Oyster Management Plan for the Lower Rappahannock River

Recommended to the Virginia Marine Resources Commission on August 28, 2007
by the
Virginia Oyster Heritage Program

This plan was coordinated by the Virginia Coastal Zone Management Program on behalf of these participating Virginia Oyster Heritage Program partners:

Virginia Coastal Zone Management Program

Virginia Marine Resources Commission

DEQ Virginia Department of Environmental Quality

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

Chesapeake Bay Foundation Save the Bay

Virginia Watermen's Association

Virginia Oyster Reef Heritage Foundation

TOGA Tidewater Oyster Gardeners Association

William & Mary VIMS Virginia Institute of Marine Science

Virginia Tech Invent the Future

Kellum Brand

I. Introduction

Background

Throughout the 1980's and 90's, government agency and academic staff in Virginia worked hard to understand and reverse severe declines in oyster biomass. The decline was caused by a long period of devastating diseases (MSX and dermo) in the face of continued harvesting and the stresses of low oxygen and sedimentation from nonpoint source run-off. Although much was learned and there were some signs of hope in smaller river systems like the Wicomico, oysters overall were failing to rebound.

In 1999 federal and state agencies, non-profits and academics formed the Virginia Oyster Heritage Program and agreed to pool resources and funding to embark on a bold experiment of building large scale oyster reefs in a large river system. The lower Rappahannock River was chosen. The idea was to see if a series of one acre, 8-10 foot high, oyster broodstock sanctuaries could eventually provide spat to replenish nearby, 2-dimensional shell beds. The reef sites were chosen based on a variety of factors such as bottom type, depth, previous existence of reefs, circulation patterns (best knowledge at the time) and proximity to harvest areas.

The hope was that the oysters living in broodstock sanctuary reefs built in the three-dimensional structure would experience less disease, grow larger and therefore produce more offspring than their counterparts in traditionally harvested waters. These sanctuary reefs, which could not be harvested or disturbed could additionally provide habitat for other finfish and shellfish, provide water quality benefits and could possibly serve as shoreline "breakwaters" to protect land from wave erosion. And if successful, these sanctuary reefs would provide spatfall to harvest areas that would then become "sustainable" fishery grounds.

Results of Lower Rappahannock Restoration Efforts

Fourteen reefs were built in the Rappahannock with a variety of funds from various agencies and private non-profits. The hoped-for success has not been realized, but there are in fact some very large oysters surviving in the lower Rappahannock. Oyster spatfall and growth have been monitored annually on each sanctuary reef and associated harvest beds. Results are in Appendix A.

Need for a New Plan

Since 2000 the entire lower Rappahannock River (from the Route 3 Bridge east) has been closed to all harvesting to allow time to test the hypothesis that small broodstock sanctuaries could "feed" the harvest areas. Seven years have now passed and for each of those years, Virginia's watermen, resource managers and scientists argued over whether, or when, Virginia's Marine Resources Commission should re-open the lower Rappahannock to oyster harvesting. The

watermen argue that they should be allowed to harvest the oysters because most of the oysters will die anyway. Managers and scientists argue that nature must be left alone and given a chance for natural selection work so that disease-resistant survivors can pass on their genes to future generations. This plan is an effort to develop a compromise that allows for some harvest but also protects the best remaining broodstock and hopefully one that ends the annual argument over the management of Rappahannock oysters.

II. New Information and Considerations

New information on four topics is now available that has lead the re-convened Virginia Oyster Heritage Program partners (see Appendix B) to believe that the time is ripe for a new approach to managing oysters in the Rappahannock River.

1) Results of Updated Circulation Model

Recently VIMS scientists re-evaluated circulation patterns in the lower Rappahannock that may be affecting where oyster larvae are most likely to settle. The oyster metapopulation modeling component for the Rappahannock River involves

- placement of historical and current oyster reef locations in the river
- release of 100 million larvae from each location, and
- analysis of the connectivity between reefs, as determined by the release and settlement locations of oyster larvae in the hydrodynamic model.

The hydrodynamic model simulates 20-day larval transport and settlement forced by mean flow within the river and observed tides during the month for a typical spring-neap tidal cycle. Flow varies from 46-266 centimeters per second and tidal range varies across the naturally occurring values. After release of 100 million larvae at the bottom from each reef, the larvae undergo advection (horizontal movement) by currents for 14 days. At day 15 larvae begin settling on the nearby reefs or continue to be advected throughout the river until they settle on a reef, die due to natural mortality, or are advected out of the river. Larvae that have not settled by day 21 are considered dead; the natural mortality rate is set at 16.5% per day, which has been derived from published estimates for other marine species.

The initial results demonstrate that there is substantial retention of larvae within the river system, but also that larvae from particular locations, such as the southern shore of the Rappahannock east of the Route 3 bridge, are not retained within the river. Consequently, there are clear reef locations that are sources and sinks for the Rappahannock River metapopulation. This information supports the proposed boundaries for the six rotational management areas in this plan. This information will also allow us to identify the specific reefs within each management area that should be designated as spawning sanctuaries.

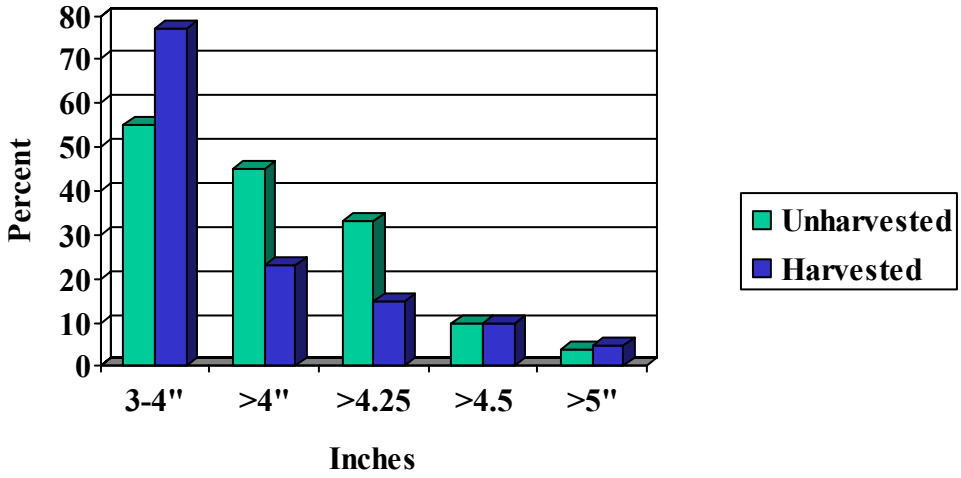
Further simulations are being revised to include aspects of larval behavior. The near-term analyses will include connectivity maps and recommended future restoration sites for both spawning stock and artificial reef locations.

2) Status of Oyster Diseases

MSX and Dermo continue to take a heavy toll on Virginia's native oyster, *Crassosstrea virginica*. Diseases caused by *Haplosporidium nelsoni* (MSX disease) and *Perkinsus marinus* (dermo disease) continue to impact *Crassostrea virginica*. Emerging evidence, however, has revealed resistance to both these diseases in Virginia oysters. *H. nelsoni*, once devastating, has become relatively rare in oysters from parasite-endemic waters such as the lower Rappahannock River. *P. marinus*, while still destructive, parasitizes many oysters only lightly, presumably leaving a substantial proportion of each oyster population fully reproductive. The observation of light dermo disease levels in the largest, oldest oysters from the lower Rappahannock River and elsewhere is especially significant. It is hypothesized that a disproportionate reproductive contribution from such large, healthy, fecund oysters counteracts contributions from young, susceptible but pre-disease oysters, promoting disease resistance and maintaining the abundance of oysters in disease-intense Virginia waters.

3) Distribution and Abundance of Lower Rappahannock Oysters

The figure below shows the size distribution of oysters larger than three inches occurring within the closed experimental area of the lower Rappahannock River.



One goal of a new management approach is to ensure protection from harvest for some of those oysters currently larger than 3 inches. These oysters may be disease resistant and it is therefore critical that some of these be protected so their genetic characteristics can be passed on to future generations.

4) A Successful Rotational Harvest Plan for Sea Scallops

In the 1990s, a new scallop fishery management practice was successfully employed on the east coast (Georges Bank and mid-Atlantic areas) that uses a

rotational harvest plan. The success is described in the excerpt below found at: http://www.nefsc.noaa.gov/sos/spsyn/iv/scallop/:

> ***Closed Areas and Spatial Management***
> *Sea scallops have a somewhat uncommon combination of life-history attributes: low mobility, rapid growth, and low natural mortality. These attributes enable sea scallop populations to respond rapidly after areas have been closed to fishing. This has been observed in the Georges Bank closed areas, where sea scallop biomass increased almost 25-fold between 1994 and 2000 (Figure 36.14 [Fig 36.14 Data]), and in the Hudson Canyon South rotational closed area in the Mid-Atlantic, where sea scallop biomass increased about five times during its three year (1998-2001) closure. Significant increases have also occurred in the Elephant Trunk rotational area since it was closed in 2004. These observations are consistent with rotational theory which predicts that rotational closed areas can increase sea scallop yield and biomass (Hart 2003).*

A rotational harvest plan, in combination with other management techniques, may also work for Virginia's oysters. Sea scallops do not face the same complex of problems (particularly disease problems) that oysters do, but they have been subjected to similar harvesting pressures.

III. Proposed Plan

Objectives

The objectives of the Lower Rappahannock Oyster Management Plan are to:

1) Maximize oyster populations throughout the lower Rappahannock River;
2) Sustain these populations for both commercial and ecological purposes;
3) Provide predictable harvest forecasts with a minimum of one year lead time; and
4) Allow for targeted supplementation of natural recruitment of oysters by deploying "spat-on-shell."
5) Implement the rotational aspects and slot size requirements of the plan for nine years and evaluate results after three years and thereafter. Aspects other than the 3 year rotational scheme and slot size may be addressed annually.

Techniques

This plan incorporates a variety of traditional management techniques and also employs a new, rotational harvest system. The lower Rappahannock will be divided into eight "Management Areas."

The lower six areas (Areas 1-6 on the map below) will be open for rotational harvests. Because it takes a minimum of three years for oysters to reach market size in the lower Rappahannock you need at least three areas, one for each year of growth. For this plan, three management areas using rotational harvests are

proposed below the Route 3 bridge and three above the bridge which will allow for two of the six areas to be open to harvest each year. The other four areas will be open in succession, two areas at a time, for the next two years. Then the first area will reopen and repeat the pattern. The time of closure will give oysters in those areas an opportunity to grow and reproduce undisturbed.

Areas 1-6 will also contain larger broodstock sanctuaries which will not be harvested. Within each of the six rotational management areas are also sites identified as suitable for reef restoration or sanctuary expansion. As funds allow, these areas will be restored. In years of low spatfall seed oysters produced as spat-on-shell in aquaculture operations will be targeted at areas that are at least two years from harvest.

The upper two management areas (Areas 7-8 on the map below) will be for 2 different types of traditional, annual "put-and-take" harvests. Area 7 will be used for the newer technique of putting out "spat-on-shell" which is large empty shells on which oyster spat have been allowed to settle in a hatchery. Use of spat-on-shell, rather than cultchless seed, may result in reduced mortality from predation. Area 8 will be used for the older technique of putting out clean, empty shell to collect wild oyster spat and for the occasional planting of wild seed as opportunities (conditions and funding) arise.

A map depicting the eight Management Areas is located in Appendix C.

Harvest Schedule for Each Management Area

Areas will be opened and closed according to the schedule below

For the 2007-8 oyster season, Areas 1 and 6 will be open for harvest excluding their sanctuary areas. Areas 2, 3, 4 and 5 will be closed.

For the 2008-9 oyster season, Areas 2 and 4 will be open for harvest excluding their sanctuary areas. Areas 1, 3, 5 and 6 will be closed.

For the 2009-10 oyster season, Areas 3 and 5 will be open for harvest excluding their sanctuary areas. Areas 1, 2, 4 and 6 will be closed.

Penalties for Working in Closed Areas

Penalties will be consistent with those recommended by the Blue Ribbon Oyster Panel.

Slot Size and Large Oyster Return Program

The legal size limit for oyster harvest shall be between 3 inches and 4.25 inches. It shall be illegal to take and sell oysters smaller than 3 inches and larger than 4.25 inches. This shall be adopted for three years and then evaluated.

Small oysters shall be returned overboard. Oysters larger than 4.25 inches shall be turned over to a designated Marine Patrol Officer at a designated sanctuary. Watermen will be compensated for these oysters based upon a rate set annually by the Marine Resources Commission.

Eligibility to Enter the Rappahannock Oyster Fishery

A limited entry permit is recommended that requires oyster landings within the Commonwealth of Virginia during at least one of the last five years.

Allowable Gear Types

Appropriate gear types for the 8 management areas will be recommended on annual basis by VMRC's Shellfish Management Advisory Committee.

Season Time and Length

Season opening and closing dates will be recommended annually by VMRC's Shellfish Management Advisory Committee.

Bushel and Daily Time Limits

Appropriate bushel limits and daily time limits for fishing will be recommended on annual basis by VMRC's Shellfish Management Advisory Committee.

IV. Expected Costs of the Rappahannock Plan

The Virginia CZM Program is providing a $15,000 grant to Virginia Tech to undertake an economic analysis of the costs of implementing this Rappahannock River Oyster Management Plan. The grant began in July 2007 and will run through September 2007. A final report will be available in fall of 2007 which should be helpful to the Marine Resources Commission and the General Assembly in determining budget needs. In addition, the Virginia CZM Program will be contracting with Virginia Tech on a more general follow-up grant for $55,000 which will analyze all of the public and private costs of both oyster and clam farming in Virginia. That grant will be completed in fall of 2008.

The summer 2007 study by Virginia Tech will analyze the following costs:

1) Sanctuaries within Management Areas 1-6
    a. Expansion of existing reefs
    b. Development of new reefs
    c. Maintenance of all reefs
    d. Cost of large oyster Buy-Back Program

2) Spat on Shell - Put and Take (Management Area 7)
    a. Hatchery costs
    b. Deployment costs

3) Shell Replenishment for All Management Areas
    a. Cost of shell and deployment

4) Enforcement

5) Monitoring

A bio-economic model of the oyster fishery at the mouth of the Rappahannock has been developed using Stella modeling software. Parameters for the model are based on data for the area collected by VMRC and 20 other sources including journal articles, various reports from VIMS, VMRC, the US Army Corps of Engineers, private consulting reports and environmental impact studies.

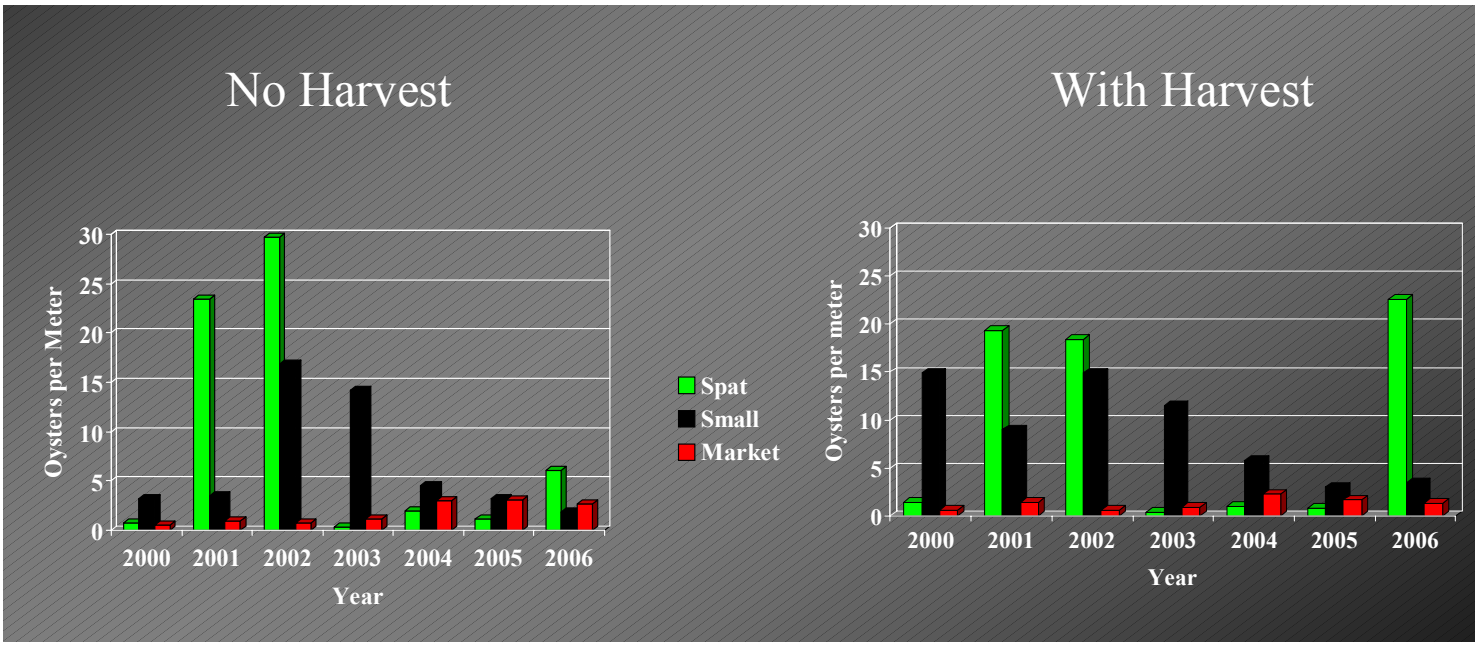
For each area, the model calculates recruitment based on the effect of the quantity of shell repletion and the population of mature oysters. Each bushel of shell results in one bushel of spat. The model includes a declining effect for planted cultch as noted in the literature. By the fourth year the planted shell has so degraded that it is of little value in attracting spat set. Therefore each area is replanted once every third year - in the spring following harvesting in the fall of the previous year. The presence of market size oysters results in an additional one and half bushels of spat per bushel of adults. Spat and juvenile oysters suffer a mortality rate of 70 percent per year. Adults suffer from an 80 percent mortality rate (100% if harvested). High mortality rates for juvenile and adult oysters are due to the high impact of disease (associated with high salinity) and predation. Harvesters are shown as taking half of the market size oysters when the fishery is opened.

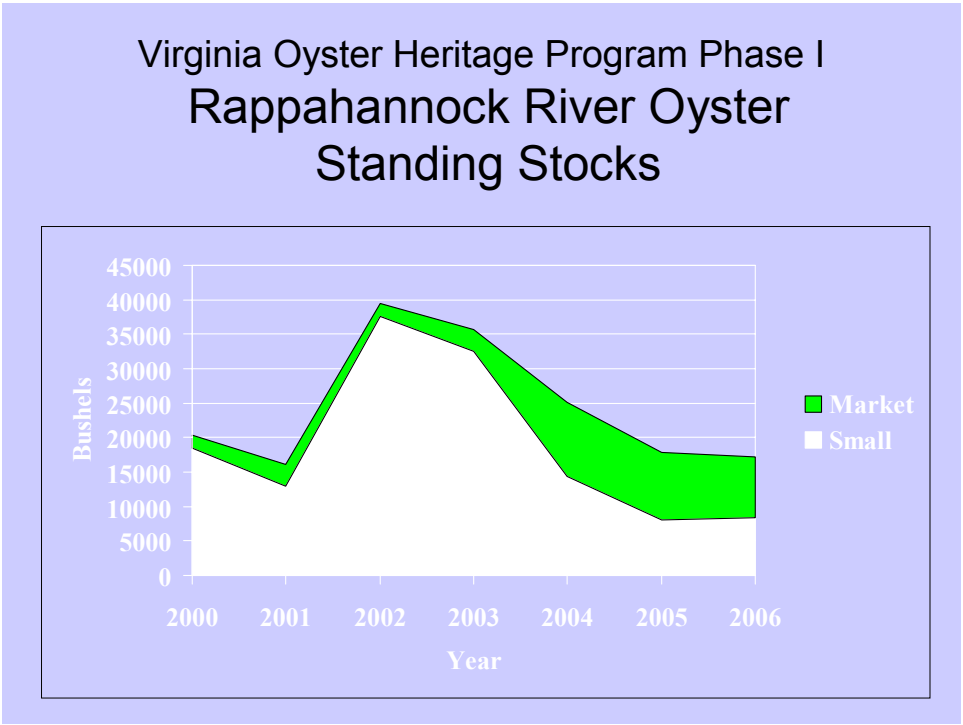
Harvest costs are based on a set number of vessels working 54 days during the open season. The cost per vessel per day, including labor, is based on a recent survey conducted by a private consulting firm.

Revenue from the harvest is based on a price of $30 per bushel. Three forms of net revenue are then calculated. The future value of the cost of planting shell is found by inflating the repletion expenditure using an interest rate. The difference

between harvest revenue and this repletion cost is net public revenue. The difference between revenue and harvest costs incurred by watermen is net harvester revenue. Harvest costs will be subtracted from net public revenue to provide an estimate of net social revenue of implementing the plan (the value after all costs of production are accounted for).

Appendix A
Results of Oyster Monitoring in Lower Rappahannock





RAPPAHANNOCK RIVER - PHASE ONE - OYSTER STANDING STOCKS, SPRING 2007

Rappahannock	Acreage	Year Plntd	Per Meter						Standing Stocks		
			Spat	Small	Market	Total	Boxes	Cultch	*Small (bu.)	*Market (bu.)	Total (bu.)
Not Harvested											
1 Spike B, offshore	5.98	2001	8.0	1.9	1.3	3.2	2.1	6.9	90	104	194
2 Spike A	2.23	2001	2.3	0.4	1.0	1.4	0.7	1.9	7	27	34
3 Spike	7.10	2001	0.1	0.1	0.0	0.1	0.0	1.3	8	0	8
4 Lower Edge, East	17.66	2001	11.3	5.9	3.6	9.5	3.4	6.0	853	867	1,720
5 Lower Edge, Middle	13.46	2001	3.1	1.3	0.9	2.2	1.1	2.7	135	150	285
6 Lower Edge, West	21.87	2001	5.3	1.1	1.3	2.4	1.4	2.3	204	382	586
7 Broad Creek	15.89	2001	7.1	2.0	3.1	5.1	0.7	6.9	259	678	937
8 Sturgeon Bar, SP 551	12.15	2001	7.3	1.7	1.6	3.3	0.6	4.4	167	255	422
9 Sturgeon Bar, SP 552	8.22	2000	9.4	1.9	0.9	2.8	1.0	6.4	120	93	213
10 North End, SP 553	10.47	2000	6.4	2.4	3.1	5.5	2.0	8.1	197	424	621
11 Parrotts East, offshore	10.37	2001	15.9	2.4	7.0	9.4	2.1	6.9	197	944	1,141
12 Parrotts West, inshore	8.59	2000	6.7	2.9	7.3	10.2	0.9	6.7	208	885	1,093
25 Larson Rock	2.24	2000	10.0	11.1	12.3	23.4	4.0	9.3	180	331	511
26 Mosquito Island	2.06	2001	6.7	0.9	0.1	1.0	0.6	4.3	14	4	18
27 Butlers Hole	6.70	2001	5.1	2.6	1.3	3.9	1.0	6.6	146	121	267
28 Broad Creek, inshore	7.97	2001	2.8	1.9	4.6	6.5	2.4	6.1	120	493	613
Mean	**153**		**6.7**	**2.5**	**3.1**	**5.6**	**1.5**	**5.4**			
Subtotals									**2,905**	**5,758**	**8,663**
Harvested											
13 Temple Bay, SP 138	5.73	2000	8.1	1.3	1.9	3.2	0.7	10.0	62	150	212
14 Temples Bay, SP 136	5.31	2001	3.1	0.6	0.6	1.2	0.7	6.0	23	39	62
15 Temples Bay 1	4.58	2001	0.9	0.0	0.6	0.6	0.0	1.7	0	39	39
16 Temples Bay 2	12.42	2001	4.0	0.9	0.7	1.6	0.0	4.9	83	116	199
17 Temples Bay 3	17.51	2001	4.3	1.6	1.1	2.7	0.0	8.7	229	278	507
18 Drumming Ground, offshore	28.39	2001	39.7	6.0	1.0	7.0	2.0	9.7	1,360	378	1,738
18.1 Drumming Ground, offshore	7.02	2001	53.9	10.1	1.7	11.8	3.6	10.0	575	162	737
19 Drumming Ground, inshore	28.94	2001	34.6	7.3	2.7	10.0	1.7	10.0	1,710	1,062	2,772
20 Corrotoman Pt., C1	8.59	2000	29.6	5.4	1.1	6.5	1.4	9.3	395	139	534
21 Corrotoman Pt., C2	8.59	2000	24.1	4.2	2.8	7.0	0.0	9.0	104	69	173
22 Corrotoman Pt., C3	8.31	2000	20.4	3.4	1.0	4.4	0.7	7.1	222	108	330
23 Middle Ground	5.32	2000	32.3	3.1	0.1	3.2	0.3	7.1	127	10	137
24 Ferry Rock	4.20	2000	30.0	6.7	1.9	8.6	1.6	6.4	217	100	317
Mean	**145**		**21.9**	**3.9**	**1.3**	**5.2**	**1.0**	**7.7**			
Subtotals									**5,107**	**2,650**	**7,757**
Totals	**298**								**8,012**	**8,408**	**16,420**

*Based on: Small-500/bu.; Market-300/bu.

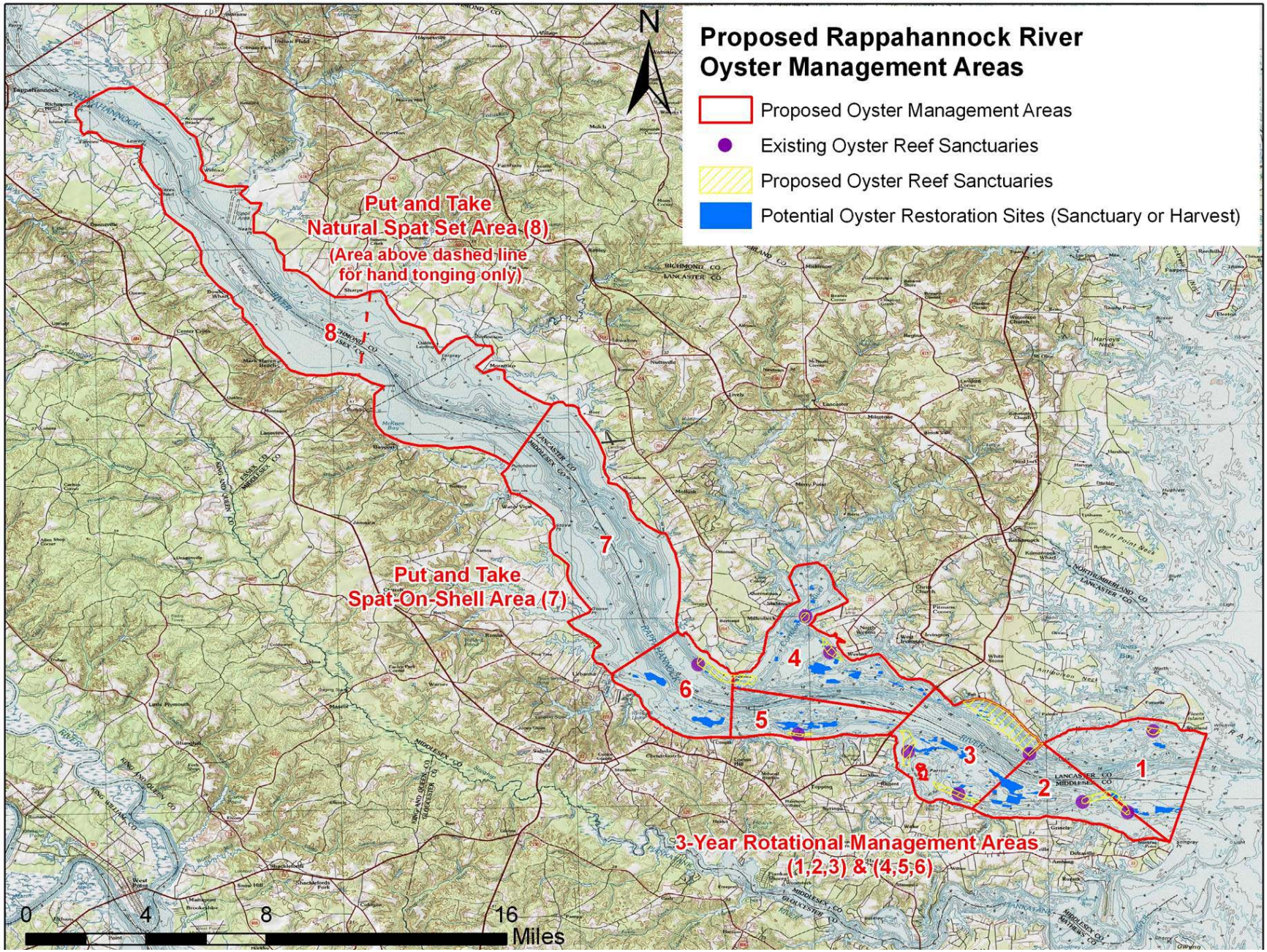
VIRGINIA REEF PROJECTS - DIVE SURVEY SUMMARY 2000 - 2006

	Date	2000				2001				2002				2003				2004				2005				**2006**			
Location	Constructed	Spat	Small	Market	Total	Spat	Small	Market	Total	Spat	Small	Market	Total	Spat	Small	Market	Total	Spat	Small	Market	Total	Spat	Small	Market	Total	**Spat**	**Small**	**Market**	**Total**
Rappahannock																													
Broad Cr. (WS)	**2001**					126	53	17	196																				
Broad Cr. (C)	**2001**					507	0	0	507	122	209	0	331	0	78	15	93	13	17	7	37	1	6	0	7				
Broad Cr. (Hse)	**2001**					430	4	1	435	87	95	7	189	1	71	11	83	4	30	6	40	0	2	2	4	6	2	3	11
Butlers Hole (C)	**2001**					397	0	0	397	176	112	1	289	0	93	4	176	0	20	1	21	1	7	2	10	2	3	1	6
Butlers Hole (Hse)	**2001**					662	19	7	688	316	119	3	438	0	116	5	121	3	49	9	61	1	4	2	7	3	5	2	10
Butlers Hole (WS)	**2001**					170	0	0	170												0				0	5	3	1	9
Sturgeon Bar	**2001**					856	15	0	861	383	191	0	574	0	8	0	8	2	2	1	5	1	4	2	7	13	2	1	16
Mosquito Pt.	**2001**					552	0	0	552																				
Mosquito Pt.	**2001**					615	20	10	645																				
Mill Creek	**2000**	6	0	0	6	113	0	0	113	301	185	0	486	0	24	1	25	2	11	6	19	1	9	2	12	7	0	1	8
Parrotts Rk.	**2000**	3	0	0	3	122	0	0	122	391	260	7	658	1	30	2	33	0	16	1	17	0	15	12	27	3	2	7	12
Drumming Gr.	**2000**					368	0	0	368	201	151	0	352	0	16	1	17	0	11	1	12	4	12	8	24	74	13	8	95
Temple Bay	**2000**					220	0	0	220	357	192	0	549	1	100	5	106	0	16	4	20	0	8	11	19	37	4	9	50
Ferry Pt., Corrotoman	**2000**					175	3	0	178	110	9	0	119	0	34	0	34	0	5	2	7	1	3	0	4	83	5	1	89
Towles Pt.	**2002**									369	0	0	369	1	181	8	190	1	63	8	72	1	9	3	13	13	4	4	21
LaGrange Cr.	**2002**									42	0	0	42	0	42	3	45	0	11	8	19	0	1	3	4	10	1	2	13
Waterview	**2003**													0	10	0	10	0	8	1	9	0	2	0	2	13	1	1	15
Wicks	**2003**													0	1	0	1	0	6	0	6	0	1	0	1	15	1	0	16

Appendix B
Participating Members of the 2007 Reconvened Virginia Oyster Heritage Program

Burreson, Gene	Virginia Institute of Marine Science
Carnegie, Ryan	Virginia Institute of Marine Science
Chandler, Chan	Tidewater Oyster Gardeners' Association
Gaskins, Russell	Virginia Watermen's Association
Jasinski, Paula	NOAA Chesapeake Bay Office
Jenkins, Doug	Virginia Watermen's Association
Kellum, Tommy	Kellum Seafoods
McKay, Laura	Virginia Coastal Zone Management Program
Leggett, Tommy	Chesapeake Bay Foundation
Lipcius, Rom	Virginia Institute of Marine Science
Luckenbach, Mark	Virginia Institute of Marine Science
Mann, Roger	Virginia Institute of Marine Science
Murphy, Michael	Virginia Department of Environmental Quality
Partin, Jackie	Tidewater Oyster Gardeners' Association
Weeks, Richard	Virginia Department of Environmental Quality
Robins, Rick	Virginia Marine Resources Commissioner
Rose, Laura	NOAA Chesapeake Bay Office
Schroeder, Clifford	Virginia Oyster Reef Heritage Foundation
Takacs, Rich	NOAA Chesapeake Bay Office
Travelstead, Jack	Virginia Marine Resources Commission
Satyal, Vijay	Virginia Department of Environmental Quality
Wesson, Jim	Virginia Marine Resources Commission

Appendix C
Map of Lower Rappahannock



Appendix D
Close-up of Rotational Management Areas 1-3