COMMONWEALTH of VIRGINIA

Marine Resources Commission
2600 Washington Avenue
Third Floor
Newport News, Virginia 23607

Molly Joseph Ward
Secretary of Natural Resources

John M.R. Bull
Commissioner

December 1, 2016

MEMORANDUM

TO: The Honorable Terry McAuliffe
Governor of the Commonwealth of Virginia
And
Members of the Virginia General Assembly

THROUGH: The Honorable Molly Joseph Ward
Secretary of Natural Resources

FROM: John M.R. Bull

SUBJECT: Blue Crab Fishery Management Plan

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

EXECUTIVE SUMMARY

Results from the 27th Bay-wide Winter Dredge Survey, conducted from December 2015 to March 2016 (Attachment I) by the Virginia Institute of Marine Science and Maryland Department of Natural Resources, indicate the blue crab stock is not depleted and overfishing is not occurring. The 2015-2016 Winter Dredge Survey estimates of abundance of all size classes of crabs was 553 million crabs, and this total abundance represents a 35% increase from the 2014-2015 Bay-wide Winter Dredge Survey and is above the long-term (1989-90 – present) average of 458 million crabs. The most recent abundance of juvenile crabs enumerated from this winter survey was 271 million, and is slightly greater than the long-term survey average of 262 million juvenile crabs. The importance of the juvenile crabs surveyed in wintertime is their contribution to the following late summer and fall harvest when they have recruited to harvestable size and their contribution to the subsequent year's late May and July-August spawning periods. The number of overwintering female crabs that could potentially spawn (if not harvested prior to the spawning seasons) in 2016 was 194 million. This was an improvement over the 2014-2015 survey estimate of 101 million and was above the threshold and about 10% below the management target of 215 million overwintering female crabs. Additionally, 194 million potential spawners is above the long-term average of 118 million potential female spawners. The importance of the mature female crabs is their contribution to the spawning events in late May and July – August of the same year

the Bay-wide Winter Dredge Survey is completed. These crabs also are important to the spring and early summer harvest, as a high proportion of the Virginia commercial and recreational harvests consist of female crabs.

Year-to-year variation in abundance of blue crabs can be expected as a result of the effects of environmental influences, especially for early life stages of crabs. Juvenile crab abundance can vary because of inter-annual difference in entrainment of crab larvae from the ocean to the Virginia portion of Chesapeake Bay that is subject to prevailing current and wind patterns. Environmental factors including weather conditions and predation can have an effect on all life stages of the crab population. Conservation of female spawning-age and juvenile crabs is the primary management objective to attempt to lessen variability of the blue crab stock abundance. Since 2008, there has been a continuation by all Chesapeake Bay jurisdictions of management measures that conserve the spawning-age female crabs. The number of spawning-age female crabs, estimated in 2016 as 194 million, increased 92% from the 2015 estimate of 101 million. This increase may be partly attributed to management measures, as fishery managers from the three Chesapeake Bay jurisdictions enacted spawning conservation measures to protect a portion of female spawning-age crabs and increase spawning stock potential by reducing the harvest of all crabs by 10%. This reduction in harvest for all blue crabs not only protects spawning-age females, but also protects some juvenile crabs that will contribute to the 2016 spawning stock. These jurisdictions also have relied on a new management framework for the past two season in which the fishery is regulated from July through July. The benefit of this approach is that two Bay-wide winter dredge surveys can be accomplished in that 12-month period, and adjustments to conservation measures can be implemented after either survey is complete.

In 2016 the Commission essentially maintained management measures implemented in 2015. VMRC remains cautious concerning variable abundance of blue crab from year to year. Just two years ago, the low abundance (68.5 million) of spawning-age female crabs indicated a depleted stock, as an abundance below the threshold of 70 million spawning-age female crabs is considered depleted. Before any substantial liberalization of current management measures concerning the blue crab occurs, the stock needs to stabilize at an annual abundance that consistently approaches the 215 million spawning-age female crab target. This management framework allows conservation of spawning-age female blue crabs in the spring prior to spawning and a portion of juvenile female crabs for the next years spawn. Maintained measures include reduced crab pot bushel and vessel possession limits for specific time periods and a season closure for all other crab gear. The reduced crab pot bushels limits extend from July 5, 2016 through July 4, 2017 for all crab pot license categories. The Commission also closed the winter crab dredge fishery season for ninth consecutive season to allow for continued rebuilding of the spawning stock biomass.

Virginia crab and oyster industries that benefitted from disaster relief funds initially provided in 2008 by the Department of Commerce for the declared Fishery Disaster in Chesapeake Bay blue crab fisheries continue to benefit today. The 2008 Disaster Relief Fund has provided various crab industry members (harvesters, buyers, and processors) negatively impacted by poor crab stock conditions during many years, through 2007, a source of employment. These funds have provided an opportunity to work in resource or habitat enhancement projects. The total amount of funding from the Disaster Relief Fund was $14,995,000. All of the six project areas detailed in previous reports have been completed as of 2014.

Two projects currently supported by the Virginia Institute of Marine Science's Fisheries Resource Grant Program focus on the commercial crab fishery. One of these, an effort to prevent juvenile flounder bycatch in crab pots, is in its second phase. The other project is directly focused on reducing mortality of blue crabs during the molting stage of soft crab production.

THE 2016 VIRGINIA BLUE CRAB FISHERY MANAGEMENT PLAN

Status of the Blue Crab Stock

The 2011 benchmark stock assessment control rule established female-specific reference points based on the biological status of female crabs. Biological reference points are a primary output of stock assessments, and fishery regulations are implemented to conform to those biological standards. The 2011 blue crab stock assessment provided female-specific reference points for both the abundance of female crabs at least 2.4 inches in carapace width (spawning-age female crabs categorized as age 1+) and the annual removal rate based on the percentage of female crabs of all sizes harvested in a year.

The abundance and exploitation rate targets and thresholds (biological limits) used to monitor the health of the blue crab stock in Chesapeake Bay are provided in Table 1 below.

Table 1. Abundance and exploitation rate targets and thresholds for the Chesapeake Bay blue crab stock. This is the control rule.

2011 Stock Assessment – Biological Reference Points		
Abundance	Overfished (Threshold)	70 million age 1+ female crabs
	Target	215 million age 1+ female crabs
Exploitation Rate	Overfishing (Threshold)	34% of all female crabs
	Target	25.5% of all female crabs

The abundance estimate from the 2015/16 Bay-wide Winter Dredge Survey of female spawning-age crabs (age 1+) was 194 million crabs, representing a 92% increase from the 2014/15 Winter Dredge Survey results. Annual winter crab dredge survey results represent the population sampled from December through March. The survey straddles two calendar years but is referenced as the latter of the two calendar years. Spawning-age crabs are crabs at least 2.4 inches in carapace width sampled by the survey, and these crabs will spawn either in late May or during the July - August peak spawning period. This estimate is above the overfished threshold of 70 million spawning-age female crabs, indicating the stock is not depleted. The most recent (2015) female crab exploitation rate estimate was 15%, and is below the target exploitation rate of 25.5% removal of female crabs on an annual basis from fisheries alone. This estimate is below the overfishing threshold of 34%, and overfishing is not occurring on this stock. For the last eight consecutive years the removal rate has been near or less than the target. Yet, the Chesapeake Bay jurisdictions are concerned that this removal rate, based on all sizes of female crabs, suffers from the assumption that the number of juvenile crabs collected by the dredge is always only 40% of the total number of juveniles each year since 2009.

The total abundance of 553 million crabs, determined by the Winter Dredge Survey, represents a 35% increase from 2015 (411 million crabs) to 2016. Total abundance has continued to

increase since 2014 but is still below peaks seen in 2012 and the early 1990s. Total abundance was low from the 2012-2013 survey, at 300 million crabs. It is likely that the July 5, 2014 through July 4, 2015 management framework promoted some additional spawning potential in 2014, resulting in slightly better recruitment in 2015 and continued improvement in 2016.

Overwintering mortality for all blue crabs in the bay was 1.9%; over-wintering mortality was highest for adult female crabs (3.0%), followed by adult males (1.1%), and lowest among juveniles (0.5%).

In the 2016 Chesapeake Bay Blue Crab Advisory Report, the Chesapeake Bay Stock Assessment Committee (CBSAC) recognized several topics as critical data and analysis needs to aid in the understanding of the variability in the blue crab stock. CBSAC identified a list of fishery dependent and independent data needs that would provide better information on blue crab abundance and survival, such as in 2015, for management measures, to include:

- Increased accountability and harvest reporting for both commercial and recreational fisheries;
- Gear efficiency pertaining to selectivity of the Winter Dredge Survey methods;
- Improving recruitment estimate through a shallow-water survey;
- Application of fishery independent survey data;
- Fishery-dependent data;
- Other sources of incidental mortality;
- Investigation of the potential for sperm limitation;
- Biological parameters.

Table 2 below provides a 27 year summary of the results from the Chesapeake Bay-wide Winter Dredge Survey conducted by the Virginia Institute of Marine Science (VIMS) and the Maryland Department of Natural Resources (MD DNR). The abundance of recruits (termed age 0 crabs) and the spawning-age crabs (termed age 1+) are differentiated according to size, with 2.4 inches in carapace width as the separator between the two size classes. Any abundance estimate represents the number of crabs that will be available to Chesapeake Bay fisheries following the end (March) of the seasonal (December - March) Bay-wide Winter Dredge Survey (Figure 1). A basis for the disaster relief can be readily understood by the overfishing that existed in 7 of 10 years from 1998 through 2007, as the removal rate or percentage of female crabs harvested exceeded the overfishing threshold of 34%.

Table 2. Bay-Wide Winter Dredge Survey results (1990 through 2014). All surveys begin in December and ended in March of the next year. Commercial harvest and percentage of female crab harvest in 2015 are not yet available.

Survey Year (Year Survey Ended)	Total Number of Crabs in Millions (All Ages)	Number of Juvenile Crabs in Millions (both sexes)	Spawning-age Crabs in Millions (both sexes)	Number of Spawning-age Female Crabs in Millions	Commercial Harvest (Millions of Pounds)	Percentage of Female Crabs Harvested
1990	791	463	276	117	96	44
1991	828	356	457	227	90	34
1992	367	105	251	167	53	60
1993	852	503	347	177	107	35
1994	487	295	190	102	77	28
1995	487	300	183	80	72	32
1996	661	476	146	108	69	20
1997	680	512	165	93	77	22
1998	353	166	187	106	56	40
1999	308	223	86	53	62	37
2000	281	135	146	93	49	43
2001	254	156	101	61	47	42
2002	315	194	121	55	50	34
2003	334	172	171	84	47	33
2004	270	143	122	82	48	42
2005	400	243	156	110	54	24
2006	313	197	120	85	49	29
2007	251	112	139	89	43	35
2008	293	166	128	91	49	24
2009	396	171	220	162	54	23
2010	663	340	310	246	85	18
2011	452	204	255	191	67	24
2012	765	581	175	95	56	10
2013	300	111	180	147	37	23
2014	297	198	99	68.5	35	17
2015	411	269	143	101	50	15
2016	553	271	284	194	?	?

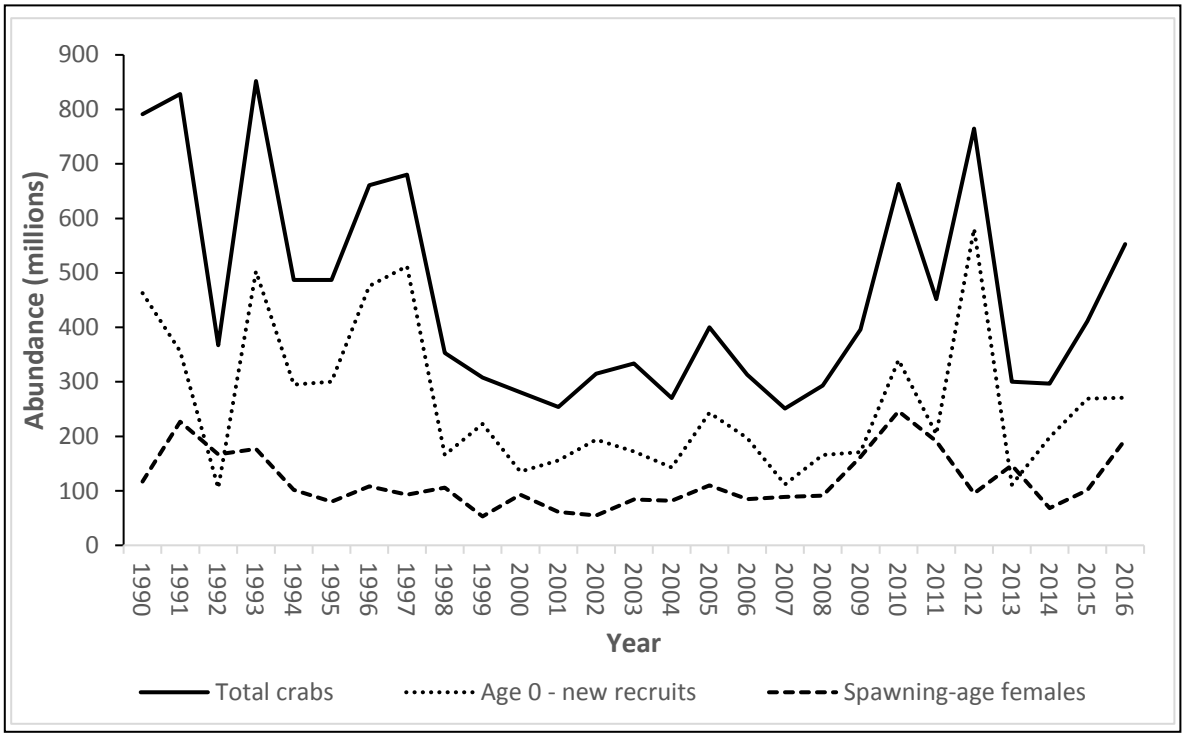

Figure 1. Abundance estimates (number of crabs in millions) for the 27 year Bay-wide Winter Dredge Survey for total crab abundance (male and female), juvenile (new recruits) crab abundance, and spawning-age (age 1+) female crab abundance, 1990 through 2016.

Harvest and Effort Statistics

In June 2016, CBSAC reported (Attachment II) the 2015 Chesapeake Bay-wide crab commercial harvest as 49.6 million pounds, 41% higher than the 2014 Bay-wide crab harvest of 35.2 million pounds, which was the lowest harvest recorded in the last 25 years. The long-term Bay-wide crab harvest is about 70 million pounds since 1990. The Bay-wide recreational harvest was estimated as 3.5 million pounds. Of the Bay-wide commercial harvest, Maryland harvested 26.7 million pounds, Virginia harvested 20.9 million pounds, and 2.0 million pounds were harvested in the jurisdiction of the Potomac River Fisheries Commission. The total 2015 Virginia reported commercial harvest for all commercial gear allowed to harvest blue crabs in all tidal waters including seaside areas was 22.9 million pounds.

Figure 2 below displays the time series of Virginia commercial crab harvest for all Virginia waters in pounds and estimated dockside value (first sale from harvester). The dockside value has been adjusted to account for inflation using the Consumer Price Index. Harvest statistics have been collected from Virginia fisheries since the late 1920s; however, 1994 is the first representative year of the mandatory commercial harvest reporting system. Both harvest and dockside value generally declined from 1994 through 2006, although dockside value began to increase in 2006 while harvest continued to decline until 2008. There were increases in both harvest and dockside values until 2010, followed by another decline in 2011 and 2012. In 2013, pounds harvested declined while value remained stable compared to 2012, which indicates price per pound increased as supply was limiting. In 2014 through 2015, both pounds harvested and dockside value increased. Value of these harvests is not considered accurate, as VMRC depends on voluntary reporting of dockside value even though harvest and effort reporting are mandatory.

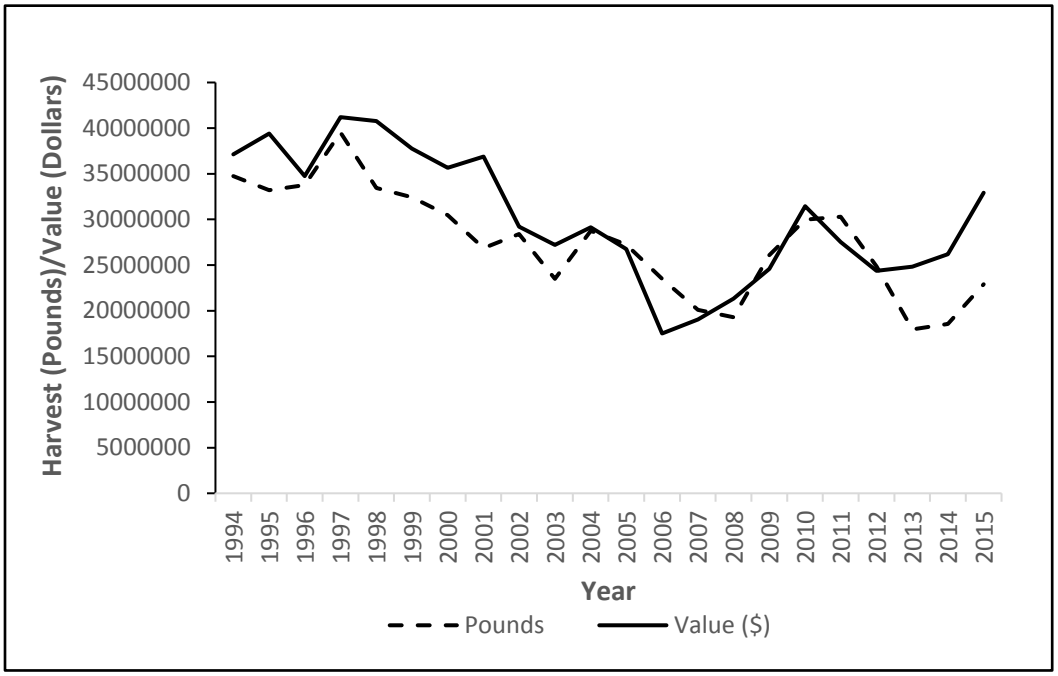

Figure 2. Virginia commercial harvest (state waters, in pounds) of blue crab and estimated dockside value (US dollars adjusted for inflation, first sale from harvester) for 1994 through 2015.

Table 3 below contains Virginia harvest data by market category (hard crabs and peeler and soft crabs), in pounds, for the last six years of complete data by month (2010 through 2015). The hard crab pot fishery has accounted for approximately 95% of the total crab harvest from Virginia tidal waters consistently since at least 2009. The hard crab pot harvest is dominated by female blue crabs. In 2015, the sex composition from crab pot harvests was 56% females, compared to 63% in 2014 and 75% in 2013.

Table 3. Virginia harvest data (state waters only, in pounds) by market category (hard crabs and peeler and soft crabs) for 2010 through 2015, by month. CD indicates confidential data. Harvest from studies is marked with an asterisk (*).

Hard Crab Market Category, Harvest in pounds

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
2010	0	0	393,989	4,863,233	3,123,948	3,996,187	4,236,363	4,194,639	3,428,107	3,359,365	1,404,282	0	29,000,113
2011	0	0	1,207,896	5,099,107	3,746,676	3,894,200	3,957,976	3,798,879	3,500,868	2,965,989	1,357,463	0	29,529,054
2012	0	0	2,591,169	2,652,213	3,541,772	3,686,564	3,286,771	3,006,328	1,969,407	2,186,328	901,769	169,832	23,992,153
2013	85,913*	85,233*	82,174	2,329,688	2,644,003	2,492,928	3,065,124	2,432,832	1,742,917	1,606,732	760,036	24,875	17,352,456
2014	0	0	6,751	804,528	1,844,133	2,302,130	2,995,689	2,961,464	2,931,133	2,843,875	876,724	0	17,566,425
2015	0	0	8,621	1,430,068	2,807,831	3,016,453	3,489,409	3,529,172	3,385,337	3,168,169	1,266,539	0	22,101,597

Peeler and Soft Crab Market Category, Harvest in pounds

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
2010	0	0	CD	62,313	414,570	133,404	164,267	114,671	71,923	8,729	CD	0	969,877
2011	0	0	CD	33,785	317,769	108,104	122,869	101,038	71,149	3,037	CD	0	757,751
2012	0	0	3,541	137,822	217,879	138,143	169,407	121,647	75,719	15,532	61	0	879,751
2013	0	0	0	6,743	171,559	92,090	137,557	122,629	59,200	9,917	CD	0	599,695
2014	0	0	0	2,534	350,646	328,005	140,231	118,954	43,106	1,778	0	0	985,253
2015	0	0	0	311	275,668	157,227	170,332	120,942	74,561	1,616	88	0	800,745

Tables 4 and 5 below show the number of active crab harvesters in the crab pot and peeler pot fisheries for the last six years of complete data, by month (2010 through 2015). June through September is the peak time period for active harvesters in the crab pot fishery. Harvester activity in the peeler pot fishery peaks in May and gradually declines from June through November.

Table 4. Number of harvesters by month for 2010 through 2015 active in the crab pot fishery. CD indicates confidential data.

Year	March	April	May	June	July	August	September	October	November	December	Total
2010	171	492	636	670	668	630	557	433	231	0	4,488
2011	298	497	607	646	632	591	504	399	249	0	4,423
2012	384	493	600	637	609	570	500	392	213	44	4,442
2013	67	422	525	579	601	595	521	389	221	36	3,956
2014	19	318	493	586	597	604	570	454	234	0	3,875
2015	20	347	527	601	632	627	586	452	253	CD	4,045

Table 5. Number of harvesters by month for 2010 through 2015 active in the peeler pot fishery. CD indicates confidential data.

Year	March	April	May	June	July	August	September	October	November	December	Total
2010	0	88	302	172	150	136	98	38	0	0	984
2011	0	61	272	154	139	120	80	26	0	0	852
2012	8	171	233	156	136	137	94	33	CD	0	968
2013	0	23	216	153	154	142	111	36	0	0	835
2014	0	12	230	165	154	154	90	3	0	0	808
2015	0	CD	238	172	171	165	118	4	0	0	868

Tables 6 and 7 below show Virginia trip data for the last six years (2010 through 2015) of complete data by month. The number of trips with reported crab harvest from crab pot gear totaled 50,735 in 2015, a 6.4% increase from 47,693 in 2014. The number of peeler pot trips in 2015 totaled 12,226, a 14.6% increase from 10,673 trips in 2014. The peeler and soft crab market category consisted of mainly peeler crabs.

Table 6. Number of commercial trips by month for 2010 through 2015 in the crab pot fishery. CD indicates confidential data.

Year	March	April	May	June	July	August	September	October	November	December	Total
2010	1,064	6,752	7,663	9,176	9,492	8,415	6,688	4,850	1,897	0	55,997
2011	1,985	6,675	7,479	8,972	8,797	7,961	6,392	4,620	2,189	0	55,070
2012	2,996	5,478	8,116	8,456	8,370	7,771	5,514	4,329	1,705	265	53,000
2013	247	4,871	6,425	7,278	8,396	8,040	5,943	4,164	1,858	124	47,346
2014	56	2,921	5,781	7,332	8,688	8,214	7,124	5,715	1,862	0	47,693
2015	63	3,691	6,581	8,174	8,887	8,411	7,236	5,347	2,345	CD	50,735

Table 7. Number of commercial trips by month for 2010 through 2015 in the peeler pot fishery. CD indicates confidential data.

Year	March	April	May	June	July	August	September	October	November	December	Total
2010	0	637	4,075	2,361	2,546	1,908	1,196	209	0	0	12,932
2011	0	329	3,601	2,134	2,282	1,714	1,155	118	0	0	11,333
2012	29	1,735	3,048	2,195	2,178	2,003	1,053	207	CD	0	12,448
2013	0	141	2,623	2,007	2,338	2,118	1,240	226	0	0	10,693
2014	0	52	2,780	2,335	2,464	2,345	685	12	0	0	10,673
2015	0	CD	3,118	2,468	2,757	2,457	1,387	39	0	0	12,226

Blue Crab Conservation Actions in 2015

Commission actions since 1994 that have attempted to promote sustainability of the blue crab stock and fishery through conservation measures are included in Attachment III. Many of these measures were designed to promote spawning potential of blue crabs, and have helped in stabilizing the crab stock. Mostly, abundance has been low since 2011, but 2014, 2015, and 2016 Bay-wide Winter Dredge Survey data do show some improvement in juvenile production. These measures were employed before scientists developed status of the stock indicators.

A short-term conservation approach for 2014 and 2015 was developed. Management measures for 2015 and 2016 were modified to provide more protection for the female spawning-age and juvenile blue crabs that will contribute to the spawning stock in 2017. The Commission approved the following management measures at its June 2016 meeting:

- Reduction in crab pot bushel limits and vessel limits

  The Commission maintained reduced crab pot bushel and vessel possession limits for specific time periods and a season closure for all other crab gear lawful to harvest crabs. The reduced crab pot bushel limits extend from July 5, 2016 through July 4, 2017 for all crab pot license categories. This time period is effectively the new commercial blue

crab management season for Virginia, shifting management measures from a commercial blue crab season of March through November each year. The Commission closed the winter crab dredge fishery season for ninth consecutive season to allow for continued rebuilding of the spawning stock biomass. The main basis was that the juvenile and female spawning-age trigger was not met (see below).

Current bushel limits could be modified in 2017. Bushel limits may be revised after July 2017, when results of the 2016/17 Winter Dredge Survey are available. Table 8 below gives the bushel limits by crab pot license category by time period for the new management season.

Table 8. Modified crab pot gear license category-specific bushel limits established by the Commission, effective July 5, 2016 through July 4, 2017.

Crab Pot License Category	Crab Pot Bushel Limits: July 5, 2016 through November 15, 2016	November 16, 2016 through December 20, 2016	March 1, 2017 through March 31, 2017	April 1, 2017 through July 4, 2017
Up to 85 Crab Pots	10	8	8	10
Up to 127 Crab Pots	14	10	10	14
Up to 170 Crab Pots	18	13	13	18
Up to 255 Crab Pots	29	21	21	29
Up to 425 Crab Pots	47	27	27	47

Daily vessel harvest possession limits are related to crab pot bushel limits, so a reduction in crab pot bushel limits results in a reduction in the vessel possession limit. A vessel harvest possession limit corresponds to the highest crab pot bushel limit of only one licensee onboard a vessel. Commercial watermen fishing for blue crab may have multiple licensees onboard a vessel.

- Winter crab dredge fishery season

The Commission closed the 2016/17 winter crab dredge fishery season from December 1, 2016 through March 31, 2017 for the ninth consecutive season after reviewing the abundance estimates from the Winter Dredge Survey and being mindful of the depleted condition of the blue crab stock in 2014.

- Season closure for all other crab harvest gears

The Commission established a seasonal closure from November 1, 2016 through March 31, 2017 for all commercial gears that are lawful for the harvest blue crabs including peeler pot gear, trotlines, traps, and scrapes.

Ecosystem Constraints on the Blue Crab Resource

§ 28.2.203.1 of the Code of Virginia provides that the blue crab fishery management plan shall be designed to reverse any fishing practices, environmental stressors, 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. The Commission relies on the efforts of its sister agencies to promote and sponsor improvements of Chesapeake Bay's water quality in order to meet the requirements of §28.2.203.1 of the Code of Virginia dealing with environmental stress and habitat deterioration.

Algal blooms can result in hypoxic and anoxic conditions (low dissolved oxygen levels) in Chesapeake Bay that cause blue crabs to be displaced or result in mortality. The Commission is a member of the Virginia Department of Health's Harmful Algal Bloom Task Force (HAB TF). This year, HAB TF members combined efforts to conduct fly-overs, take and analyze samples from areas with active HABs, and update the public about HABs. VMRC staff worked with HAB TF to provide links to VDH Harmful Algal Bloom notices on the VMRC website. VMRC staff will participate in the annual HAB TF meeting, to be held on December 6, 2016. The impact of HABs on blue crab meat safety or health is unknown.

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 fisheries; however, many water quality and habitat impacts to the stock are not fully quantified or understood. The relationship between blue crabs and other components of the ecosystem is being explored by Chesapeake Bay scientists. Many natural and man-induced impediments continue to challenge the stability of the blue crab stock, including hypoxia, shoreline development, and pollution. The issue of climate change will continue to be important as well, as blue crab behavior is linked to water temperature.

Water quality in Chesapeake Bay is improving due to the ongoing efforts of the Commonwealth and the signatories of the Chesapeake Bay Agreement. Additional work is being implemented to meet pollution reduction goals in Chesapeake Bay. Each of the bay jurisdictions has developed a Watershed Implementation Plan to guide restoration plans through 2025. The federal government developed Executive Order 13508, which guides the federal agencies plan to meet pollution reduction goals and establishes the Federal Leadership Committee that will publish an annual Chesapeake Bay Action Plan. A Chesapeake Bay Watershed Agreement was signed in June 2014 by governors from all seven watershed states, the Chesapeake Bay Commission, and the Environmental Protection Agency. The Watershed Agreement contains ten goals and 29 measureable, time-bound outcomes to improve the health of Chesapeake Bay including sustaining blue crabs. The 2015 Update to the 2014-2015 Milestone Progress Report published by the Federal Government in May, 2016, demonstrates progress toward milestones and includes planned Bay restoration and protection for fiscal year 2016.

Past reductions in submerged aquatic vegetation (SAV) beds have likely impacted the blue crab stock, especially juvenile crabs that use SAV beds as protection from predators. Seagrass beds provide nursery habitat for newly settled, young juvenile, and mating blue crabs. The dominant SAV in Virginia waters is eelgrass (a seagrass). The importance of eelgrass habitat functions in Chesapeake Bay was first demonstrated by VIMS in a 1961 report to the National Science Foundation. Subsequent

studies by VIMS have led to a greater understanding of SAV Bay-wide distribution, abundance, and health. VIMS established the first broad-scale aerial monitoring of SAV in 1974, and expanded the survey in 1978 to cover all of Virginia's tidal waters. VIMS maintains a research and monitoring program that has significantly expanded our understanding of SAV, its role in the greater Bay ecosystem, and its linkages with the health of the blue crab stock. Ongoing SAV research and monitoring programs include:

- Annual Bay wide aerial survey;
- Eelgrass restoration in Virginia's seaside bays;
- The use of restored eelgrass beds by estuarine fauna;
- Targeted water quality monitoring and study of key SAV locations in Virginia waters for effects from water quality changes, global warming, and climate change;
- Assessment and monitoring of the effects of certain fishing techniques on eelgrass beds;
- Water quality assessments for evaluation of water quality standards attainment (SAV distribution is a criterion for water clarity);
- The role of abiotic factors influencing the flowering of eelgrass;
- The roles of dispersal and seed predation in determining eelgrass population dynamics;
- The influence of climate change factors on the use of eelgrass and widgeon grass beds;
- Habitat suitability of exotic algae versus native seagrass as an alternative nursery habitat for juvenile blue crabs;
- The distribution of overwintering age-0 blue crabs in shallow water habitats; and
- The functional relationships between seagrass characteristics and juvenile blue crabs under high recruitment.

As is evident from some of VIMS monitoring and research, there is great concern in the scientific community regarding the fate of SAV in Chesapeake Bay and the effect that losses will likely have on blue crabs and other Bay fauna. The survival of most species of SAV is viewed as highly problematic as sea levels rise and water temperature continues to increase. VIMS studies have shown there is a strong effect of high summertime water temperatures on the seagrass declines observed in Virginia waters in recent years (Moore and Jarvis 2008, Moore et al. 2012), and that short term periods of high temperatures can cause large die-offs. This is due, in large part, to the high temperature intolerance of eelgrass. Eelgrass is near its southern limits along the Atlantic coast in Virginia, so high summertime water temperatures can be especially harmful to eelgrass beds. Unusually high temperatures during periods in the summer of 2005 and 2010 resulted in severe diebacks in eelgrass beds, most dramatically in high-salinity areas (Orth *et al.* 2016). After each of these diebacks, some recovery was observed over the next few years; however, VIMS research (Jarvis and Moore 2010) has shown that since eelgrass seeds in the sediment are only viable for a year or less, consecutive years of diebacks would be especially deleterious. If water temperatures continue to increase as a result of climate change, losses of eelgrass beds in Virginia may accelerate. VIMS research has demonstrated that increased water clarity can help eelgrass beds persist under higher temperatures. Therefore, VIMS is working with Virginia regulatory agencies, MD DNR, and the Environmental Protection Agency to assess the current water clarity goals for Chesapeake Bay to determine if changes are appropriate and needed. Storms can also be stressful to SAV beds through direct physical disruption or by greatly increasing sediment and nutrient inputs into the Bay and its tributaries. Excess sediments and nutrients can promote increased turbidity, compounding the effects of high temperatures (Moore et al. 2013). Results of VIMS' studies indicate that Virginia's SAV beds do relatively well in withstanding the direct physical disruption by storms.

Should regional climate change significantly affect SAV distribution and abundance in Chesapeake Bay, VIMS scientists have found that the coastal bays on the seaside of Eastern Shore may ultimately be a prime refuge location for SAV due to the proximity of these beds to the cooler waters of the adjacent Atlantic Ocean (Orth et al. 2010, Moore et al. 2012). SAV restoration efforts have been highly successful within the Eastern Shore's coastal bays, and there is much promise of continued growth through natural processes and additional restoration (Orth et al. 2010).

VIMS annual Bay-wide aerial survey serves as a significant indicator of Bay health and as a tool for determining compliance with Virginia water quality standards. Virginia tidal waters are home to 12 species of SAV, with eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) having the most overlap with the distribution of juvenile blue crabs in Chesapeake Bay. Since historically low abundances in 1984, SAV restoration has varied between tidal waters with different salinities. Seagrass beds have continually increased in lower salinity tidal waters, increased initially in areas of medium-salinity followed by variable annual abundance levels, and increased initially in the high-salinity region followed by a general decline in abundance (Orth et al. 2010). These general trends remain accurate in the years since this study. In 2015, there was a 21% increase in SAV abundance (from 24,164 ha in 2013 to 30,689 528 ha in 2014 to 37,077 ha in 2015) in Chesapeake Bay. While SAV increased in all salinity zones, medium-salinity areas saw the most dramatic increase in SAV. High-salinity zones, which were most strongly impacted by the 2005 and 2010 temperature-induced diebacks, showed modest recovery in 2015, as did low-salinity areas (Orth et al. 2016). Accurately determining a primary driver of SAV declines is difficult because the estuarine environment is complex, but Orth et al. (2010) found strong negative correlations between SAV abundance and nitrogen levels. This provides strong evidence that water quality is a primary causative element in SAV distribution and decline. It is understood through numerous published studies that most estuarine fauna, including juvenile blue crabs, experience higher growth and survival rates in vegetated versus unvegetated shallow water habitats. A recent VIMS study has shown that juvenile blue crabs prefer denser SAV beds over thinner beds (Ralph et al. 2013), further demonstrating the positive influence that the quality of seagrass beds have on blue crab population dynamics. VIMS studies have also demonstrated the high value to juvenile blue crabs of unvegetated areas both adjacent to salt marshes in upriver areas of Bay tributaries and areas that contain an abundance of food such as clams and polychaetes (marine worms); and within areas of abundant macroalgae where native SAV nursery habitat has experienced reductions in aerial coverage (Seitz et al. 2003, Seitz et al. 2005, Johnston and Lipcius 2010, Seitz et al. 2011).

Blue crabs have a diverse assemblage of parasites and pathogens, and the presence and occurrence of these pathogens has been a long-time research focus at VIMS. Many pathogens are present in the tidal waters of Virginia, but only a few have the potential to damage the blue crab stock or fisheries (Shields & Overstreet 2007, Shields 2012). Two agents, in particular, occur at high prevalence levels and show signs of high pathogencity. These are *Hematodinium perezi* and a recently identified reo-like virus. *Hematodinium perezi* is a parasitic dinoflagellate found primarily in the higher salinity waters of the Bay, particularly in the seaside bays of the Eastern Shore and along the eastern portions of lower Chesapeake Bay (Messick & Shields 2000). Prevalence levels of *Hematodinium* have a small peak in early summer and a large peak in autumn followed by a rapid decline with the onset of winter temperatures. Prevalence levels are associated with molting in juvenile blue crabs, which explains the bimodal peak occurrence of the parasite. Mortality levels of 87% have been observed in laboratory experiments (Shields and Squyars 2000). VIMS scientists recently discovered and described the life cycle of *Hematodinium perezi* in the blue crab (Li et al. 2011), and this will lead to a greater

understanding of the risk of mortality and the environmental and biological factors that may influence the effects of this pathogen. The reo-like virus was initially described from juvenile crabs held in the laboratory (Johnson and Bodammer 1975). It has been implicated as a source of mortality in the production of soft-shell crabs based on infection trials and sampling of crabs from shedding facilities (Bowers et al. 2010). VIMS continues to be actively engaged in research on these pathogens.

Blue Crab Disaster Relief Funding Updates

In 2008, Virginia was awarded $14,995,000 in disaster relief funds by the National Marine Fisheries Service (NMFS) after the declaration of a blue crab fishery disaster. The Commission implemented a set of six projects (Items I through VI, below), beginning in December 2008 with the Derelict Crab Pot and Marine Debris Removal Project. The remaining five projects were initiated in 2009, and all projects were completed by 2014.

I. Derelict Blue Crab Pot and Marine Debris Removal Project

Discarded debris such as tires, gill nets, appliances, and crab pots can be found throughout the tidal waters of Virginia. Derelict crab pots may remain in the environment for years continuing to capture and kill fish, shellfish, birds, and marine mammals, including endangered or threatened species. It is estimated that around 20% of crab pots deployed are lost each season, and each functional lost crab pot can continue to capture about a bushel of market-sized crabs per season, as well as other animals such as black seabass, Atlantic croaker, spot, flounder, and terrapins. There is an environmental benefit in removing marine debris from Virginia's waters if the removal can be accomplished safely without damaging the marine habitat and ecosystem. This project included work specifically aimed at removing marine debris from Virginia's tidal waters with the assistance of up to 70 watermen. This program recovered over 32,000 crab pots over four winters from 2008 through 2012. The project continued in the winters of 2012/13 and 2013/14 with funding from the National Oceanic and Atmospheric Administration (NOAA), the National Fish and Wildlife Foundation (NFWF), and the Office of the Virginia Secretary of Natural Resources supporting four watermen (2012/13) and seven watermen (2013/14) who removed an additional 726 and 1261 pots, respectively, from targeted 'hotspots'. In addition, research into biodegradable escape panels to prevent 'ghost fishing' of lost and abandoned pots has resulted in a Virginia-based startup company selling 'biopanels' for fishing gear (including crab and lobster pots) worldwide.

The data gathered were recently used to quantify adverse economic impacts of derelict gear. In addition to causing direct mortality of target and bycatch species, derelict gear may make active gear less effective. Because lost gear is often in close proximity to active gear, this lost gear competes with the active gear making the fishery less efficient. It is estimated that there was a 27% increase in blue crab harvest ($21 million value) because of the removal of derelict crab pots in Virginia (Scheld et al. in review).

Ongoing work to develop a national framework to evaluate the extent of ecological and economic effects/impacts of derelict fishing gear using the Chesapeake Bay blue crab trap fishery as case study continues through funding by NOAA (2015-2016). The objectives of the comprehensive study are to: (1) identify and evaluate characteristics of the Chesapeake Bay blue crab trap fishery that contribute to the distribution and densities of derelict crab traps; (2) inventory available data related to variables determined in objective one with consideration to data that would likely be available in other

U.S. regions; (3) identify data gaps and design surveys and experiments to provide those data; (4) develop a spatial model framework to evaluate factors influencing the distribution and densities of derelict crab traps; (5) quantify the ecological and economic effects/impacts of derelict crab traps in Chesapeake Bay; and (6) develop National Derelict Fishing Gear Assessment Framework.

II. Cull Ring and Terrapin Excluder Device Project

The goals of this study were to employ Virginia's watermen to: (1) investigate the effects of different crab pot cull-ring sizes on blue crab catch, biomass, and survival; and (2) determine the effects of bycatch reduction devices (BRDs) in crab pots on blue crab catch, finfish bycatch, and diamondback terrapin bycatch. The BRDs were found to exclude all but the smallest terrapins without affecting the catch of crabs (Rook et al. 2010). These pots have been accepted for use in the recreational crab fishery.

Blue crab disaster relief funding also supported the start of an ongoing project to investigate derelict blue crab pot impacts on terrapins and methods to reduce adverse interactions. Terrapins are visual predators. Blue crabs likewise are strongly visual predators. This study is looking into whether the color of Bycatch Reduction Devices (BRDs) and/or the crab pot funnels can be modified in such a way as to deter entry by terrapins and encourage entry by crabs. Currently, the movement of terrapins and crabs into pots is thought to be primarily controlled by the physical dimensions of the funnel and BRD, with some preliminary evidence that terrapins are visually detecting and actively avoiding red/orange BRDs and blue crabs are not deterred from entry.

III. Supplemental Funding for the Fishery Resource Grant Program

Restoration activities for the blue crab population in Chesapeake Bay have included several new restrictions on the harvest by Virginia. These new regulations affect the livelihoods of Virginia harvesters targeting blue crabs. In order to supplement the income of these harvesters to maintain their financial stability in response to the 2008 blue crab harvest restrictions, the state proposed to support harvesters by training them in oyster aquaculture. Two methods of oyster aquaculture were implemented, cultch less and remotes setting. Three full years of aquaculture training were supported with additional educational effort in shellfish handling, storage, and transportation. Surveys of participants indicate a strong willingness to continue to develop their shellfish aquaculture enterprises.

IV. Oyster Aquaculture

In 2010, the Commission’s Conservation and Replenishment Department began training crab industry participants in modern techniques for growing oysters on private grounds. These techniques are easily adaptable to boats and equipment available to crab harvesters and should provide alternative sources of income for harvesters active in the blue crab fishery. More than 130 watermen were trained in cage aquaculture in 2010 and 2011, and all individuals have harvested their first crop of oysters. Many individuals have purchased additional oyster seed and equipment to continue growing oysters after the completion of their training projects. More than 110 crab industry participants have also been trained in spat-on shell oyster production from 2010 through 2013. With the spat-on-shell method, oyster larvae are purchased from hatcheries, and the larvae are deployed into large tanks filled with Bay water and shell. Once the larvae have attached to shell, the oyster seed is very similar to wild oyster seed. The seed and shell is spread over the bottom, for later harvest by conventional methods. The oysters produced in this manner are primarily used for the shucking industry. In all

of the training projects, selectively bred, disease tolerant, triploid (reproductively sterile) oysters are being grown. These oysters are highly marketable because of superior meat quality year round.

Blue crab industry participants were again trained in 2014 in oyster aquaculture, with more than 20 individuals participating in the spat-on-shell program. There were very significant problems in Virginia oyster hatcheries in 2014 and 2015 due to water quality issues. Oyster larvae production was about one third of the previous year's production. In total, 7,980 bushels of shell were set with 293 million eyed larvae produced by Virginia hatcheries. These shells were deployed with 52 million small oysters on private oyster beds throughout Virginia's Chesapeake Bay and tributaries. 2014 was the least productive for this project, and many of the participants could not complete their projects. Water quality problems continued into 2015. The private oyster hatcheries are also making improvements to their water filtration methods, and began production early in 2015. The oyster aquaculture industry is entirely dependent on the successful operation of these private hatcheries. Harvests of oysters from private oyster ground have increased significantly over the past five years due partly to the overall success of this project.

V. Crab Pot and Peeler Pot License Buy Out Program

The Crab License Buy-Back Program was initiated and completed in 2009, in order to reduce the overcapacity in the crab pot and peeler pot fisheries. In total, 75,441 crab pots or peeler pots and 359 crab licenses were purchased and removed from future fisheries. Overcapacity remains an issue in the crab fisheries.

VI. Update of the blue crab stock assessment

In 2016, the CBSAC Report was completed (Attachment II). Findings of the stock assessment were endorsed by the Chesapeake Bay Program Sustainable Fisheries Goal Implementation Team's executive committee. The executive committee is represented by VMRC, MD DNR, the Potomac River Fisheries Commission, the National Oceanic and Atmospheric Administration's Chesapeake Bay Office, Maryland Sea Grant, the Atlantic States Marine Fisheries Commission, and the District of Columbia's Division of Fish and Wildlife.

Managers and scientists expect annual estimates of abundance and exploitation rate to vary. However, if at any time the Bay-wide Winter Dredge Survey results indicate the abundance of female spawning-age crabs has fallen below the overfished level of 70 million, then management measures would be implemented to protect the biological stability of the blue crab stock. Based on results from the 2015/16 Winter Dredge Survey, the female spawning-age biomass is not below the overfished threshold and has shown some recovery since management measures to reduce harvest on all crabs by 10% Bay-wide were implemented. These measures were largely maintained for 2016/2017 to allow for continued rebuilding. Despite a history of variable abundance over the last several years, VMRC continues to promote conservation efforts that can afford benefits to all user groups.

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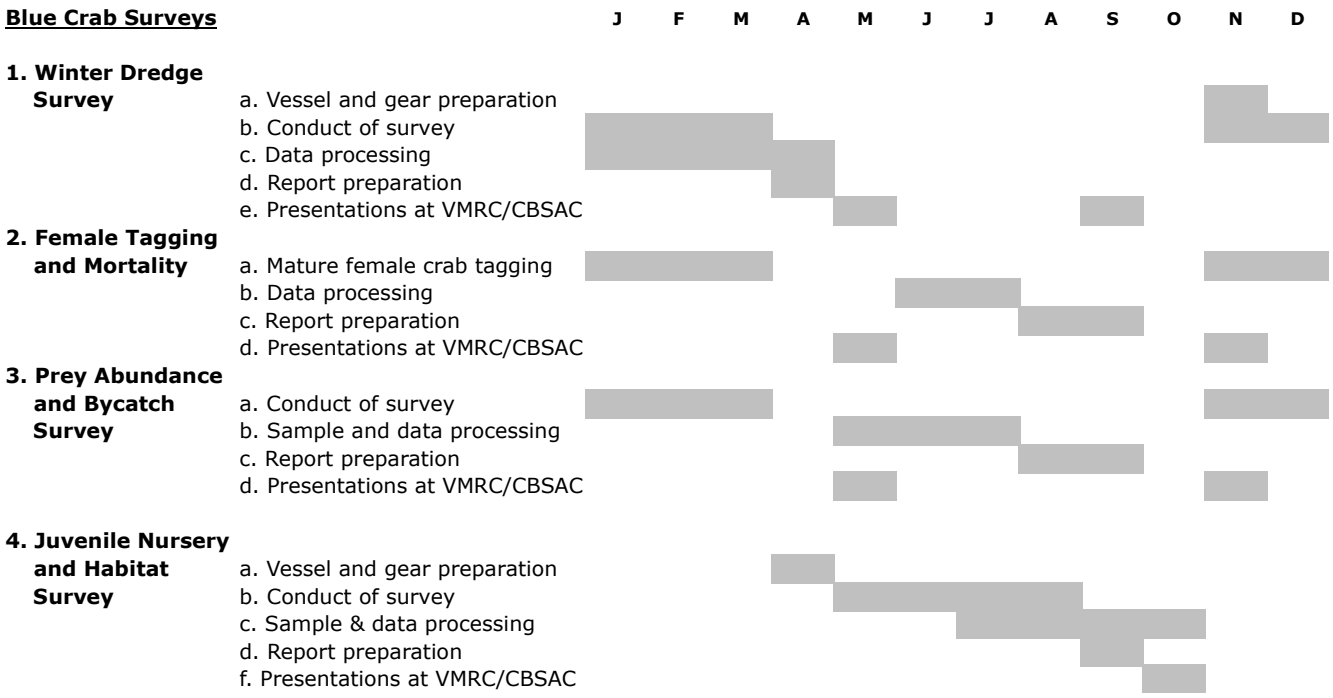
VIMS Blue Crab Surveys (2014-2015)

In 2015-2016, the Blue Crab Surveys Program conducted the: (i) Winter Dredge Survey (WDS), (ii) Mainstem Prey and Bycatch Survey (MPBS) associated with the WDS, (iii) Female Tagging and Mortality (FTM) estimation associated with the WDS, and (iv) Juvenile Nursery Habitat Survey (JNS). In addition, blue crab data was also gathered by VIMS Trawl Survey and ChesMMAP. The JNS is complementary to VIMS Trawl Survey in that it gathers data on juvenile blue crabs and habitat quality in shallow-water habitats where none of the other surveys is able to sample. Samples and data from the WDS, MPBS and FTM were processed during the course of the WDS and into the summer, whereas samples from JNS required laboratory processing (e.g. a single seagrass sample can take up to a full workday to process) and were frozen for processing during a portion of each month from August through October. The activities of the WDS and their timing (by month) are listed below.



2016 Chesapeake Bay Blue Crab Advisory Report

CBSAC Meeting Date: May 18, 2016
Report Final Draft: June 30, 2016

1. INTRODUCTION

1.1 Background: Science and Management

The Chesapeake Bay Stock Assessment Committee (CBSAC) combines the expertise of state representatives and scientists from the Chesapeake Bay region with federal fisheries scientists from the National Marine Fisheries Service's Northeast and Southeast Fisheries Science Centers. This committee has met each year since 1997 to review the results of annual Chesapeake Bay blue crab surveys and harvest data, and to develop management advice for Chesapeake Bay jurisdictions: the state of Maryland, Commonwealth of Virginia, and the Potomac River Fisheries Commission (PRFC).

Three benchmark stock assessments of the Chesapeake Bay blue crab have been conducted since 1997. The most recent assessment was completed in 2011[1] with support from the Virginia Marine Resources Commission (VMRC), Maryland Department of Natural Resources (MD DNR), and the NOAA Chesapeake Bay Office (NCBO). The 2011 assessment recommended revision of the former overfishing reference point, which had been based on conserving a fraction of the maximum spawning potential (MSP), to one based on achieving the maximum sustainable yield (MSY; Table 1). The 2011 stock assessment recommended replacing the empirically-estimated overfished age-1+ (both sexes) abundance threshold and target with an MSY-based threshold and target based solely on the abundance of female age-1+ crabs.

Female-specific reference points were formally adopted by all three management jurisdictions in December 2011. Management of the blue crab stock is coordinated among the jurisdictions by the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team (SFGIT). Organized by the Chesapeake Bay Program and chaired by NCBO, the SFGIT is led by an Executive Committee of senior fisheries managers from the MD DNR, VMRC, PRFC, the Atlantic States Marine Fisheries Commission and the District Department of the Environment.

CBSAC adopted the Baywide Winter Dredge Survey (WDS) as the primary indicator of blue crab population health in 2006 because it is the most comprehensive and statistically robust of the blue crab surveys conducted in the Bay[2]. The WDS measures the density of crabs (number per 1,000 square meters) at approximately 1,500 sites throughout the Bay. The measured densities of crabs are adjusted to account for the efficiency of the sampling gear and are expanded based on the area of Chesapeake Bay, providing an annual estimate of the number of over-wintering crabs by age and sex[2]. An estimate of the mortality during winter is also obtained from the survey results.

1.2 Background: Stock Status and Current Management Framework

Under the current framework, annual estimates of exploitation fraction are calculated as the annual harvest of female crabs in a given year (not including discards, bycatch, or unreported losses) divided by the total number of female crabs (age 0+) estimated in the population at the start of the season. As part of this calculation, the juvenile component of the total estimated number of crabs is scaled up

by a factor of 2.5 so that the empirical estimate of exploitation uses the same assumption about juvenile susceptibility to the survey as the stock assessment that generated the reference points. Thus, the empirical estimates of exploitation rate can be compared with the assessment model derived target and threshold reference points. The 2016 exploitation fraction cannot be calculated until the completion of the 2016 fishery and is therefore listed as TBD (to be determined). Crab abundance is estimated from the WDS each year. The current framework recommends monitoring the abundance of female age-1+ crabs in comparison to female-specific abundance reference points. Management seeks to control the fishery such that the number of crabs in the population remains above the minimum set by the overfished (depleted) threshold. Ideally, the fishery should operate to meet target values and should never surpass the exploitation fraction threshold value and never go below the abundance threshold value (Table 1).

Table 1. Stock status based on reference points for age 0+ (exploitation fraction) and age 1+ (abundance) female crabs. Recent stock status levels that did not exceed threshold values are shown in green; whereas exploitation values or abundance estimates exceeding thresholds are shown in red.

Control Rule	Reference Points			Stock Status					
	Period	Target	Threshold	2011	2012	2013	2014	2015	2016
Exploitation Fraction (age 0+ female crabs)	Current, Female-specific	25.5%	34% (max)	24%	10%	23%	17%	15%	**TBD**
Abundance (millions of age 1+ female crabs)	Current, Female-Specific	215	70 (min)	190	97	147	68.5	101	194

2. CONTROL RULES

2.1 Control Rule from 2011 Benchmark Assessment

The 2011 benchmark assessment recommended a control rule based on biological reference points for the female component of the population. The application of a control rule to management of the blue crab fisheries was first adopted by the Bi-State Blue Crab Advisory Committee in 2001[3]. The current female-specific targets and thresholds were developed using an MSY approach. UMSY is defined as the level of fishing (expressed as the percentage of the population harvested) that achieves the largest average catch that can be sustained over time without risking stock collapse. Following precedent adopted by the New England and Mid-Atlantic Fishery Management Councils, the 2011 assessment recommended a target exploitation level that was associated with 75% of the value of UMSY and a

threshold exploitation level set equal to UMSY. The female-specific, age-1+ abundance target and threshold were set accordingly at abundance levels associated with N0.75*UMSY (target) and 50% NMSY (threshold).

2.2 Spawning-age Female Crabs: Reference Points

The 2011 benchmark assessment recommended a threshold abundance of 70 million female spawning-age (age 1+) crabs and a target abundance of 215 million female spawning-age crabs. Approximately 194 million female spawning-age crabs were estimated to be present in the Bay at the start of the 2016 crabbing season, a 92% increase from the 2015 estimate of 101 million spawning-age female crabs (Figure 1). The 2016 abundance of spawning-age female crabs is above the threshold, and about 10% below the target.

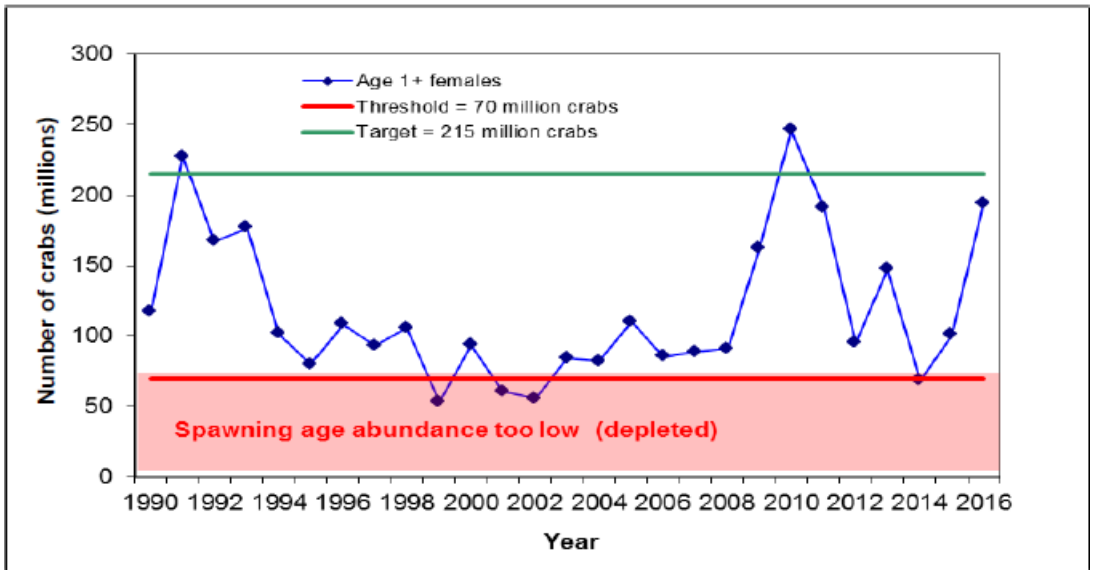


Figure 1. Winter dredge survey estimate of abundance of female blue crabs age one year and older (age 1+) 1990-2016 with female-specific reference points. These are female crabs measuring greater than 60 mm across the carapace and are considered the 'exploitable stock' that could spawn within this year.

2.3 Female Exploitation Fraction: Reference Points

The percentage of all female crabs (ages 0+) removed by fishing (exploitation fraction) in 2015 was approximately 15%. This exploitation fraction is below the target of 25.5% and the threshold of 34% for the eighth consecutive year since female-specific management measures were implemented in 2008 (Figure 2).

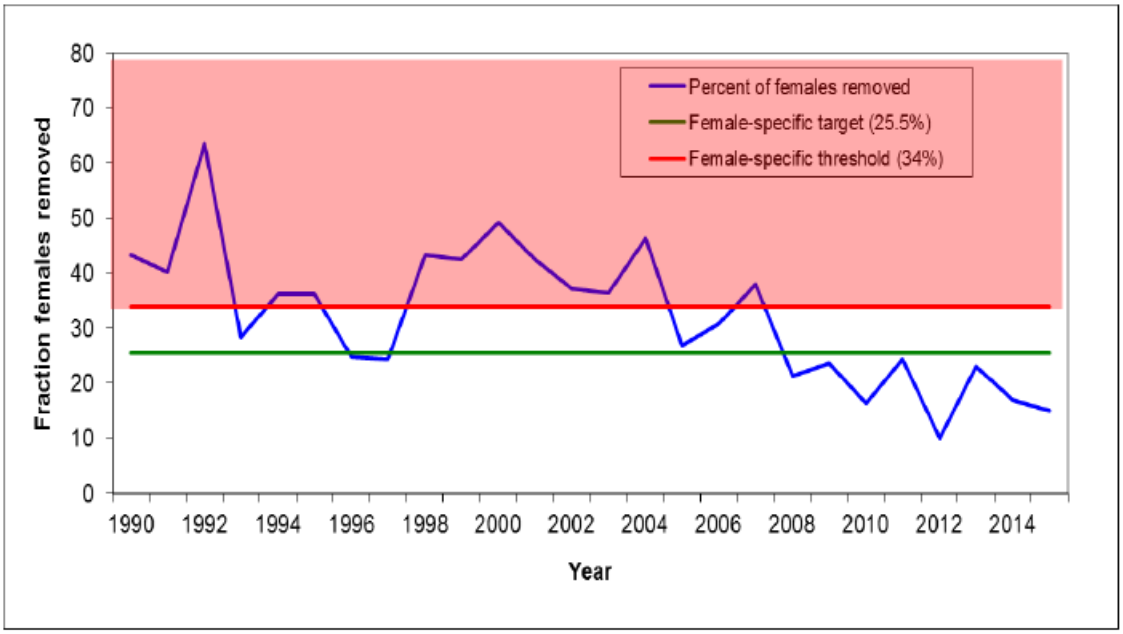


Figure 2. The percentage of all female blue crabs removed from the population each year by fishing relative to the female-specific target (25.5%) and threshold (34%) exploitation rates, 1990 through 2015. Exploitation rate (% removed) is the number of female crabs harvested within a year divided by the female population (age 0 and age 1+) estimated by the WDS at the beginning of the year.

2.4 Control Rule Visualization

Figure 3 shows the status of the blue crab stock for each year relative to both the female age 1+ abundance (N) reference points and female age 0+ exploitation (U) reference points (explained in sections 2.2 and 2.3). The red areas show where the threshold for female abundance and/or the threshold for female exploitation fraction are exceeded. The intersection of the green lines shows where both the abundance and exploitation fraction targets would be reached.

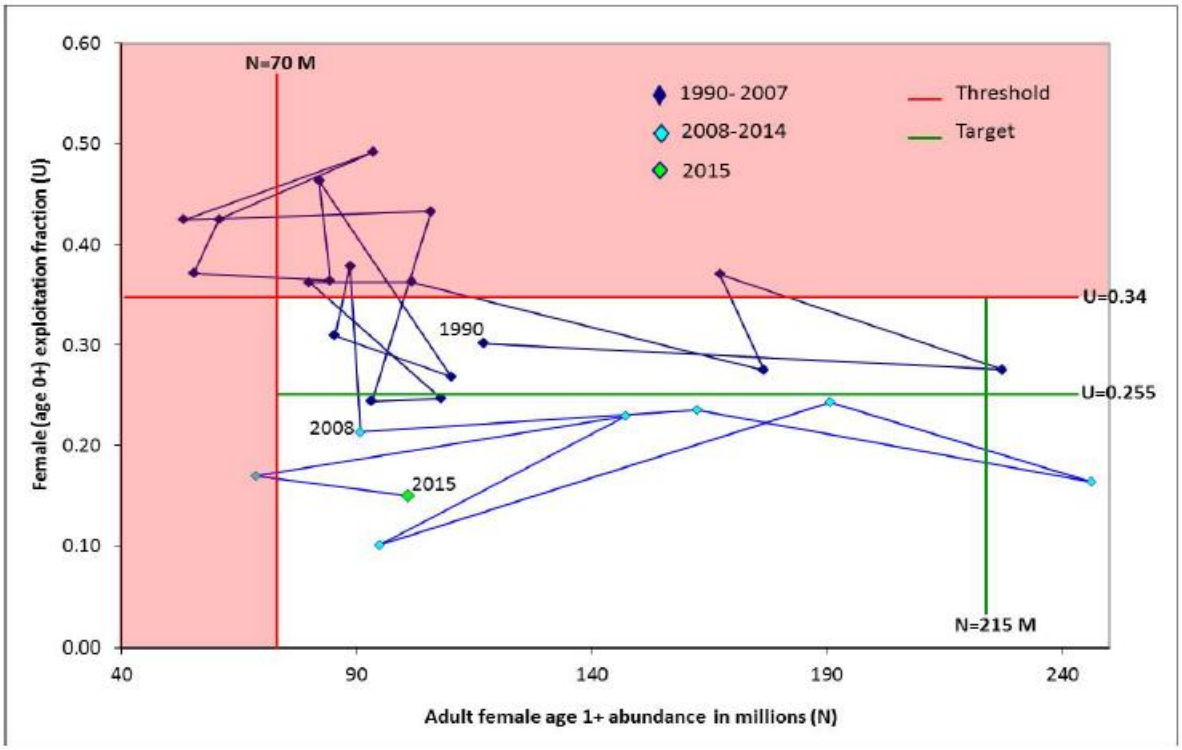


Figure 3. The female-specific control rule for the Chesapeake Bay blue crab fishery prior to and after implementation of initial female-specific management measures in 2008. The current female-specific management framework was formally adopted in 2011. In 2015, adult female abundance (N) was below the 215 million target, while the female exploitation rate (U) was below the 25.5% target. In 2016, age 1+ female abundance was 194 million crabs. 2016 data will be added at the completion of the 2016 fishery.

3. POPULATION SIZE (ABUNDANCE)

3.1 All Crabs (both sexes, all ages)

The total abundance of all crabs (males and females of all ages) increased by 35% from 411 million crabs in 2015 to 553 million crabs in 2016 (Figure 4). This level continues an increasing trend seen since 2014, but is still below peaks seen in 2012 and the early 1990s.

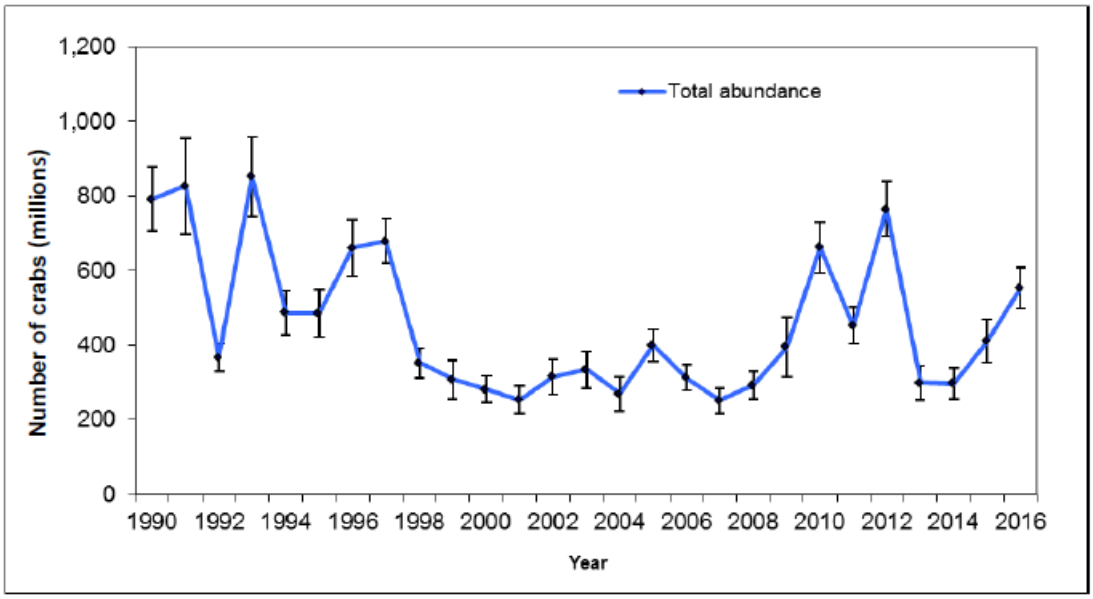


Figure 4. Winter dredge survey estimate of abundance of all crabs (both sexes, all ages) in Chesapeake Bay, 1990 through 2016. Error bars represent 95% confidence intervals.

3.2 Age-0 Crabs

Recruitment is estimated as the number of age 0 crabs (less than 60 mm or 2.4 inches carapace width) in the WDS. The estimate of age 0 crabs in 2016 was 271 million crabs, about the same as the 2015 abundance of 269 million crabs (Figure 5).

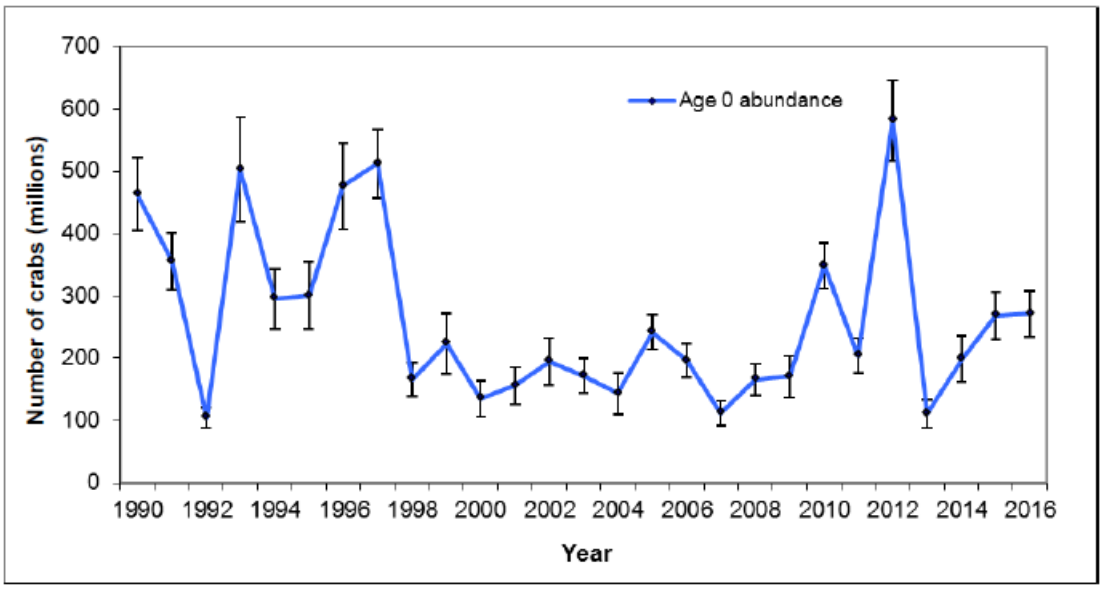


Figure 5. Winter dredge survey estimate of abundance of juvenile blue crabs (age 0), 1990-2016 calculated without the catchability adjustment for juveniles. These are male and female crabs measuring less than 60 mm across the carapace. Error bars represent 95% confidence intervals.

3.3 Age-1+ Male

In 2016, the number of age 1+ male crabs (greater than 60 mm or 2.4 inches carapace width) estimated to be present in the Bay was 91 million crabs (Figure 6), more than double the 2015 estimate of 44 million adult male crabs.

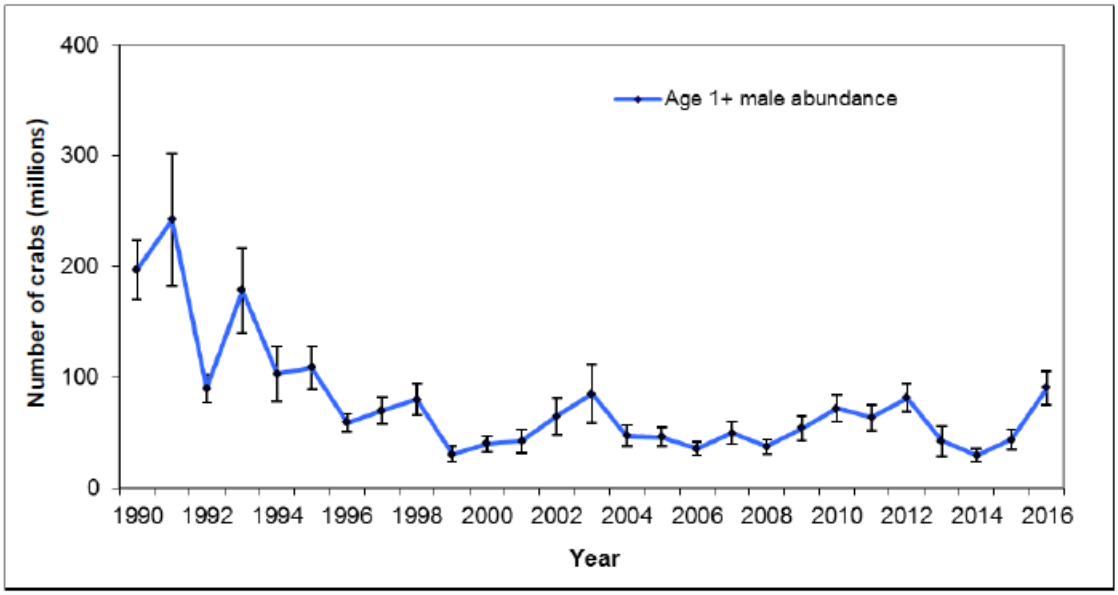


Figure 6. Winter dredge survey estimate of abundance of male blue crabs age one year and older (age 1+), 1990-2016. These are male crabs measuring greater than 60 mm across the carapace and are considered the 'exploitable stock' capable of mating within this year. Error bars represent 95% confidence intervals.

3.4 Overwintering Mortality

Overwintering mortality in 2016 was below average and lower than the high values seen in 2015 (Table 2).

Table 2. Percent dead crabs found in late winter dredge samples each year from 2012-2016 and the average for 1996-2011.

Baywide Age/sex group	1996-2011 average	2012	2013	2014	2015	2016
All crabs	4.78%	1.59%	4.00%	3.79%	15.68%	1.9%
Juveniles	1.00%	0.52%	0.00%	0.89%	10.84%	0.5%
Adult Females	9.53%	2.69%	3.00%	7.68%	19.25%	3.0%
Adult males	9.11%	4.90%	13.88%	13.58%	28.11%	1.1%

4. HARVEST

4.1 Commercial and Recreational Harvest

The three management jurisdictions implemented additional commercial harvest restrictions, mostly lower bushel limits, for females for the 2014 season in response to the depleted abundance of females in 2014. These harvest restrictions were generally maintained for the 2015 season. The 2015 commercial harvest for both males and females from the Bay and its tributaries was estimated as 26.7 million pounds in Maryland, 20.9 million pounds in Virginia and 2.0 million pounds in the Potomac River. This was an increase from 2014 commercial harvest levels for all three jurisdictions: a 62% increase for Maryland, 23% increase for Virginia and a 17% increase for the Potomac River. The total 2015 Baywide commercial harvest of 49.6 million pounds remains below average, but increased by 41% from the 2014 Baywide commercial harvest of 35.2 million pounds, which was the lowest harvest recorded in the last 25 years (Figures 7-8).

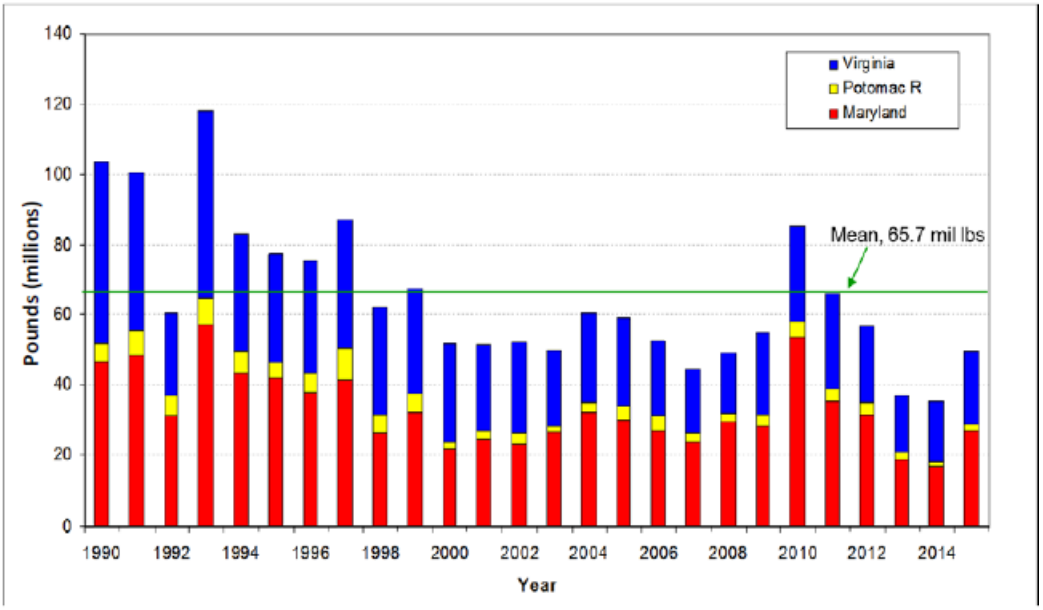


Figure 7. Total commercial blue crab landings (all market categories) in Chesapeake Bay, 1990-2015.

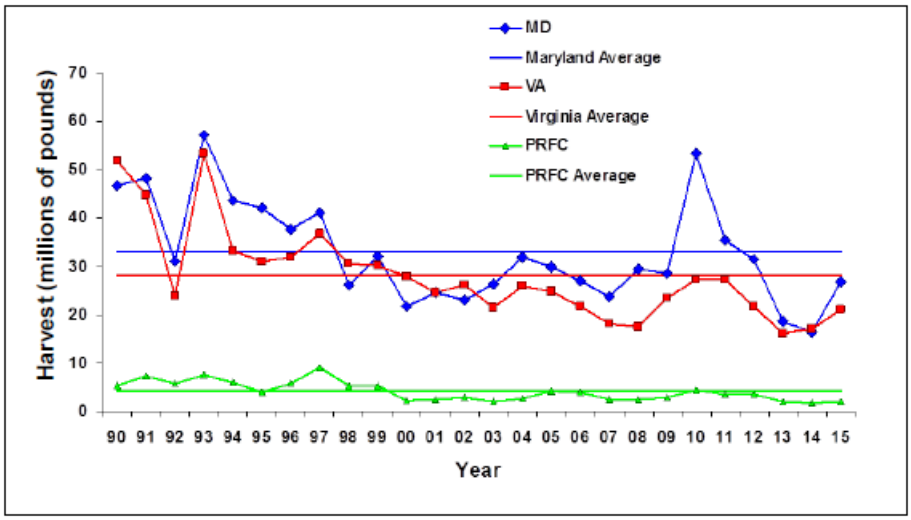


Figure 8. Maryland, Virginia and Potomac River commercial blue crab harvest in millions of pounds from Chesapeake Bay, all market categories, 1990-2015.

Prior to 2009, recreational harvest had been assumed to be approximately 8% of the total Bay wide commercial harvest[4,5,6]. Since recreational harvest of female blue crabs is no longer allowed in Maryland or in the Maryland tributaries of the Potomac River, recreational harvest is better described as 8% of male harvest in those jurisdictions. 2015 Baywide recreational harvest was estimated as 3.5 million pounds, a 52% increase from the 2014 recreational harvest estimate of 2.3 million pounds. Combining the commercial and recreational harvest, approximately 53.1 million pounds of blue crabs were harvested from Chesapeake Bay and its tributaries during the 2015 crabbing season.

5. STOCK STATUS

5.1 Female Reference Points

The Chesapeake Bay blue crab stock is currently **not depleted and overfishing is not occurring** (Figure 1-2). The estimated abundance of the stock is between the threshold of 70 million age 1+ female crabs and the target of 215 million age 1+ female crabs outlined in the current management framework. The 2015 exploitation fraction of 15% was below the target (25.5%) and threshold (34%). Abundance, harvest, and exploitation of all crabs are summarized in Appendix A.

5.2 Male Conservation Triggers

In 2011, CBSAC recommended that male abundance should not be allowed to decline to a critically low level relative to female abundance and a conservation trigger based on male abundance should be developed. In 2013, CBSAC recommended a conservation trigger for male crabs based on the history of male exploitation. Under this trigger, conservation measures should be considered for male blue crabs if male exploitation rate exceeds 33% (calculated with the juvenile scalar as described in section 1.2), which is the second highest exploitation fraction observed for male crabs since 1990. Choosing the second highest value in the time series ensures a buffer from the maximum observed value of exploitation. It should be noted that this value does not represent a fishing threshold or target. Rather, this trigger will ensure that the male component of the stock is not more heavily exploited,

relative to females, than at levels that have occurred in the last 24 years. The 2015 male exploitation fraction was estimated at 22%, which is below the 33% male exploitation rate conservation trigger (Figure 9). Because the male conservation trigger was not exceeded, no management action is recommended at this time specific to male blue crabs.

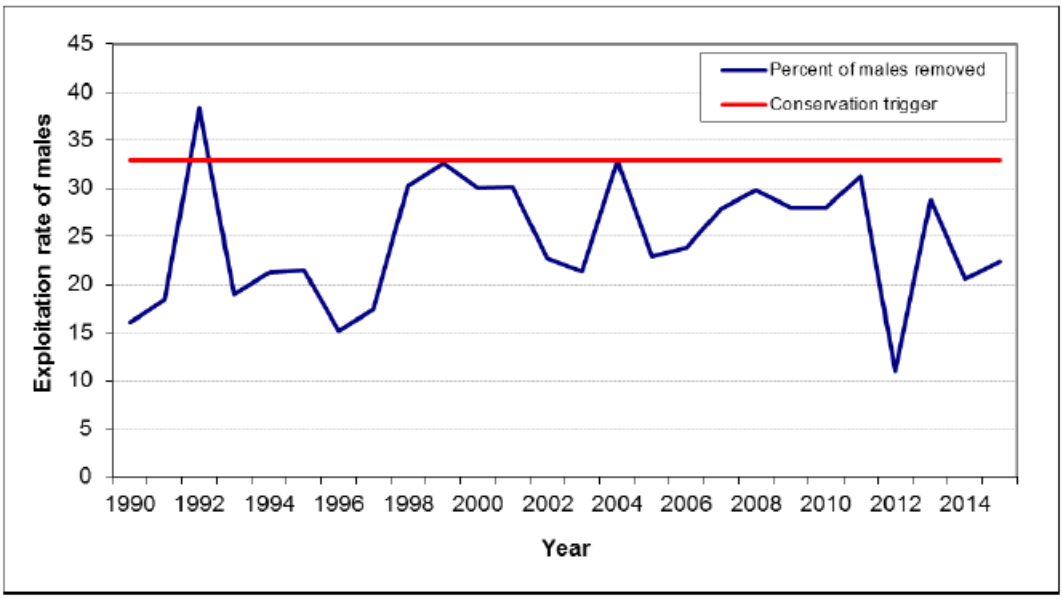


Figure 9. The percentage of male crabs removed from the population each year by fishing, 1990 through 2015. Exploitation rate (% removed) is the number of male crabs harvested within a year divided by the male population estimate (age 0 and age 1+) at the beginning of the year calculated with the juvenile scalar.

5.3 Potential Management Impact

Female exploitation fractions from 1990-2007 were much higher than the exploitation fractions seen from 2008-2013. These lower exploitation fractions in recent years illustrate the probable influence of the female-specific management measures implemented by the jurisdictions starting in 2008. Male exploitation fractions have not shown the same pattern (Figure 10). Additionally, the rapid increase in abundance from 2008 to 2010 and again from 2014 to 2016 may indicate that the current management framework has allowed the stock to regain some of its natural resilience to environmental perturbations.

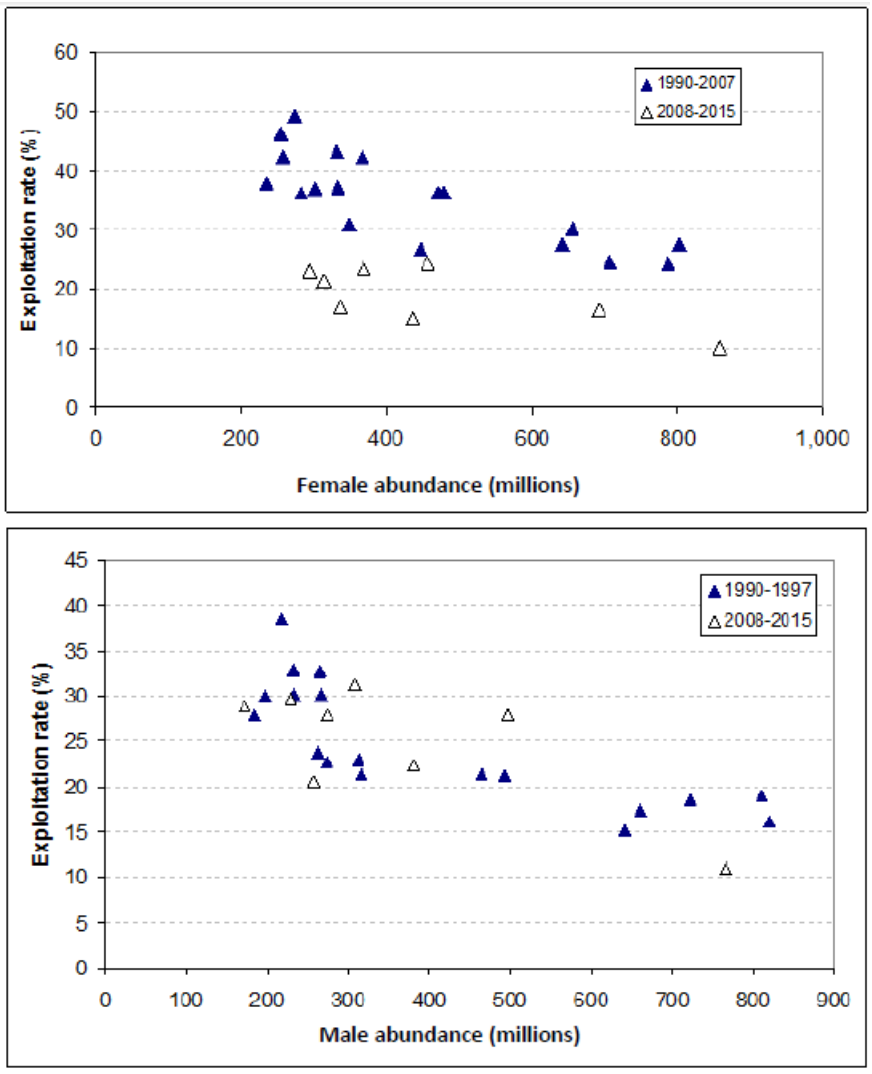


Figure 10. Female (top) and male (bottom) exploitation rate comparison of the time periods prior to and after the 2008 implementation of female-specific management measures.

6. MANAGEMENT ADVICE-SHORT TERM

6.1 Monitor fishery performance and stock status relative to reference points

The female exploitation fraction in 2015 was below the target of 25.5% for the eighth consecutive year. The abundance of adult female crabs increased in 2016, and the abundance of juveniles stayed about the same. While all signs are currently positive for the status of the stock, it has only been two years since the adult female abundance dropped below the threshold of 70 million crabs. The inherent variability of the stock means that management should continue a risk-averse and adaptive management strategy to ensure that harvest is maintained at an appropriate level relative to abundance and the target exploitation fraction.

Beginning in the 2014 crabbing season, the three management jurisdictions adjusted their management

timeframe to run from July 2014 through July 2015. CBSAC recommended this switch in the 2014 Blue Crab Advisory Report, which allows for consideration of the WDS results in the spring before management decisions are made in the summer. However, it places more importance on the estimate of juvenile abundance, as each year class is presumed to be the majority component of the fishery within this time frame, and the current control rule does not account for juvenile abundance as a management-setting metric. In the context of the management year starting in July or August, CBSAC is further exploring if the jurisdictions should more formally consider juvenile abundance levels in management decisions, and how best to do so. CBSAC will report back with findings at a future date.

6.2 Catch Reports

CBSAC again recommends that the jurisdictions implement procedures that provide accurate accountability of all commercial and recreational harvest. All three Chesapeake Bay management jurisdictions have ongoing efforts to improve the quality of catch and fishing effort information submitted by commercial and recreational harvesters. Maryland, Virginia, and PRFC all require daily harvest reports to be submitted on a regular basis and are also collaborating with industry groups to pursue new reporting technologies. Maryland has implemented a pilot electronic reporting program that allows for daily harvest reporting in real time and harvest validation. Virginia continues to promote its online reporting system that began in 2009. PRFC is exploring the use of electronic reporting to potentially begin in the next few years.

While implementing systems for greater accuracy, efforts should also be made, where possible, to better determine the biological characteristics of the catch, both landed and discarded. Note that when changes in reporting requirements are implemented, it is vital that an analysis be undertaken to quantify the impact of these changes on the estimates of harvest. Efforts should also be undertaken to assess the reliability of estimates of recreational harvest Baywide.

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7. MANAGEMENT ADVICE- LONG TERM

7.1 Catch Control

A management approach that sets annual catch levels based on estimates of abundance from the WDS and that accounts for sex-specific, spatial, and seasonal distribution of crabs could potentially balance annual harvests with highly variable recruitment events. The CBSAC supports the commitment by the blue crab management jurisdictions in the 2014 Chesapeake Bay Watershed Agreement to evaluate the establishment of a Baywide allocation-based management framework, which refers to the development of one or more methods to allocate an annual total allowable catch (TAC) of female and male crabs for the Chesapeake Bay blue crab fishery among the three management jurisdictions. CBSAC will assist the jurisdictions with any scientific and/or data analysis needs during their evaluation of a potential framework, although a comprehensive evaluation of these schemes will require a stock assessment.

7.2 Annual sanctuary and complementary management measures

CBSAC recommends that Virginia consider establishing a year-round sanctuary for mature females in

the lower Bay, and Maryland and PRFC consider complementary sanctuaries or other management measures in the upper Bay and Potomac River that would promote survival of mature females in their first and subsequent spawning seasons. Protection of mature females in multiple spawning seasons should bolster the spawning stock and recruitment, and provide a buffer for the population from the combined effects of environmental disturbance and high fishing pressure. The VMRC Crab Management Advisory Committee has discussed possible adjustments to the current Virginia blue crab sanctuary areas and corresponding closing dates in the past. Discussion will continue as needed.

7.3 Characterizing and Quantifying Effort

The blue crab fishery is managed by both effort control and output control strategies. Most regulations in place focus on effort control in the form of limited entry, size limits, daily time limits, pot limits, spatial closures, spatial gear restrictions, and seasonal closures. Output controls currently used are daily harvest limits. In many cases, the amount of effort expended in the fishery is recorded at a broad resolution that makes it difficult to quantify. CBSAC recommends further quantification of effort data in the next stock assessment and increased investment in Baywide effort monitoring, which may include a pot marking system and a Baywide survey of gear-specific effort to estimate the total, as well as spatial and temporal patterns of effort in the blue crab fishery.

7.4 Latent effort

In both Maryland and Virginia, significant numbers of commercial crabbing licenses are unused. The risk posed by this situation is that unused effort could enter the fishery, causing unforeseen impacts on the fishery and the blue crab population. Given recent fluctuations in the crab population, CBSAC recommends analyzing effort levels over time, relative to crab abundance, to evaluate the potential for significant changes in overall effort due to changes in latent effort. A comprehensive analysis of latent effort would, ideally, include a socio-economic component.

CBSAC also recognizes that temporal and seasonal shifts in blue crab abundance may alter existing effort exerted by active licenses. The impact of this variability on both latent and active effort should be investigated as a part of this recommendation.

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8. CRITICAL DATA AND ANALYSIS NEEDS

CBSAC has identified the following prioritized list of fishery-dependent and fishery-independent data needs as well as the benefits provided to management. CBSAC recognizes the importance and high priority of the next stock assessment in providing in-depth analyses of the Chesapeake Bay blue crab population and scientific guidance to managers.

8.1 Increased accountability and harvest reporting for both commercial and recreational fisheries

CBSAC recommends jurisdictions continue to develop, explore and evaluate implementation of real time electronic reporting systems to increase the accuracy of commercial and recreational landings. Improving commercial and recreational blue crab harvest accountability would provide managers

with a more accurate exploitation fraction each year and better support mid- season management changes.

The jurisdictions have been working to implement new harvest reporting technologies over the past few years. Since pilot efforts were introduced in 2012, MD DNR has been using an electronic reporting system that allows commercial crabbers to enter each day's harvest from their vessel. The system includes random daily catch verification and a "hail-in, hail-out" protocol. Maryland is continuing to expand the use of this system for the commercial crabbing fleet. Virginia implemented electronic reporting in 2009 as an alternative mandatory harvest reporting option, but growth has been slow. Through cooperative work among VMRC, Virginia Sea Grant and various industry groups, promotional products were produced and participation of commercial crab harvesters has increased. There is interest among PRFC stakeholders, and it is possible that PRFC may begin using an electronic reporting system in the next few years.

CBSAC recommends a survey of recreational catch and effort be undertaken to ensure the reliability of estimates of recreational removals. The last available estimate for Maryland waters was that for 2011[4,5,6,7]. The last available estimate for Virginia was 2002[5]. Future surveys should ensure that recreational harvest from the Potomac River is also included. A license for recreational crabbing in all jurisdictions would greatly increase the accuracy of catch and effort estimates.

8.2 Gear efficiency pertaining to selectivity of WDS methods

There is no update from 2015-16 regarding how gear efficiency is estimated. Data from paired tows between the two survey vessels were again collected, and the multi-year dataset should be analyzed to help guide the process dealing with the evaluation of efficiency corrections and, possibly, juvenile catchability.

Planning discussions for an upcoming stock assessment have included the possible use of the winter dredge survey as an index of abundance rather than an index of absolute abundance. This approach was recommended by the independent review panel of the last stock assessment. If successful, this approach would provide an estimate of the survey efficiency directly.

8.3 Improving recruitment estimate through a shallow-water survey

Based on the 2011 stock assessment and field experiments by VIMS and the Smithsonian Environmental Research Center, a large fraction of juvenile blue crabs in shallow water is not sampled by the WDS[8]. CBSAC recommends that funding be pursued at the state and federal levels for Bay-wide shallow-water surveys to assess the potential for interannual bias in the fraction of juveniles not sampled by the WDS.

8.4 Application of fishery independent survey data

CBSAC recommends continued review of existing fishery-independent survey data and potential application to provide additional information on the blue crab population, complementing the population estimates from the WDS. Characterizing the spring through fall distribution and sex-specific abundance of blue crabs remains important, especially if agencies are considering spatial management strategies.

8.5 Fishery-dependent data

Mandatory harvest reporting is currently the only fishery-dependent data in Virginia and the Potomac River. Understanding catch composition, by size, sex, and growth phase, spatially and temporally, as well as effort characterization (mentioned in 7.3), would help improve the effectiveness of regulations and assure they were compatible at a Baywide level. CBSAC recommends that the jurisdictions consider options for future fishery-dependent sampling programs.

8.6 Other sources of mortality

CBSAC also recommends analyzing the magnitude of other sources of incidental mortality, specifically sponge crab discards, unreported losses after harvest from the peeler fishery, and predation. An analysis of non-harvest mortality could improve reliability of exploitation fraction estimates and inform future assessments.

8.7 Investigation of the potential for sperm limitation

CBSAC recommends continued examination to quantify and better understand the influence of male crabs on reproductive success and overall population productivity. The evidence for sperm limitation resulting from a lower abundance of sexually mature male crabs is ambiguous and has been discussed in several recent studies[9,10,11].

8.8. Biological parameters

Longevity, age structure and growth rates, particularly with respect to the timing of recruitment to the fishery within the season) are not fully characterized and remain as sources of uncertainty**.**

CBSAC Participants:

Glenn Davis (Chair)	Maryland Department of Natural Resources
Joe Cimino	Virginia Marine Resources Commission
Ellen Cosby	Potomac River Fisheries Commission
Lynn Fegley	Maryland Department of Natural Resources
Daniel Hennen	NMFS, Northeast Fisheries Science Center
John Hoenig	Virginia Institute of Marine Science
Eric Johnson	University of North Florida
Katie May Laumann	Virginia Marine Resources Commission
Rom Lipcius	Virginia Institute of Marine Science
John McConaugha	Old Dominion University
Tom Miller	UMCES, Chesapeake Biological Laboratory
Rob O'Reilly	Virginia Marine Resource Commission
Amy Schueller	NMFS, Southeast Fisheries Science Center
Mike Seebo	Virginia Institute of Marine Science
Alexei Sharov	Maryland Department of Natural Resources
Mike Wilberg	UMCES, Chesapeake Biological Laboratory
Emilie Franke (Coordinator)	ERT/NOAA Chesapeake Bay Office

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Attachment 1

Appendix A. Estimated abundance of blue crabs from the Chesapeake Baywide winter dredge survey, annual commercial harvest, and removal rate of female crabs.

Survey Year (Year Survey Ended)	Total Number of Crabs in Millions (All Ages)	Number of Juvenile Crabs in Millions (both sexes	Number of Spawning-Age Crabs in Millions (both sexes)	Number of spawning age Female crabs in Millions	Baywide Commercial Harvest (Millions of Pounds)	Percentage of Female Crabs Harvested
1990	791	463	276	117	96	44
1991	828	356	457	227	90	34
1992	367	105	251	167	53	60
1993	852	503	347	177	107	35
1994	487	295	190	102	77	28
1995	487	300	183	80	72	32
1996	661	476	146	108	69	20
1997	680	512	165	93	77	22
1998	353	166	187	106	56	40
1999	308	223	86	53	62	37
2000	281	135	146	93	49	43
2001	254	156	101	61	47	42
2002	315	194	121	55	50	34
2003	334	172	171	84	47	33
2004	270	143	122	82	48	42
2005	400	243	156	110	54	24
2006	313	197	120	85	49	29
2007	251	112	139	89	43	35
2008	293	166	128	91	49	24
2009	396	171	220	162	54	23
2010	663	340	310	246	85	18
2011	452	204	255	191	67	24
2012	765	581	175	95	56	10
2013	300	111	180	147	37	23
2014	297	198	99	68.5	35	17
2015	411	269	143	101	**50**	**15**
2016	**553**	**271**	**284**	**194**	**TBD***	**TBD***

* 2016 Baywide commercial harvest and exploitation rate are preliminary (TBD= to be determined)

Attachment 3

VIRGINIA'S 21-POINT BLUE CRAB MANAGEMENT PLAN

October 1994, the Commission established the following 7-point blue crab management plan:

- Expanded the spawning sanctuary (146 sq. mi.) establish in 1942 by 75 sq. mi., with no crab harvest allowed from June 1 through September 15.
- Established a 14,500-acre winter-dredge sanctuary in Hampton Roads.
- Shortened the crab pot season to April 1 through November 30.
- Required two cull (escape) rings in each commercial and recreational crab pot.
- Required four cull rings in each peeler pound that allows escapement of small peeler crabs.
- Capped the number of peeler pots per license to prevent expansion of the fishery.
- Limited the crab dredge size to 8 feet to prevent increases in effort.

The Commission reinforced the 7-point management plan in January 1996.

- Prohibited the possession of dark-colored (brown through black) sponge crabs (adult female hard crab which had extruded her eggs on her abdomen), with a 10-sponge crab per bushel tolerance.
- Limited license sales of hard crab licenses, based on previous eligibility or exemption requirements.
- 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.
- Established a 3 1/2-inch minimum possession size limit for all soft shell crabs.

Concerns over excess effort in the fisheries and a persistent trend of low spawning stock biomass during most of the 1990's led to additional crab conservation measures in 1999 and 2000.

- Lowered the maximum limit on peeler pots from 400 to 300 pots in 1999. Harvest by this gear type increased by 90%, from 1994 through 1998, while the overall harvest remained relatively static.
- Initiated a moratorium on additional commercial licenses for all commercial crabbing gear. This moratorium became effective May 26, 1999 and continued until May 26, 2004.
- Established (in 2000) a Virginia Bay-wide Blue Crab Spawning Sanctuary, in effect June 1 through September 15. This additional sanctuary (435 sq. mil) allows for increased spawning potential.

A cooperative Bay-wide agreement (October 2000) to reduce harvest 15% by 2003 led to new measures.

- Enacted an 8-hour workday for commercial crabbers (2002) that replaced Wednesday closures of 2001.
- Established a 3-inch minimum size limit for peeler crabs (2002).
- Reduced peeler pot limits from 400 to 300 pots (for 2001).
- Reduced the winter dredge fishery limit from 20 to 17 barrels (2001).
- Augmented (2002) the Virginia Blue Crab Sanctuary by 272 sq. mi. (total sanctuary area = 928 sq. mi.).
- Reduced unlicensed recreational harvester limits to 1 bushel of hard crabs, 2 dozen peelers (2002).
- Reduced licensed recreational harvester limits to 1 bushel of hard crabs, 2 dozen peelers, with vessel limit equal to number of crabbers on board multiplied by personal limits (2001).

Attachment 3

ACTIONS TO PROMOTE REBUILDING OF CHESAPEAKE BAY BLUE CRAB STOCK (2008 through 2016)

February 2008

- Larger cull ring (2-5/16") required to be open at all times in all tidal VA waters to promote additional increases in escapement.
- Peeler crab minimum size limit increased from 3" to 3 ¼" (through July 15) and to 3 ½" (as of July 16).
- Use of agents modified to prevent license "stacking" and to curtail use of agents.
- Winter dredge fishery capped at 53 licensees (from previous 225 licensees), all being active harvesters in previous two winter seasons.

March 2008

- Adopted an extended closure (May 1 - September 15) of blue crab spawning sanctuary, to protect spawning females, except for the historical sanctuary (146 square miles) managed by law.

April 2008

- Established a fall closure for female harvest (October 27 – November 30).
- Implemented a 15% reduction in pots per individual for 2008 crab pot fishery and a 30% reduction for 2009 crab pot and peeler pot fishery.
- Closed 2008/09 winter dredge fishery season.
- Required use of two 3/8" cull rings for all areas (except Seaside of Eastern Shore) effective July 1.
- Eliminated 5-crab pot recreational license.
- Revamped revocation procedures, to allow a hearing after just two crab violations in a 12-month period.

November 2008

- In an attempt to address the latent effort, the Commission placed crab pot and peeler pot fishermen who had been inactive (no harvest) for a 4-year period (2004-07) on a waiting list until the abundance determined from the Bay-wide Winter Dredge Survey of age-1+ crabs exceeds the interim target of 200 million.

May 2009

- Shortened closed season for female crabs to November 21 - November 30.
- Closed 2009/10 winter dredge fishery season.
- Lowered percentage reduction of crab pots from 30% (2008) to 15% (2009).
- Reestablished 5-pot recreational crab pot license but prohibited harvest on Sunday and from Sept 16 - May 31.
- Right to hold revocation hearing for crab licensee after two crab violations by authorized agent (agents cannot be licensed for any crab fishing gear).

May 2010

- Made it unlawful (from March 17 - June 30) to possess dark sponge crabs exceeding regulation tolerance of 10 per bushel (previously March 17 – July 15).
- Made it lawful (indefinitely) that commercial licenses (crab/peeler pot, scrape, trap, ordinary/patent trot line, dip net) shall be sold only to commercial fishermen eligible in 2010, except those placed on the waiting list established in November 2007.
- Closed 2010/11 winter dredging fishery season.

April 2011

- Changed closed season on harvest from Virginia Blue Crab Sanctuaries from May 16 to May 1.
- Changed boundary line of Blue Crab Sanctuary in upper Bay near Smith Point Light.

September 2011

- Closed 2011/12 winter dredging fishery season.
- Established 5-day maximum tending requirement for crab pots and peeler pots.

November 2012

- Closed 2012/13 winter dredge fishery season.
- Funded the Winter Dredge Gear Study using Marine Fishing Improvement Funds.
- Extended the 2012 season until December 15, 2012 for both male and female crabs and applied conservation equivalent bushel limits to the 2013 crab pot season by gear license categories as follows:
    - For up to 85 crab pots a maximum limit of 27 bushels.
    - For up to 127 crab pots a maximum limit of 32 bushels.
    - For up to 170 crab pots a maximum limit of 38 bushels.
    - For up to 255 crab pots a maximum limit of 45 bushels.
    - For up to 425 crab pots a maximum limit of 55 bushels.
- Restricted crabbing in the Virginia portion of the Albemarle and Currituck watersheds to crab pots and peeler pots only.

February 2013

- Established a vessel harvest and possession limit equal to only one of the largest legal bushel limits on board any vessel.
- Limited the use of agents in the hard pot fishery to 168, with priority going to those licensees who received approval for agent use in 2012.

June 2013

- Established daily individual and vessel harvest and possession limits for the 2013 season.

October 2013

- Closed 2013/14 winter dredge fishery season.
- Results of the Winter Dredge Mortality Project were presented.
- Extended the 2013 season until December 15, 2013 for both male and female crabs and applied conservation equivalent bushel limits to the 2013 season extension and the 2014 crab pot season by gear license categories as follows:
    - For up to 85 crab pots a maximum limit of 16 bushels.
    - For up to 127 crab pots a maximum limit of 21 bushels.
    - For up to 170 crab pots a maximum limit of 27 bushels.
    - For up to 255 crab pots a maximum limit of 43 bushels.
    - For up to 425 crab pots a maximum limit of 55 bushels.
- Established the 2014 crab pot season as March 17 through November 30, 2014 for both male and female blue crabs.
- Established a declaration date for agent use requirements in the crab pot fishery for the 2014 season.

June 2014

- Closed the 2014/15 winter dredge fishery season.
- Enacted management reductions in response to the current scientific determination that the Chesapeake Bay blue crab abundance of spawning-age female crabs is depleted. The basis for this 10 percent reduction, which equals a potential savings of 1,316,726 pounds of female blue crab, is to augment spawning in summer 2014 and spring 2015 and help reverse the depleted stock condition of blue crab.
- From July 5, 2014 through November 15, 2014 and April 1, 2015 through July 4, 2015:
    - 10 bushels, or 3 barrels and 1 bushel, of crabs, if licensed for up to 85 crab pots.
    - 14 bushels, or 4 barrels and 2 bushels, of crabs, if licensed for up to 127 crab pots.
    - 18 bushels, or 6 barrels, of crabs, if licensed for up to 170 crab pots.
    - 29 bushels, or 9 barrels and 2 bushels, of crabs, if licensed for up to 255 crab pots.
    - 47 bushels, or 15 barrels and 2 bushels, of crabs, if licensed for up to 425 crab pots
- From November 16, 2014 through November 30, 2014 and March 17, 2015 through March 31, 2015:
    - 8 bushels, or 2 barrels and 2 bushels, of crabs, if licensed for up to 85 crab pots.
    - 10 bushels, or 3 barrels and 1 bushel, of crabs, if licensed for up to 127 crab pots.
    - 13 bushels, or 4 barrels and 1 bushel, of crabs, if licensed for up to 170 crab pots.
    - 21 bushels, or 7 barrels of crabs, if licensed for up to 255 crab pots.
    - 27 bushels, or 9 barrels of crabs, if licensed for up to 425 crab pots.
- The lawful season for the commercial harvest of blue crabs by all other commercial gears shall be March 17, 2014 through September 15, 2014 and May 1, 2015 through November 30, 2015. It shall be unlawful to place, set, fish or leave any lawful commercial gear used to harvest crabs, except crab pots, in any tidal waters of Virginia from September 16, 2014 through April 30, 2015.

May 2015

- Maintained and modified measures to conserve and allow rebuilding of the Blue Crab Resource:
    - Maintained previous crab management season and bushel limits.
    - Adjusted closure dates for non-crab pot gear season, closing September 26 and reopening April 21.
    - Amended Chapter 4 VAC 20-270-10 et seq., making it unlawful for any vessel to act as both a crab harvester and a crab buyer on the same trip.
    - Amended Chapter 4 VAC 20-370-10 et seq., making it unlawful for any person to possess dark sponge crabs from March 17 through June 15.
    - Amended Chapter 4 VAC 20-752-10 et seq., redefining Virginia Blue Crab Sanctuary Area 1 as Virginia Blue Crab Sanctuary Area 1A and Blue Crab Sanctuary Area 1B and implement separate closure dates for Blue Crab Sanctuary Areas 1A, 1B and Areas 2 through 4.
    - Amended Chapter 4 VAC 20-1140 et seq., to close the winter crab dredge fishery season from December 1, 2015 through March 31, 2016.

October 2015

- Closed 2015/16 winter dredge fishery season to allow for continued rebuilding of the spawning-stock biomass.

June 2016

- Closed 2016/17 winter dredge fishery season to allow for continued rebuilding of the spawning stock biomass.