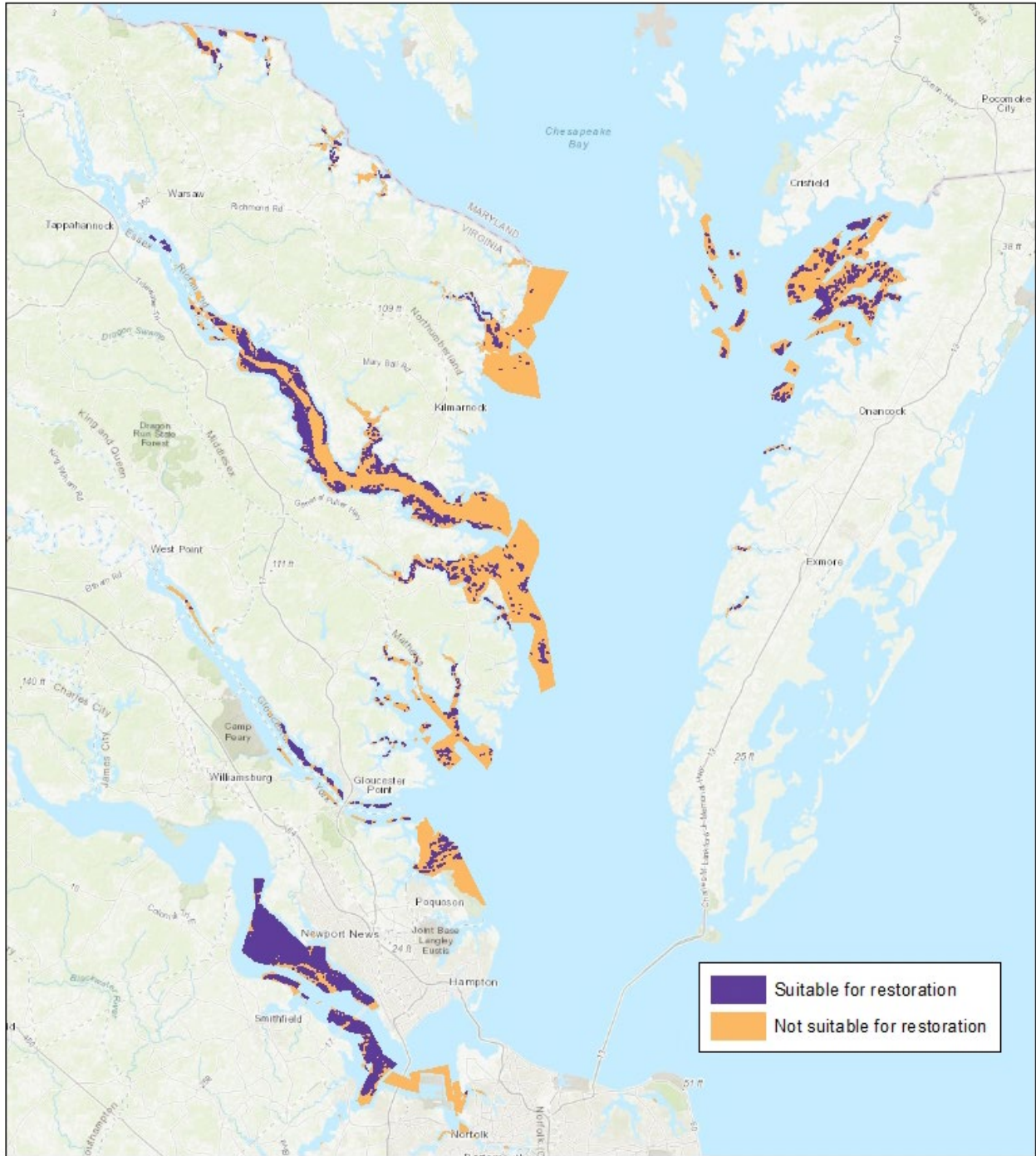


Figure 3. Targeting restoration potential within public Baylor grounds.

Chesapeake Bay Lower West and Poquoson/Back Rivers:

Of the 8,909 acres of Baylor Ground, around 9% of the bottom may be suitable for oyster production/restoration. None of these areas has been open to harvest or received shell additions for at least the past thirty years. The remaining 91% of the bottom in this area is

not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

Chesapeake Bay Upper West and Fleets Bay:

Of the 36,341 acres of Baylor Ground, approximately 2% of the bottom has oysters and/or is suitable for oyster production/restoration. Annual oyster settlement is consistent in frequency, but highly variable in quantity. The portion of this area with suitable bottom is actively managed for harvest by annual stock assessments and shell supplementation as needed. Harvest gear in this area is a combination of hand scrapes and patent tongs. The remaining 98% of the bottom in this area is not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

Great Wicomico River:

Of the 2,694 acres of Baylor Ground, approximately 17% of the bottom has oysters and/or is suitable for oyster production/restoration. Annual oyster settlement is consistent in frequency and is typically moderate to high in quantity. Due to this, in years of good settlement a portion of the Great Wicomico is used as a state seed replenishment area. Additionally, a large portion of the upper area of the river system has been set aside as a sanctuary. The Great Wicomico River is actively managed by stock assessments and shell supplementation as needed. Harvest in the lower section of the river system is by hand scrape and is a rotational harvest management area. The remaining 83% of the bottom in this area is not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

James River and tributaries:

Of the 31,047 acres of Baylor Ground, around 58% of the bottom has oysters and/or is suitable for oyster production/restoration. Annual oyster settlement in the upper portion of the James River (above the line extending from Deep Creek on the North side of the river to the Pagan River on the South side) is consistent in both frequency and quantity. Due to the consistency of the spat set, this area of the river is primarily managed as a seed harvest area. There is a large sanctuary, at Wreck Shoal, which is located within the seed area. All harvest in the seed area is by hand tong. The seed harvest area is actively managed by annual stock assessment and seed harvest quotas, with very rare shell replenishment. Annual oyster settlement in the section of the James River East of the seed area is consistent in frequency, but variable in quantity. This section is managed by rotational harvest, annual stock assessments and shell replenishment. Harvest in this area is by hand scrape. The remaining 42% of the bottom in this area is not suitable for oyster production/restoration. A large portion of this remaining area is located where there is significant industrial activity with portions in the Elizabeth and Lafayette Rivers closed to direct marketing of shellfish. This leaves a relatively small area within this section of the Baylor Ground that could be repurposed for aquaculture.

Lynnhaven Bay:

In the Lynnhaven Bay, 67 acres have been set aside by the Virginia Marine Resources Commission as public ground. Of this total, 48 acres (72%) were constructed as part of a

special project and are designated as oyster sanctuaries. All of the oyster sanctuaries are monitored by annual stock assessments. Annual oyster settlement is consistent in frequency, but variable in quantity. Since construction, no significant cultch additions has occurred on the sanctuary reefs.

Piankatank River and Milford Haven:

Of the 8,377 acres of Baylor Ground, around 11% of the bottom has oysters and/or is suitable for oyster production/restoration. Annual oyster settlement is consistent in frequency and is typically moderate to high in quantity. Due to this, the Piankatank River has been set aside by the state as a seed replenishment area where a portion of the seed are annually harvested and moved to other areas within the state. In order to maintain the seed area for production, the river is actively managed with annual stock assessments and the bottom is regularly supplemented with shell by the state. Harvest in Milford Haven is by hand tong. The remaining 89% of the bottom in this area is not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

Pocomoke/Tangier Sounds and Chesapeake Bay Upper East:

Of the 32,647 acres of Baylor Ground, around 18% of the bottom has oysters and/or is suitable for oyster production/restoration. Annual oyster settlement throughout this area is inconsistent in both frequency and quantity. This area is actively managed through rotational harvest, annual stock assessments and shell supplementation as needed. Harvest in most of the area is by dredge, with a small portion in the mouth of the Pocomoke River using hand scrapes. The remaining 82% of the bottom in this area is not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

Potomac River Tributaries:

Of the 3,268 acres of Baylor Ground, approximately 22% of the bottom has oysters and/or is suitable for oyster production/restoration. Due to relatively low salinities in this area, annual oyster settlement is rare. The quality of the cultch is poor. The combination of rare spat sets and inadequate and degraded cultch means even the areas where oysters are currently present are incapable of supporting a self-sustaining oyster population. The majority of the oysters that are currently located in these areas are a direct result of an active repletion program by the state that has moved both seed and shell to these areas. All oyster harvest in these areas is by hand tong. The remaining 78% of the bottom in this area is not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

Rappahannock River and Tributaries:

Of the 43,420 acres of Baylor Ground, approximately 23% of the bottom has oysters and/or is suitable for oyster production/restoration. Annual oyster settlement in the section of the river East of the Rappahannock River Bridge is consistent in frequency, but highly variable in quantity. From west of the Rappahannock River Bridge to the town of Urbanna, including the Corrotoman River, annual oyster settlement is less consistent in frequency and occurs in much lower quantities. Annual oyster settlement in the upper most part of the Rappahannock occurs infrequently and is modest at best when it does occur. The

Rappahannock River is actively managed through rotational harvest, annual stock assessments and shell supplementation. This system has both large harvest areas and sanctuary areas. Overall, the shell base of suitable bottom is relatively stable, but this is primarily due to active monitoring of bottom condition and shell replenishment. The disease pressure in the upper reaches is much lower, so low recruitment can occasionally result in harvestable quantities of oysters. The majority of the Rappahannock River is harvested by hand scrape, with several small areas in the upper section of the river being harvested by hand tong. The remaining 77% of the bottom in this area is not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

York River, Mobjack Bay and Tributaries:

Of the 12,145 acres of Baylor Ground, around 14% of the bottom has oysters and/or is suitable for oyster production/restoration. Annual oyster settlement in this area is inconsistent in both frequency and quantity. The York River and Mobjack Bay are actively managed through rotational harvest, annual stock assessments and annual shell supplementation. Harvest in this area is by hand scrape. The remaining 86% of the bottom in this area is not suitable for oyster production/restoration and some portion could be repurposed for aquaculture.

Summary

The following summarizes the status of shell production resulting from the analysis conducted in this study:

- Shell from natural mortality is the literal base of natural reefs
- Self-sustaining reefs, with respect to shell, constitute a very small proportion of public Baylor bottom.
- With unlimited financial and shell resources we estimate that approximately 22% of the Baylor bottom could theoretically be maintained. However, shell resources are limited and will continue to be so
- Long-term stock assessment will be used to strategically target repletion programs in the future to both maintain reef structures and maximize productivity
- The vast majority of Baylor ground (78%) cannot be maintained with available shell resources and should be considered for alternate strategies and uses.

Assessment of Private Lease Use and Harvest Reporting

As productivity on public grounds declines, shellfish production on private leases will expand. Competition for space and suitable leases on state-owned subaqueous bottom is inevitable. For decades, state leasing practices have allowed for large tracts of subaqueous bottom to be leased at low cost for the purpose of encouraging shellfish propagation in the Commonwealth. However, low application costs and low lease rates, in addition to the absence of any required use plan for the bottom has encouraged leasing with no thought of propagation or without purpose altogether. Once acquired, a lease which is good for a 10-year period, effectively removes available bottom from active shellfish growing and harvesting; and current regulations do not require leaseholders to submit or implement a

plan for use of the bottom lease. In addition, current law requires lease holders to show some activity only once during that 10-year period in order for the lease to be renewed. Activity could constitute as little as harvesting 5 bushels of oysters or seeding an area with 5 gallons of shell. The absence of stringent policy and practices that discourage inactivity or non-productive uses of the bottom is creating a severe limitation in available area to allow more modern, intensive, hatchery-based aquaculture to expand. Lease-holders retain leases in perpetuity because the cost is low and regulation to prohibit inactivity is lacking.

Harvest reporting, which began around 2006 is required by Virginia law, and tracks uses and activity on privately leased bottom on a monthly basis. The VMRC maintains these data. This study reviewed activity on privately leased bottom in the Virginia portion of the Chesapeake Bay and its tributaries over the last 5 years (2013-2017). Results are reported for the total Bay area studied and for 14 individual waterbodies.

In total, there are 3,977 private leases issued in Virginia for the Chesapeake Bay. These encompass just over 110,000 acres of subaqueous bottom. A review of the past five years of harvest reports indicate only 34% of all private leases reported harvest at some point during 2013 through 2017. Approximately 15% of those reporting harvest reported less than 10 bushels of shellfish over the entire 5-year period. Only 10% of all reporting involved intensive aquaculture. Table 2 summarizes harvest activity for each of 14 designated waterbodies. Figure 4 shows the distribution of this activity for the Virginia portion of the Chesapeake Bay.

Table 2. Assessment of Aquaculture Harvest Metrics between 2013-2017

River Area Name	Number of Leases	Acres of Private Leases	Water Area Acres	% of Water Area that is Leased	Active (reporting) Private Lease Acres	Inactive Private Lease Acres	Intensive Aquaculture Acres	Extensive Aquaculture Acres	Number of Leases Reporting Intensive Harvest
Chesapeake Bay Lower East	162	2797.03	103409.24	2.70	1323.41	1473.62	1196.32	730.72	48
Chesapeake Bay Lower West	68	3495.52	228474.56	1.53	375.02	3120.51	57.12	323.27	6
Chesapeake Bay Upper East	335	5339.07	183874.03	2.90	2172.81	3166.27	1883.03	990.06	100
Chesapeake Bay Upper West	142	2283.02	253747.78	0.90	419.96	1863.06	121.81	371.73	6
Fleets Bay	114	1899.94	5780.79	32.87	275.71	1624.24	20.50	255.20	2
Great Wicomico River	250	2003.67	7987.41	25.09	837.88	1165.80	202.79	694.14	15
James River	542	30353.23	129103.13	23.51	8771.14	21582.14	27.40	8743.74	1
Lynnhaven Bay	167	2378.61	5015.98	47.42	491.37	1887.24	321.39	291.99	20
Piankatank River	235	3394.35	16302.48	20.82	1276.49	2117.87	285.95	1126.52	18
Poquoson/Back Rivers	228	4599.71	10626.37	43.29	1680.89	2918.83	402.77	1510.73	16
Potomac Tributaries	514	9678.36	30027.75	32.23	3707.20	5971.17	1414.21	2972.99	87
Rappahannock River	448	10689.02	90299.94	11.84	4379.54	6309.50	1348.73	3315.19	26
Tangier/Pocomoke Sound	70	3254.65	149851.85	2.17	2479.59	775.07	210.65	2341.02	8
York River/Mobjack Bay	702	28176.97	84354.09	33.40	9204.87	18972.15	1168.95	8202.62	28
Chesapeake Bay Total	3,977	110,343	1,298,855		37,396	72,947	8,662	31,870	381
Percent					33.89	66.11	7.85		9.58

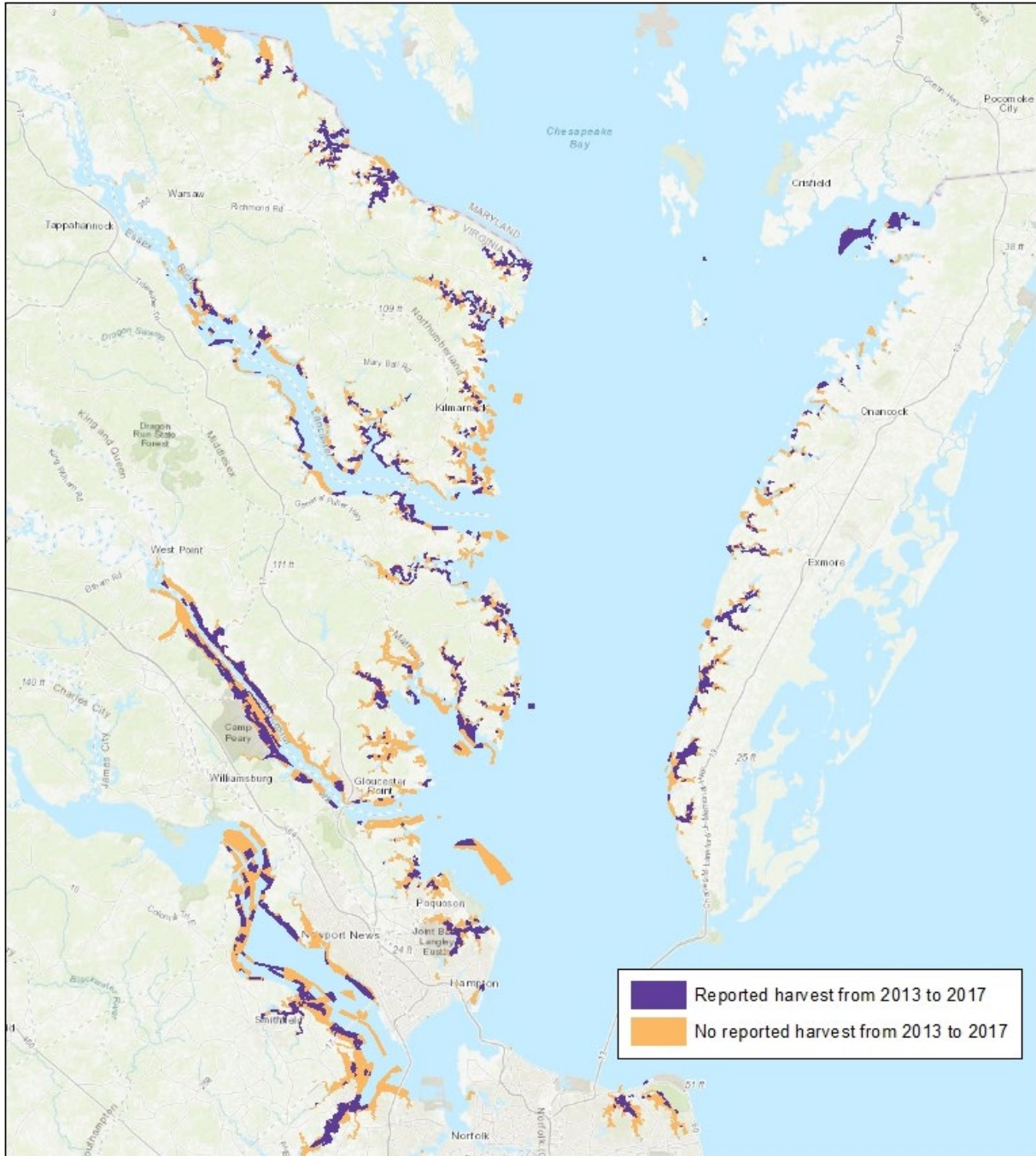


Figure 4. Active harvesting reported on private leases between 2013 and 2017. Based on data from the VMRC Mandatory Harvest Reporting Database, the distribution of private leases reporting activity versus not reporting any harvest activity is shown for the Virginia portion of the Chesapeake Bay. The map illustrates intensive and extensive clam and oyster aquaculture activity for the period of record.

Conflicts and Aquaculture

For this study we are confining our assessments of conflicts to those associated with the conservation of submerged aquatic vegetation (SAV) which is regulated by the VMRC, and

to perceived conflicts affiliated with various upland or water dependent anthropogenic activities.

In addition, the spatial contiguity of these conflicts with private leases is also relevant. This study will assess conflict within buffer zones extending channelward of the present shoreline. The extent to which conflicts may arise is a function of the presence or absence of activity and resources within each buffer zone. The analyses use buffer zones that extend 100, 200, 300, and 500 feet from the shoreline. Presently 2,545 or 64% of all private, non-riparian leases exist within 100 feet of the shoreline (see Table 3 below).

Assessment of Aquaculture Conflicts and SAV

Current regulation restricts aquaculture in areas where SAV is present. New leases are not permitted in SAV areas, and use within existing leases can be restricted if SAV spreads into the area. The VMRC uses data mapped by the VIMS Submerged Aquatic Vegetation program which measures the growth of SAV annually from high resolution aerial photography. The surveys date back to 1984, and cover the Virginia and Maryland portions of the Chesapeake Bay.

This study combined results of SAV distributions over the five-year period from 2012 to 2016 to be consistent with practices used by the VMRC for assessing presence or absence of SAV. The location of aquaculture activity on private leases was compared to determine the extent of the conflict.

The results are summarized in Table 3. Addressing non-riparian leases only, it is apparent that almost 24% of all leases contain some SAV. The majority of these (80%) are located within 200 feet of the shoreline. On many of these leases, there is no aquaculture activity, and therefore no apparent conflict with SAV. An examination of those leases that report intensive aquaculture where adverse impacts to SAV could be anticipated, the results indicate that just over 40% of all leases that are actively reporting intensive aquaculture, co-occur with SAV. More than half of those leases reporting activity are located within the first 100 feet buffer.

Clearly the data supports the assumption that SAV and aquaculture co-occur in the same space geographically. A revised analysis that brought in the latest (2017) SAV data indicated an expansion of SAV into 84 more leases. At face value, the data suggests that intensive aquaculture and SAV can coexist, and perhaps regulation could be relaxed to reflect this. Additional study looking at historic trends in SAV growth with respect to active reporting records is recommended to more thoroughly assess this coexistence.

Table 3. Conflict Assessment between SAV and Private Lease Activity (2012-2016)

	100 ft Buffer			200 ft Buffer			300 ft Buffer			500 ft Buffer			Chesapeake Bay Totals		
Total Leases	2545			2835			2997			3215			3977		
Percent Leases	63.99			71.28			75.36			80.84			100.00		
	Number of Leases	Percent of Total	Percent of SAV Leases	Number of Leases	Percent of Total	Percent of SAV Leases	Number of Leases	Percent of Total	Percent of SAV Leases	Number of Leases	Percent of Total	Percent of SAV Leases	Number of Leases	Percent of Total	Percent of SAV Leases
Non-Riparian Leases with SAV	654	16.44	68.99	761	19.14	80.27	821	20.64	86.60	887	22.30	93.57	948	23.84	100.00
Non-Riparian Leases with No SAV	1891	47.55		2074	52.15		2176	54.71		2328	58.54		3029	76.16	
Intensive Harvest - Oysters & Clams	Number of Leases	Percent of Total	Percent of Intensive Leases	Number of Leases	Percent of Total	Percent of Intensive Leases	Number of Leases	Percent of Total	Percent of Intensive Leases	Number of Leases	Percent of Total	Percent of Intensive Leases	Number of Leases	Percent of Total	Percent of Intensive Leases
Intensive Harvest with SAV	106	2.67	27.82	122	3.07	32.02	125	3.14	32.81	140	3.52	36.75	154	3.87	40.42
Intensive Harvest with No SAV	180	4.53	47.24	199	5.00	52.23	208	5.23	54.59	215	5.41	56.43	227	5.71	59.58
Total Intensive Harvest	286	7.19	75.07	321	8.07	84.25	333	8.37	87.40	355	8.93	93.18	381	9.58	100.00

Assessment of Aquaculture Conflicts and Anthropogenic Uses

Recently, aquaculture has been the spotlight of several highly contentious proposed activities on private leases. Protests express concerns over navigation impediments, impacts to marine mammals, increased noise, loss of property value, and reduction in aesthetics. Often these cases require public hearings before the Marine Resources Commission resulting in uncertainty and delay for the applicant as they attempt to start or expand their aquaculture business. A study of property owner perception of aquaculture would provide a better understanding of the driving forces behind the protests. In the absence of that, we can speculate that the NIMBY (or Not In My BackYard) rule plays a major force among neighboring property owners who raise opposition.

With the expansion of aquaculture anticipated, it is highly conceivable that opposition will continue. This study examined the relationship of the shoreline to private leases and harvest activity through intensive aquaculture which provides the most reliable indicator of active caged based growing practices. A spatial analysis created four zones extending channelward of the shoreline at distances of 100, 200, 300, and 500 ft. Computations were performed to assess the amount of intensive aquaculture activity occurring within each zone relative to all intensive activity in the Bay. Table 4 summarizes the results.

Table 4. Nearshore Intensive Aquaculture

Oysters and clams combined	100 ft Buffer	200 ft Buffer	300 ft Buffer	500 ft Buffer	Chesapeake Bay Totals
Total Leases	2,545	2,835	2,997	3,215	3,977
Percent Leases	63.99	71.28	75.36	80.84	100.00
Total Intensive Harvest	286	321	333	355	381
Percent Intensive Harvest (of total)	7.19	8.07	8.37	8.93	9.58
Percent Intensive Harvest	75.07	84.25	87.40	93.18	100.00

Based on mandatory harvest reporting, intensive aquaculture occurs on only 10% of the current leases in Chesapeake Bay and its tributaries. However, the results confirm that the majority of intensive aquaculture takes place within 100 feet of the shoreline (75%), and nearly all intensive aquaculture is within 500 feet of the shoreline (93%). Additional work in subsequent years of this project will examine the issues surrounding conflict in greater detail; particularly with respect to current policy and practices that drive intensive aquaculture inshore.

Summary

Year one of this proposed three-year study set out to assess the state of the oyster industry as reflected in the current and future sustainability of the public fishery. It was found that future productivity of the public fishery has a significantly smaller footprint than the

original boundaries established by Baylor in the 1800s. Year two will more closely examine opportunities for alternative uses of areas designated as not suitable for production in the future with a focus on enabling the aquaculture industry to expand.

The expansion of aquaculture will ultimately become self-limiting due to current policy surrounding leasing of state-owned bottom. Competition for space is already apparent and available areas for aquaculture are declining rapidly. If public conflict with the practice of aquaculture gains more traction, this could further reduce incentives among the industry. Furthermore, regulated conflicts between SAV and aquaculture will also be limiting; despite initial evidence from this study that suggests SAV and aquaculture can and currently do co-occur.

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