COMMONWEALTH of VIRGINIA

L. Preston Bryant, Jr.
Secretary of Natural Resources

Marine Resources Commission
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Steven G. Bowman
Commissioner

December 1, 2009

MEMORANDUM

TO: The Honorable Timothy M. Kaine
Governor of the Commonwealth of Virginia
And,
Members of the Virginia General Assembly

THROUGH: The Honorable L. Preston Bryant, Jr.
Secretary of Natural Resources

FROM: Steven G. Bowman

SUBJECT: Blue Crab Fishery Management Plan

On behalf of the Virginia Marine Resources Commission, I am writing to report on the status and current implementation of the blue crab fisheries management plan, in accordance with the provisions of § 28.2-203.1 of the Code of Virginia.

EXECUTIVE SUMMARY

All findings from recent reviews of the status of the Chesapeake Bay blue crab stock indicate a major improvement in the abundance of adult crabs (age-1+). For the first time in 16 years, the abundance of age-1+ blue crabs has exceeded the target of 200 million crabs. The production of new crabs or recruits; however, remains low. For the twelfth consecutive year, the abundance of these age-0 crabs was less than the 1990 – 2008 average. This component of the stock provides harvestable size crabs in the fall, and, more importantly, represent an important fraction of the future spawning stock.

Results from the December 2008 to March 2009 Chesapeake Bay-wide Blue Crab Winter

Dredge Survey indicate the abundance of age-1+ blue crabs was 223 million crabs. This value represents a 70% increase over the 2007-2008 survey value of 131 million. The estimate of 223-million harvestable-size crabs recorded from the winter dredge survey was substantially greater than the overfished threshold of 86 million recorded in 1999. This abundance of age-1+ crabs is above the interim target level of 200 million spawning age crabs established by the Chesapeake Bay Stock Assessment Committee (CBSAC). In January 2008, CBSAC established an interim target of 200 million spawning age crabs, based on analyses suggesting that 200 million age-1+ crabs is a minimum associated with consistently higher levels of recruitment.

The increase in abundance of spawning-age adults (male and female crabs), in the 2008-2009 Chesapeake Bay-wide Winter Dredge Survey, was mainly due to an increase in the number of female crabs that are likely to spawn in 2009. The abundance of male crabs in 2008-2009 was only 59 million crabs, and represented a more moderate increase than determined for female crabs. Data from three supporting blue crab surveys (the Maryland and Virginia trawls and the Calvert Cliffs Pot study) were reviewed. The results of these surveys were generally consistent, with the Chesapeake Bay-wide Blue Crab Winter Dredge Survey results, showing an increase in the abundance of adult crabs, and a continued low abundance of age 0 recruits.

The estimated 2008 Bay-wide crab harvest was 48.6 million pounds, slightly higher than the record-low 2007 harvest of 43.5 million pounds. The 2008 Maryland harvest is estimated to be 29.4 million pounds. The 2008 Virginia harvest was 16.7 million pounds, while 2.5 million pounds were reported harvested in the jurisdictional waters of the Potomac River Fisheries Commission. The poor Bay-wide commercial harvest was very near the intended 34% reduction (in pounds) of female crabs, from the average 2004-07 harvest. Similarly, the 2008 Virginia commercial harvest was 32.2% below the average 2004-07 harvest, and conservation measures were implemented in 2008 to achieve a 34% reduction in the harvest of female crabs. Nearly all conservation measures adopted by the Commission in 2008, were maintained for the 2009 crab fisheries, as discussed below

Managers within the Chesapeake Bay continue to utilize the control rule, whereby annual estimates of abundance and exploitation rates are referenced against empirical and model-based standards, respectively, to guide management efforts. The control rule established an overfishing threshold, equal to an annual percentage harvest-removal rate of 53% and an overfished threshold of 86 million crabs, the lowest stock abundance recorded from the Chesapeake Bay-wide Winter Dredge Survey in 1999.

The percentage of the population of crabs removed by commercial and recreational fishing (exploitation rate or fraction) in 2008 was estimated to be 48%. This annual removal rate by fisheries is below the overfishing threshold of 53%, but above the target exploitation rate of 46%. In 8 of the last 11 years the exploitation rate has been above the threshold (53%).

It will take several years of maintaining an exploitation rate at or near the target level (46%), for this stock to sustain a spawning potential that will also provide improved harvests. Harvest information through July 2009 indicates that the increased abundance of harvestable-size crabs has contributed to a higher Virginia harvest of hard crabs, as compared to 2008. The harvest of hard crabs in the early months of 2009 is only 4% less than the average 2004-07 harvest through July. Less effort was also expended through July 2009 in the peeler crab fishery,

but harvest (pounds) was about 30% less. Since May accounts for about 50% of the annual peeler crab harvest, it is expected that final 2009 peeler harvests (pounds) will be lower than in 2008. That decrease in peeler crab harvest is easily attributable to the fact that age-0 crab abundance has been well below the average.

Extensive steps were taken by the Marine Resources Commission, from 2007 to 2009, to gather scientific and industry expertise from the Blue Crab Regulatory Review Committee (2007), the Virginia Institute of Marine Science and the Commission's Crab Management Advisory Committee. The Blue Crab Regulatory Review Committee was assembled by request of the Commission, as the Commission recognized the need for a peer-based review of the effectiveness of previously adopted conservation measures, for the blue crab resource. The findings of the Blue Crab Regulatory Review Committee were included in last year's blue crab management plan but remain as a source of advice for the Commission. The final report is located at the following web address:

http://www.mrc.state.va.us/BCAC/Blue%20Crab%20Review%20Report%20March%202008.pdf

The Commission also reviewed the findings from the advisory reports conducted by the Chesapeake Bay Stock Assessment Committee, and the most recent advisory (2009) is detailed below (Attachment I). The Commission's management process and actions, on behalf of the blue crab resource, are detailed, below, as the 2009 Virginia Blue Crab Fishery Management Plan.

The Commission has initiated several projects using federal disaster relief assistance funds ($14,995,000) to provide opportunities for eligible crab licensees to participate in resource or habitat conservation projects. The first project to be implemented was a work program, at a cost of $1.3 million, designed to assist 58 previously active crab dredge fishermen who were impacted by the closure of the 2008/09 winter crab dredge season. This work project was led by scientists from the Virginia Institute of Marine Science and extended from mid-December 2008 through mid-March and utilized side-scan sonar techniques to retrieve 8,790 derelict pots ("ghost" pots) in several areas of the Chesapeake Bay. Just under 5000 organisms, mostly blue crabs, were removed from the collected derelict pots. This project also removed other types of marine debris from the Chesapeake System (191 items) and identified five sunken vessels. As the Commission also closed the 2009/10 crab dredge season, the second year of this 3-year project is expected to get underway in early December. There will be 66 previously active crab dredge fishermen that take part in the second season of this program. The remainder of the programs that are funded by the disaster relief fund are discussed below, and a complete listing may be found in Attachment II.

THE 2009 VIRGINIA BLUE CRAB FISHERY MANAGEMENT PLAN

The Commission's 2009 blue crab management efforts were guided by the most recent CBSAC Advisory Report, as well as advice from its Blue Crab Management Advisory Committee. Results from the 2008 conservation measures that produced a 32.2% reduction in the harvest of female crabs and the first major increase in crab abundance in 16 years played a major role in establishing the 2009 management plan. The Commission is interested in

management strategies that result in a continued, stable abundance of harvestable-size (age-1+) crabs (200 million or more) and help to increase the prevailing low abundance of recruits.

The Commission was aware that harvesters may capitalize on the increased abundance of crabs in 2009, if conservation measures in 2009 were not equally effective, as in 2008. While harvests have generally declined during the last 10 years, the Commission's early expectation was that the 2009 harvests could be above those of the past few years because of the increased abundance of age-1+ crabs. Tables 1 and 2 provide a 10-year summary of annual harvests of blue crab, from all tidal waters, including seaside areas. The lowest total harvest occurred in 2008.

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Table 1. Annual harvests (pounds) of hard blue crab, 1999 - 2008, by month and from Virginia waters.

Month	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
January	375,856	752,031	438,042	807,441	367,964	852,679	830,932	701,607	609,864	327,112
February	93,525	993,359	177,227	304,811	440,521	672,341	848,913	325,951	173,978	168,948
March	51,301	236,910	132,056	198,129	237,910	311,382	359,897	126,058	614,472	711,033
April	3,253,588	4,287,438	1,290,719	3,417,745	1,208,053	2,651,756	2,208,484	4,234,382	2,553,822	1,973,980
May	2,074,695	3,162,424	1,643,394	2,494,483	2,159,471	2,586,418	2,561,681	2,434,734	1,723,017	1,525,662
June	3,046,710	3,591,376	2,723,672	3,211,911	1,906,196	3,654,918	2,661,259	2,720,572	2,424,561	2,432,599
July	4,427,563	3,325,680	3,220,089	4,055,830	3,051,304	3,573,699	3,351,586	2,997,126	2,355,422	3,165,445
August	4,062,842	3,432,835	3,895,212	3,707,174	3,366,307	3,529,648	3,721,111	2,743,616	2,511,692	2,953,908
September	3,986,883	3,124,198	3,625,598	2,980,198	2,487,301	3,129,465	3,322,319	1,829,144	2,085,007	2,525,031
October	3,990,888	3,089,210	4,154,181	2,881,012	3,361,607	3,355,512	3,175,523	2,244,521	2,334,286	2,258,857
November	1,929,515	1,172,115	1,884,885	1,128,805	1,660,737	1,334,645	1,772,141	1,097,513	1,152,419	194,381
December	2,976,048	1,171,092	1,193,376	1,025,707	1,565,595	1,366,665	1,255,978	1,102,417	817,864	
Sub Total	30,269,414	28,338,668	24,378,451	26,213,246	21,812,966	27,019,128	26,069,824	22,557,641	19,356,403	18,236,956

Table 2. Annual harvests (pounds) of peeler and soft blue crab, 1999 - 2008, by month and from Virginia waters.

Month	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
March	229									10
April	65,174	104,312	48,457	342,847	18,450	60,568	9,155	35,876	12,397	37,319
May	850,840	886,698	1,121,529	855,394	649,379	831,286	430,748	474,286	358,260	460,875
June	432,637	261,362	375,376	242,217	248,193	213,368	231,571	118,342	104,301	156,597
July	398,185	357,006	369,651	357,018	292,041	266,339	224,591	165,597	112,376	152,390
August	303,196	353,314	369,199	231,098	334,730	207,563	166,784	113,401	104,452	108,664
September	111,519	161,243	168,682	132,220	100,717	123,334	68,347	46,223	47,586	65,767
October	13,442	8,541	9,397	10,995	19,899	8,705	26,797	6,070	6,005	8,965
November	310	329	258	2	1,037	32	60	3	4	2
Sub Total	2,175,532	2,132,805	2,462,549	2,171,791	1,664,446	1,711,194	1,158,053	959,797	745,382	990,588
TOTAL	32,444,946	30,471,473	26,841,000	28,385,037	23,477,412	28,730,322	27,227,877	23,517,438	20,101,786	19,227,544

Notes: As of 2007, the traditional starting date of the potting season of April 1 was replaced by March 17; in 2008 there was an October 27 through November 30 closed season on the harvest of female crabs, and the 2008/09 dredge fishery was suspended (no December 2008 harvest).

The Commission addressed overcapacity of effort in the blue crab fisheries, at its November 2008 meeting. The 2008 report by the Blue Crab Regulatory Review Committee and information from the VMRC staff strongly supported the Commission's decision to place inactive harvesters on a waiting list, until such time that the resource was more stable. The Commission decided there was too much risk on the resource involved to allow inactive licensees to become active, once there was even a marginal improvement in the blue crab stock. That added effort could further erode stock abundance and delay a rebuilding of the stock.

Therefore, those eligible licensees in 2008 who had failed to harvest a single pound of crab, by either peeler pot or crab pot, from 2004-07, were declared ineligible to purchase a 2009 crab fishery license

In total there could have been 867 (534 crab pot and 343 peeler pot) licenses placed on the waiting list. That total is less because of several factors. The Commission also implemented an extensive appeal process, for those individuals placed on the waiting list. That process resulted in many individuals being allowed to retain their licenses, rather than those licenses remaining on the waiting list. One main reason for that license reinstatement was that individuals had medical conditions that prevented them from harvesting in 2004 through 2007 period. In addition, the Commission exempted individuals, from the crab pot or peeler pot waiting list, who held a crab dredge license and reported harvest during both the 2005/06 and 2006/07 crab dredge seasons and were eligible crab pot or peeler pot licensees in 2008. To date, there are 287 licenses on the crab pot waiting list and 197 licenses on the peeler pot waiting list, and some individuals have both gear licenses on the waiting list. The Commission has also stipulated that once three consecutive Winter Dredge Survey results indicate an age-1+ abundance of 200 million crabs or more, there would be opportunities for those individual on the waiting list to reenter the fishery. At this time there has been one result wherein the abundance of age-1+ crabs equaled or exceeded 200 million, and that was from the 2008/09 survey.

The Commission enacted a number of conservation measures, at the conclusion of its May 2009 public hearings, in addition to maintaining many of the conservation measures adopted in 2008, as described below. The prevailing conservation plan affords the blue crab resource an opportunity to better replenish itself, by establishing management measures that would promote at least the same level of conservation of female crabs, as in 2008. At the May 2009 public hearing, the Commission was guided in its decision-making process by provisions established in §§ 28.2-201, 28.2-202, 28.2-203 and 28.2-203.1 of the Code of Virginia, and the adopted conservation measures are summarized below.

May 26, 2009: Adopted or Maintained Blue Crab Conservation Measures

- Mandatory use of 2 3/8" cull rings, in crab pots, in all areas, except the Seaside of Eastern Shore, was continued for the 2009 season. Two 2 3/8" cull rings are required in all areas, except the Seaside area, where the 2 3/16" and 2 5/16" cull rings are required. The Commission also allowed harvesters, in areas other than the Seaside areas, to keep the smaller cull rings in their crab pots, as long as two 2 3/8" cull rings were in place, to avoid damage to those pots. These larger (2 3/8") cull rings will afford greater escapement of female crabs but will also allow small, poor-quality males to escape from pots and increase their marketability. Studies have shown that the Seaside area crabs possess a different physical morphology, as compared to the bay, and requiring larger cull rings in the Seaside are would result in significant losses of legal-size crabs.

- The peeler crab minimum size limit was maintained, for 2009, as 3 ¼ inches, through July 15. As of July 16, the legal peeler crab size limit became 3 ½ inches. These measures were initially adopted in 2008. This gradation of size limits matches the Maryland provisions. The Potomac River rule is 3 ½ inches all season. For the Seaside of Eastern Shore, the peeler size limit will remain 3 ¼ inches throughout the season

(these crabs are not fully a component of the Bay stock). These increases in the minimum size limit improve the spawning potential of the blue crab. This is particularly important since the recruitment of young crabs has been poor for many years.

- The winter dredge fishery was closed for the December 1, 2009 through March 31, 2010 season. This was the second consecutive closure of the winter dredge season. The Virginia Institute of Marine Science provided information to the Commission, in May 2009, that showed a much higher abundance of over-wintering crabs, within the mainstem Bay, in January, February and March 2009, as compared to previous months in 2006 and 2008, when a winter dredge season was open.

- In 2009 the Commission expanded the May 1 through September 15 closures of the blue crab sanctuary areas, in the lower bay, by including the historical, 146-square mile sanctuary, as part of this seasonal closure. Previously, this sanctuary area was closed, by Code of Virginia, from June 1 through September 15. Through successful legislation, in the 2009 General Assembly, the Commission is now authorized by the Code of Virginia to establish times for the year that are open to harvest in this historical sanctuary area. Blue crab scientists have indicated that the early to mid-may spawning event, in the lower bay, is not as extensive as the production of larvae during summer. Yet, given the generally low abundance of the spawning stock during most of the last 17 years and the fact that overall abundance (all size groups) of crabs has been less than average (= 465 million crabs), since 1997, this additional spawning grounds closure will augment production of recruits to the stock. The Crab Management Advisory Committee supported this conservation measure.

- A fall closure to the harvest of female crabs from November 21 through November 30. For the 2008 season, this closure started on October 27 and continued through the end of November. For 2009 the Commission felt that other measures, such as the first-time May closure of all spawning sanctuary areas could compensate for the shorter closed harvest season on female crabs. This measure was supported by the Crab Management Advisory Committee.

- The Commission adopted a 15% reduction (relative to 2007 limits) in the number of crab pots that was allowed per license category, effective June 1, 2009. From March 17 through May 31, the allowable number of crab pots was equal to a 30% reduction in crab pots, relative to 2007 limits per license category. Therefore, there was less effort (pots) in the water, at the start of the season and during the time of the 2009 spring spawning by the first-time spawners. As was established for the 2008 season, a 30% reduction in peeler pot use (relative to 2007 limits) was maintained for the 2009 season. More specifically, a crab fisherman who could set 300 pots in 2007 was allowed to set only 255 pots in 2009. Similarly, a fisherman who was able to set and fish 300 peeler pots in 2007 could only set 210 peeler pots in 2009 (see Attachment II, a 22-Point Management Plan).

- The Commission maintained its prohibition on license "stacking" that was initially implemented in 2008. This means a single licensee is prohibited from holding the licenses of several family members, for example, in order to increase his competitive advantage. This measure was initiated by the Crab Management Advisory committee.

- The Commission reinstated the commercial license for recreational use of 5 crab pots that had been suspended for the majority of the 2008 season. In 2008 the Commission had provided that this 5-pot recreational license would be reinstated, when the abundance of age 1+ crabs reaches the interim target of 200 million crabs. Since the 2008-09 results from the Baywide Winter Dredge Survey indicated an age-1+ abundance of 223 million crabs, the Commission reinstated this license. However, the Commission did confine use of this license to June 1 through September 15. The reasoning behind this limited open season is that the closed seasons will afford additional protection to the cohort of first-time spawners (in fall, after September 15 and in spring, before June 1) In 2007 there were 510 licensees, and a 2001 study, by Old Dominion University, reported that the first-order estimate of the 2001 recreational harvest was equivalent to about 4% of that year's commercial harvest. The Crab Management Advisory Committee supported this measure.

- The Crab Management Advisory Committee recommended that any crab licensee whose agent (one who retains the licenses of another as a surrogate harvester) is convicted by a court of two crab fishery violations, may be subject to having any of his licenses to take crabs revoked by the Commission.. In turn, the advisor committee also recommended that any person, serving as an agent, who is convicted by a court of two crab fishery-related violations, may be subject to having his authority to serve as an agent revoked by the Commission. The Commission agreed with these recommendations and established regulations to contain these stiffer deterrents to violations.

Ecosystem Constraints on the Blue Crab Resource

§28.2.203.1.of the Code of Virginia provides that the Blue Crab Management Plan shall be designed to reverse any fishing practices, environmental stress and habitat deterioration negatively impacting the short and long term viability and sustainability of the crab stock in Virginia waters. In recent years the Commission has adopted effective conservation measures to reverse fishing practices that have negatively impacted the stock. Concerning environmental stress and habitat deterioration, the Commission relies on the efforts of its sister agencies to promote and sponsor improvements in the Chesapeake's water quality, such as the 2006 Clean Water Bond Initiative, authorizing $250 million in bonds to upgrade sewage treatment plants throughout the Chesapeake Bay Watershed. Other initiatives that may directly or indirectly translate into blue crab stock enhancements are: 1) in December 2007, Governor Kaine announced progress in bay cleanup efforts, as Virginia expects to meet Bay nutrient reduction goals for wastewater by the end of 2010; 2) in May 2009 Governor Kaine announced a $185 million investment in Chesapeake Bay cleanup by Virginia Resources Authority (from 2007 to 2009, investments total more than $810 million.); and, 3) in August 2009, Governor Kaine accepted American Recovery Act funds for wastewater treatment facilities, whereby over $80 million in funds for construction of facilities and environmental upgrades was secured.

There is keen interest, in many quarters, on the role of habitat and environmental drivers on the status of the blue crab stock. Clearly, the blue crab, as an r-strategist with a relatively quick population turnover rate, will fluctuate in abundance. However, from 1997 – 2008, overall abundance remained very low. It seems that the blue crab stock can be resilient, even in the face

of sub-optimal habitat and environmental conditions. There is now one data point (2009) that suggests this resiliency of the stock, as the abundance of age-1+ crabs increased by 70%. The Commission and the industry recognize that improvements in blue crab habitat and water quality could increase the probability for improved recruitment to the stock and the fisheries; however, many water quality and habitat impacts on this stock are not fully quantified or understood, and the relationship of blue crab among other components of the ecosystem is still being explored by Chesapeake Bay scientists.

Currently, these scientists have joined to cooperatively formulate an Ecosystem-Based Fishery Management Plan for the Blue Crab. Attachment IV contains the scientists' findings concerning the many natural and man-induced impediments that currently challenge the stability of the blue crab stock, such as hypoxia, loss of seagrass beds, shoreline development and pollution. These potential impacts are identified, but it has not yet been determined which of these environmental or habitat stressors or combination of physical, chemical or man-induced factors are deleterious to the blue crab resource and habitat that supports that resource. As part of a pending Ecosystem-Based Fishery Management Plan, scientists will utilize analytical techniques (models) to help answer these questions. Once that process is complete, the Plan will provide information and guidance to the natural resource agencies, regarding these findings. In turn, the Commission's blue crab management plan can be improved.

Nutrient enrichment and the systemic increase of hypoxic and anoxic zones within the Chesapeake Bay are also listed as potential contributors to the sustained (1997 – 2007) low abundance of blue crab, in the bi-state blue crab disaster-relief request. Scientists involved in the development of the Ecosystem-Based Fishery Management Plan For The Blue Crab note that when deeper waters of the mainstem are affected by low dissolved oxygen, mature females are forced into shallower areas where they are more susceptible to fishing pressure, predation and competitive interactions. Severe hypoxic events also destroy entire populations of benthic prey (e.g. clams, worms), thereby excluding them entirely from exploitation by blue crabs (see Attachment IV).

These Chesapeake Bay scientists also describe the effects of seagrass loss and degradation on the blue crab stock and yield from the crab fishery and explain that seagrass beds provide nursery habitat for newly settled, young juvenile and mating blue crabs. They note that peak densities of 50 to 90 newly settled juvenile crabs per square meter in seagrass beds exceed those in surrounding unvegetated habitats by a factor of 10 or more and that seagrass beds also harbor high densities of larger molting blue crabs because of the refuge provided from predators (see Attachment IV).

Recently, Dr. Robert Orth (VIMS) provided the Commission with an update of the distributional limits of submerged aquatic vegetation (SAV) in the Chesapeake Bay and adjacent areas (Attachment V). The Chesapeake Bay Program goal is to have 185,000 acres of SAV covering the bottom of the Bay and its tidal tributaries by 2010. As Dr. Orth notes (slide 1 of Attachment V), there has been an increase in SAV , since 1984, but existing coverage (in acres) is far below this program goal. The goal of the Chesapeake 2000 Agreement was to recommit to the existing goal of protecting and restoring 114,000 acres of submerged aquatic vegetation. Dr. Orth also characterizes SAV restoration efforts (see slides 4 and 5 of Attachment V).

Predators of blue crab, especially striped bass and, more recently, blue catfish have been linked by many, in industry and elsewhere, as contributors to the trend in low abundance of blue crab. These predator-prey relationships have been explored for striped bass and blue crab, by a number of researchers. Blue crab removals from grass beds and other areas of the bay, by striped bass, have been documented, and the results, to date, indicate that blue crab have become a more important prey item of striped bass in recent years, but there is variability, by area and time of year. Prior to the 1995 – present period of high biomass of striped bass, the 1960- 1972 period was also one of high striped bass biomass. High landings during part of this 13-year period suggest that blue crab biomass was also high during several of those years, despite high striped bass biomass.

VIMS has analyzed gut contents (diet) of striped bass collected from its Chesapeake bay Multispecies Monitoring and Assessment Program (CHESMMAP)--a Chesapeake Bay-wide trawl survey designed to collect, enumerate, age and analyze adult fishes. Combined diet data from 2002 through 2008 trawl cruises indicates that crabs (22 different types) comprise < 2% of the 7 year collection of striped bass (N = 2251 striped bass). The investigators do indicate a different approach was used to calculate the fish diet. This and other information on the Virginia Institute of Marine Science program can be found at:
http://www.fisheries.vims.edu/chesmmap/cmaptrawl.htm.

The Virginia Department of Game and Inland Fisheries has been conducting diet studies on blue catfish. These studies can help us to learn more about the effect of blue catfish predation on blue crab. However, in all cases more directed efforts may be needed to adequately quantify the impacts, on blue crab, from these predators. For example, there is a need for an estimate of the abundance or biomass of blue catfish, in order that any derived blue catfish predation rates on blue crab can be expanded to a blue catfish population basis. Without these blue catfish population estimates, estimates of predation on blue crab are speculative. The Commission is expecting a detailed report from the Virginia Institute of Marine Science.

Blue Crab Fishery Resource Disaster Relief Plan

On June 13, 2008, Commissioner Bowman and the Director of the Maryland Department of Natural Resources Fisheries Service requested the determination, by the National Marine Fisheries Service, of a Fishery Resource Disaster in the Chesapeake Bay Blue Crab Fisheries

This request, for a disaster assistance evaluation, was based mainly on commercial fishery losses (harvest opportunities), in 2008 and a subsequent 3-year period. Economic losses accumulated over the last decade, as blue crab abundance in Chesapeake Bay persisted at extremely low levels. The request stated that economic losses will be severely compounded in 2008, as the states of Maryland and Virginia have committed to a plan that maximizes the chance for rebuilding the crab population and associated fisheries. This plan includes regulatory measures designed to achieve a 34% reduction of the bay-wide harvest of female crabs in 2008. A fundamental component of this plan is for each state to enact early season closure to the harvesting of females crabs, in order to allow pregnant female crabs that have yet to spawn transit from Maryland waters to the lower (Virginia) bay, where these female crabs can over-winter and spawn in 2009.

On September 23, 2008 U. S. Commerce Secretary Carlos M. Gutierrez determined that there had been a fishery failure in Virginia. By November 18, 2008 NOAA's Fisheries Service announced that Virginia will each be eligible for up to $10 million to assist watermen who have been economically hurt by the commercial fishery failure. The NMFS requested that the VMRC submit a plan that would detail how potential disaster grant funds would be utilized. The Commission plan (submitted in January 2009) is detailed, as Attachment II, below. There are two parts to the Virginia plan, as the initial plan was provided when NOAA had planned to grant $10 million, in disaster relief funding, to the state. The second plan or addendum was submitted to the NMFS (June 2009), once it was known there would be additional money ($4,995,000) available for the state via the Omnibus Appropriations Act of 2009. All programs or projects will enlist those individuals that were impacted by the declared blue crab fishery disaster, as described throughout Attachment II.

The initial disaster relief funding of $10 million is dedicated to six projects, with a modest amount for VMRC to administer those projects. The second amount of funding ($4,995,000) will be used mainly to augment projects of the initial plan. For example, the additional funding will allow eight additional participants in the Derelict Blue Crab Pot and Marine Debris Removal Project that was summarized above. The additional funding will also supplement oyster aquaculture projects, by allowing the spat on shell oyster production project and the project that involves crab industry participants in cultchless oyster aquaculture to continue for three years. Part ($50,000) of the additional allocated funds was applied to Project VI: Update of Blue Crab Stock Assessment. The only new project funded from the additional $4.995 million was: Promotion of Markets for Oyster Aquaculture (Marine Products Board).

Please find a brief progress update (year 1) on two of the oyster aquaculture project listed as IV. Oyster Aquaculture in Attachment II:

Cage Aquaculture Training

The Conservation and Replenishment Department has been training watermen in oyster aquaculture for a number of years. In cage aquaculture, cultchless, individual oysters are grown in structures to protect them from predation. These oysters are grown for the more lucrative, though smaller, half shell market. Grow out requires more labor, but the schedule for husbandry is flexible and works well with the schedules of most watermen in Chesapeake Bay. In 2009, this program was expanded with Blue Crab Disaster funding to make the training available to crab fishermen. More than 60 crab fishermen began the cage aquaculture training program in the fall of 2009.The boats and crab pot handling equipment that the crab fishermen work with every day, work very well with the cages used in this program. The training program will be advertised again in 2010 for crab fishermen. A training manual for growing oysters in cages is also being completed for the watermen.

Spat on Shell Aquaculture

The Conservation and Replenishment Program has been training watermen since 2005 in setting oyster larvae on shell (spat on shell), and deploying these shell loose on the bottom. This method of oyster aquaculture requires that shells be containerized, the containerized shells placed in large tanks which are filled with bay water, and the deployment of eyed, oyster larvae on the shells while they are in the tanks. This program has depended on the expansion of the

private oyster hatchery capacity in Virginia to provide the billions of eyed larvae necessary to make this program move forward. Blue Crab Disaster funding has allowed approximately 35 crab fishermen to start a spat on shell project in late 2009, and an additional 35 crab fishermen to begin a spat on shell project in 2010. Currently at least 5 hatcheries in Virginia are preparing to provide eyed oyster larvae for these projects, and about 12,000 bushels of oysters should be produced in 20

Crab License Buy-Back Program

The Commission provided nearly 45% of the disaster relief funds to the crab pot and peeler pot license buyback program (Project V of Attachment II). The Commission has been aware of overcapacity in these fisheries, for a decade. In May 1999, the Commission initiated a one-year moratorium on the sale of all additional commercial crabbing licenses. In May 2000, the crabbing license sales moratorium was continued until May 26, 2001. The moratorium was again extended for 2002 and 2003, and, recently, this moratorium on the sale of additional crabbing licenses was extended through 2011. Key recommendations of the Commission-convened Blue Crab Regulatory review Committee included: 1) the VMRC should consider any measures that would reduce effort in this fishery, until such time that exploitation rates remain at or near the target, for several years. Any effort reductions in this fishery will also improve the exploitation rate on female crabs, as this fishery harvests the majority of female crabs; and, 2) a crab pot and peeler pot license buy-back program could be useful in reducing active and potential effort, while providing compensation to harvesters impacted by the resource disaster. Total fishing effort includes both active and latent crab licenses, approximately in a 1:1 ratio. A continued high exploitation rate and low abundance of every size group of crabs, despite a 40% - 45% reduction in active harvesters, since 2003, indicates there is an excess of active effort in the crab pot and peeler pot fisheries, and these two gear types account for 87% or more of the annual crab harvest. Priority should be given to the buy-out of active licensees, for these reasons. Among active harvesters, there are different levels of activity. Roughly, 35% of active harvesters are “full-time” crab fishermen.

There was $ 6,724,470 allocated by the Commission to the buy-back program. The objectives of the program were to reduce both active and currently inactive effort (waiting list participants) in the crab pot and peeler pot fisheries. Buy outs were based on a fisherman-bid process, whereby the active or inactive licensees could negotiate a buy-out price, with the Commission. Priority, for buy-outs, was given to active licensees, and it was intended that 50% of the budget funds would be used to buy out active licensees who can be considered “full-time” crab harvesters (e.g. fished crab pots at least 100 days or fished peeler pots at least 60 days).

Of total program funds, the Commission intended that 30% would be used to buy back licenses from less active crab fishermen (e.g. fished crab pots less than 100 days or fished peeler pots less than 60 days). The remainder of the funds (20%) were obligated to purchase inactive licenses of those individuals currently on the waiting list. At some future time, these currently inactive fishermen could become active, so a buy-out, now, will help lessen future overcapacity.

Low bids, within an activity category (active, partly active, inactive), were targeted for buyouts (a reverse-auction process), after the Commission received bids from the peeler pot and crab pot crab fishermen on November 1, 2009. The reverse auction process was concluded, by

the Commission, on November 18, 2009, and letters were sent to all bidders, regardless of whether their bids were accepted. The following statistics characterize this successful buy-back program.

Table 1. Summary of buy-back statistics, according to full time, part time or waiting list status.

	Relief Funds		Buy-Back		Bids	
Class	**Proportion**	**Allocation**	**Spent**	**Proportion**	**Offers**	**Accept**
Full-Time	0.50	3,362,235	3,320,397	0.49	76	59
Part-Time	0.30	2,017,341	2,036,131	0.30	358	131
Wait List	0.20	1,344,894	1,368,633	0.20	230	169
Total	1.00	6,724,470	6,725,161	1.00	664	359

Table 1 shows the Commission stayed within its pre-determined objectives, concerning the proportional allocation (50%, 30%, 20%), according to status of activity. The Commission expended $674 more than allocated to the buy-back program and will use part of its administrative costs to cover this extra expenditure. A total of 359 licenses were purchased.

Table 2. Total number and value of bids accepted, by harvester category and gear.

		Full-Time		Part-Time		Wait List		Total	
Gear	# Pots	# Licenses	# Pots	# Licenses	# Pots	# Licenses	# Pots	# Licenses	# Pots
Crab Pot	85	3	255	18	1,530	42	3,570	63	5,355
Crab Pot	127	2	254	4	508	2	254	8	1,016
Crab Pot	170	0	0	4	680	6	1,020	10	1,700
Crab Pot	255	21	5,355	42	10,710	46	11,730	109	27,795
Crab Pot	425	7	2,975	5	2,125	7	2,975	19	8,075
Peeler Pot	210	26	5,460	58	12,180	66	13,860	150	31,500
	Total	59	14,299	131	27,733	169	33,409	359	75,441

Table 2 shows the number of licenses purchased, according to category (full time, part-time or waiting list) and the corresponding number of pots previously licensed by those individuals. By category, 59 full time (as of 2009) harvesters' licenses were purchased, and, collectively, 14,299 pots (5,460 peeler pots and 8,839 crab pots) are removed from the 2010 fisheries. Similarly, 15,553 crab pots, from 73 part-time crab pot fishermen were retired, and 12,180 peeler pots were retired from the fishery, from the purchase of 58 part-time peeler licenses. From the wait list, the Commission purchase 169 licenses (66 were former peeler pot licensees, the remainder were previously licensed for the crab pot fishery). Table 2 also summarizes the license purchases by gear category amounts (e.g. up to 85 crab pots, 425 crab pots or 210 peeler pots).

Table 3 provides a summary of statistics related to the overall buy-back program, in terms of the magnitude in value of bids that were accepted by the Commission, according to harvester and gear category. These median or mid-point statistic means that 50% of the successful bids were either less or more than this median (mid-point estimate).

The license buy-back program lowered the number of pots (peeler pot and crab pot) that could be used by the fishermen, from 422,976 pots to 347,408 pots. This represents a 17.87%

reduction in the number of pots available for these two fisheries. By gear-based fishery, the number of peeler pots available for the fishery was lowered by 22.2%, and the number of available crab pots was lowered by 15.7%.

Table 3. Statistics summarizing the value of purchased licenses, by gear and harvester category.

Harvester Category	Gear	Successful Bid Statistics			
		Lowest	Highest	Average	Median
Full-Time	Crab Pot	$6,000	$150,000	$57,667	$49,998
	Peeler Pot	$5,000	$175,000	$54,515	$39,500
Part-Time	Crab Pot	$500	$100,000	$18,555	$10,000
	Peeler Pot	$500	$50,000	$11,753	$9,500
Wait List	Crab Pot	$1,000	$35,000	$8,721	$6,000
	Peeler Pot	$500	$21,000	$7,127	$5,375

ATTACHMENT I.

2009 Chesapeake Bay Blue Crab Advisory Report
Approved by the Fisheries Steering Committee: June 22, 2009

2009 Chesapeake Bay Blue Crab Advisory Report
Approved by the Fisheries Steering Committee: June 22, 2009

In 2006, the NOAA Chesapeake Bay Stock Assessment Committee (CBSAC) adopted the Bay-wide winter dredge survey (WDS) as the primary indicator of blue crab stock status because it is the most comprehensive and statistically robust of the blue crab surveys conducted in the Bay[1]. The WDS measures the density of crabs (number per 1,000 square meters) in Chesapeake Bay. These densities are then adjusted to account for the efficiency of the sampling gear and then expanded to reflect the area of Chesapeake Bay. The WDS provides a precise annual estimate of abundance of over-wintering crabs by age and gender grouping (Sharov et al. 2000).

Abundance

The abundance of spawning age crabs (age 1+) is a key indicator of stock status, and is used to determine if the population is overfished (see control rule section below). At the beginning of the 2009 commercial season, results of the 2008-2009 WDS indicated that the abundance of age 1+ blue crabs was 223 million crabs, based on a mean survey abundance of 23.8 crabs per 1,000 square meters (Figure 1). This value represents a 70% increase over the 2007-2008 value of 131

million, based on a survey mean of 13.3 crabs per 1,000 square meters. The abundance of age-1+ crabs in 2008-2009 is above the interim target level of 200 million spawning age crabs (Figure 1). The increase in abundance of spawning-age adults in the 2008-2009 survey was due primarily to an increase in the number of females that are likely to spawn this season (females greater than 60 mm or 2.4 inches carapace width). The estimated abundance of spawning age females in the 2008-2009 survey is 165 million crabs, based on a survey abundance of 18.3 crabs per 1,000 square meters (Figure 2). Male spawning potential (abundance of males greater than 60mm or 2.4 inches carapace width) in 2008-2009 was 59 million crabs, based on a survey mean of 6.5 crabs per 1,000 square meters (Figure 3).

Recruitment, as measured by the abundance of age 0 crabs (less than 60 mm or 2.4 inches carapace width) did not increase measurably from the 2007-2008 WDS. The estimated abundance of age 0 crabs was 169 million crabs during the 2007-2008 survey and 179 million crabs during the 2008-2009 survey. The abundance of young crabs remains well below the survey average of 258 million crabs (Figure 4).

Data from three supporting blue crab surveys (the Maryland and Virginia trawls and the Calvert Cliffs Pot study) were reviewed. Results of these surveys are presented in Appendix 1 of this report. The results of these surveys were generally consistent, showing an increase in the abundance of adult crabs, and a continued low abundance of age 0 recruits.

Harvest

The estimated 2008 Bay-wide crab harvest was 48.6 million pounds, slightly higher than the record-low 2007 harvest of 43.5 million pounds. The 2008 Maryland harvest is estimated to be 29.4 million pounds. The 2008 Virginia harvest was reported to be 16.7 million pounds, and 2.5 million pounds were reported harvested in the jurisdictional waters of the Potomac River Fisheries Commission (Figure 5). Recreational harvest is assumed to be 8% of the total harvest in all years (Ashford and Jones 2002) [2].

A comparison of harvest data in 2008 with those from earlier years gave no indication of changes in the pattern of reporting in either Virginia or in the Potomac River. However, Maryland experienced significant reporting problems in 2008 due to the 2008 management actions, which assigned daily catch limits based on an individual's catch history. Crabbers with no catch history in the most recent 4 years were not permitted to harvest female crabs during Maryland's 2008 fall female crab fishery, which begins September 1 and is historically responsible for 60 to 65% of Maryland's annual female harvest. This management action, combined with the large number of latent crab licenses in Maryland, resulted in inflated catch reports as previously inactive crabbers filed inaccurate, positive catches in order to position themselves for future regulatory action. Other changes in reporting behavior were evident and are outlined in Appendix 2. Maryland's 2008 harvest estimate is derived from weekly CPUE data gathered via Maryland's reference fleet of crabbers, and a concurrent survey that estimates the number of crab pots deployed in Maryland waters (Appendix 2). Inspection of Virginia and Potomac River Fisheries Commission reports did not reveal any similar reporting problems.

Control rule

The control rule, which was adopted by the Bi-State Blue Crab Advisory Committee in 2001[3], and updated in the 2005 stock assessment[4], is the foundation for sustainable management of the blue crab fishery in Chesapeake Bay (Figure 6). The control rule represents the relationship between adult crab abundance (millions of crabs), exploitation (the fraction of crabs removed by the fishery in a year) and management reference points. In 2006 the CBSAC defined the overfished limit to be 86 million age 1+ crabs. This threshold value, observed in the 1999-2000 WDS, is the lowest value in the 20-year WDS time series, and is applied as a proxy based on a lack of historical evidence that a sustainable fishery can be maintained at less than 86 million crabs. The overfishing definition, or exploitation threshold, for this stock is based on the consensus that a minimum of 10% of the spawning potential of an unfished population must be preserved to reliably produce the next generation of crabs. The target exploitation fraction of 46%, maintained over several years, represents an exploitation fraction that would preserve 20% of the unfished spawning potential.

In January 2008, CBSAC established an interim target of 200 million spawning age (1+) crabs. This target was established based on analyses suggesting that 200 million age 1+ is a minimum age 1+ (or spawning age abundance) associated with consistently higher levels of recruitment.

Stock Status

The abundance of spawning-age crabs in 2009 exceeded the interim target level for the first time since 1993. The percentage of crabs removed by commercial and recreational fishing (exploitation fraction) in 2008 is estimated to be 48%, which is below the overfishing threshold of 53%, but slightly above the target of 46%. When considering both commercial and recreational harvest, the exploitation fraction has been above the threshold exploitation fraction of 53% in 8 of the last 11 years (Figure 7). Further, the exploitation fraction has not been below the threshold for more than 2 consecutive years since the mid-1990s.

Recommended harvest and exploitation

The 2008-2009 WDS produced an estimated total abundance of 402 million crabs. A Bay-wide harvest that is constrained to the 46% target would be approximately 53.7 million pounds – slightly higher than the 2008 harvest of 48.6 million pounds.

Management Advice – Short Term

1) Maintain conservation measures until full effects of these are known:

The 2008 management actions substantially restricted female harvest. Surviving females will begin spawning during the spring of 2009, and the success of this spawn should be reflected in the abundance of age 0 crabs estimated during the 2009-2010 WDS. Recruitment is strongly influenced by environmental drivers which could prevent an immediate substantial increase in recruitment (age 0 abundance) despite increased adult abundance. Thus, the effectiveness of the conservation measures in the commercial fishery in 2008 will not be fully known until abundance in the 2009-2010 and 2010-2011 WDS is estimated. The CBSAC considers it important that conservation efforts be maintained until their impacts on recruitment and future spawning potential can be assessed.

2)Latent effort:

The conservation effort in 2008 led to an increase in the abundance of mature female crabs in the 2008-2009 WDS. One threat to the sustainability of the crab stock, even under equivalent conservation levels to 2008, is the substantial effort that remains latent in the fishery. The CBSAC recommends that management pursue methods for eliminating latent effort so that it cannot enter the fishery sufficiently rapidly so as to compromise the ability of Bay managers to constrain the fishery to the 46% target removal level. Control of active effort requires constraint that is impossible with the unknown quantity of latent licenses.

3) Catch Reports:
Implement procedures that allow jurisdictions to validate harvest reports such as expanding the current observer coverage, implementing broader scale effort surveys, or developing logbooks that are linked with dealers as a means for validation. The jurisdictions should explore techniques that would promote reliable and real-time reporting.

4) Recreational Catch and Effort:
Recreational catch and effort remains poorly quantified in Chesapeake Bay. The jurisdictions should consider methods for more precisely calculating recreational catch and effort, possibly through licensing systems.

Management Advice – Long Term

CBSAC recommends two principal strategies for consideration of future management of the blue crab fishery:

1) Catch Control:
A management strategy that sets annual catch targets based on estimates of abundance from the winter dredge could potentially balance annual harvest with highly variable recruitment. If jurisdictions wish to consider such an approach, now is the time to begin work developing a foundation for implementation and enforcement of catch-based management. This would require reliable, real-time reporting. In addition, a limited entry and/or property based approach would require identifying a suitable number of participants.

2) Effort Control:
Controlling effort has been the foundation of crab management in recent years. The principal tools used by managers have been limited entry, size limits, catch limits and seasonal closures. However, the total amount of effort expended in the fishery remains poorly quantified. Thus, the effectiveness of management efforts remains difficult to quantify. As part of a long term management plan, tighter effort controls maybe necessary. Effort monitoring programs could be improved by incorporating pot tagging so that pot effort is measurable and enforceable.

Recommended Analyses:

The last benchmark assessment for blue crabs was completed in 2005 with data through 2003. CBSAC recommends undertaking a new benchmark assessment that advances current knowledge of stock status and fishery performance. Terms of reference could include:

Terms of reference from the 2005 assessment:

- Assess and quantify the life history and vital rates of blue crab in the Chesapeake Bay that are relevant to an assessment of the stock.
- Describe and quantify patterns in fishery-independent surveys.
- Describe and quantify patterns in catch and effort by sector and region
- Develop and implement assessment models for the Chesapeake blue crab fisheries.

Possible additional terms of reference for new benchmark assessment:

- Examine density-dependent exploitation patterns.
- Evaluate the potential for sex-specific biological reference points, including a sex-ratio benchmark.
- Recommend biological reference points.
- Describe and quantify patterns in catch and effort by sector and region, including analysis that examines trends in CPUE.
- Conduct life-history modeling that characterizes sensitivity of population to demographic rates. Some elements to be considered include:
  - -Sperm limitation potential.
  - -Fecundity and maturity schedules for female crabs.
  - -Exploitation rates for different fishery sectors such as peelers.
  - -Interactions of life history differences between male and female and different exploitation patterns (both management and market driven) rates.
  - -Spatial variation

Critical Data Needs:

It is critical that robust, fishery-dependent data collection programs be maintained and improved for blue crabs throughout the Chesapeake Bay. The WDS remains the core of the assessment of blue crab in the Chesapeake Bay. However, this sampling framework provides an abundance estimate for crabs only for the beginning of the season. A mid-season abundance estimate and a fall recruitment estimate would also be of high utility. Other program should consider the need for improved information on biological characteristics of the harvest and reliable effort data for the commercial and recreational fisheries. A collaborative and coordinated Bay-wide fishery-independent survey focused on the spring through fall distribution and abundance of blue crabs remains important.

Chesapeake Bay Stock Assessment Committee Members:

Chris Bonzek VIMS (not present)
Lynn Fegley Maryland DNR – chair
John Hoenig VIMS
Tom Miller CBL
Rob O'Reilly VMRC
Derek Orner NMFS/NCBO
Alexei Sharov Maryland DNR
Josef Idoine NMFS/NEFSC
Doug Vaughan NMFS/SEFSC

Also Participating:

Rom Lipcius VIMS
Eric Johnson Smithsonian Environmental Research Center
Glenn Davis Maryland DNR

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1. Sharov, A. F., J. H. Volstad, G. R. Davis, B. K. Davis, R. N. Lipcius, and M. M. Montane. 2003. Abundance and exploitation rate of the blue crab (Callinectes sapidus) in Chesapeake Bay. Bulletin of Marine Science **72**:543-565.
2. Ashford, J. R., and C. M. Jones. 2002. Survey of the blue crab recreational fishery in Maryland, 2002. Final Report to the Maryland Department of natural Resources. Annaplos, MD. 31p.
3. Bi-State Blue Crab Advisory Committee. 2001. Taking Action for the Blue Crab: Managing and Protecting the Stock and its Fisheries. A report to the Chesapeake Bay Commission; Annapolis, Md, Richmond , Va. 24p.
4. Miller, T. J. et al. 2005. Stock Assessment of the Blue Crab in Chesapeake Bay. Technical Report Series No. TS-487-05 of the University of Maryland Center for Environmental Science, 162p.
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Attachment I
(continued)

CBSAC

2009 Blue Crab
Advisory Report

Figure 1. Winter dredge survey estimate of **abundance of male and female blue crabs aged one year and older (age 1+) 1989-2009.** These are crabs measuring greater than 60mm across the carapace and are considered the 'exploitable stock' that will spawn within the coming year. The lowest observed abundance of 86 million crabs was observed in the 1998-1999 survey. This is considered the overfished threshold. The interim target abundance has been set at 200 million crabs.

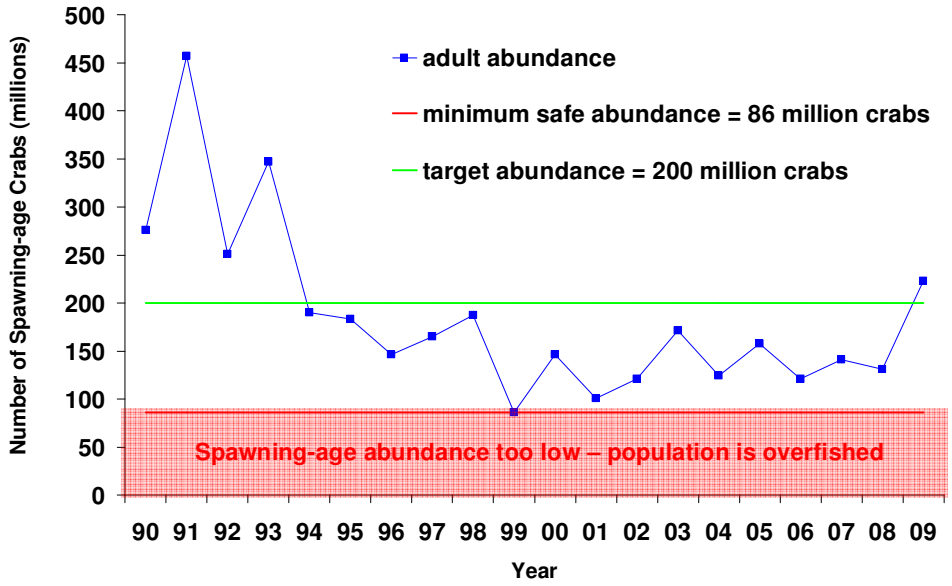


Figure 2. Winter dredge survey estimate of **abundance of female blue crabs aged one year and older** (age 1+) 1990-2009. These are female crabs measuring greater than 60mm across the carapace and are considered the 'exploitable stock' that will spawn within the coming year.

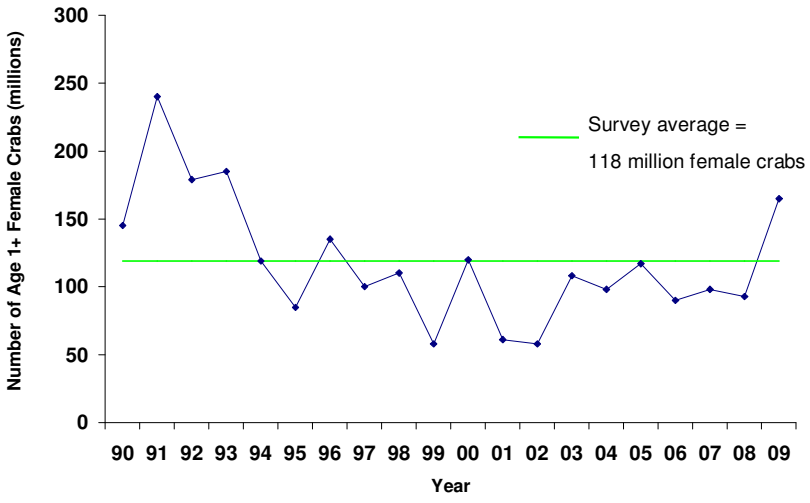


Figure 3. Winter dredge survey estimate of **abundance of male blue crabs aged one year and older (age 1+)** 1990-2009. These are female crabs measuring greater than 60mm across the carapace and are considered the 'exploitable stock' that will spawn within the coming year.

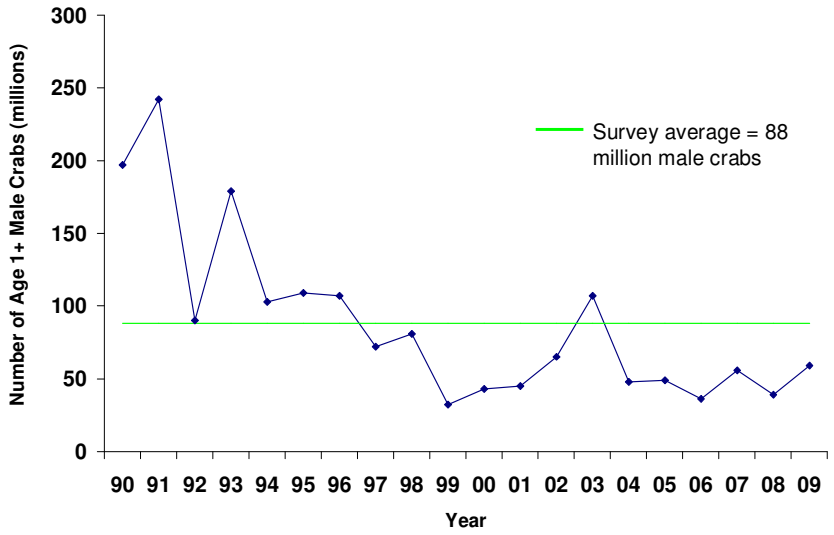


Figure 4. Winter dredge survey estimate of **abundance of age 0 crabs.** 1990-2009. These are male and female crabs measuring less than 60mm across the carapace.

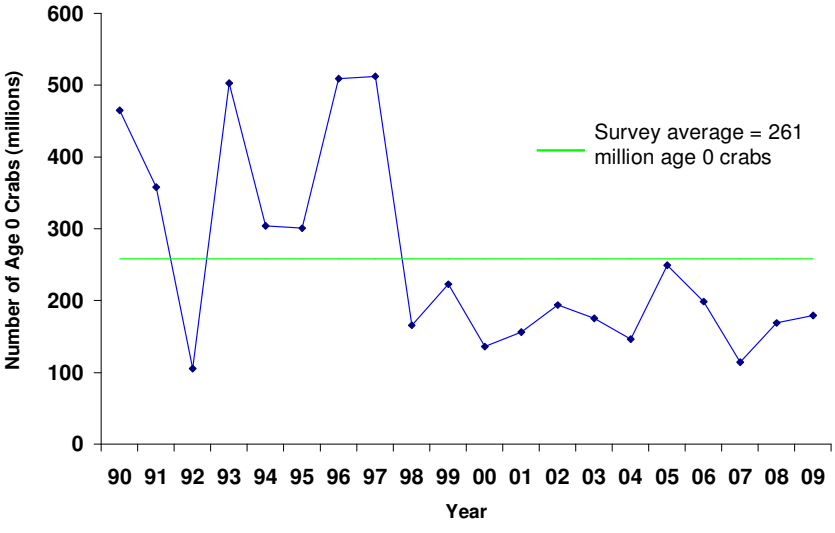


Figure 5. Maryland and Virginia Chesapeake Bay Blue Crab harvest 1945-2009, adjusted for changes in reporting methods.

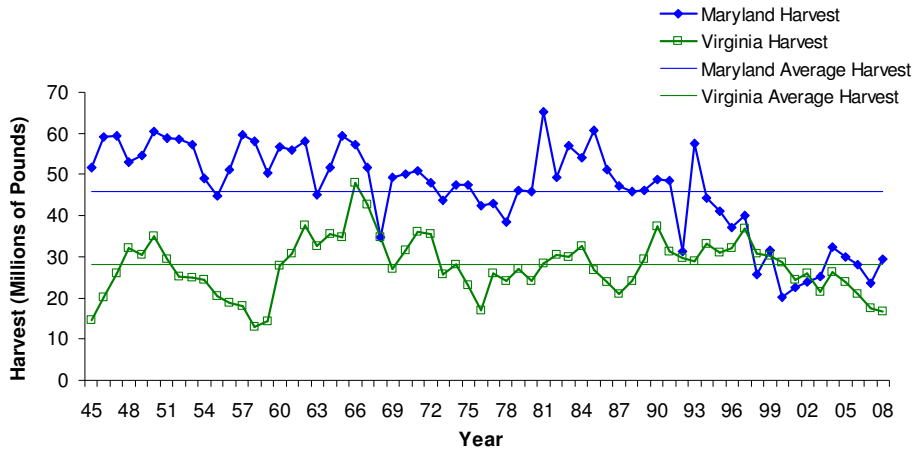


Figure 6. The control rule used to manage the Chesapeake Bay blue crab fishery. An abundance of 86 million age 1+ crabs represents the overfished threshold. In 2007, abundance was above the overfished threshold and the exploitation rate was above the overfishing threshold.

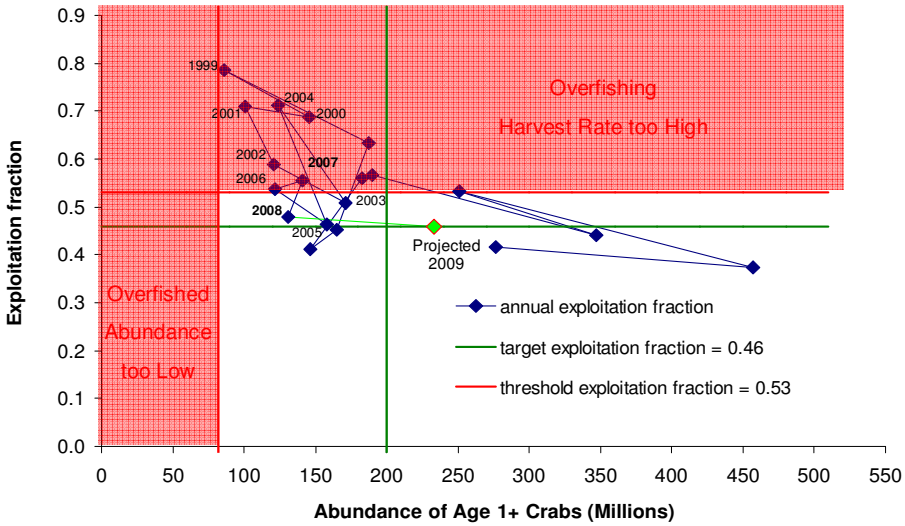
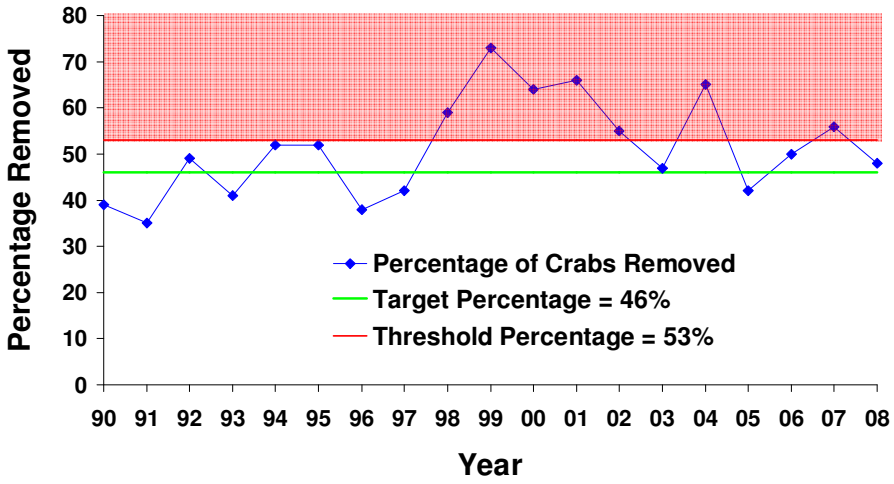


Figure 7. The percentage of crabs removed from the population each year by fishing relative to target and threshold levels between 1990 and 2008.



ATTACHMENT II

Virginia Marine Resources Commission
Blue Crab Fishery Resource Disaster Relief Plan
(Submitted January 30, 2009 to the National Marine Fisheries service)

Overview

The Commonwealth of Virginia's plan, for the blue crab fishery resource disaster funding, consists of several projects that are designed to provide additional work opportunities to those in the crab industry and to restructure the blue crab fishery. Specific details and budget narratives, for each component, are summarized below.

I. Derelict Blue crab pot and marine debris removal project (VMRC/VIMS)
II. Cull ring and excluder device project (VIMS)
III. Supplemental funding, for the Fishery Resource Grant Program (VIMS)
IV. Oyster Aquaculture (VMRC)
V. Crab pot and peeler pot license buy out (VMRC)
VI. Update of blue crab stock assessment (VMRC/MD DNR)
VII. Administration fees (VMRC)

It is intended that various crab industry members (harvesters, buyers, processors), who have experienced financial setbacks from the decade-long condition of very low abundance of the blue crab resource, are provided an opportunity to work in resource enhancement projects. In some cases, priority, for participation in certain projects, will be given to those peeler pot, crab dredge, and crab pot harvesters previously described in documents provided to the National Marine

Fisheries Service, requesting the determination of a blue crab fisheries resource disaster in the Chesapeake Bay.

I. DERELICT BLUE CRAB POT AND MARINE DEBRIS REMOVAL PROJECT

Estimated costs, for this project, are $1,593,151 million, in the first year (this assumes a per day payment to 57 watermen of $300/day), with compensation for services (vessel use, time and gasoline costs included), for payments to participating watermen and $247,171 (year 1); $250,118 (year 2); and, $270,307 (year 3), for project management by the Virginia Institute of Marine Science.

This project began on December 15, 2008. Discarded debris such as tires, gill nets appliances and crab pots are located throughout Virginia waters. Derelict crab pots may persist in our waters, for several years, and trap many different species of wildlife. This study offers a means to safely remove and dispose of this marine debris. Derelict crab pots can be removed by hand, from shallow, intertidal waters, but un-buoyed derelict pots, in deeper water, require sonar, for identification, and some type of grappling, for retrieval. Watermen who would have been eligible to participate in the 2008/09 crab dredge season (this season was closed, by the VMRC, in April 2008) were invited to participate in the sonar-based, crab pot and marine debris retrieval project.

II. CULL RING AND TERRAPIN EXCLUDER DEVICE PROJECT

Goal: To provide employment for Virginia's watermen, while concurrently generating information on the effectiveness of current regulations, restoration approaches, and potential ecosystem-based management measures for the blue crab and native oyster fisheries and populations in Chesapeake Bay. The following activities have been endorsed by the Virginia Waterman's Association (VWA) and will be conducted in collaboration with VWA and VMRC.

Project Objectives and Activities

1. To employ Virginia's watermen, particularly crabbers, while conducting restoration activities aimed at enhancing secondary production of the blue crab and native oyster. In ALL of the following activities, watermen will be employed to do the bulk of the work.
2. To determine the effects of different cull ring sizes in crab pots on blue crab catch, biomass and survival.
3. To determine the effects of bycatch reduction devices in crab pots on blue crab catch, biomass and survival, on finfish bycatch, and on diamondback terrapin survival.

Study Sites

Project activities will be conducted in the Lynnhaven River system (Site a), James River (Site b), York River (Site c), Rappahannock River (Site d), Great Wicomico River (Site e), Tangier Sound (Site f), Pocomoke Sound (Site g), and bayside Eastern shore (Site h). Activity 2 will be conducted at Sites a-h; activity 3 at a-c and h.

Methods and Rationale

All activities will be coordinated by VIMS and implemented by watermen in five tributaries of the western shore and three locations on the eastern shore of Virginia during two seasons in 2009. The role of VIMS will be to coordinate the effort with VMRC and VWA, analyze the data, and prepare reports on the results. This is expected to be a fully cooperative effort with VMRC and VWA. All three entities (VIMS, VMRC and VWA) will design the work plan and cooperate in its conduct and analysis. Selection of the watermen will be accomplished in discussions with and approval by VMRC and VWA so that the selection process is fair and equitable.

Activity 2 will be conducted at downriver and upriver locations in the tributaries and bayside Eastern shore. On the bayside Eastern shore, the study will be conducted near Sites f and g, and at two additional areas along the bayside Eastern shore south of Tangier Island (e.g. Silver Beach). There will be upriver (nearshore) and downriver locations to achieve wide spatial coverage. There will be five cull ring treatments across four sizes of cull rings and a no-ring control. Pots will be sampled daily for different time periods by watermen. Final cull ring sizes and field sites will be determined in consultation with VMRC and VWA. This activity will use existing crab pots retrofitted with the cull rings so that there will not be additional gear in the water as a result of the activity. The lines from the crab pots are short and simple enough that they do not typically cause problems for marine mammals or sea turtles. In fact, the PI is head of the VIMS Sea Turtle Program and is therefore keenly aware of any potential gear issues with sea turtles and marine mammals.

Activity 3, using bycatch reduction devices to reduce diamondback terrapin and finfish bycatch, will be conducted in shallow marsh-fringed coves or shorelines where diamondback terrapins are known to reside. This project stems from our recent work in summer 2008 where we deployed 20 crab pots at Felgate's Creek in the York River and at Fort Eustis in the James River. Those experiments demonstrated that crab catch was not reduced in pots with excluders, but that terrapin mortality was eliminated. The crab pots are outfitted with "breathing chimneys" which allow terrapins to surface and breathe while still being retained in the pot to allow estimation of terrapin capture. In the previous study, there were no terrapin injuries or mortalities in the experimental pots. This activity will also use existing crab pots retrofitted with the excluders and breathing chimneys so that there will not be additional gear in the water as a result of the activity.

- Employment of watermen to conduct the study
- Conservation benefits of cull rings and terrapin excluder devices
- Crab catch effects of cull rings and terrapin excluder devices

Expenses

Most of the expenses will be directed at employment of watermen; a smaller portion will cover some VIMS staff time, crab traps, travel, vessel use, and terrapin excluder devices. We expect to employ 20-30 watermen/crabbers, in the locations noted previously, at $300 per day plus fuel and supplies. VIMS will be reimbursed for staff time, pots, cull rings, excluders, vessels and travel.

BUDGET (The total cost of the project is $339,500).

III. Supplemental funding, for the Fishery Resource Grant Program. The estimated cost, for this project, is $300,000.

Background

The Virginia Legislature created the Fishery Resource Grant Program Trust Fund (VFRGP) [1] within the state treasury to "protect and enhance the Commonwealth's coastal fishery resource through the awarding of grants" in four areas: 1) new marine fisheries equipment or gear; 2) environmental pilot studies on issues including water quality and fisheries habitat; 3) aquaculture or mariculture of marine-dependent species; and 4) seafood technology.

A basic principle of the program is that people in the fishing industry often have valid ideas for enhancing and protecting fisheries, but they lack the financial resources to experiment with innovations. The Fishery Resource Grant Program invests in ideas generated by the fishing public through fair and competitive methods.

Fishery Resource Grant Trust Fund and Blue Crab Industry Assistance

The VFRGP "waterman's fund' as it has come to be called, is well positioned to provide an efficient, effective and fiscally responsible conduit for disaster relief funds related to the Commonwealth's blue crab fisheries. Since the program's inception in fiscal year 2000, 72 fishing industry projects have been funded for in excess of $1.1 million. The charter of the Fund is closely aligned with the direction desired by the Virginia Marine Resources Commission's objective of supporting the crab fishing industry diversification and long term economic sustainability.

The VFRGP proposes to assist the VMRC in implementing one-time disaster mitigation assistance by utilizing the Fund as a primary financial conduit with which to accommodate both immediate and long term approaches to the disaster assistance funding. For the sake of discussion two general approaches are offered here for consideration:

1. Blue Crab-Oyster Aquaculture Industry Training and Transition.
2. Continued provision of grant funds for applied fishery development ideas.

1. Blue Crab Industry -Oyster Aquaculture Training and Transition.

Short Term (January 2009 – June 2009)

The VFRGP proposes immediate funding in support of outreach and training for crabbers in oyster aquaculture. The training would be initiated by assisting crabbers with broad based technology transfer and training on the basic elements of oyster aquaculture field equipment fabrication, deployment, operation and maintenance. Existing industry and advisory service personnel would be engaged to train crabbers on all facets of "contained" oyster aquaculture.

This activity could also include expansion of extensive oyster aquaculture activity already funded and contracted via the VFRGP. One example of expanding an on-going VFRGP industry

[1] House Bill No. 1634 amended the Code of Virginia by adding Chapter 2 of Title 28.2 article 8, sections 28.2-245, 28.2-246, and 28.2-247, relating to establishment of the Fishery Resource Grant

project would be the implementation of a large scale program for crabbers and crab shedders. The VFRGP would direct disaster funds to support training and materials necessary for the immediate use of soft-crab shedding tables for oyster seed nursery and grow-out. In addition to the value-added by virtue of the industry training, the oyster seed nurseried in existing crab shedding systems would be destined for use by crabbers for further grow-out to market, sale to new or existing oyster growers, sale to "oyster gardeners', or sale to other merchantable outlets.

Intermediate Term (2009-2010)

While training industry in the rudiments of oyster aquaculture VFRGP proposes supporting cooperative evaluations with existing shellfish aquaculture industry and newly trained crabbers on the development of oyster aquaculture cooperative structures modeled on the successful network of eastern shore hard clam cooperative growers. As is the case with the clam aquaculture business model, the local oyster aquaculture co-ops would work directly with larger lease holders, growers, processors and wholesalers to achieve a level of vertical integration sufficient to rebuild the Commonwealth's oyster industry infrastructure.

Long Term (2010-2011)

As an extension to the short and intermediate term objectives the VFRGP proposes to also direct disaster funds to further significantly expand training and outreach in the areas of oyster aquaculture including "spat on shell" programs currently being funded by the VFRGP. This would include initiation of additional cooperative training in advanced culture and hatchery techniques for those who develop as good prospects under the first two phases.

2. On-Going Solicitation of Commercial Blue Crab Fishery Economic Assistance & Development Projects (2009-2011)

While implementing the efforts regarding oyster aquaculture training for crabbers, the VFRGP proposes to assist in directing disaster funds to expand its well established and proven outreach to focus upon the crab industry. The following list of potential research, development and demonstration ideas is provided as suggestions of the types of subjects that could be appropriate for disaster assistance funding proposals to the VFRGP. It is the intent of this initiative that the activities funded will provide economic assistance and benefits to the blue crab industry while enhancing sustainable fisheries in the future. These are not intended as a complete listing of all possible projects; nor are the topics listed in order of importance. These projects will be targeted at reducing pressure on blue crab and moving industry to more sustainable fishery products in the future. In addition to the established review process which includes the use of 4 out-of-state experts and the Fund's program management board the application of NEPA review guidelines will be followed with the new crab industry projects. The VIMS sponsored programs office is quite experienced in the implementation of required NEPA reviews and is committed to assisting with these future projects.

I. New Inshore and Offshore Crab harvesting Equipment or Gear

1. Reduce by-catch by technology development and education.
2. Develop "environmentally friendly" gear.
3. Develop more effective/efficient mechanisms for handling catch.
4. Develop and evaluate mechanisms to release crabs and related byatch to increase their survival.
5. Develop species-specific gear.
6. Develop information leading to Fishery Management Plans.

7. Develop new gear and/or improve current gear and/or document catch per unit effort ("CPUE").
8. Develop gear to improve selectivity of target species.

II. Environmental Pilot Studies

1. Develop mechanisms to restore damaged habitat or create new habitat critical to crab populations.
2. Develop mechanisms to prevent vital crab habitat impairment.
3. Reduce crab habitat impact from fishing activities.
4. Assess effects of water quality and habitat alteration on crab production.

III. Market Research and Development

1. Support market research for value-added crab products.
2. Assess regulations that impact crab fisheries as submerged aquatic vegetation protection.
3. Assess the potential of blue crab hatcheries and aquaculture to enhance wild populations.
4. Provide the opportunity for crabbers, including minorities, to diversify their businesses through aquaculture.

IV. Seafood Technology

1. Increase returns in the crab industry by improving packaging and handling.
2. Develop mechanisms for reducing effluents and the environmental impacts.
3. Develop alternative uses for crab processing byproducts.

Budget Details:
It is estimated that 2 formal requests for proposals will be conducted during 2009 directly targeted to Virginia's crab industry. The typical VFRGP award has been approximately $20,000 over the program's 10 years. It is expected that the blue crab funding will be at similar levels.

The allowable expenditures will be limited to defined personnel costs associated with the project. Allowable project travel will be budgeted and reimbursed at State of Virginia rates. Expendable supplies and non-capital equipment are permitted under the program's guidelines as are field expenses related to boat or vessel use on the project. Typically industry participants open a separate project checking account to allow the most cost effective tracking of expenditures.

IV. OYSTER AQUACULTURE

A). **Project to Involve Crab Industry Participants in 'Spat on Shell' Production of Oysters**
(The costs for this project will be $500,000 in Year 1 and $440,000 in Year 2).

The process to produce oysters on private ground using hatchery produced larvae which is set on shell is now relatively well established in Virginia waters. After three years of conducting projects and tests with the industry, a manual has been developed that can allow a beginner to readily participate in the process. Both crab harvesters and crab processors should be able to transition into this industry if they have access to private oyster leases. There are

currently thousands of acres of private grounds in Virginia, which have potential for spat on shell production. Many of these leases are held by crab industry participants and many others could be subleased from current leaseholders that have become inactive. Shells will have to be added to most of these leases, but plots are generally very small for each year's production (usually 1 acre or less). The VMRC Conservation and Replenishment Department will assist the participants in identifying suitable private lease areas for oyster production. Shells and spat on shell can be added to private leases after notification of the location to the Army Corps of Engineers. A program for this transition would be set up at 3 levels that will depend on the amount of equipment and water access that an interested person might have.
Tier I participants would be those crab industry participants that need the most equipment, with **Tier III** participants needing the least equipment. The allotments for each participant will be based on 600 bushels per year of oyster production.

Requirements: **Tier I-** Crabber or processor with access to the water for setting up a tank, but with no current equipment.

- Access to a private oyster ground lease.
- Ability to bag, transport, and plant 600 bushels of shell per year in three 200-bushel setting events.

Tier II

- Crabber or processor with no access to the water for a setting tank, but with the ability to rent tank space from another person with a tank.
- Access to a private oyster lease.
- Ability to bag, transport, and plant 600 bushels of shell per year in three 200-bushel setting events.

Tier III

- Crabber or processor with setting tanks.
- Access to private oyster lease.
- Ability to bag, transport, and plant 600 bushels of shells per year in three 200-bushel setting events.

The VMRC Conservation and Replenishment Department has the ability and experience to advertise for participants in this project and to train the participants in the 'spat on shell' oyster production process. If there is more interest in the project than there are funds, participants could be selected by a lottery. We anticipate that most of the participants would be in the Tier II and Tier III levels, since there is currently tank space available in most areas of the Bay. Estimated annual of costs for the project for each participant would be as follows:

Tier I, Year 1

Tank, pump, air blower	$ 5,000.00
Shells for 'spat on shell' bags, 600 bushels @ $1.00/bu.	$ 600.00
Triploid Eyed Oyster Larvae, 42 million @ $250/M	$10,500.00
Shells for preparing ground, 1,200 bushels @ $1.00/bu.	$ 1,200.00
Total	$17,300.00

Tier I, Year 2

Shells for 'spat on shell' bags, 600 bushels @ $1.00/bu.	$ 600.00

Triploid Eyed Oyster Larvae, 42 million @ $2.50/M	$10,500.00
Shells for preparing ground, 1,200 bu. @ $1.00/bu.	$ 1,200.00
Total	$12,300.00

Tier II, Year 1-2

Shells for 'spat on shell' bags, 600 bu. @ $1.00/bu.	$ 600.00
Triploid Eyed Oyster Larvae, 42 million @$250/M	$10,500.00
Shells for preparing ground, 1,200 bu. @ $1.00/bu.	$ 1,200.00
Rent of tank space, $300.00/set @ 3 sets @200 bu./set	$ 900.00
Total	$13,200.00

Tier III, Year 1-2

Shells for 'spat on shell' bags, 600 bu. @ $1.00/bu.	$ 600.00
Triploid Eyed Oyster Larvae, 42 million @ $250/M	$10,500.00
Shells for preparing ground, 1,200 bu. @ $1.00/bu	$ 1,200.00
Total	$12,300.00

Income Replacement for each participant.

A conservative estimate of one bushel of market oysters for each for each bushel of spat on shell, based on $30/bushel for the market oysters would be $18,000.00 per year. With triploid oysters, the return should be much higher both for the market price of the oysters sold, and for the number of bushels produced for each bushel of 'spat on shell'. Based on $ 500,000 of crab disaster funds in Year 1, 29 **Tier** 1, 37 **Tier II**, or 40 **Tier III** allotments could be handled, with a slightly lower number in Year 2. The production of 'spat on shell' for market oyster production on the private ground could revitalize the oyster industry in Virginia. Currently, the wild production of oysters from the Bay is seasonal, and quantity and quality of the local oysters is unpredictable. Importation of oysters from the Gulf of Mexico is also not dependable and transportation costs lower the margin of probability for the industry. The availability of locally grown, triploid oysters, year round, would add stability to the Virginia oyster industry in both meat quality and quantity. Additionally, the increased demand for the eyed larvae will lower the risk and spur investment for new private hatcheries to be constructed in Virginia.

Units of 600 bushels per participant per year would be chosen based on the tank capacity and the ability of small processors to handle the shell commodity. It is unlikely that an individual could handle any more than that amount in a single year. 'Spat on shell' oysters have been produced on the west coast by watermen for many years, in small backyard operations. After a waterman has gained experience and confidence in the production methods, they could easily expand to two to three times that amount per year.

The VMRC Conservation and Replenishment Department has not added any request for staff time in the above budget. It would be possible to collect more information on the economics of spat on shell aquaculture; however, we believe that most participants will be interested in triploid oyster production only.

B). **Project to Involve Crab Industry Participants in Cultchless Oyster Aquaculture Production (The costs for this project will be $480,000 in Year 1 and $395,000 in Year 2).**

Oyster aquaculture using cages to produce oysters for the 'half shell' market has potential for crab industry participants. Crab fishermen can use the same boats and crab pulling equipment to lift and handle oyster cages. Stocks of native oysters have been selected for faster growth and disease resistance, and these oysters can be grown in cages to market size in less than two years. Cage oyster aquaculture requires only a small amount of 'hands on' instruction, but many watermen have not entered this activity because of the relatively high initial costs, and the delayed time period to grow out oysters to a size that they can receive a return on their investment.

For the past several years, the VMRC Conservation and Replenishment Department has been providing equipment and training ten watermen per year in oyster aquaculture. Most of the participants have continued buying oyster seed and equipment on their own once they have started. The Conservation and Replenishment Department has used other oyster aquaculturists to assist with the training, and now there are many sources of information for new oyster aquaculturists. Nearly 100 crab fishermen could be trained in Year 1 and 81 crab fishermen could be trained in Year 2. If more crab fishermen are interested than can be accommodated, in either year, participants would be selected by lottery. Each participant must have access to a private oyster lease, but generally this has been no problem. There are currently thousands of acres of private oyster leases in Virginia. Many are held by the crab fishermen themselves (or they can sublease from others that are not using their grounds.) The Conservation and Replenishment Department will assist the participants in finding the growout areas on private ground. All of the cages used in this program are less than 12 inches off the bottom and are therefore exempt from State permits. The Conservation and Replenishment Department will assist the participants in getting the necessary Army Corps of Engineers permit for the small aquaculture sites. The Conservation and Replenishment Department will provide 50,000 cultchless, triploid oyster seed and all of the bags and cages needed to grow that quantity of oysters to market size. The Conservation and Replenishment Department has not added any requests for staff time funding in the budget below. It would be possible to collect information on the economic success of the project; however, we believe that since most participants will want to use triploid oysters, that a triploid-diploid comparison would not be possible.

Estimated annual costs for each participant:	
Oyster growout cages and bags	$4,100.00
40 cages (2 feet long, 3 feet wide and 1 foot high)	
120 bags	
50,000 triploid oyster seed at $15/thousand	$ 750.00
Total	$4,850.00

The potential return will vary with the success of the participant, the location, and market conditions. Cultchless oysters are grown for the 'half shell' market, and the value of Chesapeake Bay oysters varies with market demand. Generally at least $0.20 per oyster is an expected return, which would provide the participant with $10,000.00 of income. With careful marketing, the grower can significantly improve this return. The more dependable availability of high quality, market oysters from the Chesapeake Bay should increase the value of the local product.

More Virginia oysters will help the oyster industry and spur development of new oyster hatchery infrastructure.

V. CRAB POT AND PEELER POT LICENSE BUY OUT PROGRAM

Estimated costs, for this project, are $3 million, for the 3-year period. It is expected that the majority of buy-outs would occur in year 1. At this time, the VMRC does not know specific buy-out costs, per fishermen. However, as discussed below, price paid for buy-outs would generally be based on an individual basis. That basis would also be determined according to the level of activity, of the individual who requests a buy-out, during recent, past fisheries, as discussed below. The VMRC would not only allow eligible and active crab pot and peeler pot licensees to submit requested buy-out prices but would also extend that offer to past eligible fishermen who are currently inactive, as a result of recent regulations that began the process of reducing overcapacity in these fisheries.

The objectives of the program would be to reduce both active and currently inactive effort in the crab pot and peeler pot fisheries. Buy outs would be based on a fisherman-bid process, whereby the active or inactive licensees could negotiate a buy-out price, with the Commission. Priority, for buy-outs, would be given to active licensees, and it is anticipated that 50% of the budget funds will be used to buy out active licensees who can be considered "full-time" crab harvesters (e.g. fished crab pots more than 100 days; fished peeler pots more than 60 days).

Of total program funds, 30% would be used to buy back licenses from less active crab fishermen (e.g. fished crab pots 100 days or less or fished peeler pots 60 days or less). The remainder of the funds (20%) will be used to purchase inactive licenses. At some future time, these currently inactive fishermen could become active, so a buy-out, now, will help lessen future overcapacity.

Low bids, within an activity category (active, partly active, inactive), would be targeted for buyouts, after the Commission received bids from the peeler pot and crab pot crab fishermen. Tables 1 through 4 provide examples of possible buy-out categories, for the peeler pot and crab pot fishermen.

Table 1. Average number of days of activity reported by crab pot fishermen that harvested blue crab, 2004–2007.

Days	# Harvesters
0	442
1–19	247
20–39	277
40–59	160
60–79	136
80–99	96
100–119	57
120–139	51
140–159	24
160–179	22
180–199	3
≥ 200	2

Table 2. Average pounds of blue crab harvest reported by crab pot fishermen, 2004–2007.

Pounds	# Harvesters
0	442
1–4,999	393
5,000–9,999	160
10,000–14,999	112
15,000–19,999	65
20,000–24,999	61
25,000–29,999	49
30,000–34,999	42
35,000–39,999	17
40,000–44,999	20
45,000–49,999	18
50,000–59,999	27
60,000–69,999	20
70,000–79,999	22
80,000–89,999	17
90,000–99,999	11
100,000–149,999	33
150,000–199,999	7
≥ 200,000	1

Tables 1 and 2 rank current active and inactive crab pot harvesters, in terms of average days of harvest during 2004-07 and amount (pounds) harvested, on average during those same years. From Table 1, the VMRC classifies a full-time, active, crab pot fisherman as one that harvested crabs during 100 days, or more, on average, during 2004-07 (N = 159). From Table 2, it can be established that a full-time crab pot fisherman harvested 45,000 pounds, or more, on average, during the 2004-07 period (N = 156). Fifty percent of allocated funds would be used to buy out these full-time crab pot fishermen. Thirty percent of the funds would be used to buy out less active (than full time) or part-time crab pot fishermen. These are the fishermen who harvested some amount of crabs, but less than 80,000 pounds, or harvested during some days, but less than 100 days. It is expected that the buy-out price paid to part-time harvesters would generally be less than amounts paid to active harvesters, on a per capita basis.

It is impractical to think that the open bid process will result in buy-outs equal to 50% of full-time and 30% of part-time crab pot fishermen, as these days of harvest and amounts (pounds) harvested are subjective criteria, but these percentages will serve to guide the buy-out process. Concerning inactive licensees, who are currently on the waiting list (until the abundance of age 1+ crabs equals 200 million, for 3 consecutive years), it is expected that providing 20% of the expenditures of relief funds to buy out these individuals, at generally a lower price than for part-time crab pot fishermen, will, in the long term, reduce part of the overcapacity in the fishery. Buy-outs, alone, won't eliminate overcapacity entirely. Future plans are to implement a pot tagging and effort control systems (e.g. Individual Number of Crab Pots Quota), to further manage overcapacity.

Table 3. Average number of days activity reported by peeler pot fishermen that harvested blue crab, 2004–2007.

Days	# Harvesters
0	287
1–19	262
20–39	100
40–59	56
60–79	38
80–99	21
100–119	21
120–139	8
≥ 140	2

Table 4. Average pounds of blue crab harvest reported by peeler pot fishermen, 2004–2007.

Pounds	# Harvesters
0	287
1–499	126
500–999	73
1,000–1,499	50
1,500–1,999	51
2,000–2,499	40
2,500–2,999	31
3,000–3,499	21
3,500–3,999	17
4,000–4,499	11
4,500–4,999	11
5,000–5,999	18
6,000–6,999	13
7,000–7,999	10
8,000–8,999	9
9,000–9,999	2
10,000–10,999	6
11,000–11,999	2
12,000–12,999	5
13,000–13,999	3
14,000–14,999	2
15,000–19,999	4
≥ 20,000	3

Tables 3 and 4 rank current active and inactive peeler pot harvesters, in terms of average days of harvest during 2004-07 and amount (pounds) harvested, on average during those same years. From Table 3, a full-time peeler pot fisherman would be one that harvested crabs during 60 days, or more, on average, during 2004-07 (N = 90). The most productive (amount harvested) portion of the peeler pot season extends for many fewer days than the crab pot season. At least one-half

of the annual peeler pot harvest occurs in May, whereas any month, from June through October, is associated relatively major portions of the annual harvest, by crab pot.

From Table 4, it can be established that a full-time peeler pot fisherman harvested 4,000 pounds (N = 99), or more, on average, during the 2004-07 period. Four thousand pounds roughly equals 20,000 peeler crabs. Fifty percent of allocated funds would be used to buy out these full-time crab pot fishermen. Thirty percent of the funds would be used to buy out less active or part-time peeler pot fishermen. These are the fishermen who harvested some amount of crabs, but less than 4,000 pounds or harvested during some days (1 to 60). Again, delineation of buy-out categories among full-time, part-time, based on days of harvest or pounds harvested, are only exact, for the inactive category, but will guide the buy-out process. Similar to buy-out plan, for the crab pot fishermen, 20% of funds would be allocated to buy out some of the 287 currently inactive fishermen,

Effort reduction in the blue crab fisheries has been a focus of the Commission for a decade. Concerns about overcapacity were expressed, by the Commission, starting in 1998. However, the table, shown below, indicates there has been no decline in effort, from 13 years ago. The VMRC has determined that, if the status of the resource and harvest in 2009 mirrors that status of the years 2004 through 2007, on average, only 249 eligible crab pot harvesters, of 1073 total eligible harvesters, could harvest the current quota of female crabs.

The Commission recently (November 2008) removed a significant amount of latent effort (licenses that had not been utilized by harvesters, for a 4-year period, 2004-07), but these latent licenses have not contributed to the persistently high exploitation rates. In 7 of the last 10 years, the exploitation rate has been above the threshold exploitation rate (a 53% removal of the crab stock, by fishing alone).

Overcapacity is more pronounced than in earlier years because the crab stock abundance has remained low. The last two years when abundance of age 1+ (crabs 2.4 inches and greater) reached the recently established target of 200 million crabs were 1998 and 1994. The most recent abundance of age 1+ crabs was 120 million.

Comparison of crab license sales, 1995 - 1998 and eligible licensees in 2008.

License Type	1995	1996	1997	1998	2008
Crab Pot	1642	1741	1697	1714	1775
Peeler Pot	585	739	813	894	993

In 2007, the Commission established a multi-state panel of blue crab scientists and ecologists, for the purposes of reviewing the Commission's laws. Findings from that panel are described in the report entitled "Report of the Blue Crab Regulatory Review Committee On: The Virginia Marine Resources Commission Management Plan For Blue Crab" and summarized below.

- Conservation merits of the current VMRC plan are often compromised by the overcapacity of effort in the fisheries. The larger number of legal, inactive licensees

poses risk to any rebuilding strategy, as inactive licenses could become active, in response to any gains in blue crab abundance. The Commission should consider measures that more effectively reduce and control effort in these fisheries

- The VMRC should take corrective action to end overfishing in the blue crab fishery and constrain mortality towards the exploitation target. The VMRC should develop an effort control strategy that will enable the Commission to directly control and monitor effort as part of a comprehensive management plan, and in response to changing biological conditions. The VMRC should consider any measures that would reduce effort in this fishery, until such time that exploitation rates remain at or near the target, for several years. Any effort reductions in this fishery will also improve the exploitation rate on female crabs, as this fishery harvests the majority of female crabs.

- There have been a number of attempts by the VMRC to limit or reduce effort in these fisheries. Overall, these attempts have resulted in caps on existing licenses but have not effectively reduced effort in the fishery. For example, pot limits were implemented for the hard crab pot and peeler pot fisheries but have proven to be very difficult to enforce. Industry has reported that harvesters can, and do, circumvent enforcement of pot limits. In general, managers think there is a large surplus or overcapacity of effort in the fishery, given the sustained low level of abundance.

A crab pot and peeler pot license buy-back program could be useful in reducing active and potential effort, while providing compensation to harvesters impacted by the resource disaster. Total fishing effort includes both active and latent crab licenses, approximately in a 1:1 ratio. A continued high exploitation rate and low abundance of every size group of crabs, despite a 40% - 45% reduction in active harvesters, since 2003, indicates there is an excess of active effort in the crab pot and peeler pot fisheries, and these two gear types account for 87% or more of the annual crab harvest. Priority should be given to the buy-out of active licensees, for these reasons. Among active harvesters, there are different levels of activity. Roughly, 35% of active harvesters are “full-time” crab fishermen, fishing

At the same time, latent effort poses a future problem. Many latent licenses have been suspended, by the Commission, and those previous license holders have been wait-listed, until the crab stock abundance reaches 200 million crabs and remains at that abundance, for 3 consecutive years. In the future, those on the waiting list will be able to return to the fishery, and a buy-out program, for some of those individuals should be included in this plan.

VI. UPDATE OF BLUE CRAB STOCK ASSESSMENT

Estimated cost, for this project, is $100,000, but would be jointly and equally funded with Maryland. Participants would include the VMRC, MD DNR, VIMS, and CBL. It would be preferable for any contracts to be established and monitored, by an outside vendor, but the VMRC can also contract directly with principal investigators’ institutions, as it did in 2001, for a blue crab recreational harvest survey. Virginia requests one-half the total expected cost ($200,000), and Maryland will furnish the remainder.

The last analytical stock assessment was peer-reviewed and published in December 2005. That assessment incorporated Chesapeake Bay fisheries data through 2003. At a minimum, a new assessment would update its findings, based on 5 additional years of data. That data, whether fishery-dependent or fishery-independent is housed at VMRC, MD DNR, VIMS, and CBL, and, as with the 2005 assessment, specific data requests would be supplied to the institutions, in order to collect the needed data. No additional removals, beyond the fisheries' past (up to and including 2008) removals of blue crab will be needed to accomplish the assessment. No disruption of blue crab habitat or other species' habitats is necessary to accomplish the assessment.

A peer-reviewed stock assessment can improve our understanding of certain sex-specific blue crab life history aspects, such as growth and mortality rates. In addition, fecundity and maturity schedules of female crabs would benefit from a new stock assessment. The 2005 stock assessment did not analyze effort data, and it is very important that each Bay jurisdiction's effort data be assessed, for trends in catch per unit of effort, and to determine the underlying relationship between harvest and effort. There have been attempts in the past to characterize sex-specific mortality rates, using length-base methods, and that objective remains for the next assessment.

At this time, managers utilize a control rule that is based on an overfished and overfishing definition, but the basis for the overfished definition is only based on empirical information, rather than a mathematical construct. The lowest recorded abundance of the harvestable size crabs (86 million) occurred in 1999. Managers recognize that the lowest abundance of 86 million crabs has been deemed the overfished threshold but are unsure, as to what abundance threshold stymies effective replacement mechanisms. More importantly, there should be an overfished definition based strictly on the limiting or threshold biomass of the female spawning stock. In addition, the control rule does not address the difference in sex-specific fishing mortality rates, over time, and that objective has become critical to management's attempts to stabilize and augment the spawning stock biomass. Updated, different overfishing biological reference points would result from sex-specific analyses of a new assessment.

The terms of reference of a new stock assessment will include some earlier ones established, for the last assessment (e.g. describe and quantify patterns in catch and effort by sector and region; re-evaluate and where necessary, update control rules for the Chesapeake Bay blue crab fishery), but there should also be more emphasis on assessment models that derive fishing mortality rates from disparate, gear-specific fisheries such as, at least, the peeler pot and crab pot fisheries.

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VII. Administrative costs need (VMRC):

The VMRC requests $19,985 ($10,000 for Year 1, $6500 for Year 2 and $3385 for Year 3), for staffing, to assist with mail-outs, application procedures, database operations and disbursement of funds.

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ATTACHMENT II (Continued)

Virginia Marine Resources Commission
Blue Crab Fishery Resource Disaster Relief Plan Addendum
(Submitted in June, 2009 to the National Marine Fisheries Service)

Federal funding in the amount of $4,995,000 has been allocated to the Virginia Marine Resources Commission (VMRC) to further support efforts to address the Chesapeake Bay Blue Crab Fishery Disaster. These funds were allocated under NOAA's Unallied Science Program and available under the Omnibus Appropriation Act, 2009. The funds identified above will be used to add to the funding for several of the tasks outlined in VMRC's current project. A detailed description of the uses of these funds is provided below. Some additional changes in certain tasks are also noted. The component projects are numbered as they are in the original proposal.

I. Derelict Blue Crab Pot and Marine Debris Removal Project (ADD-ON)
Estimated costs of this addition is $653,030.00.

This would add 8 watermen participants to the existing project. Watermen would be trained according to the existing protocols, including the additional protocols requested by NOAA which require specific actions in regard to marine mammals and listed species.

These participants would concentrate on shallow water areas (less than 3 meters) that were generally not accessible to the existing participants because of their deeper draft crab dredge vessels. Participants would be selected in a manner to cover the entire Virginia portion of the Bay, excluding the Atlantic shore. Participants would be compensated in the same manner as the existing project participants.

All protocols approved by NOAA regarding the existing project would apply to the additional participants. Additional equipment needs include 8 Humminbird side-imaging units which have proven to be quite effective in locating marine debris, especially lost crab pots, as well as, 8 waterproof digital cameras to visually record marine debris and bycatch.

VIMS staff time is added to manage the additional participants spread across the entire Virginia bay region, collect, manage and analyze data, train participants, trouble-shoot equipment, and provide quality control and quality assurance. This

IV. Oyster Aquaculture

A. Crab Industry Participants in "Spat on Shell" Production of Oysters – Year 3 (ADD-ON). Costs for this project will be $420,000.00 for Year 3.

At the completion of Year 1 and 2 of this program, approximately 80 crab industry participants will have been trained in the production of "spat on shell" for oyster production on private ground. Approximately 48,000 bushels of seed oysters should be on private leases, with a portion of the oysters in some stage of harvest. To further augment this project, the participants will be provided with an additional allotment of eyed larvae to begin a second location. The participant will be required to purchase

the shells for the "spat on shell" and to prepare the planting area with their own funds. Each participant will also be required to pay for one-half of the costs of their eyed-larvae. This will allow for an easier transition into production on their own and will further ensure the long-term use of their equipment.

Larvae costs for 600 bushels of "spat on shell" will be $5,250.00. The estimated annual costs for the project would be as follows:

Year 3		
Triploid, Eyed Oyster Larvae, 42 million @$250/M	=	$5,250.00
Eighty participants @ $5,250.00	=	$420,000.00

A conservative estimate of an economic return, based on one bushel of market oysters with a value of $30.00 for each bushel of "spat on shell", would be $18,000.00 per year. With triploid oysters, the return should be much higher both for the market price of the oysters sold, and for the number of bushels produced for each bushel of "spat on shell."

The Virginia Marine Resources Commission intends that the settling tanks, associated water pumps, cages, and oyster larvae, supplied to each participant as a part of this project, will at the end of this project, be transferred to the project participants.

B. Project to Involve Crab Industry Participants in Cultchless Oyster Aquaculture Production, Year 3. (ADD-ON)--The costs for this project will be $82,500.

More than 150 crab fishermen should be trained in caged oyster aquaculture by the end of Year 2. The growth rates for the selected strains of native oysters should have allowed most of the oysters to have been harvested by Year 3. Most of the crab fishermen that have shown interest in the caged aquaculture training program are just interested in oyster aquaculture as a part-time, supplemental income for their other water dependent activities. The 150 participants will be given an additional allotment of 25,000 cutchless oysters that they can grow in the same cages that they are already using. By Year 3, the participants should be able to grow these oysters with little additional supervision.

Estimated Costs for each participant:

25,000 triploid oyster seed @ $22.00/thousand	=	$550.00

Estimated Costs for the cage aquaculture project

150 crab industry participants @ $550.00 each	=	$82,500.00

The potential return will again vary with the success of the participant, the location, and market conditions. Cultchless oysters are grown for the "half-shell" market, and the value of Chesapeake Bay oysters varies with market conditions.

Generally at least $0.20 per oyster is the expected return, which would provide each participant with up to $5,000.00 of income. With careful marketing, the participants can significantly improve this return. The more dependable availability of high quality market oysters from the Chesapeake Bay should increase in value of the local product. More Virginia oysters produced by aquaculture will also help spur development of new oyster hatchery infrastructure for the future.

The Virginia Marine Resources Commission intends that the bags, cages and oyster larvae, supplied to each participant as a part of this project, will at the end of this project, be transferred to the project participants.

C. Promotion of Markets for Oyster Aquaculture (NEW). The estimated costs of this new sub-project are $65,000.00.

The Virginia Marine Products Board is the seafood marketing and promotion agency with the Virginia government.

In this capacity, the board conducts a comprehensive marketing program designed to upgrade and expand both domestic and foreign sales and markets to further the overall economic development of the industry.

The board staff conducts trade advertising, direct marketing, trade shows, and international video conferences, marketing calls and merchandising programs for wholesale distributors, retailers and restaurateurs. The board has launched an in-state public education program to help the Commonwealth citizens understand the part the seafood industry plays in the state's tradition and economy, as well as the part citizens can play in keeping Virginia's waterways clean. The staff also maintains an up-to-date web site at www.virginiaseafood.org.

This new oyster aquaculture industry, developed by other components of this project, above, would help relieve the pressure on the crab stocks in Virginia. The Virginia Marine Products Board proposes to produce and print educational materials, fact sheets, promotional materials, supplier directories, training for retailers, foodservice and wholesalers. These materials would also be distributed at trade shows, seafood festivals, and educational programs which the funds would allow us to participate in. We will also provide public relations to the media on behalf of the oyster aquaculture industry and identify U.S and international buyers. We would also like to update our web site to represent this new industry with recipes, educational, promoting and marketing materials.

The following specific elements of this project are identified:

1) Set up and design fact sheets, promotional and educational materials, supplier's directory and direct mailing literature.

$10,000.00

2) Printing costs for 3,000 copies of each of the following materials: fact sheets, promotional and educational materials, suppliers' directory and direct mailing literature and the cost to distribute.

$10,000.00

3) These materials will be distributed at the International Boston Seafood Show, Busan Seafood Expo, European Seafood Expo and any other trade shows the Virginia Marine Products Board participates in. Shucking and sampling oysters at the International Boston Seafood Show.

$4,000.00

4) Direct mailing to an estimated 1,000 seafood buyers inviting them to visit the Virginia Marine Products Board booth at the International Boston Seafood Show in 2010 to sample aquaculture oysters.

$1,000.00

5) Travel to wholesale distributors, food service buyers, restaurants and retail seafood stores with marketing materials to educate them on the aquaculture oyster.

$15,000.00

6) Web site to be updated with the new species fact sheet, promotional and educational materials, and supplier's directory.

$15,000.00

7) Packing and shipping costs to distribute samples.

$10,000.00

TOTAL = $65,000.000

V. Crab Pot and Peeler Pot License Buy Out (ADD-ON)

The VMRC proposes to add $3,724,470 to its previous proposal for crab license buy back. The additional funds will greatly enhance the agencies ability to purchase licenses and thereby reduce overcapacity in the blue crab fisheries. All procedures previously identified for the license buy-back will remain unchanged.

The addition of this funding brings the total for this component to $6,724,470.00.

VI. Update of Blue Crab Stock Assessment (ADD-ON)

This is an additional request, for $50,000 to add-on to the previously approved funding, by NOAA, of $100,000. Maryland has also previously been approved for $100,000 for this project and has submitted a request for additional funding, in the amount of $50,000. Virginia would utilize this additional $50,000 to fund outside experts who would conduct a benchmark (complete update) stock assessment of the blue crab population. The last analytical stock assessment was peer-reviewed and published in December 2005. That

assessment incorporated Chesapeake Bay fisheries data through 2003. At a minimum, a new assessment would update its findings, based on 5 additional years of data. A new assessment would likely establish separate fishery management goals for male and female blue crabs, thereby ensuring greater effectiveness of management actions. In addition, revised biological reference points (overfished and overfishing definitions will be products of the analytical assessment.

Budget Summary

Project Component	Budget Estimate
I. Derelict Blue Crab Pot and Marine Debris Removals Project (ADD-ON)	$653,030
IV. Oyster Aquaculture	
A. Crab Industry Participants in "Spat on Shell" Production of Oysters (ADD-ON)	$420,000
B. Project to Involve Industry Participants in Cultchless Oyster Aquaculture Productions for Year 3 (ADD-ON)	$82,500
C. Promotion of Markets for Oyster Aquaculture (New)	$65,000
V. Crab Pot and Peeler Pot License Buy Out (ADD-ON)	$3,724,470
VI. Update of Blue Crab Stock Assessment (ADD-ON)	$50,000
Total	**$4,995,000**

ATTACHMENT III. Blue Crab Management Efforts of the Virginia Marine Resources Commission: A 22-Point Management Plan

The first Blue Crab Fishery Management Plan, adopted in 1989, placed controls on fishing effort and established other measures to reduce or eliminate wasteful harvesting practices in the blue crab fishery. By 1995, the Commission expanded, by 75 square miles, the Blue Crab Spawning Sanctuary (146 square miles), originally established by the General Assembly in 1942. It also shortened the crab pot season to the current April1 through November 30 period, and for the first time, required two cull rings in each crab pot to allow for the escapement of the smaller, immature, crabs.

In January 1996, the Commission reinforced it prior management efforts, by adoption of the following additional measures:

1. Prohibited the possession of dark-colored (brown through black) female sponge crabs, with a 10- sponge crab per bushel tolerance.

A sponge or cushion of eggs is caused by the extrusion of eggs onto the abdomen of the female crab. Prior to that time, female crabs carry their eggs internally, from the onset of maturity and mating (at approximately 1 ½ years of age), and can produce 2 or more batches of eggs within its lifetime. The prohibition on the taking of dark-colored sponge crabs is projected to protect approximately 28 percent of female crabs. This action effectively increases the spawning potential of the blue crab stock, yet allows the lower Bay crabbing industry, which depends on egg-bearing female crabs, to continue. Crabs are available to the fishery, within a few days after they release their eggs. Protection of the dark sponge crabs occurs over the entire spawning season, increasing the probability that those crabs that are allowed to spawn will do so during a period of favorable environmental conditions.

2. Limited license sales of hard crab and peeler pot licenses, based on previous eligibility or exemption requirements.

This moratorium on the sale of crab pot and peeler pot licenses was proposed for one year. Eligible participants for the 1996 crabbing season were limited to those who participated in the 1995 fishery. This element was considered as critical to preventing further expansion of the fishery in order to stabilize the resource and its fisheries.

3. Established a 300-hard crab pot limit for all Virginia tributaries of the mainstem Chesapeake Bay. Other Virginia harvest areas were limited to a 500-hard crab pot limit.

The 300-pot limit was the second element needed to cap effort and attempt to stabilize the resource and its fisheries. Only eight percent of the crabbers, from 1993 – 1995, reported fishing more than 300 hard crab pots. This measure was designed as a cap on effort and was not intended to reduce effort substantially.

4. Established a 3 ½-inch minimum possession size limit for all soft shell crabs.

The 3 ½-inch minimum size limit for soft shell crabs provides additional protections for the resource, by reducing harvests of small peeler crabs, at a time of low crab abundance. The measure complimented similar action in the State of Maryland and at the Potomac River Fisheries Commission to protect small soft crabs. Continued concern over excess effort in the blue crab fisheries and a persistent trend of low spawning stock biomass during most of the 1990's led the Commission to adopt additional crab conservation measures in 1999 and 2000:

1. Lowered the maximum limit on peeler pots per licensee from 400 to 300 pots in 2000.

Effort reductions were clearly needed in this fishery that had grown significantly since 1994, but severe reductions on an immediate basis would result in severe economic burdens on the industry. Consequently, the Commission lowered the pot limit by 25 percent to minimize the economic impacts of the provision. Reports from many fishermen indicated that many did not fish the maximum 400 pots previously allowed.

2. In May 1999, the Commission initiated a one-year moratorium on the sale of all additional commercial crabbing licenses. In May 2000, the crabbing license sales moratorium was continued until May 26, 2001. The moratorium was again extended for 2002 and 2003, and, recently, this moratorium on the sale of additional crabbing licenses was extended through 2011.

Although scientists continue to debate the finer points of the blue crab stock assessment, all agree that the levels of effort in the peeler and hard crab fisheries have increased substantially, are too high to support viable incomes for many industry members, and may be eroding the abundance of the spawning stock

3. Established (in 2000) the Virginia Blue Crab Spawning Sanctuary. This additional sanctuary of 435 square miles was closed to all crabbing during the spawning season of June 1st through September 15th.

Through extensive research by Dr. Rom Lipcius (VIMS), the Commission was able to identify the proper boundaries of the sanctuary, in order to protect female crabs during their spawning migration down the Bay. To effectively protect females during their entire migration in Virginia waters and their entire spawning period, the sanctuary is closed from June 1 through September 15 and stretches from the VA-MD line to the mouth of the Bay. The sanctuary was further supported by research that indicated the blue crab abundance continued below average levels and the stock was fully exploited. Recruitment of young crabs to the fishery was also below average. Scientists also reported studies documenting a 70 percent decline in female spawning stock.

In 2000, the Commission entered into crab management discussions with the State of Maryland and the Potomac River Fisheries Commission, through the Bi-State Blue Crab Advisory Committee, a subcommittee of the Chesapeake Bay Commission. An Action Plan was adopted that recommended a harvest threshold that would preserve 10 percent of the blue crab spawning potential and a minimum stock size threshold that would be set at the lowest stock size that had been shown to have subsequently sustained a fishery. Managers further recommended the adoption of fishing targets that are more conservative than the thresholds and are the levels of fishing to be achieved each year. The recommended target level for blue crab fishing mortality was that level which achieves a doubling of the blue crab spawning potential. More importantly, it is estimated that a 15 percent decrease in harvest (based on the 1997-1999 landings average) was needed to achieve the target (F=0.7) in 2001. The Chesapeake Bay Commission recommended that the reductions be phased in over one to three years to minimize economic impacts associated with large reductions in harvest. The Marine Resources Commission endorsed the recommendations of the Chesapeake Bay Commission and its Bi-State Blue Crab Advisory Committee and promulgated the following regulations in 2002 to achieve the agreed upon harvest reduction target.

1. Enacted an 8-hour workday for commercial crabbers (2002) that replaced a prior closure of crabbing on Wednesdays.

In April 2001, staff conducted analyses of the harvest reductions associated with a variety of restrictions such as hourly workday limits, day of week closures, seasonal or monthly closures, and catch limits. Percent harvest reductions were calculated for each targeted fishery as well as

the contributions each measure provided to the overall goal of a five percent reduction in blue crab harvest for the first year. The Commission adopted a Wednesday closure of the crab pot and peeler pot fisheries from June 6 through August 22, calculated as a 5.7 percent reduction in harvest in the crab pot/peeler pot fishery. The advantages of this measure included equal treatment of all fishermen and ease of enforcement.

In January 2002, the Commission removed the Wednesday closure, at the request of industry, and replaced it with an 8-hour workday. There appeared to be more support from industry members for an 8-hour workday than there was in 2001. The new measure also was endorsed by the industry-based Crab Management Advisory Committee

2. Established a 3-inch minimum size limit for peeler crabs in 2002.

The size limit on soft crabs had proven to be difficult to enforce on the water, where conservation is best served, since the fishery harvests mostly peeler crabs. Consequently the Commission adopted a 3- inch size limit on peeler crabs, with the intent to improve enforcement and to protect a significant portion of the immature female crab population.

The previously adopted crab sanctuary and the ban on harvesting dark sponge crabs protects over half the female spawning stock. Yet, these measures are meaningless, if crabbing effort is redirected to the immature female crab portion that has not had an opportunity to spawn. The minimum peeler size limit provides protection for those immature females. Thus, the combined efforts, to protect the adult spawners and the immature portion of the population, work together to provide more biological stability to the population.

3. Reduced the winter dredge fishery trip limit from 20 to 17 barrels per boat per day in 2001.

The Crab Management Advisory Committee supported this measure and noted that it should be enforceable. Staff determined that a reduction of the catch limit of 20 barrels during the Virginia winter dredge season to 17 barrels would result in a 3.1 percent reduction in harvest from that fishery.

4. Augmented (2002) the Virginia Blue Crab Sanctuary by 272 sq. miles.

The expansion of the Virginia Blue Crab Sanctuary increased the closed area from 661 square miles to 947 square miles. Commercial and recreational harvesting of crabs is prohibited in the Sanctuary from June 1 through September 15. The benefit of the expanded sanctuary is its significant protection of spawning female crabs, about 70 percent of the spawning stock.

5. Reduced unlicensed recreational harvester limits to 1 bushel of hard crabs, 2-dozen peelers (2002).

Recreational fishermen willingly supported reductions in their crab harvest. The regulations established a harvest limit for the vessel regardless of the number of crabbers on board. Since most recreational harvesters take well less than one bushel per day, the total reduction in harvest was expected to be minimal. A 2001 study concluded that the Virginia recreational harvest was

only a fraction (< 5%) of total blue crab harvests, but other studies show the Bay-wide recreational fishery can be significant when blue crab abundance is not low.

6. Reduced licensed recreational harvester limits to 1 bushel of hard crabs, 2 dozen peelers, with a vessel limit equal to number of crabbers on board multiplied by personal limits (2001).

In March 2007 the Commission modified its prohibition on the possession of dark sponge crabs, based on advice from scientists at Old Dominion University, and implemented an additional crab spawning sanctuary to compensate for any possible reinforced it prior management efforts, by adoption of the following additional measures:

1. Prohibited the possession of dark-colored (brown through black) female sponge crabs, with a 10- sponge crab per bushel tolerance, only through July 15 of the crab season.

2. Established an additional sanctuary (95 square miles) in coastal Virginia, to compensate for any loss of spawning potential resultant from the modification to the ban on sponge crabs regulation.

These measures were supported by the Crab Management Advisory Committee.

ATTACHMENT IV.

ECOSYSTEM-BASED FISHERY MANAGEMENT PLAN FOR THE BLUE CRAB: HABITAT EFFECTS ON THE POPULATION AND FISHERY YIELD

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The College of William and Mary
30 October 2009

Habitat degradation is a major concern in Chesapeake Bay and around the world. With populations increasing along the shoreline and in watershed areas, the human footprint has had an ever-increasing impact on Chesapeake Bay biota. Hypoxia, habitat destruction, shoreline development, chemical toxicants and global warming are among the most pressing threats that directly or indirectly affect the blue crab population and fishery in Chesapeake Bay.

This document provides a summary of critical habitat issues for the blue crab population and fishery in Chesapeake Bay. The summary is derived from draft briefs prepared by various scientists of technical workgroups producing the Ecosystem-Based Fishery Management Plan for the blue crab. Members of the workgroups are listed in Appendix 1.

Hypoxia

One of the most widespread influences on estuarine and marine ecosystems is caused by anoxia (the absence of O_2 in bottom waters) and hypoxia ($\leq$ 2 mg of O_2 L^{-1}), both of which have increased in frequency and aerial cover. Low dissolved oxygen (DO) events arise either seasonally (after the spring-summer phytoplankton bloom) or periodically due to weather events or spring-neap tidal cycles. Hypoxic and anoxic zones are usually in areas > 10 m deep.

Blue crabs will circumvent anoxic and hypoxic waters of < 4 mg dissolved O_2 L^{-1}. Typically, blue crabs move out of deeper water affected by low DO and into shallow areas during hypoxic or anoxic events. In doing so, they become concentrated in the shallows and are more susceptible to fishing gear, density-dependent predation and agonistic interactions. For example, mature female crabs migrating to the spawning grounds are affected by low DO since they utilize deep water (13-25 m) to reach the grounds. During the summer spawning season, mature females are most abundant at depths of 6-14 m. Thus, when deeper waters of the mainstem are affected by low DO, mature females are forced into shallower areas where they experience the aforementioned stresses due to fishing pressure, predation and agonistic interactions. Severe hypoxic events also destroy entire populations of benthic prey (e.g. clams, worms), thereby excluding them entirely from exploitation by blue crabs.

Seagrass Degradation and Loss

Seagrass beds provide nursery habitat for newly settled, young juvenile and mating blue crabs. Peak densities of 50 to 90 newly settled juvenile crabs per m^2 in seagrass beds exceed those in surrounding unvegetated habitats by a factor of 10 or more. Seagrass beds also harbor high densities of larger molting blue crabs because of the refuge provided from predators.

The two primary species of seagrass are eelgrass *Zostera marina,* a Boreal species, and widgeon grass *Ruppia maritime*, of sub-tropical origin. Marginalized water clarity from phytoplankton blooms caused by agricultural chemical runoff, sewage treatment plant discharges and other nutrient sources, and sediment-induced turbidity from excessive soil erosion have caused substantial declines in seagrass aerial distribution. Seagrass loss also occurs when cownose rays occupy Chesapeake Bay in mid-summer and search for infaunal bivalve prey in seagrass beds. Their excavations uproot eelgrass shoots and create bare patches, thereby producing a mosaic of seagrass patches of varying size interspersed with areas of bare sediment. Seagrass loss reduces optimal nursery habitat, thereby exacerbating competition for resources, cannibalism and predation, due to dispersal to less favorable habitats.

Restoration of seagrass beds has often been considered vital to sustaining blue crab populations and fisheries and has prompted conservation measures of these habitats. However, global warming threatens the persistence of *Zostera marina*, which exists at the southern extent of its range in Chesapeake Bay and North Carolina. As oceanic temperatures rise, *Z. marina* will likely be displaced northward from these areas. Conversely, subtropical widgeon grass *Ruppia maritima* will be favored and likely extend its temporal and spatial cover throughout the bay during global warming. In addition, non-native red algae (*Gracilaria* spp.) have colonized and expanded throughout Chesapeake Bay and serves as an excellent structured nursery habitat, which may offset some of the losses of eelgrass. Whether these changes will be favorable or damaging to the blue crab remains unresolved.

Oyster reefs, coarse woody debris and salt marsh habitats

Blue crabs seek structurally complex habitats to forage and for protection from predators. In addition to seagrass, complex habitats include salt marshes, oyster reefs, and coarse woody debris from land. These habitats also serve as secondary nurseries for small juvenile crabs that emigrate from seagrass beds. Each of these habitats has also undergone substantial declines because of coastal development, which has had a significant effect on the blue crab population.

Shoreline development

Natural marshes stabilize shorelines, provide nutrient subsidies to the estuary, and dampen wave action. Collectively these promote the establishment and persistence of benthic communities upon which blue crabs forage. These habitats have suffered historically from residential and commercial development and the replacement of emergent marsh edges by inert structures like bulkheads to stabilize shorelines. Consequently, benthic prey such as worms and clams have been greatly reduced, depriving blue crabs of an optimal food source and reducing population production. The consequences are manifested in low abundances of juvenile blue crabs in urbanized watersheds. Fringing salt marsh habitats should therefore be designated essential blue crab nursery habitat and restored or protected from development.

Chemical contaminants: pollution and toxicants

The omnivorous feeding behavior and benthic habitat requirements of blue crabs make them prone to bioaccumulation of various toxicants including heavy metals and xenobiotics (chemical pollutants). These chemicals reach the hemolymph via the stomach or gills and are transported to the lipid-rich hepatopancreas where they often bioaccumulate or are metabolized. The multitude of contaminants to which blue crabs are exposed in Chesapeake Bay each have very different effects depending upon their physico-chemical properties and how these compounds are processed, accumulated and biotransformed. Organic xenobiotics, including metals and pesticides, affect crab growth, reproduction, and development. In excess, naturally occurring trace metals such as cobalt, copper, and selenium, which are essential for a various physiological processes including digestive enzyme synthesis and secretion, nutrient uptake and accumulation of nutrient reserves, may become toxic.

Organometallic compounds commonly found in the blue crab's environment include tributyltin and methylmercury. The anti-fouling chemical, tributyltin (TBT), has extensive toxicity to most marine invertebrates. In blue crabs, TBT is rapidly metabolized by the hepatopancreas and eliminated. Tributyltin inhibits growth of blue crab oocytes and reduces successful embryonic hatching by 50 %. Limb regeneration and ecdysis (molting) are delayed in fiddler crabs exposed to TBT, and regenerated limbs are deformed; similar results are likely in blue crabs. Laboratory studies demonstrated numerous effects of heavy metals (e. g. methylmercury) at the cellular level and also a reduction of limb regeneration in fiddler crabs.

Organophosphate and organochlorine compounds developed as insect pesticides are also inherently toxic to blue crabs and other crustaceans. These compounds are of concern when insect eradication efforts occur in habitats that overlap with those of blue crabs (e.g. mosquito control near salt marshes). Insect pesticides impair nervous system function and have far greater

effects on crustaceans than on marine fishes. Organochlorine compounds in contaminated estuaries affect blue crab growth, reproduction and development.

Polycyclic aromatic hydrocarbons (PAHs) are also of great concern. Decreases in shrimp populations along the southeastern United States have been correlated with increased concentrations of PAHs, and in areas where farms using various pesticides border estuaries, population decreases have occurred. In juvenile blue crabs, PAHs act as endocrine disrupters, which inhibit growth and molting. Contaminants may therefore have significant effects on the blue crab at the population level. In a review of the effects of contaminants on the blue crab, it was postulated that greater threats to blue crab populations may be posed by increased nutrient loading, alterations of freshwater inflow, and physical destruction of estuarine and coastal habitats that accompany increasing human population densities and development near the coast.

Direct effects of fishing gear on habitat

Fishing with mobile gears such as trawls and dredges not only removes target and non-target fishery species, but also represents a human disturbance to natural environments. These gears can negatively impact blue crab habitat by reducing complexity and refuge value of biogenic habitats (e.g. seagrass, oyster reefs), reducing overall productivity, and by altering the diversity and composition of infaunal benthic communities that serve as prey for blue crabs. Fishing impacts on oyster reefs are well studied. Destructive gears eliminate vertical relief in these habitats, which lessens their habitat value as crab foraging grounds and refuge. Historically, hydraulic dredges used to harvest clams in seagrass beds caused severe damage; however, current regulations in both Maryland and Virginia prohibit this method of harvest in seagrass.

Climate change

Climate change is predicted to have a wide range of effects on the blue crab in Chesapeake Bay. These effects can occur through direct effects on blue crab demography, indirect effects on habitat and ecosystem characteristics, and weather effects on recruitment dynamics. Blue crab populations extend over a broad range of latitude from the species' tropical origins into the temperate zone. Blue crab researchers recently reviewed and projected demographic effects of latitude, which served as a surrogate for the effects of climate change. The review suggested that there could be strong effects on seasonal temperature variation, primarily causing warmer winters and longer warm seasons, rather than simply increasing temperature uniformly in all seasons. Demographic impacts were based on analyses of survival, growth, reproduction and maturation of populations in Florida, North Carolina, Maryland and Virginia.

Reproduction is accelerated and extended over a longer reproductive season at lower latitudes and with climate warming. Brooding in populations at lower latitudes begins 3-4 months earlier than at high latitudes, allowing more broods per season. Blue crabs in Chesapeake Bay now produce 1-3 broods per year, those in North Carolina produce up 3-5 broods per year, while crabs in Florida produce 3-8 broods per year. Warming winter temperatures could reduce winter mortality of blue crabs and allow northward range expansion. However, warmer temperatures may promote increased juvenile mortality and reduced size at maturity. Demographic schedules for fishery models will need to consider complex effects of warming.

Salt marshes will suffer extensively from climate change. With sea-level rise, by the year 2100 161,000 acres of salt marsh are predicted to be lost in Chesapeake Bay, although subsidence of the Eastern shore may accelerate this loss. In addition, changes in coastal currents and weather patterns along the East Coast due to climate change may have marked effects on blue crab recruitment due to shifts in current systems, increased storm and hurricane activity, and the continental pattern of weather fronts.

Conclusions and recommendations

Habitat degradation can significantly reduce the blue crab population and fishery yield in Chesapeake Bay either directly by diminishing growth, reproduction and survival, or indirectly by lowering ecosystem carrying capacity. Consequently, the capability of fishery management actions to enhance population abundance and fishery yield could be severely impeded, such that the potential for recovery is much lower than in past decades when the Chesapeake Bay ecosystem was in a healthier state. The habitat alterations that pose the most severe and pressing threats to the blue crab include hypoxia, shoreline development that destroys salt marshes, and seagrass damage by biotic and physical processes. Potential threats with uncertain consequences include chemical toxicants and climate change.

The major issue requiring resolution deals with quantifying the effects of hypoxia, shoreline development and seagrass degradation on population abundance, fishery yield and ecosystem carrying capacity. Without quantitative estimates of these impacts, it will be difficult to determine the actual effects of fishery management actions, which could undermine restoration efforts based on the current stock assessment and fishery management plans.

Appendix 1. Technical workgroup members and affiliations contributing to the document.
Anson H. Hines, Smithsonian Environmental Research Center, Smithsonian Institution
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Eric J. Schott, University of Maryland Center of Marine Biotechnology
Jacques van Montfrans, Virginia Institute of Marine Science, College of William and Mary

ATTACHMENT V. Distribution of SAV in Virginia Tidal Waters (Dr. Robert Orth, VIMS)

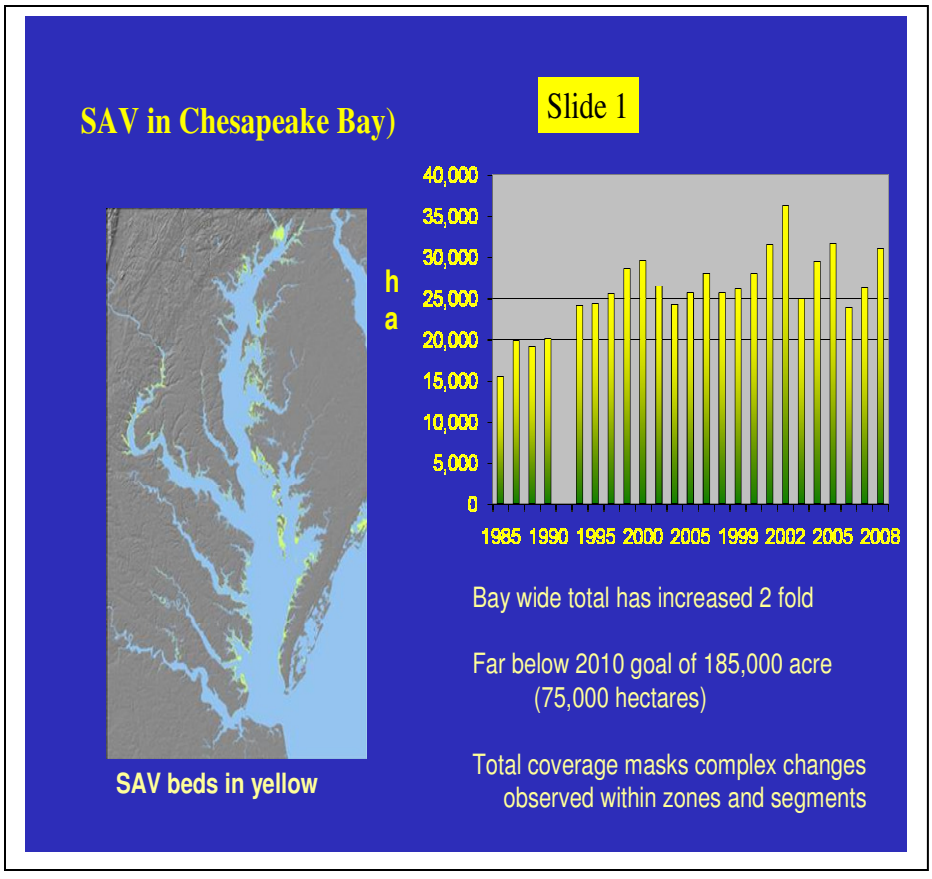
1. Bay-wide SAV coverage though 2008 is shown in slide 1. While SAV coverage has generally increased two-fold since 1984, abundance levels are still well below the bay-wide target of 184,000 acres. The bay-wide acreage masks the complex changes occurring in different parts of the bay, e.g. the different salinity regions, as reflected in slide 2.

2. SAV abundance in low, medium and high salinity zones is shown in slide 2. The significant increase in the low salinity zones has occurred primarily at the head of the bay in the Susquehanna Flats region. The declining trend in the high salinity areas is disturbing given the relationship of these areas to blue crab settlement and early juvenile survival.

3. Eelgrass abundance in Chesapeake Bay, Chincoteague Bay, and Virginia Southern Coastal bays. Map of mid-Atlantic region showing three analysis regions and eelgrass abundance in each from 1984 – 2007 is shown in slide 3. The shaded polygon in the Chesapeake Bay shows the upper extent of eelgrass distribution in the 1960s, while the lower, clear polygon represents the current distribution. These regions were derived from all mapped seagrass beds based on field observations of eelgrass and widgeongrass distribution.

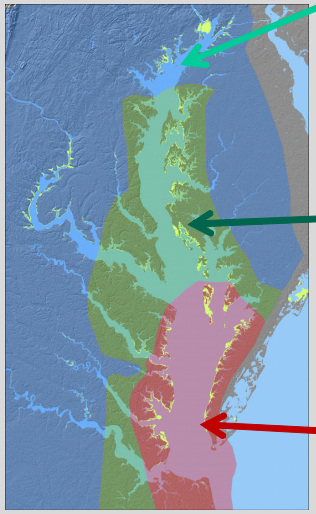
4. Slide 4 shows restoration trajectories in the Southern Virginia Coastal Bays, as measured by three metrics: (1) cumulative area seeded with eelgrass between 1998 and 2007 (with 25 million seeds); (2) area mapped by an annual seagrass monitoring program each year; and, (3) area of bottom cover, the estimated area of eelgrass canopy cover calculated from the weighted sum of areas in four cover classes assigned during mapping.

5. Slide 5 provides aerial photographs of the eelgrass restoration site in South Bay, one of the four Virginia Coastal bays, in 2004 (left) and 2008 (right). Polygon surrounds an area of approximately 300 hectares showing change in eelgrass coverage between those two time periods. Dark squares in 2004 are 0.4 ha plots of eelgrass that were seeded in 2001 and 2002; by 2008, the area within the polygon has become almost completely vegetated with eelgrass.



Slide 2

SAV Area Trends By Salinity Zone

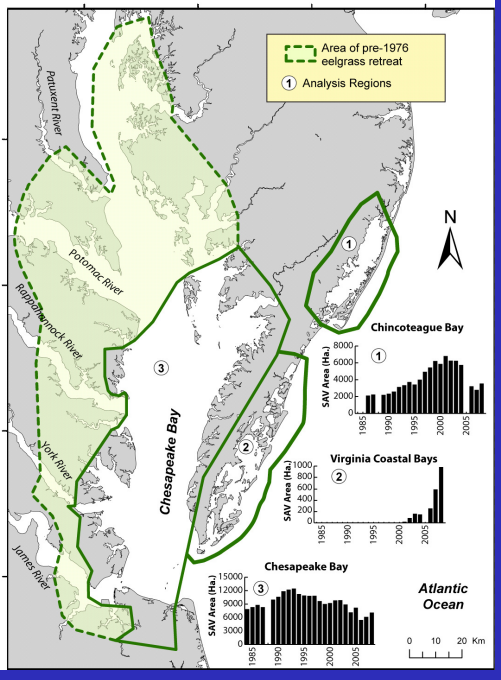


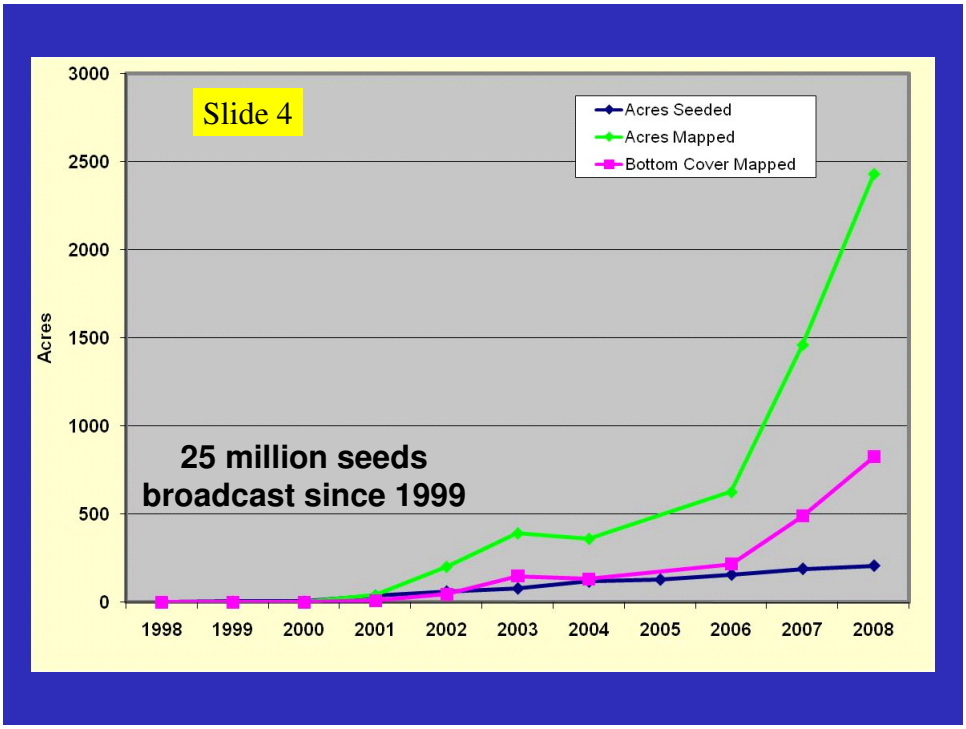
Low Salinity Zone

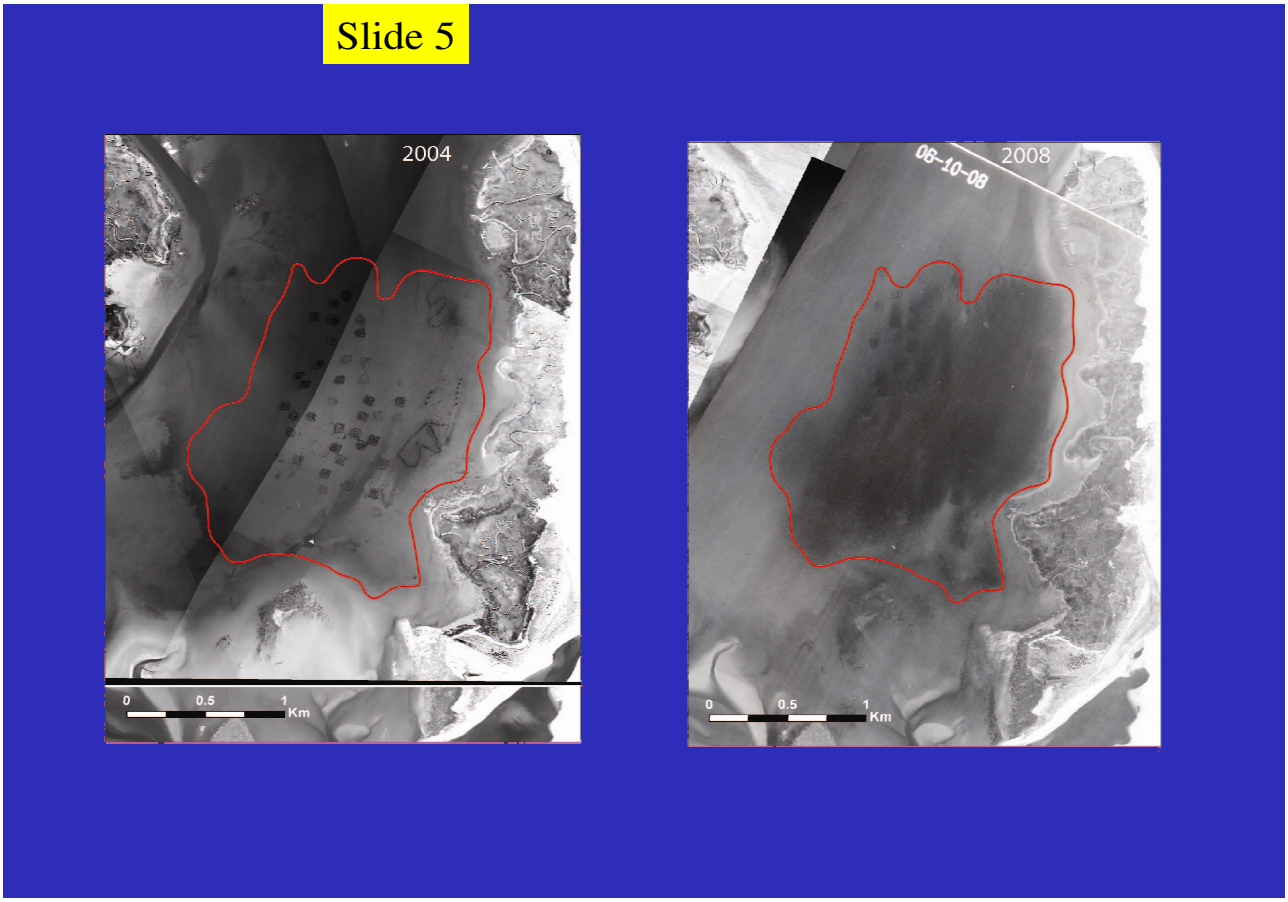
Medium Salinity Zone

High Salinity Zone

Slide 3




Slide 4
Acres Seeded
Acres Mapped
Bottom Cover Mapped
Acres
3000
2500
2000
1500
1000
500
0
25 million seeds
broadcast since 1999
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008


Slide 5
2004
0
0.5
1
Km
2008
06-10-08
0
0.5
1
Km