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, 2015

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 26th Bay-wide Winter Dredge Survey, conducted from December 2014 to March 2015 (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 2014-2015 Winter Dredge Survey estimates of abundance of all size classes of crabs was 411 million crabs, and this total abundance represents a 38% increase from the 2013-2014 Bay-wide Winter Dredge Survey but is below the long-term (1989-90 – present) average of 454 million crabs. The most recent abundance of juvenile crabs enumerated from this winter survey was 269 million, and is slightly greater than the long-term survey average of 261 million juvenile crabs. The importance of the juvenile crab surveyed in wintertime is its contribution to the following late summer and fall harvest when it has recruited to harvestable size and its contribution to the subsequent year's 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 2015 was 101 million. This was an improvement over the 2013-2014 survey estimate of 68.5 million which was considered a depleted spawning stock. However, 101 million potential spawners is below the long-term average of 115 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 the Chesapeake Bay. Environmental factors including weather conditions and predation can have an effect on all life stages of the crab population. Conservation of female spawning-age crabs is the primary management objective to ensure variability of the blue crab stock abundance is moderate. 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 2015, as 101 million, increased 47% from the 2014 estimate of 68.5 million. This increase may be partly due 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 blue crabs that will contribute to the 2016 spawning stock.

In 2015 the Commission essentially maintained management measures implemented in 2014. 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, 2015 through July 4, 2016 for all crab pot license categories. This time period allows the Commission to review two winter dredge survey results for any needed adjustments. The Commission also closed the winter crab dredge fishery season for eighth 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 the 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.

Two projects currently supported by the Fisheries Restoration 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 crabs, reducing mortality of blue crabs during the molting stage of soft crab production.

THE 2015 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 the 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 2014/15 Bay-wide Winter Dredge Study of female spawning-age crabs (age 1+) was 101 million crabs, representing a 47% increase from the 2013/14 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, as in the previous year. The most recent (2014) female crab exploitation rate estimate was 17%, 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 six consecutive years the target removal rate has been near or less than the target.

The total abundance of 411 million crabs, determined by the Winter Dredge Survey, represents a 38% increase from 2014 (297 million crabs) to 2015. Total abundance was also 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 this slightly better recruitment in 2015.

Overwintering mortality for all blue crabs in the bay was 15.68%; over-wintering mortality was highest for spawning-age male crabs (28.11%), followed by adult females (19.25%), and lowest among juveniles (10.84%).

In the 2015 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. The 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 2013, 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;
- Other sources of incidental mortality
- Developing a collaborative bay-wide fishery independent survey focused on the spring through fall distribution of blue crabs.

Table 2 below provides a 26 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 (MDDNR). 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 the Chesapeake Bay fisheries following the end (March) of the seasonal (December-March) Bay-wide Winter Dredge Survey (Figure 1).

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	35	17
2015	411	269	144	101	?	?

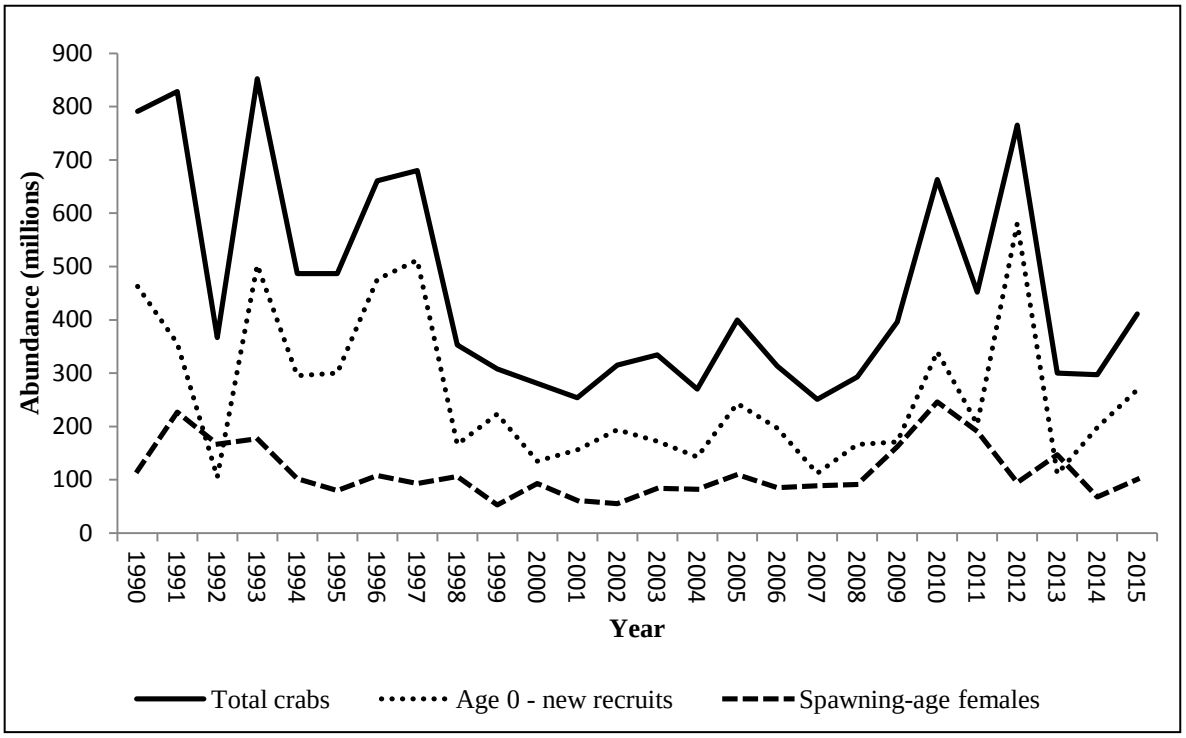


Figure 1. Abundance estimates (number of crabs in millions) for the 26 year Bay-wide Winter Dredge Survey for total crab abundance (male and female), juvenile (new recruits) crab abundance, and spawning-age (age-1+) female crab abundance, 1990 through 2015.

Harvest and Effort Statistics

In May 2015, the CBSAC reported (Attachment II) the 2014 Chesapeake Area Bay-wide crab commercial harvest as 35.2 million pounds, 5% lower than the 2013 Bay-wide crab harvest of 37 million pounds, and the second lowest harvest record in 26 years. The Bay-wide recreational harvest was estimated as 2.3 million pounds. Of the Bay-wide commercial harvest, Maryland harvested 16.5 million pounds, Virginia harvested 17.0 million pounds, and 1.7 million pounds was harvested in the jurisdiction of the Potomac River Fisheries Commission. The total 2014 Virginia reported commercial harvest for all commercial gear allowed to harvest blue crabs, for all tidal waters including the seaside areas, was 18.5 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 last 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, both pounds harvested and dockside value increased slightly.

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 2014.

Table 3 below contains Virginia harvest data by market category (hard crabs and peeler and soft crabs), in pounds, for the last five years of complete data by month (2009 through 2014). The hard crab pot fishery has accounted for approximately 96% 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 2014, the sex composition from crab pot harvests was 63% females, compared to 74% in 2013 and 67% in 2012.

Table 3. Virginia harvest data (state waters only, in pounds) by market category (hard crabs and peeler and soft crabs) for 2009 through 2014, by month. CD indicates confidential data.

Hard Crab Market Category

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
2009	0	0	332,795	4,076,354	3,186,225	3,438,653	3,319,844	3,567,021	3,101,128	3,036,680	1,053,435	0	25,112,135
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	804,510	1,843,637	2,295,453	2,988,169	2,955,144	2,921,463	2,836,565	865,964	0	17,517,656

Peeler and Soft Crab Market Category

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
2009	0	0	0	17,882	411,375	133,664	165,678	133,475	88,946	10,453	1	0	961,474
2010	0	0	55	62,313	414,570	133,404	164,267	114,671	71,923	8,729	9	0	969,942
2011	0	0	5	33,785	317,769	108,104	122,869	101,038	71,149	3,037	1,260	0	759,016
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	1	0	599,696
2014	0	0	0	2,534	350,646	328,005	140,136	118,874	43,106	1,778	0	0	985,079

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 (2009 through 2014). 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 2009 through 2014 active in the crab pot fishery.

Year	March	April	May	June	July	August	September	October	November	December	Total
2009	199	463	600	683	708	719	619	510	263	0	4,764
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	584	597	604	569	453	233	0	3,870

Table 5. Number of harvesters by month for 2009 through 2014 active in the peeler pot fishery

Year	March	April	May	June	July	August	September	October	November	December	Total
2009	0	48	353	214	193	186	113	46	0	0	1,153
2010	0	86	300	172	150	135	98	38	0	0	979
2011	0	60	271	154	139	120	80	25	0	0	849
2012	8	171	233	155	136	137	93	33	1	0	967
2013	0	23	216	150	154	142	111	36	0	0	832

Tables 6 and 7 below show Virginia trip data for the last six years of complete data, by month (2009 through 2014). The number of trips with reported crab harvest from crab pot gear totaled 7,552 in 2014, a slight increase from 47,346 in 2013. The number of peeler pot trips in 2014 totaled 10.532, a slight increase from 10,415 trips in 2013. The peeler and soft crab market category consists mainly of peeler crabs.

Table 6. Number of commercial trips by month for 2009 through 2014 in the crab pot fishery.

Year	March	April	May	June	July	August	September	October	November	December	Total
2009	938	5,911	6,952	9,149	10,103	9,672	7,486	5,798	2,096	0	58,105
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	7,301	8,667	8,193	7,093	5,691	1,849	0	47,552

Table 7. Number of commercial trips by month for 2009 through 2014 in the peeler pot fishery. CD indicates confidential data.

Year	March	April	May	June	July	August	September	October	November	December	Total
2009	0	236	4,330	2,826	2,975	2,610	1,498	279	0	0	14,754
2010	0	607	4,032	2,351	2,543	1,907	1,192	208	0	0	12,840
2011	0	326	3,554	2,131	2,281	1,712	1,153	107	0	0	11,264
2012	29	1,728	3,044	2,177	2,178	1,998	1,050	207	3	0	12,414
2013	0	141	2,603	1,993	2324	2,116	1,238	CD	0	0	10,415
2014	0	49	2,746	2,302	2,428	2,313	682	12	0	0	10,532

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 and 2015 bay-wide Winter Dredge Survey data do show some improvement in juvenile production.

A short-term conservation approach for 2014 and 2015 was developed. Management measures for 2014 and 2015 were modified to provide more protection for the female spawning-age and juvenile blue crabs that will contribute to the spawning stock in 2016. The Commission approved the following management measures at its May 2015 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 added a season closure for all other crab gear lawful to harvest crabs. The reduced crab pot bushel limits extend from July 5, 2015 through July 4, 2016 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. In October, 2015, the Commission closed the winter crab dredge fishery season for eighth consecutive seasons to allow for continued rebuilding of the spawning stock biomass. The main basis was that the female spawning-age trigger was not met (see below).

Current limits could be modified in 2016. Bushel limits may be revised after July 2016, when results of the 2015/16 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, 2015 through July 4, 2016.

Crab Pot License Category	Crab Pot Bushel Limits:			
	July 5, 2015 through November 15, 2015	November 16, 2015 through November 30, 2015	March 17, 2016 through March 31, 2016	April 1, 2016 through July 4, 2016
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 can have multiple licensees onboard a vessel.

- Winter crab dredge fishery season

The Commission closed the 2015/16 winter crab dredge fishery season from December 1, 2015 through March 31, 2016 for the eighth consecutive season after reviewing the abundance estimates from the Winter Dredge Survey. The VMRC staff developed several potential winter crab dredge fishery season triggers to determine when the winter crab dredge fishery season can reopen in the future. Of four alternative triggers the VMRC staff developed, an arithmetic trigger was selected. The trigger will afford the winter crab dredge fishery season to open based on a combination of abundance estimates from the Winter Dredge Survey for juvenile and spawning-age female crabs and the exploitation rate. This trigger uses Winter Dredge Survey abundance estimates from years when the percentage of female exploitation was less than or equal to 29%, but can incorporate subsequent survey results.

- If total abundance, juvenile abundance and female spawning-age abundance are all one standard deviation above the mean of eligible (29% or lower) Winter Dredge Survey samples, effort may be expanded.
- If total abundance, juvenile abundance and female spawning-age abundance are all one standard deviation below the mean of eligible (29% or lower) Winter Dredge Survey samples, effort will be reduced.

- Season closure for all other crab harvest gears

The Commission established a seasonal closure from September 26, 2015 through April 20, 2016 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 the 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 the Chesapeake Bay that cause blue crabs to be displaced or result in mortality. The Commission participated in a Harmful Algal Bloom Task Force (HAB TF) meeting on September 18, 2015 to review and provide updates regarding the 2014 and 2015 HAB seasons. Since a previous meeting in 2014, VMRC staff worked in conjunction with the Virginia Department of Health's (VDH) HAB TF to add an informational page about HABs to the VMRC Commercial Fisheries Annual Newsletter, which is mailed to all active Commercial Harvesters.

HAB TF members combined efforts this year, using land, boat, the VMRC plane, HRSD (data flows), a NASA drone, a plane with hyper spectral sensors (NASA CESSNA plane), and images from two satellites (NASA MODIS and NASA LANSAT). These efforts were performed on August 17, 2015, allowing for the simultaneous collection of a high amount of data.

HAB TF members used these data to compare bloom activity during April- September 2015 to May-August 2014. In general, bloom activity was higher in 2015 than in 2014, but it was lower than in 2012 and 2013. Some fish kills occurred, but it remains unclear if they were caused by HABs. Towards the end of the 2015 season, there was also a bioluminescence event caused primarily by A. monilatum. No link has yet been detected between the occurrence of bioluminescence and toxin production. 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 the 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 the 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 twenty-nine measureable, time-bound outcomes to improve the health of the Chesapeake Bay including sustaining blue crabs. The 2014 Milestone Progress Report published by the Federal Government in March, 2015, demonstrates progress toward milestones and includes planned Bay restoration and protection for fiscal year 2015.

Past reduction in submerged aquatic vegetation (SAV) beds 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 sea grass). The importance of eelgrass habitat functions in Chesapeake Bay was first demonstrated by the 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. The 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. The 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 the 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. The 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.* 2015). 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. The VIMS research has demonstrated that increased water clarity can help eelgrass beds persist under higher temperatures. Therefore, VIMS is working with Virginia regulatory agencies, MDDNR, and the Environmental Protection Agency to assess the current water clarity goals for the 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 the 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 the 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).

The 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 widgeongrass (*Ruppia maritima*) having the most overlap with the distribution of juvenile blue crabs in the Chesapeake Bay. Since the historically low abundances of 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 irregular 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 for the years since this study. In 2014, there was a notable increase of 27% (from 24,164 ha in 2013 to 30,689 ha in 2014) in the Chesapeake Bay. 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 2014, as did low-salinity areas (Orth et al. 2015). Because of the complexity of the estuarine environment, it is difficult to accurately determine a primary factor behind SAV declines, especially in individual beds, 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, generally experience higher growth and survival rates in vegetated versus unvegetated shallow water habitats. A recent VIMS study (Ralph et al. 2013), has shown that juvenile blue crabs prefer denser SAV beds over thinner beds, further demonstrating the positive influence that the quality of seagrass beds have on blue crab population dynamics. The VIMS has also demonstrated a high value to juvenile blue crabs for 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). The VIMS scientists recently discovered and described the life cycle of *Hematodinium perezi* from 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 from the blue crab 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). The 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 the 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 to support 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: (1) to investigate the effects of different crab pot cull-ring sizes on blue crab catch, biomass, and survival, and (2) to 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. 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 terrapin 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 the 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 shells 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 2015, 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 the VMRC, MDNR, 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 the 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 blue crab stock. Based on results from the 2014/15 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 2015/2016 to allow for continued rebuilding.

References

Federal Leadership Committee for the Chesapeake Bay. 2015. Executive Order 13508, Strategy for Protecting and Restoring the Chesapeake Bay Watershed: 2014-2015 Milestones Progress Report. Available at: http://executiveorder.chesapeakebay.net/category/Reports-Documents.aspx.

Jarvis, J.C., and K.A. Moore. 2010. The role of seedlings and seed bank viability in the recovery of Chesapeake Bay, USA, *Zostera marina* populations following a large-scale decline. Hydrobiologia 649: 55-68.

Johnston, C.A., and R.N. Lipcius. 2012. Exotic macroalga *Gracilaria vermiculophylla* provides superior nursery habitat for native blue crab in Chesapeake Bay. Marine Ecology Progress Series467: 137-146.

Li, C., T.L. Miller, H.J. Small, and J.D. Shields. 2011. In vitro culture and developmental cycle of the parasitic dinoflagellate *Hematodinium* sp. from the blue crab *Callinectes sapidus*. Parasitology 138: 1924-1934.

Moore, K.A., and J.C. Jarvis. 2008. Environmental factors affecting recent summertime eelgrass diebacks in the lower Chesapeake Bay: implications for long-term persistence. Journal of Coastal Research 55: 135-147.

Moore, K.A, E.C. Shields, D.B. Parrish, and R.J. Orth. 2012. Eelgrass survival in two contrasting systems: role of turbidity and summer water temperatures. Marine Ecology Progress Series 448: 247-258.

Orth, R.J., M.R. Williams, S.R. Marion, D.J. Wilcox, T.J.B. Carruthers, K.A. Moore, W. M. Kemp, W.C. Dennison, N. Rybicki, P. Bergstrom, and R.A. Batiuk. 2010. Long-term trends in submersed aquatic vegetation (SAV) in Chesapeake Bay, USA, related to water quality. Estuaries and Coasts 33: 1144-1163.

Orth *et al.* 2015. 2014 Distribution of Submerged Aquatic Vegetation in Chesapeake Bay and Coastal Bays, Executive Summary.

Ralph, G.M., R.D. Seitz, R.J. Orth, K.E. Knick, and R.N. Lipcius. 2013. Broad-scale association between seagrass cover and juvenile blue crab density in Chesapeake Bay. Marine Ecology Progress Series 488: 51-63.

Seitz, R.D., R.N. Lipcius, W.T. Stockhausen, and M.M. Montane. 2001. Efficacy of blue crab spawning sanctuaries in Chesapeake Bay. Spacial Processes and Management of Marine Populations, Alaska Sea Grant College Program. 607-626.

Seitz, R.D., R.N. Lipcius, W.T. Stockhausen, K.A. Delano, M.S. Seebo, and P.D. Gerdes. 2003. Potential bottom-up control of blue crab distribution at various spatial scales. Bulletin of Marine Science 72(2): 471-490.

Seitz, R.D., R.N. Lipcius, and M.S. Seebo. 2005. Food availability and growth of the blue crab in seagrass and unvegetated nurseries of Chesapeake Bay. Journal of Experimental Marine Biology and Ecology 319: 57-68.

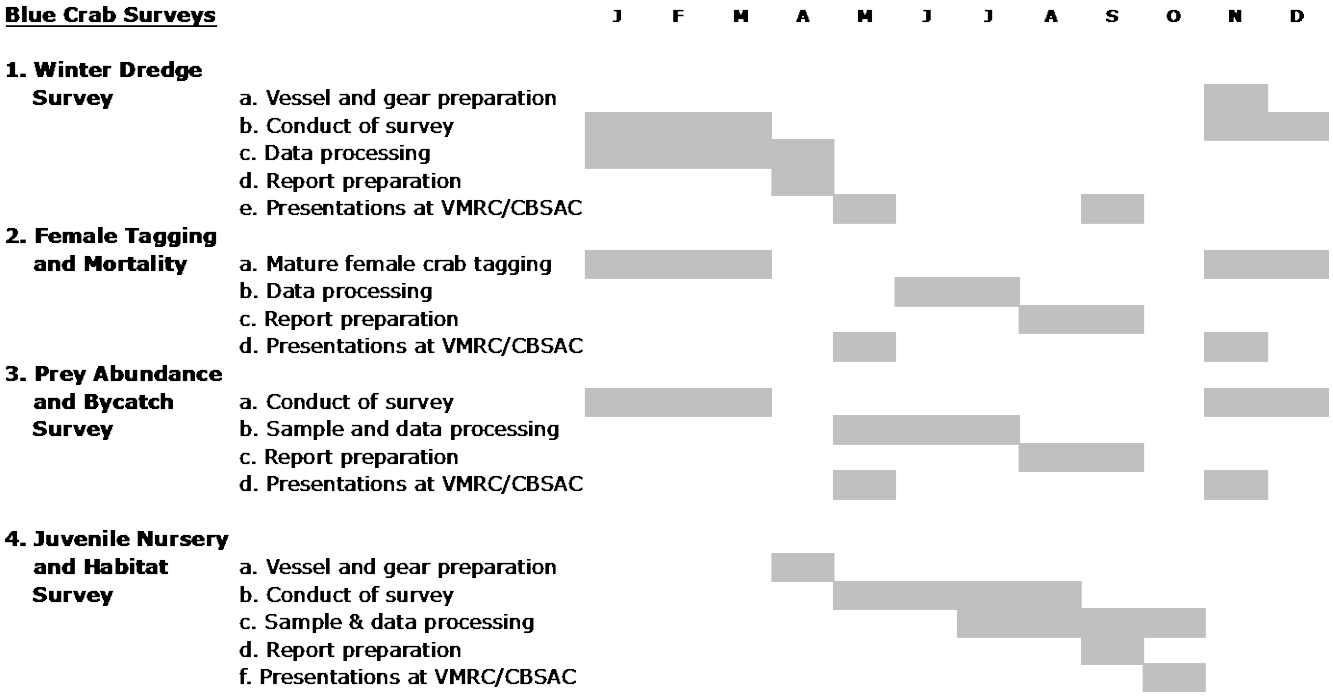
Shields, J.D. and C.M. Squyars. 2000. Mortality and hematology of blue crabs, *Callinectes sapidus*, experimentally infected with the parasitic dinoflagellate *Hematodinium perezi*. Fishery Bulletin 98(1): 139-152.

Shields, J.D. and R.M. Overstreet. (2007) Parasites, symbionts, and diseases, pp. 299-417. In: The blue crab *Callinectes sapidus*. (V. Kennedy and L.E. Cronin, eds.). University of Maryland Sea Grant College, College Park , Maryland.

Shields, J.D. 2012. The impact of pathogens on exploited populations of decapod crustaceans. Journal of Invertebrate Pathology 110: 211-224

VIMS Blue Crab Surveys (2014-2015)

In 2014-2015, 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 the VIMS Trawl Survey and ChesMMAP. The JNS is complementary to the 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



2015 Chesapeake Bay Blue Crab Advisory Report

CBSAC Meeting Date: May 15th, 2015
Report Final Draft: June 30th, 2015

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 divided by the total number of female crabs (age 0+) estimated in the population at the start of the season. The 2015 exploitation fraction cannot be calculated until the completion of the 2015 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 1+ female crabs. Recent stock status levels that did not exceed threshold values are shown in green, whereas exploitation values exceeding or abundance estimates beneath thresholds are shown in red.

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

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 the MSY concept. U_{MSY} 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 U_{MSY} and a threshold

exploitation level set equal to U_{MSY}. The female-specific, age-1+ abundance target and threshold were set accordingly at abundance levels associated with 75% N_{MSY} (target) and 50% N_{MSY} (threshold). The annual exploitation fractions is calculated as the number of female crabs harvested divided by the total number of age-0+ female crabs in the Bay at the beginning of the fishing season, as estimated by the WDS. As part of this calculation, the juvenile component of the total estimated number of crabs was scaled up by a factor of 2.5 to achieve the best fits of the empirical estimates to the modeled data as determined by the 2011 stock assessment.

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 101 million female spawning-age crabs were estimated to be present in the Bay at the start of the 2015 crabbing season (Figure 1). The 2015 estimate of total spawning age female crabs represented a 32% increase with respect to the 2014 estimate of 68.5 million crabs. The 2015 abundance of spawning-age female crab is above the recommended threshold but remains below the recommended target.

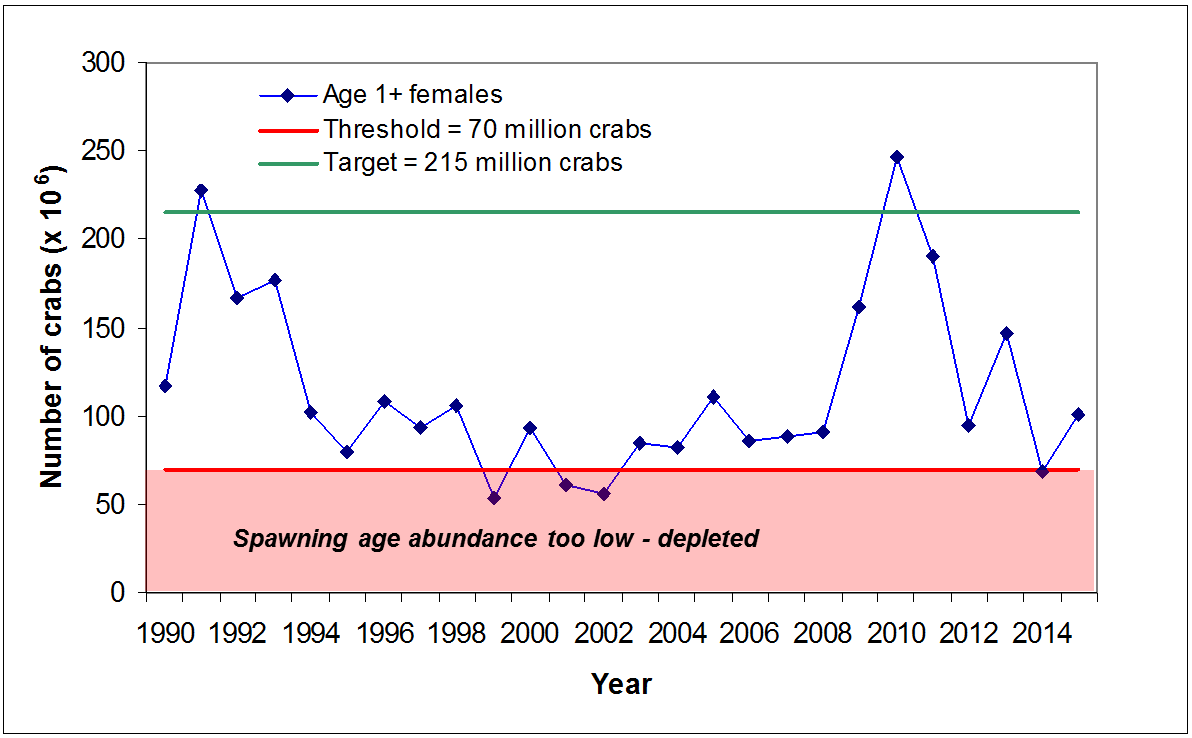


Figure 1. Winter dredge survey estimate of abundance of female blue crabs age one year and older (age 1+) 1990-2015 with female-specific reference points. These are female crabs measuring greater than 60 mm across the carapace and are considered the 'exploitable stock' that could spawn within this year.

2.3 Female Exploitation Fraction: Reference Points

The percentage of all female crabs (ages 0+) removed by fishing (exploitation fraction) in 2014 was approximately 17%. This exploitation fraction is below the target of 25.5% and the threshold of 34% for the seventh consecutive year (Figure 2).

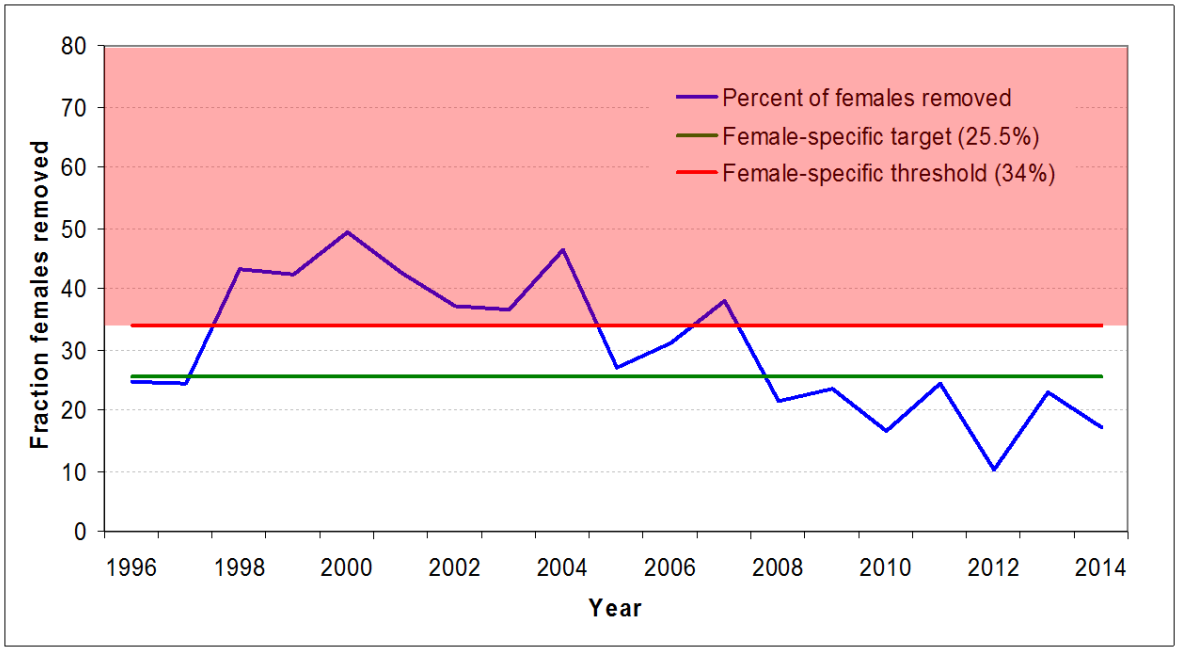


Figure 2. The percentage of all female blue crabs removed from the population each year by fishing relative to the female-specific target (25.5%) and threshold (34%) exploitation rates, 1990 through 2014. Exploitation rate (% removed) is the number of female crabs harvested within a year divided by the female population (age 0 and age 1+) estimated at the beginning of the year.

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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 38% from 297 million crabs in 2014 to 411 million crabs in 2015 (Figure 3).

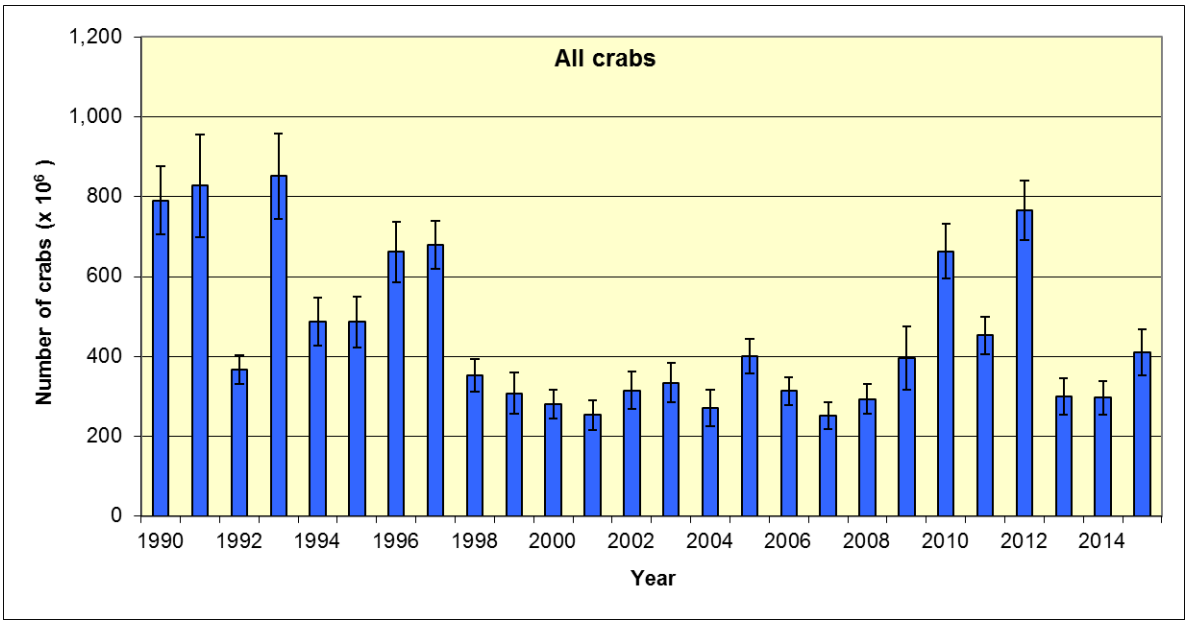

Figure 3. Winter dredge survey estimate of abundance of all crabs (both sexes, all ages) in Chesapeake Bay, 1990 through 2015. Error bars represent 95% confidence intervals.

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 increased by approximately 36% from 198 million in 2014 to 269 million crabs in 2015 (Figure 4). High recruitment variability is a characteristic of blue crab populations. The sex composition of the 2015 juvenile estimate is approximately 50% male and 50% female.

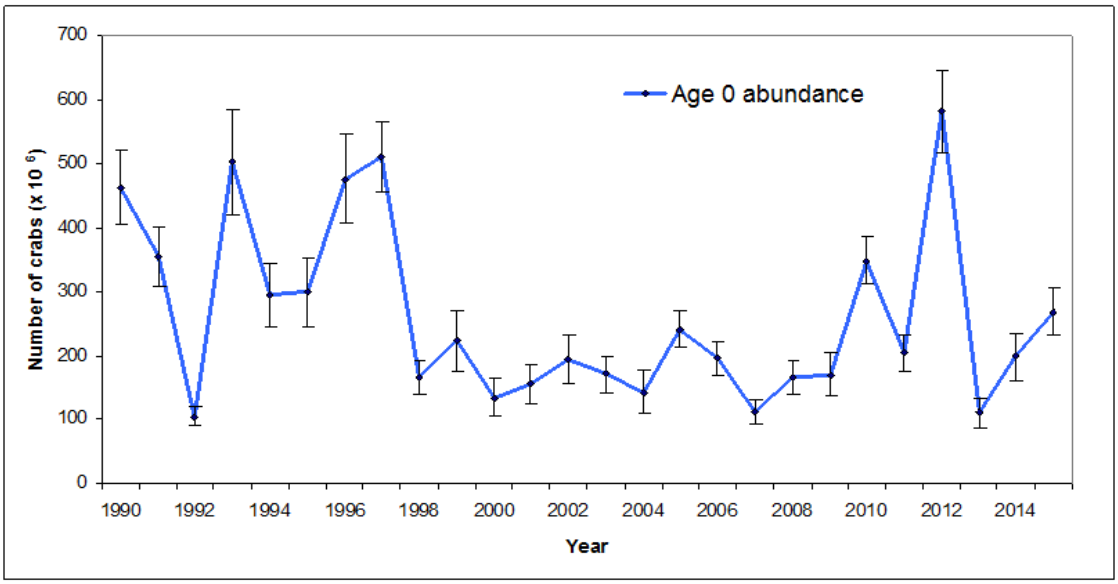

Figure 4. Winter dredge survey estimate of abundance of juvenile blue crabs (age 0), 1990-2015 calculated without the catchability adjustment for juveniles. These are male and female crabs measuring less than 60 mm across the carapace. Error bars represent 95% confidence intervals.

3.3 Age-1+ Male

In 2015, 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 43.6 million crabs (Figure 5), a 49% increase from the 2014 estimated adult male abundance of 29.3 million crabs. However, the 2015 male abundance estimate remains relatively low.

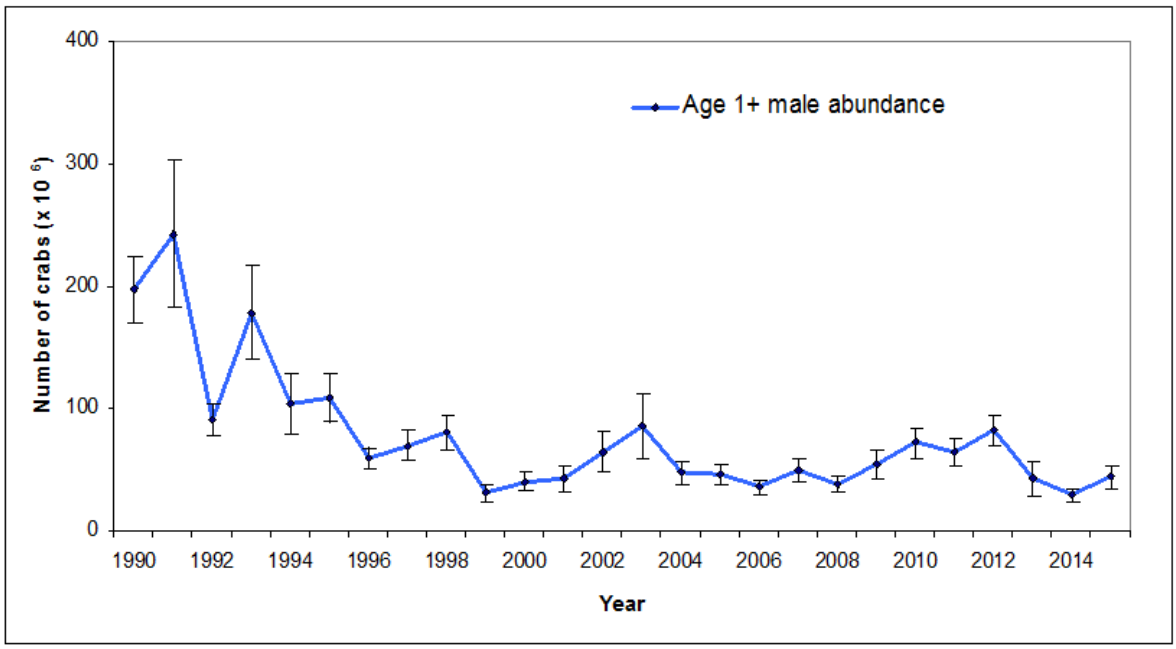

Figure 5. Winter dredge survey estimate of abundance of male blue crabs age one year and older (age 1+) 1990-2015. These are male crabs measuring greater than 60mm across the carapace and are considered the 'exploitable stock' capable of mating within this year. Error bars represent 95% confidence intervals.

3.4 Overwintering Mortality

The 2015 estimates of overwintering mortality of blue crabs in the Bay are some of the highest values in recent history (Table 2).

Table 2. Percent dead crabs found in late winter dredge samples each year from 2012-2015 and the average for 1996-2011.

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

Overwintering mortality decreased the abundance of all sectors of the blue crab population in 2015 (Table 3).

Table 3. Baywide abundance estimates for 2015 before and after overwintering mortality.

Baywide Age/sex group	Abundance estimate in millions before overwintering mortality (millions of crabs)	Final abundance estimate in millions after overwintering mortality (millions of crabs)	% Overwintering mortality
All crabs	487	411	15.68%
Juveniles	302	269	10.84%
Adult Females	125	101	19.25%
Adult Males	61	44	28.11%

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 2014-15 season in response to the depleted abundance of females in 2014. The 2014 commercial harvest for both males and females from the Bay and its tributaries was estimated as 16.5 million pounds in Maryland, 17.0 million pounds in Virginia and 1.7 million pounds in the Potomac River. Maryland's 2014 commercial harvest declined 12% from 2013, Virginia's commercial harvest increased by 5.5%, and the Potomac River's commercial harvest decreased by 15%. The Baywide commercial harvest of 35 million pounds is the lowest harvest recorded in the last 25 years (Figures 6-7).

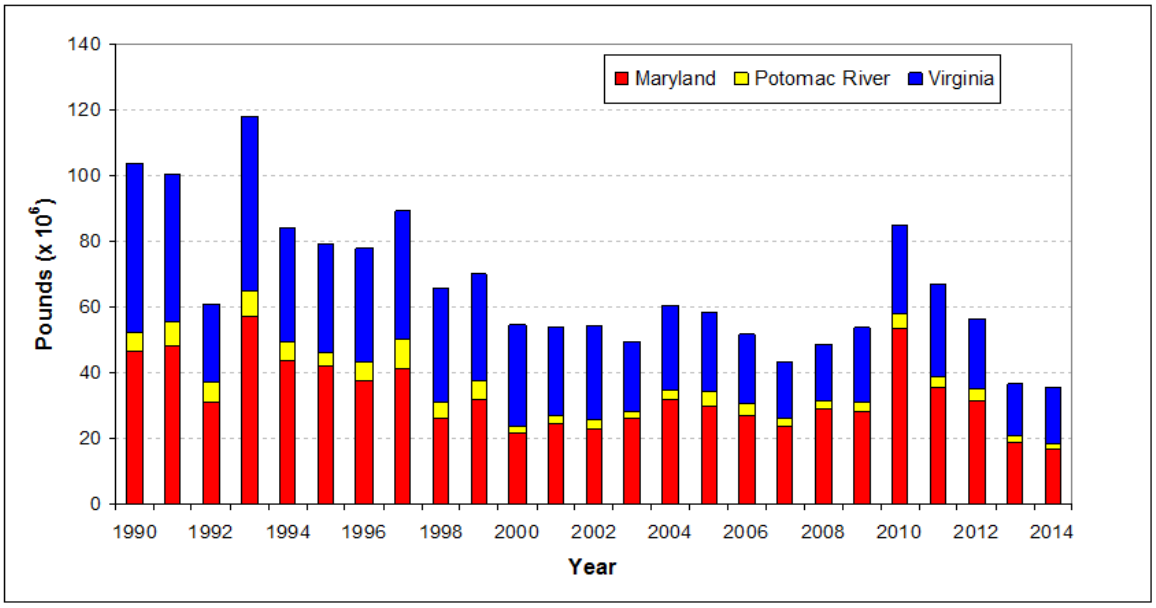

Figure 6. Total commercial blue crab landings (all market categories) in Chesapeake Bay, 1990-2014.

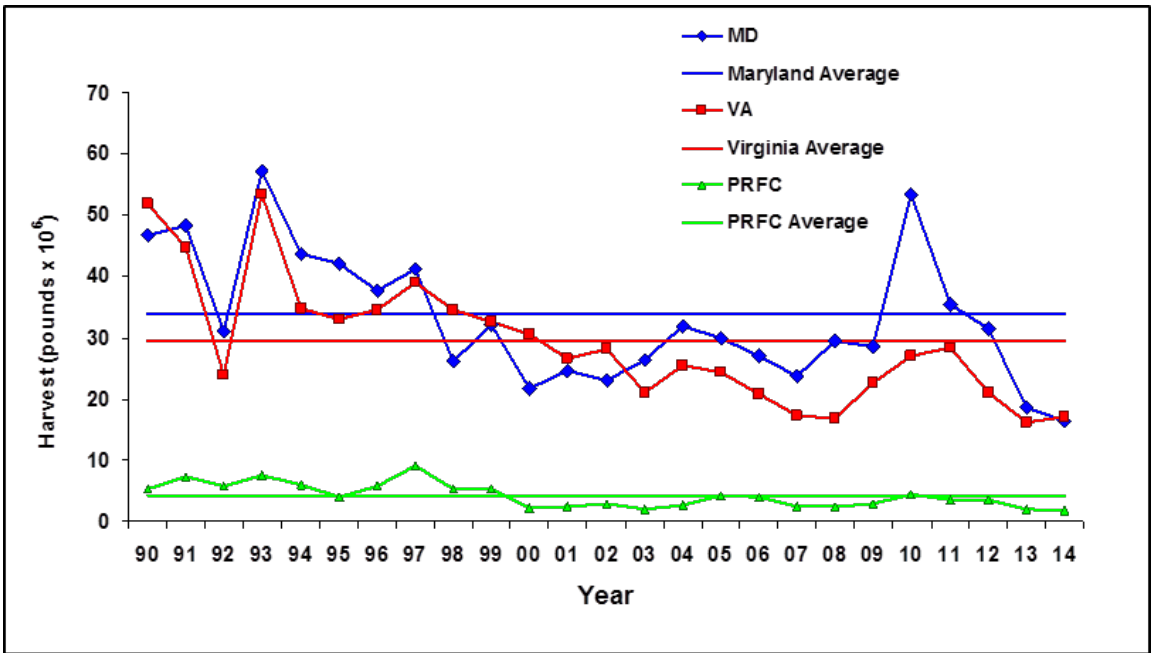

Figure 7. Maryland, Virginia and Potomac River commercial blue crab harvest in millions of pounds, all market categories, 1990-2014.

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. 2014 Baywide recreational harvest was estimated as 2.3 million pounds, the same as the 2013 recreational harvest estimate. Combining the commercial and recreational harvest, approximately 37.3 million pounds of blue crabs were harvested from Chesapeake Bay and its tributaries during the 2014 crabbing season. The 2014 Baywide blue crab harvest was one of the lowest seen this century.

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5. STOCK STATUS

5.1 Female Reference Points

The Chesapeake Bay blue crab stock is currently between the abundance threshold of 70 million age 1+ female crabs and the abundance target of 215 million age 1+ female crabs outlined in the current management framework. The 2014 exploitation fraction of 17% was below the target (25.5%) and threshold (34%). The stock is **not depleted and overfishing is not occurring** (Figure 1-2). 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. The reference points from the former management framework were used to develop the conservation triggers below.

Previously, estimates of male exploitation that were presented did not utilize the juvenile scalar in calculations, as it has been when calculating female exploitation. The male exploitation rate (Trigger #1) below has been revised to include the scalar (described in Section 2.1), so it is consistent with the female-specific reference points (Trigger #2). This change has no impact on the performance of the metrics or the application of the male conservation triggers described below. The exploitation rate of both sexes combined (Trigger #2) was calculated without the juvenile scalar so the value could be related to the prior management framework.

CBSAC recommended conservation triggers for male crabs based on male exploitation and on the former management framework. Under these triggers, conservation measures should be considered for male blue crabs if either of the following occurs:

1) The male exploitation rate exceeds 33% (calculated with the juvenile scalar as described in section 2.1), 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 biologically significant 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 2014 male exploitation fraction was estimated at 21%, which is below the 33% male exploitation rate conservation trigger (Figure 8).

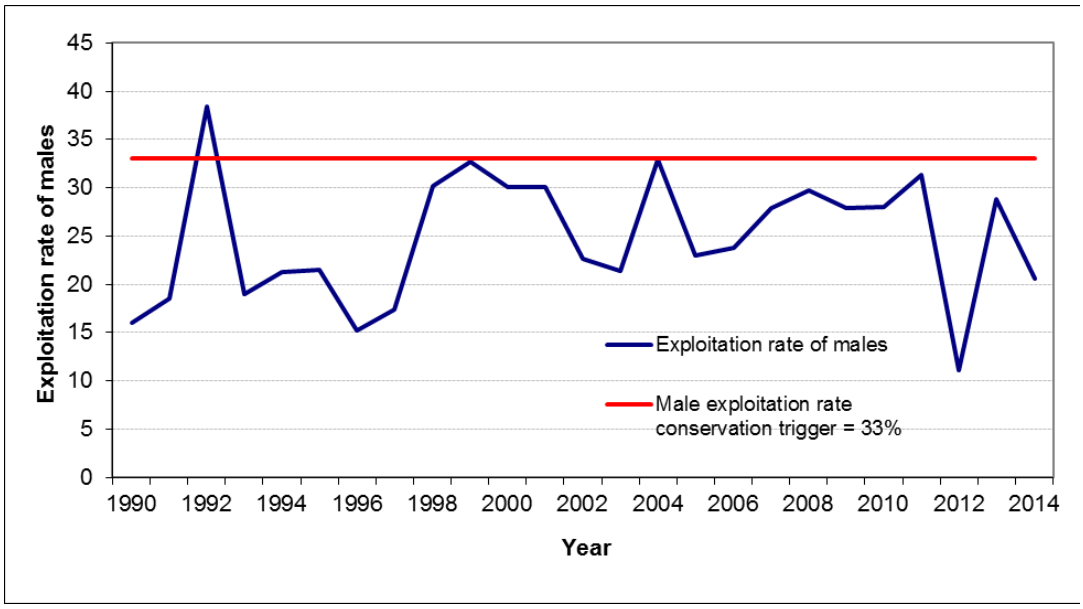

Figure 8. The percentage of male crabs removed from the population each year by fishing, 1990 through 2014. Exploitation rate (% removed) is the number of male crabs harvested within a year divided by the male population estimate (age 0 and age 1+) at the beginning of the year.

2) If female exploitation is below the established overfishing threshold of 34% and the total annual exploitation rate of male and female crabs exceeds the threshold defined by the previous control rule of 53% of crabs, both sexes combined. The 2014 female exploitation was estimated at 17%, which is below the 34% threshold (Figure 7). The 2014 exploitation fraction of males and females combined was estimated at 26%, which is below the 53% threshold (Figure 9).

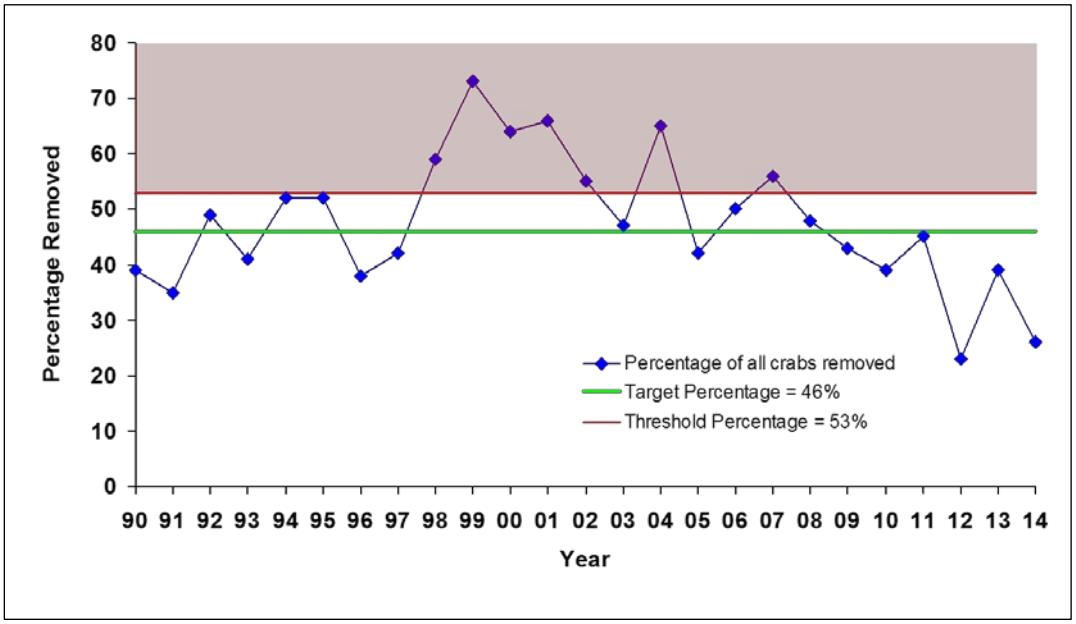

Figure 9. The percentage of male and female crabs removed from the population each year by fishing relative to previously used target (46%) and threshold (53%) exploitation rates, 1990 through 2014. Exploitation rate (% removed) is the number of crabs harvested within a year divided by the population of all crabs estimated at the beginning of the year.

Because neither of the male conservation triggers was reached, no management action is recommended at this time specific to male blue crabs.

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)

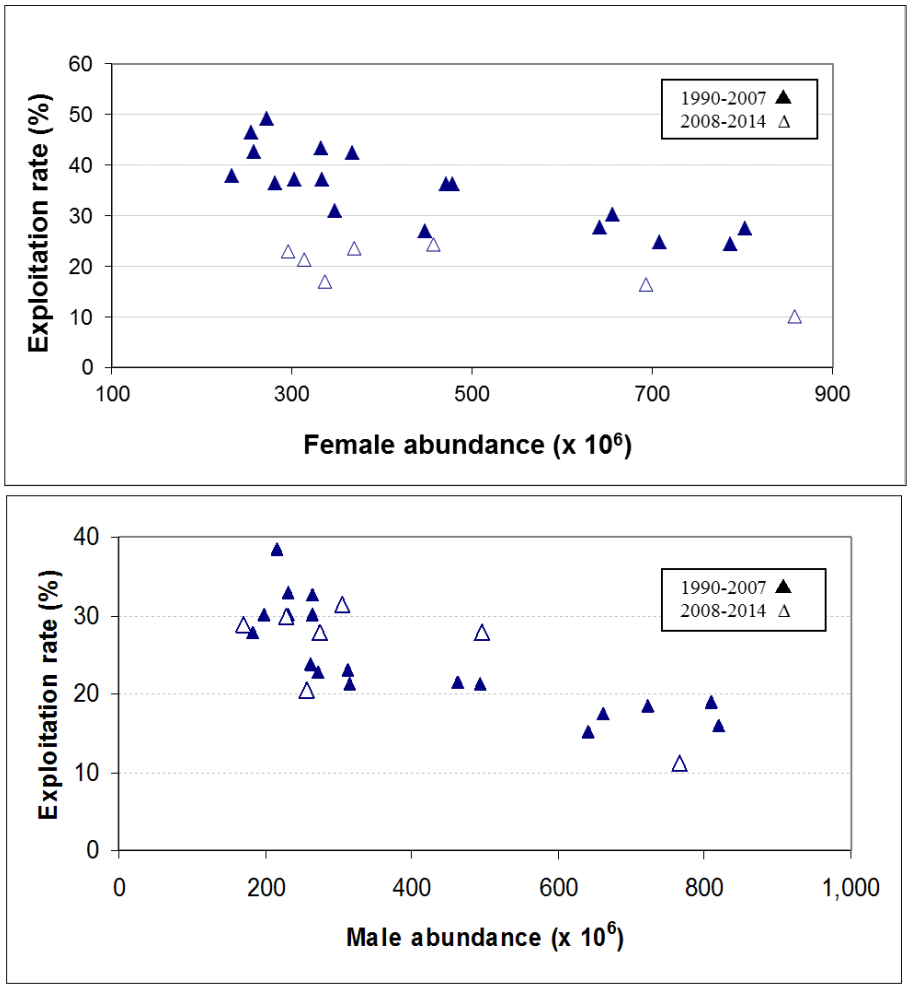

Figure 10. Female (top) and male (bottom) exploitation rate comparison of the time periods prior to and after the 2008 implementation of female-specific management measures.

6. MANAGEMENT ADVICE-SHORT TERM

6.1 Monitor fishery performance and stock status relative to recommended reference points and maintain a risk-averse management approach protecting 2015 recruits

The female exploitation fraction in 2014 was below the recommended target of 25.5% for the seventh consecutive year. The abundance of both juvenile and adult female crabs increased in 2015. However, the number of recruits year to year remains highly variable.

Future catches and ability of the blue crab stock to reach abundance targets could depend heavily on the survival and successful reproduction of the 2016 exploitable female stock. Conservation of this year's juveniles is expected to maintain or increase future spawning potential. CBSAC finds this as justification for a continued risk-averse and cautious management approach that ensures harvest is adequately constrained relative to abundance and the target exploitation fraction.

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 2016. Importantly, CBSAC notes that when changes in reporting requirements are implemented, it is vital that an analysis of the impact of the changes in reporting methodology of the estimated harvest be undertaken.

If the jurisdictions continue with a sex-specific regulatory strategy, CBSAC again recommends greater efforts to determine the biological characteristics of all catch, both harvested and discarded.

Update: Shifting management time frame: July to July

For the 2014-15 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. CBSAC is further exploring the potential long-term impacts of a July-July management time frame and will report back at a future date.

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7. MANAGEMENT ADVICE- LONG TERM

7.1 Catch Control

A management strategy 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.

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.

7.3 Abundance specific exploitation

In the upcoming 2016-17 stock assessment CBSAC recommends the evaluation of variable targets and thresholds based on the fluctuating abundance of all sectors of the female segment of the population.

7.4 Jurisdictional Management Controls

The blue crab fishery is primarily managed under an effort control framework with limited entry, size limits and seasonal closures serving as the principal tools. Additionally, the blue crab fishery is also managed by output controls such as harvest and bushel limits. In many cases, the amount of effort expended in the fishery remains poorly quantified. CBSAC recommends an increased investment in Baywide effort monitoring that should include actions in all jurisdictions to implement a pot marking system and a Baywide survey of crab pot effort to estimate the total, spatial and temporal patterns of the crab pot fishery.

7.5 Latent effort

In both states, significant numbers of commercial crabbing licenses are unused. An increase in the blue crab population may increase the use of licenses that have, for some time, been inactive. CBSAC recommends that the level and possible re-entry of latent effort into the fishery be estimated and monitored. In addition to increases in latent effort, CBSAC also recognizes that temporal and seasonal shifts in blue crab abundance may alter existing effort exerted by active licenses. The impact of inherent variability of blue crab abundance 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 list of fishery-dependent and fishery-independent data needs as well as the benefits provided to management. CBSAC recognizes the importance of the upcoming 2016-17 benchmark 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 2012, the Maryland Blue Crab Design Team has been conducting a pilot electronic reporting system in conjunction with MD DNR 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 by 2016.

8.2 Gear efficiency pertaining to selectivity of WDS methods:

There is no update on gear efficiency studies from the 2014-15 winter dredge survey due to the severe winter, which imposed time constraints on the survey vessels. The below update still stands from the 2014 Blue Crab Advisory Report.

The WDS survey methods to estimate gear efficiency differ between MD and VA. CBSAC recommends continuation of a comprehensive comparison between MD and VA WDS methodologies and gear efficiency and selectivity with regard to age 0 and age 1+ crabs.

Following the comprehensive comparison, the accuracy and reliability of current scalars and efficiency corrections should be re-evaluated. MD DNR and the Virginia Institute of Marine Science (VIMS) will meet to discuss survey design in an attempt to develop this comparison over the course of the next year. Costs and required time are unknown.

8.3 Improving recruitment estimate through a shallow-water survey:

Based on the results of the 2012-2013 WDS, a large number of recruits observed in the 2011-2012 WDS did not recruit to the fisheries in 2012-2013. Based on the 2011 stock assessment and field experiments by VIMS and the Smithsonian Environmental Research Center, a large fraction of juvenile blue crabs (76-86%) in shallow water are not sampled by the WDS[7]. For the former, CBSAC recommends analyzing pertinent environmental and ecological variables to examine potential hypotheses to explain the poor survival of this record recruitment event and

improve the accuracy of the WDS. This examination includes the definition of viable hypotheses, not the assessment of their veracity. For the latter, CBSAC recommends that funding be pursued at the state and federal levels for shallow-water surveys to assess the potential for interannual bias in the fraction of juveniles that is not sampled by the WDS.

8.4 Investigation of the potential for sperm limitation:

CBSAC recommends continued examination to quantify and better understand the role male crabs on reproductive success and overall population productivity. The potential for sperm limitation resulting from a lower abundance of sexually mature male crabs is discussed in several recent studies[8,9,10]. Further clarity could be brought to this issue through an analysis of the age composition of mature females over the history of the WDS to determine whether the proportion of females in their second reproductive year has increased.

8.5 Other sources of incidental 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, disease, and predation. An analysis of non-harvest mortality could improve reliability of exploitation fraction estimates and inform future assessments. Initial efforts should be focused on better defining analyses that could address the problem.

8.6 Collaborative Baywide fishery independent survey:

A collaborative and coordinated Baywide, fishery-independent survey focused on the spring through fall distribution and sex-specific abundance of blue crabs remains important, especially if agencies are considering regional or spatially-explicit management strategies. Costs and time commitments are unknown.

CBSAC Participants:

Joe Grist (Chair)	Virginia Marine Resource Commission
Ellen Cosby	Potomac River Fisheries Commission
Glenn Davis	Maryland Department of Natural Resources
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
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

Literature Cited

1. Miller, T. J. et al. 2011. Stock Assessment of Blue Crab in Chesapeake Bay. 2011. Final Report. Ref: [UMCES] CBL 11-011. UMCES Tech. Ser. No. TS-614-11-CBL.

2. 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.

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. Ashford, J. R., and C. M. Jones. 2001. Survey of the blue crab recreational fishery in the Chesapeake Bay, 2001. Final Report to the Maryland Department of Natural Resources. Annapolis, MD. 61p.

5. 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. Annapolis, MD. 31p.

6. Ashford, J. R., and C. M. Jones. 2005. Survey of the blue crab recreational fishery in Maryland, 2005. Final Report to the Maryland Department of Natural Resources. Annapolis, MD. 31p.

7. Ralph, G.M., and R.N. Lipcius. 2014. Critical habitats and stock assessment: age-specific bias In the Chesapeake Bay blue crab population survey. Transactions of the American Fisheries Society *in press*.

8. Ogburn, M.B., P.M. Roberts, K.D. Richie, E.G. Johnson, and A.H. Hines. 2014. Temporal and spatial variation in sperm stores in mature female blue crabs (*Callinectes sapidus*) and potential effects on brood production in Chesapeake Bay. Marine Ecology Progress Series *in press*.

9. Hines, A.H., and M.B. Ogburn. 2014. Evaluating population level impacts of sperm limitation on the Chesapeake blue crab stock. Final Report to NOAA Chesapeake Bay Office for NA11NMF4570230.

10. Rains, S.A. 2014. Potential for sperm limitation in blue crabs of Chesapeake Bay. M.S. thesis, University of Maryland.

Attachment 2

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**	**TBD**	**TBD**

* 2014 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 2015)

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)
- Regulation tolerance of 10 per bushel (Previously March 17 – July 15)

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