



COMMONWEALTH of VIRGINIA

Marine Resources Commission
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Matthew J. Strickler
Secretary of Natural Resources

Steven G. Bowman
Commissioner

December 1, 2020

MEMORANDUM

TO: The Honorable Ralph S. Northam
Governor of the Commonwealth of Virginia
And
Members of the Virginia General Assembly

THROUGH: The Honorable Matthew J. Strickler
Secretary of Natural Resources

FROM: Steven G. Bowman
Commissioner, Virginia Marine Resources Commission

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

The 31st Bay-wide Winter Dredge Survey was conducted from December 2019 to March 2020 by the Virginia Institute of Marine Science (VIMS) and Maryland Department of Natural Resources (MD DNR). Results indicate the blue crab stock is not depleted and overfishing is not occurring. The 2019-20 Winter Dredge Survey estimate of abundance of all size classes of blue crabs is 405 million crabs, which is 32% lower than the 2018-19 total abundance estimate of 594 million crabs and 5% lower than the long-term survey average of 427 million crabs.

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Juvenile crabs accounted for 45.7% of the 2019-20 total abundance, numbering 185 million crabs. This is 43% lower than the 2018-19 juvenile population of 324 million crabs and 18% lower than the long-term survey average of 229 million juvenile crabs. Juvenile crabs surveyed in wintertime are important to the current year's harvest, as they recruit to harvestable size in late summer and fall and contribute to the following year's late May and July-August spawning periods.

The survey estimated 141 million overwintering female crabs that could potentially spawn in 2020 (if not harvested prior to the spawning seasons), which is 7% below the average since female-conservative measures were put in place in 2008, but 23% above the long term average. The 2020 abundance estimate of spawning-age female crabs is well above the threshold of 70 million crabs established by the 2011 Chesapeake Bay Blue Crab Stock Assessment but below the target of 215 million crabs. Since 2008, there has generally been a continuation of management measures by all Chesapeake Bay jurisdictions to conserve the spawning-age female crabs. The Virginia winter dredge fishery season has been closed each year since 2008. That conservation measure may partially account for above average spawning-age female abundance in eight of the twelve years because closing the winter dredge season allows juvenile crabs to be free of fishing pressure after they mature in fall. 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 are also important to the spring and early summer harvest, as a high proportion of the Virginia commercial and recreational harvests consists of female crabs.

Conservative management can lessen the effects of annual variation, but year-to-year variation in abundance of blue crabs will be expected due to environmental influences, especially during the early life stages of crabs. Conservation of female spawning-age crabs as well as juvenile crabs is the primary management objective to attempt to lessen variability of the blue crab stock abundance. The extensive management measures from 2008 that were implemented throughout the Chesapeake Bay jurisdictions have helped to mitigate year-to-year variability in the fisheries that previously resulted in overfishing during many prior years (see Attachment 1). Juvenile crab abundance can vary because of inter-annual differences in the entrainment of crab larvae from the ocean to Chesapeake Bay. This process is subject to natural fluctuations in the prevailing current and wind patterns. Environmental factors including weather conditions and predation can have an effect on all life stages of the crab population. Due to a mild winter, overall overwintering mortality was 0.36% in 2020 - the lowest mortality of the time series.

The Chesapeake Bay jurisdictions have relied on a management framework enacted in 2014 in which the fishery is regulated from July 5 through July 4 of the next year. The benefit of this approach is that two Bay-wide Winter Dredge Surveys can be accomplished in that 12-month period, and conservation efforts can be applied after either survey is complete. Since 2014, the Virginia Marine Resources Commission (VMRC) and other Chesapeake jurisdictions (Maryland and the Potomac River Fisheries Commission) have paid close attention to the current year's juvenile abundance, as well as the mature female abundance, as the juveniles are the subsequent year's spawning stock. The current July-to-July regulatory framework for blue crabs allows for the conservation of female crabs for spawning in both the current and following year. In 2020, the abundance of juvenile crabs at 185 million was 18% lower than the long-term survey average. Predation and harvest in late summer and fall of 2020 will determine how many juveniles will mature as spawning-age female crabs in 2021 and join the mature female crabs that were not exploited by fisheries in 2020. Additional crab conservation measures maintained since 2014 include a shorter harvest season closure for all other crab gear that exploits juvenile or peeler-size crabs.

The VMRC, MD DNR, and PRFC (Potomac River Fisheries Commission) agree that any liberalization of current management measures concerning the blue crab fisheries must not interfere with the stability of the stock or annual Bay-wide abundances near the 215 million spawning-age female crab target. In

response to the 2019-20 Winter Dredge Survey results, the jurisdictions agreed to maintain the current cautious, risk-averse approach in the 2020 season and to focus on the sustainability of the fishery.

Each year the Commission uses the results of the Winter Dredge Survey to consider potential adjustments to blue crab management measures, such as changes in bushel limits and seasons. At a July 28, 2020 public hearing, the Commission reestablished the traditional crab pot season for 2020 and 2021: a March 17 opening and a November 30 closure. On October 27, 2020, the Commission voted to extend the 2020 crab pot season to December 19 to help offset economic losses from the COVID-19 pandemic for the industry. Based on estimates of abundance and the lack of fishing effort during the early period of the pandemic, researchers believe the extended season will have minimal impact on annual harvest.

THE 2020 VIRGINIA BLUE CRAB FISHERY MANAGEMENT PLAN

Status of the Chesapeake Bay Blue Crab Stock

Managers and scientists expect annual estimates of abundance and exploitation rate to vary, so biological reference points are set to indicate stock status. Biological reference points, often including a target to manage around and a threshold to avoid, are a primary output of stock assessments, and fishery regulations are implemented to conform to those biological standards. The 2011 benchmark stock assessment control rule established female-specific reference points based on the biological status of adult female crabs. 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 2017 update to the blue crab stock assessment resulted in slight changes to the biological reference points, decreasing the target abundance from 215 to 196 million blue crabs and increasing the target and threshold fishing mortality rates to 28% and 37%, respectively. The 2017 stock assessment update was approved for use by the National Oceanographic and Atmospheric Administration Chesapeake Office (NCBO) Sustainable Fisheries Goal Implementation Team (SFGIT) and in 2020, the SFGIT Executive Committee approved adopting the new biological reference points. This report will reference the 2011 biological reference points as in the 2020 Chesapeake Bay Stock Assessment Committee (CBSAC) Annual Report. The 2020 CBSAC Annual Report is shown in Attachment 2.

The annual Bay-wide Winter Dredge Survey has been conducted since 1990 and was adopted as the primary indicator of blue crab population health in 2006 by CBSAC because it is the most comprehensive and statistically robust of the blue crab surveys conducted in the Bay. Each winter from December to March, MD DNR and VIMS dredge their respective portions of the bay, recording the density (number per 1,000 square meters), size, and sex of crabs 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 expanded based on the area of Chesapeake Bay, providing an annual estimate of the number of overwintering crabs by age and sex.

Based on results from the 2019-20 Winter Dredge Survey, the female spawning-age biomass is not below the overfished threshold, is not being harvested above the overfishing threshold, and has shown some recovery since management measures to reduce harvest on all crabs Bay-wide were implemented in 2008. Despite a history of variable abundance over the last several years, VMRC continues to promote conservation efforts that can afford benefits to all user groups. 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, then management measures would be implemented to protect the biological stability of the blue crab stock.

The 2011 abundance and exploitation rate targets and thresholds (biological limits) used to monitor the health of the blue crab stock in Chesapeake Bay are provided in Table 1. The abundance estimate from the 2019-20 Bay-wide Winter Dredge Survey of female spawning-age crabs (age 1+) was 141 million crabs. This abundance for 2020 is the twelfth highest amount of spawning-age female crabs in the 31 years since the Winter Dredge Survey was first implemented in 1990 and is double the threshold of 70 million spawning-age female crabs that signals a depleted stock condition. The most recent stock depletion occurred in 2014. The spawning-age crabs of at least 2.4 inches carapace width will spawn in late May or during the July-August peak spawning period. However, this spawning potential is limited by continuous Bay-wide harvesting nine months out of the year.

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

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

* In October 2020, the SFGIT Executive Committee voted to adopt updated Biological Reference Points from the 2017 Blue Crab Stock Assessment Update. See Attachment 3.

The 2019 female crab exploitation rate estimate was 17%, which is below the target exploitation rate of 25.5% annual removal of female crabs by fisheries. This estimate is below the overfishing threshold of 34%, so overfishing is not occurring on this stock. For the last eleven consecutive years, the removal rate has been near or below the target. Some in the industry believe the fishery is underperforming given it is uncommon to reach this target. However, removal rates are likely underestimations due to 1) lack of information on dead discards, 2) magnitude of the unreported recreational fishery, 3) potential commercial under-reporting, and 4) juvenile abundance estimates since 2011 that assume the dredge only captures 40% of these smaller crabs. The Chesapeake Bay jurisdictions believe it is prudent to remain slightly below the target by keeping present regulations in place rather than risk exceeding it.

The total abundance of 405 million crabs, determined by the Winter Dredge Survey, is below the survey average. The relative balance of the population has stayed consistent since 2019, in that approximately 35% of the total abundance is represented by spawning-age females and 45% is represented by juveniles. It is equally important that both mature female crabs and juvenile crabs are conserved for spawning potential.

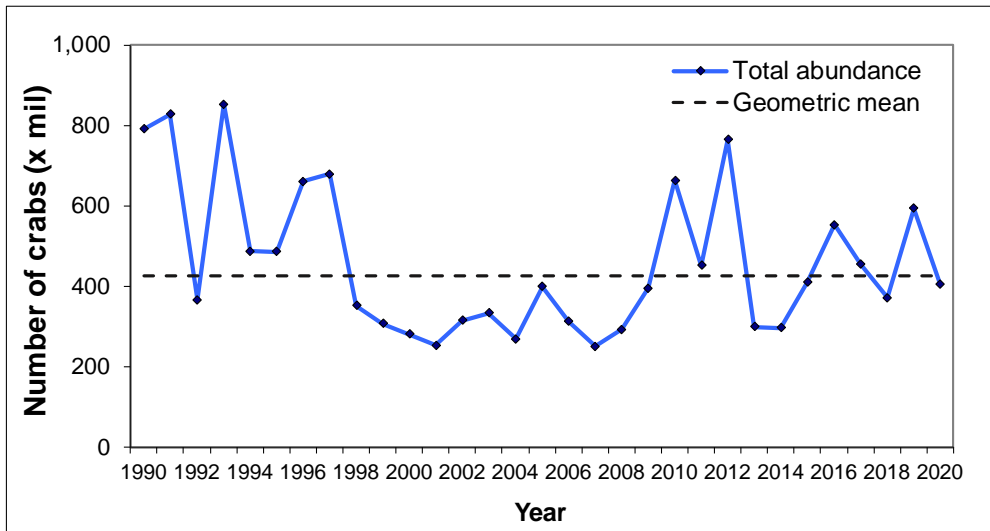
Overwintering mortality—the percent of dead crabs found in late winter dredge samples—for all blue crabs in the Chesapeake system was only 0.36% in 2020. This mortality rate is the lowest of the time series and is well below the 1996-2020 average of 4.53%. Mortality was highest for adult male crabs (0.78%), followed by adult females (0.47%), and negligible among juveniles (0.00%). This may be due to a warmer than average winter.

Table 2 provides a summary of the results from the Winter Dredge Survey since 2011, when the last benchmark stock assessment was released. Results from the entire 30-year survey history can be found as a table in Attachment 1. The abundance of recruits (age-0 crabs) and the spawning-age crabs (age 1+ crabs) are differentiated according to size, with 2.4 inches in carapace width as the separator between the two size classes. Any abundance estimate represents the number of crabs that will be available to Chesapeake Bay fisheries following the end of the survey (Figures 1A, 1B, & 1C).

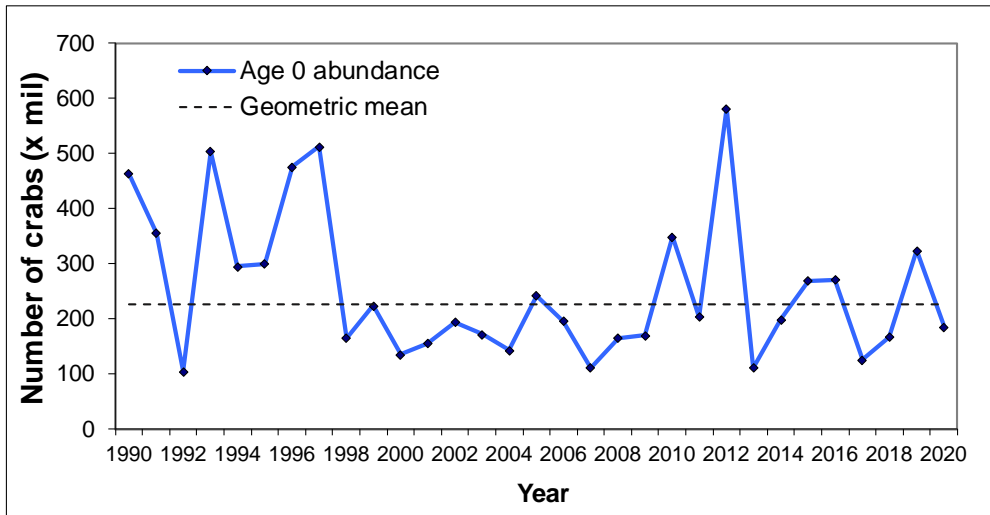
Table 2. Bay-Wide Winter Dredge Survey results (winter of 2010-11 through winter of 2019-20). All surveys begin in December and end in March the next year. Commercial harvest and percentage of female crabs removed in 2020 are not yet available (TBD = to be determined).

Survey Year (year survey ended)	Total crab abundance (all ages in millions)	Juvenile abundance (both sexes in millions)	Spawning-age crab abundance (both sexes in millions)	Spawning-age females abundance (in millions)	Bay-wide Commercial harvest (in millions of pounds)	Percentage of female crabs harvested
2011	452	204	255	191	67	24%
2012	765	581	175	95	56	10%
2013	300	111	180	147	37	23%
2014	297	199	99	69	25	17%
2015	411	269	143	101	50	15%
2016	553	271	284	194	60	16%
2017	455	125	330	254	54	21%
2018	372	168	206	147	55	23%
2019	594	324	271	191	61	17%
2020	404	185	220	141	TBD	TBD

A.



B.



C.

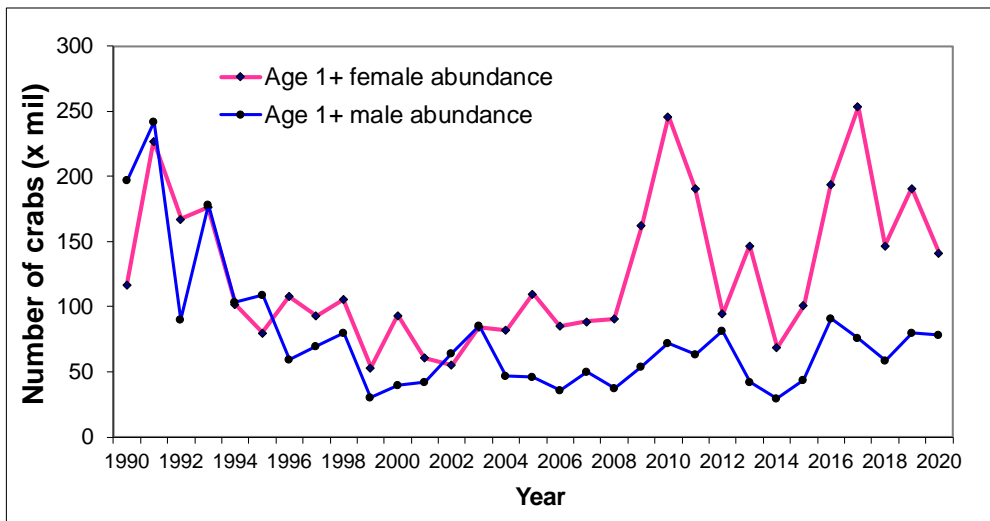


Figure 1A, 1B, & 1C. Abundance estimates (number of crabs in millions) from the 29-year Bay-Wide Winter Dredge Survey for (A) total crab abundance (males and females of all ages); (B) juvenile crab abundance (male and female new recruits); and (C) spawning-age (age 1+) female and male crab abundance, 1990 through 2020.

Commercial Harvest of Blue Crabs

The total Bay-wide commercial harvest in 2019 from the CBSAC report was approximately 61 million pounds, which remains below the long-term average but is above the average of 54 million since the 2008 conservation measures were put in place. Harvest increased 10% from the 2018 Bay-wide commercial harvest of approximately 55 million pounds (Table 2). The 2019 commercial harvest for both males and females from the Bay and its tributaries was estimated at 32 million pounds in Maryland, 25.8 million pounds in Virginia, and 3.1 million pounds in the Potomac River. This was a 3% increase for Maryland, 22% increase for Virginia, and 5% increase for the Potomac River from 2018 commercial harvest levels (Figure 2). Note, Virginia provides harvest numbers to CBSAC before all harvester reports are submitted (due to delinquent reporting). As such, Virginia's 2019 harvest, reported by CBSAC at 25.8 million pounds, is now estimated at 28.7 million pounds.

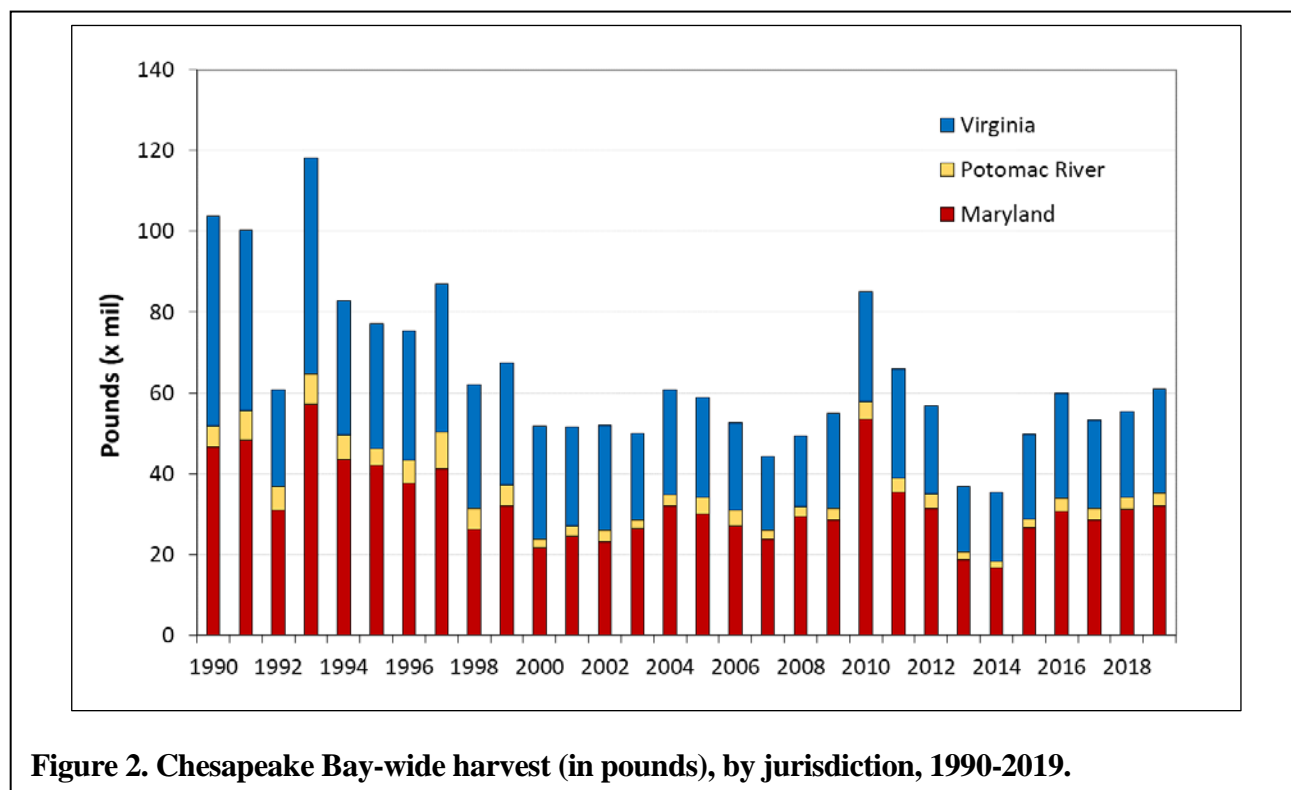


Figure 2. Chesapeake Bay-wide harvest (in pounds), by jurisdiction, 1990-2019.

Harvest statistics have been collected from Virginia fisheries since the late 1920s; however, 1994 is the first representative year of Virginia's Mandatory Commercial Harvest Reporting Program. The National Marine Fisheries Services (NMFS) collected annual Virginia landings from 1929 to 1972. Between 1973 to 1992, monthly Virginia landings were collected by gear and Virginia implemented a voluntary monthly in-shore dealer reporting system. In 1993, the Mandatory Commercial Harvest Reporting Program was implemented in which every harvester is required to report daily harvest for each month by the fifth of the following month.

Figure 3 displays the commercial crab harvest for all Virginia waters in pounds and estimated dockside value (first sale from harvester) since 1995. The dockside value of commercial blue crab harvest in 2019 was estimated at \$34.5 million. The pre-2019 values have been adjusted to 2019 dollars to account for inflation using the Consumer Price Index. Fluctuations in dockside value track closely with those in harvest,

although the overall magnitude depends on that year’s market. Value of these harvests is not considered highly accurate, as VMRC depends on voluntary buyer reporting of dockside value while harvest and effort reporting are mandatory.

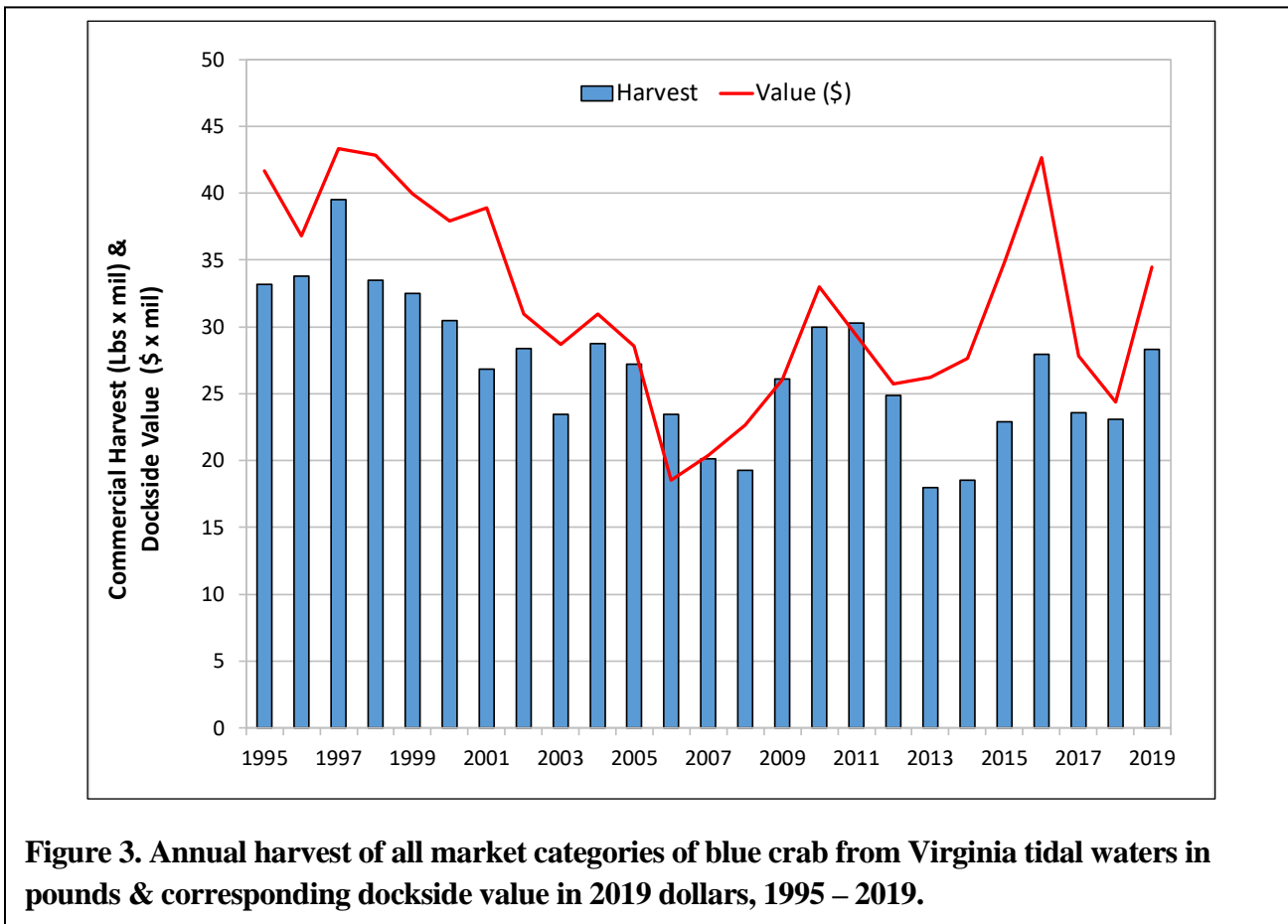


Figure 3. Annual harvest of all market categories of blue crab from Virginia tidal waters in pounds & corresponding dockside value in 2019 dollars, 1995 – 2019.

Table 3 provides a summary of harvest data by crab type. Hard crabs (minimum size for hard male and immature female crabs is five inches, no minimum size for hard female crabs) dominate Virginia’s harvest, making up 98% of harvest in 2019. Peeler and soft crabs (minimum size for soft crabs is 3 ½ inches; minimum size for peelers is 3 ¼ inches through July 15 and 3 ½ inches after July 15) contribute significantly less to the overall harvest in pounds—about 2-4% of a given year’s harvest. However, because peeler and soft crabs are smaller than hard crabs, they may comprise up to 8% of the harvest in numbers. Harvest of peeler crabs peaked in 1998 at more than 2.5 million pounds, but has remained below one million pounds since 2006. In 2008, all Chesapeake Bay jurisdictions imposed a 34% reduction in the harvest of blue crab using varied conservation measures and nearly all of those measures remain today. For example, there is now a larger minimum size limit in place for peelers, and the number of peeler pots per license was reduced. In recent years, peeler harvest has ranged from less than 600,000 pounds to more than 900,000 pounds.

Table 4 provides harvest data by gear type, which indicates that crab pots account for most of the harvest. From 2008 through 2019, the crab pot accounted for 95% of the total harvest from Virginia waters, and the peeler pot fishery contributed 4%. The remaining 1% of annual harvest is comprised of crab trotlines, traps and pounds, scrapes, and dip nets.

Table 3. Annual harvest of blue crab from Virginia waters by market category (hard crabs and peeler or softshell crabs), in pounds (2008 – 2019).

Year	Hard Crabs	Percent of Total Harvest	Peeler & Soft Crabs	Percent of Total Harvest	Total Harvest
2008	18,278,467	95%	995,014	5%	19,273,481
2009	25,112,135	96%	961,474	4%	26,073,609
2010	29,000,485	97%	969,942	3%	29,970,427
2011	29,534,671	97%	759,031	3%	30,293,702
2012	23,992,153	96%	879,751	4%	24,871,904
2013	17,352,456	97%	599,696	3%	17,952,152
2014	17,566,425	95%	985,254	5%	18,551,680
2015	22,101,632	97%	800,745	3%	22,902,377
2016	27,184,207	97%	735,197	3%	27,919,404
2017	22,899,140	97%	651,244	3%	23,550,384
2018	22,483,738	97%	641,742	3%	23,125,480
2019	28,081,127	98%	635,198	2%	28,716,325

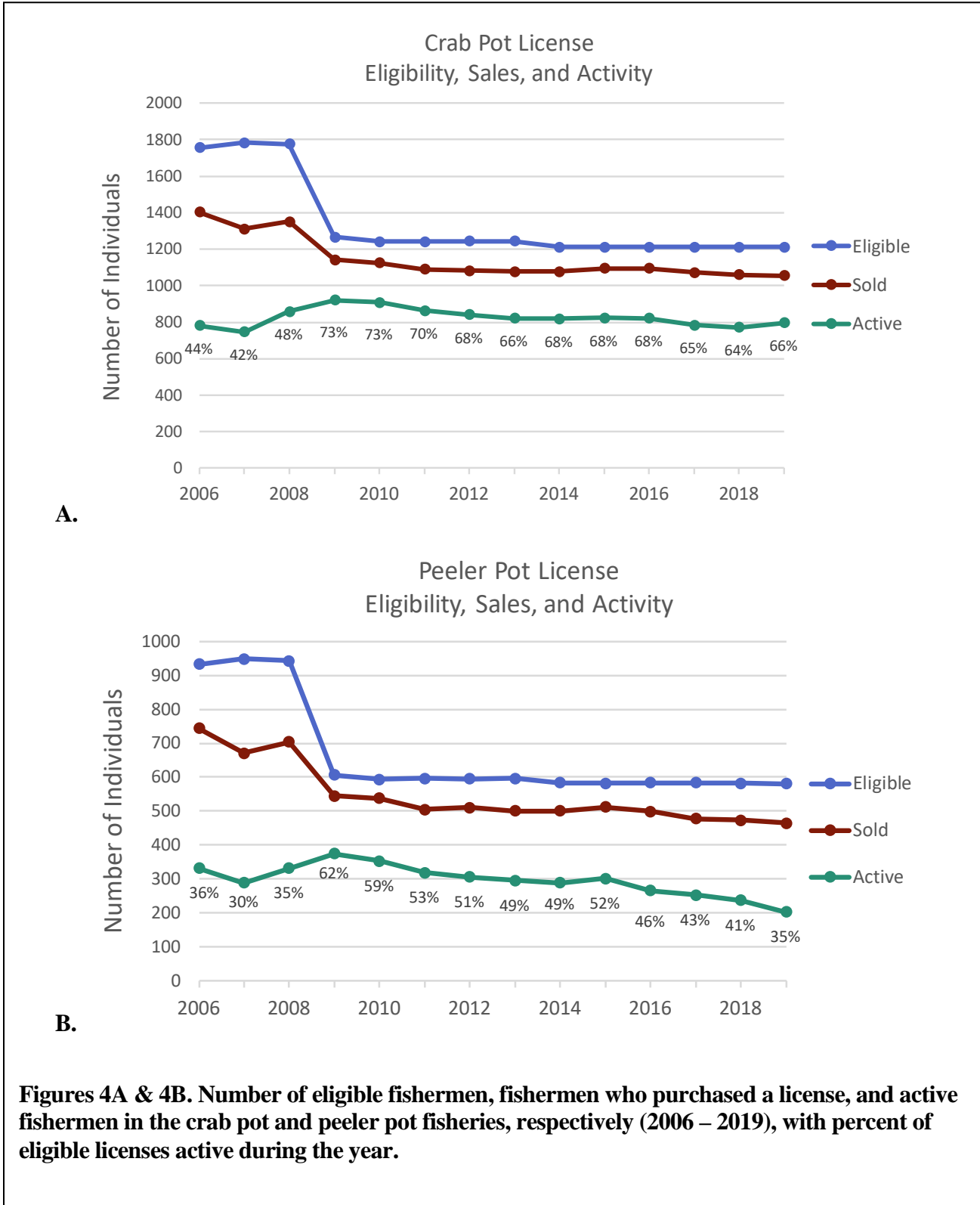
Table 4. Annual Virginia harvest of blue crabs by gear type, in pounds (2008 – 2019).

Year	Gear						Total
	Hard Pot		Peeler Pot		Other Gears*		
2008	17,512,157	91%	963,324	5%	798,000	4%	19,273,481
2009	24,914,941	96%	981,319	4%	177,349	1%	26,073,609
2010	28,733,411	96%	1,057,239	4%	179,777	1%	29,970,427
2011	29,224,573	96%	900,169	3%	168,960	1%	30,293,702
2012	23,750,604	95%	917,917	4%	203,384	1%	24,871,904
2013	16,981,833	95%	646,156	4%	324,162	2%	17,952,152
2014	17,400,699	94%	1,040,753	6%	110,228	1%	18,551,680
2015	21,787,650	95%	1,006,207	4%	108,521	0.5%	22,902,377
2016	26,825,259	96%	982,348	4%	111,796	0.4%	27,919,404
2017	22,615,209	96%	858,690	4%	76,485	0.3%	23,550,384
2018	22,162,594	96%	868,644	4%	94,243	0.4%	23,125,480
2019	27,621,697	96%	924,970	3%	159,744	1%	28,706,411

* includes harvest by trot line, dip net, crab trap/pound, crab scrape, and (2008 only) crab dredge

Figures 4A and 4B provide a 14-year summary of participation in the crab pot and peeler pot fisheries. Each chart indicates the numbers of harvesters who were eligible to purchase a license for the fishery, purchased a license, or were active in a given year by harvesting at least one pound of blue crab. Since 2010, fishermen can maintain their eligibility without purchasing a license. Similarly, those fishermen who purchase a license may choose whether to be an active harvester. These charts show that in recent years the number of active crab pot fishermen has remained relatively stable between 65% and 70% of eligible fishermen. The number of eligible peeler pot fishermen who are active declined over

the same period, from 62% to 35%. These charts indicate that potential latent effort might exist in either fishery. However, there is no indication that eligible but inactive crab fishermen join either fishery when the blue crab abundance is particularly high in any given year. Since the license moratorium went into effect in 1999, many eligible crabbers are holding onto licenses for family members or for sale.



Blue Crab Conservation Actions in 2020 and Previous Years

Commission actions since 1994 that have attempted to promote sustainability of the blue crab stock and fishery through conservation measures are included in Attachment 4. Many of these measures were designed to promote spawning potential of blue crabs and have helped in the recovery of the Chesapeake Bay stock. Many measures taken by the Commission were employed before scientists developed status of the stock indicators, and these health-of-the stock indicators improved after each analytical stock assessment in 1997, 2005, and 2011. These improvements in science allowed the Commission to better target problem areas in the stock and its fisheries.

Total abundance increased following the blue crab fishery disaster in 2008, with the 2016-17 Bay-wide Winter Dredge Survey indicating the highest adult abundance in the survey's history. This is attributed partly to the conservation measures implemented since 2008. The 2019-20 survey results showed a decline in juvenile production from the strong year-class in 2019, which was surprising with the low overwintering mortality, but the adult population remained robust. Juvenile production is known to be the most unpredictable variable life stage.

Previously enacted management measures were maintained this year at the recommendation of CBSAC. Jurisdictional managers and scientists are in agreement that the stock appears stable, but precaution is still necessary. In 2020, the Commission maintained its conservative management approach from the previous year. The only regulatory change was an extension of the hard crab pot season through December 19, 2020. This change was requested by the Crab Management Advisory Committee in order to offset economic effects of the COVID-19 pandemic. Previous December harvests were low and staff estimates the extra 19 days in the season could add 100-200,000 pounds to the annual total. The season for peeler pots and other commercial crab gears still ended on October 31 to protect the juvenile population. The same crab pot bushel limits and other regulations extend from July 5, 2020 through July 4, 2021 for all crab pot license categories.

The Commission continued the closure of the winter crab dredge fishery season for the twelfth consecutive season to allow for continued rebuilding of the spawning stock biomass. The main basis for this continued action is conservation of the juvenile abundance, which would mature this year and be exploited by a 2020-21 winter dredge season, and of the adult female abundance, which would spawn the next juvenile year-class in 2021.

Ecosystem Constraints on the Blue Crab Resource

§ 28.2.203.1 of the Code of Virginia provides that the blue crab fishery management plan shall be designed to reverse any fishing practices, environmental stressors, and habitat deterioration negatively impacting the short and long term viability and sustainability of the crab stock in Virginia waters. In recent years, the Commission has adopted effective conservation measures to reverse fishing practices that have negatively impacted the stock. The Commission relies on the efforts of its sister agencies to promote and sponsor improvements of Chesapeake Bay's water quality in order to meet the requirements of §28.2.203.1 of the Code of Virginia dealing with environmental stress and habitat deterioration.

Algal blooms can result in hypoxic and anoxic conditions (low dissolved oxygen (DO) levels) in Chesapeake Bay that cause blue crabs to be displaced or result in mortality. These mortality events are uncommon and generally limited to situations where crabs cannot move away, such as when they are in crab pots in low DO zones. Although such mortality events are unlikely to affect the population significantly,

the Commission is working to minimize these events. The Commission is a member of the Virginia Department of Health's Harmful Algal Bloom Task Force (HAB TF). In 2018 HAB TF members combined efforts to implement an online reporting system for Virginia residents, conduct fly-overs to visually determine the extent of bloom conditions, collect and analyze samples from areas with active HABs, and update the public about HABs. VMRC staff collaborated with the HAB TF to provide links to VDH Harmful Algal Bloom notices on the VMRC website. The impact of HABs on blue crab meat safety or health is unknown.

The Commission and Virginia's crab 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 anthropogenic stressors continue to challenge the stability of the blue crab stock, including hypoxia, shoreline development, and pollution. The issue of climate change and associated sea level rise will continue to be important as well, as blue crab behavior is linked to water temperature and availability of sufficient habitat.

Water quality in Chesapeake Bay is improving due to the ongoing efforts of the Commonwealth and the signatories of the Chesapeake Bay Agreement. Additional work is being implemented to meet pollution reduction goals in Chesapeake Bay. Each of the bay jurisdictions has developed a Watershed Implementation Plan to guide restoration plans through 2025. The federal government developed Executive Order 13508, which guides the federal agencies' plan to meet pollution reduction goals and established 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 10 goals and 29 measureable, time-bound outcomes to improve the health of Chesapeake Bay, including sustaining blue crabs. The 2018 update to the 2016-2017 Milestone progress report, published by the Federal Government in July 2018, demonstrated advancement toward milestones and included planned Bay restoration and protection during fiscal year 2019. The assessment found that there has been considerable progress made, including record acreage of underwater grasses and the highest estimate of water quality standards attained in more than 30 years. A new 2-year workplan for the Blue Crab Abundance Outcome was finalized in 2020, prioritizing research needs identified by CBSAC and the jurisdictions.

Seagrass beds provide nursery habitat for newly settled, young juvenile, and mating blue crabs. The dominant submerged aquatic vegetation (SAV) in Virginia waters is eelgrass (a seagrass). The importance of eelgrass habitat functions in Chesapeake Bay was first demonstrated by VIMS in a 1961 report to the National Science Foundation. Subsequent studies by VIMS have led to a greater understanding of SAV Bay-wide distribution, abundance, and health. VIMS established the first broad-scale aerial monitoring of SAV in 1974, and expanded the survey in 1978 to cover all of Virginia's tidal waters. VIMS maintains a research and monitoring program that has significantly expanded our understanding of SAV, its role in the greater Bay ecosystem, and its linkages with the health of the blue crab stock. In 2019, VIMS found that percent cover of SAV had declined, mostly through losses to *Ruppia widgeon* grass. Ongoing research and monitoring programs of SAV and other critical habitats in Chesapeake Bay include:

- Annual Bay wide aerial survey;
- Targeted water quality monitoring and study of key SAV locations in Virginia waters for effects from water quality changes, global warming, and climate change;
- Water quality assessments for evaluation of water quality standards attainment (SAV distribution is a criterion for water clarity);

- 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;
- Importance of salt marshes as nursery habitats for the blue crab;
- The distribution of age-0 blue crabs in shallow water habitats including seagrass, algal patches, salt marshes, restoration oyster reefs, and shallow-water soft bottom (e.g., muddy coves) ; and
- The functional relationships between habitat characteristics and juvenile blue crabs.

Eelgrass is near its southern limits along the Atlantic coast in Virginia, so high summertime water temperatures can be especially harmful to eelgrass beds. If water temperatures continue to increase as a result of climate change, losses of eelgrass beds in Virginia may accelerate. VIMS research has demonstrated that increased water clarity can help eelgrass beds persist under higher temperatures. Therefore, VIMS is working with Virginia regulatory agencies, MD DNR, and the Environmental Protection Agency to assess the current water clarity goals for Chesapeake Bay to determine if changes are appropriate and needed.

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*), widgeon grass (*Ruppia maritima*), and exotic red macroalgae (as well as salt marshes) having the greatest overlap with the distribution of juvenile blue crabs in Chesapeake Bay. Since historically low abundances in 1984, SAV restoration has varied between tidal waters with different salinities. Seagrass beds have continually increased in lower salinity tidal waters, increased initially in areas of medium-salinity followed by variable annual abundance levels, and increased initially in the high-salinity region followed by a general decline in abundance (Orth et al. 2010). These general trends remain accurate in the years since this study. The results of a VIMS study showed that juvenile blue crabs prefer denser SAV beds over thinner beds (Ralph et al. 2013), further demonstrating the positive influence that the quality of seagrass beds has on blue crab population dynamics. Recent VIMS studies have also demonstrated the high value to juvenile blue crabs of salt marshes and shallow 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 and salt marshes where native SAV nursery habitat has experienced reductions in aerial coverage (Seitz et al. 2003, Seitz et al. 2005, Johnston and Lipcius 2012). The recent studies are indicating that the blue crab will be resilient to loss of eelgrass due to its ability to use alternative nursery habitats opportunistically, such as widgeon grass, salt marshes, and exotic red macroalgae.

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 pathogenicity. These are *Hematodinium perezii* and a recently identified reo-like virus. *Hematodinium perezii* 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 Squyers 2000). VIMS scientists discovered and described the life cycle of *Hematodinium perezii* in the blue crab

(Li et al. 2011), and this will lead to a greater understanding of the risk of mortality and the environmental and biological factors that may influence the effects of this pathogen. The reo-like virus was initially described from juvenile crabs held in the laboratory (Johnson and Bodammer 1975). It has been implicated as a source of mortality in the production of soft-shell crabs based on infection trials and sampling of crabs from shedding facilities (Bowers et al. 2010). At present, these pathogens do not pose a significant risk to the Chesapeake Bay stock, but VIMS is now evaluating the potential role of climate change, specifically increasing water temperatures and salinities in the lower bay, on pathogen prevalence in the future.

VIMS Blue Crab Surveys

VIMS conducts multiple blue crab surveys: the Juvenile Fish and Blue Crab Trawl Survey, the Winter Dredge Survey (WDS), and two surveys associated with the WDS, the Main-stem Prey and Bycatch Survey (MPBS) and the Juvenile Nursery Habitat Survey (JNS). In addition, blue crab data is also gathered by the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP), a Bay-wide main-stem trawl survey of mostly adult fishes and mature female crabs. Data from the VIMS Juvenile Fish and Blue Crab Trawl Survey are used to develop indices of abundance for annual recruitment to the stock. The JNS is complementary to the VIMS Juvenile Fish and Blue Crab Trawl Survey, in that it gathers data on juvenile blue crabs and habitat quality in shallow-water habitats where the other surveys are unable to sample. Samples and data from the WDS and MPBS are processed during the course of the winter and spring as they are collected. Samples from the JNS require lengthy laboratory processing, so they are frozen and then processed later in the year from August through October.

The Winter Dredge Survey was unaffected by the COVID-19 pandemic in 2020, as it finished before widespread survey shutdowns, and staff expects the 2021 survey to be unaffected. The JNS and Juvenile Fish and Blue Crab Trawl Survey were both shutdown through all or most of their season so therefore there will be a missing year in the survey time series for 2020.

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Attachment 1

Bay-Wide Winter Dredge Survey results (winter of 1989-90 through winter of 2019-20). All surveys begin in December and end in March the next year. Commercial harvest and percentage of female crabs removed in 2020 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)	Number of Mature Crabs in Millions (both sexes)	Number of Mature Female Crabs in Millions	Bay-wide Commercial Harvest in Millions of Pounds	Percentage of Female Crabs Harvested
1990	791	463	276	117	104	43
1991	828	356	457	227	100	40
1992	367	105	251	167	61	63
1993	852	503	347	177	118	28
1994	487	295	190	102	84	36
1995	487	300	183	80	79	36
1996	661	476	146	108	78	25
1997	680	512	165	93	89	24
1998	353	166	187	106	66	43
1999	308	223	86	53	70	42
2000	281	135	146	93	54	49
2001	254	156	101	61	54	42
2002	315	194	121	55	54	37
2003	334	172	171	84	50	36
2004	270	143	122	82	60	46
2005	400	243	156	110	60	27
2006	313	197	120	85	52	31
2007	251	112	139	89	43	38
2008	293	166	128	91	49	21
2009	396	171	220	162	54	24
2010	663	340	310	246	85	16
2011	452	204	255	191	67	24
2012	765	581	175	95	56	10
2013	300	111	180	147	37	23
2014	297	198	99	68.5	35	17
2015	411	269	143	101	50	15
2016	553	271	284	194	60	16
2017	455	125	330	254	54	21
2018	371	168	206	147	55	23
2019	594	323	271	191	61	17
2020	405	185	220	141	TBD*	TBD*

2020 Chesapeake Bay Blue Crab Advisory Report

CBSAC Meeting Date: May 19, 2020

Report Final: June 2020

EXECUTIVE SUMMARY

The Chesapeake Bay Stock Assessment Committee (CBSAC) meets annually to review the results of the Chesapeake Bay blue crab surveys and harvest data, and to develop management advice. CBSAC adopted the Bay-wide 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. Based on survey estimates, the total abundance of all crabs (males and females of all ages) was estimated at 405 million crabs in 2020. Recruitment, or the number of age 0 crabs (less than 60 mm or 2.4 inches carapace width), was estimated as 185 million crabs in 2020. Approximately 141 million age 1+ female crabs were estimated to be present in the Bay at the start of the 2020 crabbing season, which is above the abundance threshold of 70 million crabs, but below the target of 215 million crabs. The 2011 benchmark stock assessment recommended a control rule based on biological reference points for the female component of the population. The percentage of female crabs (ages 0+) removed by fishing (exploitation fraction) in 2019 was 17%. This exploitation fraction is below the target of 25.5% and the threshold of 34% for the 12th consecutive year since 2008. Therefore, overfishing is not occurring and the population is not depleted.

Based on analysis of the 2020 winter dredge survey results, CBSAC recommends that substantial changes in management are not necessary. CBSAC further recommends that the jurisdictions implement procedures that provide accurate accountability of all commercial and recreational harvest moving forward, as this is an important component for accurately assessing stock health.

1. INTRODUCTION

1.1 Background: Management and Science

Management of the blue crab stock is coordinated among the jurisdictions by the Chesapeake Bay Stock Assessment Committee, a workgroup of 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 MD DNR, VMRC, PRFC, the Atlantic States Marine Fisheries Commission, and the DC Department of Energy and Environment.

The Chesapeake Bay Stock Assessment Committee (CBSAC) combines the expertise of state representatives and scientists from the Chesapeake Bay region, as well as 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, the 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 benchmark [assessment](#) was completed in 2011¹ 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.

CBSAC adopted the Bay-wide 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 Bay². 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 expanded based on the area of Chesapeake Bay, providing an annual estimate of the number of overwintering crabs by age and sex². An estimate of the mortality during winter is also obtained from the survey results.

1.2 Stock Status and Current Management Framework

Under the current framework, annual estimates of exploitation fraction are calculated as the annual harvest of female crabs in a given year (not including discards, bycatch, or unreported losses) divided by the total number of female crabs (age 0+) estimated in the population at the start of the season. As part of this calculation, the juvenile component of the total estimated number of crabs is scaled up by a factor of 2.5 so that the empirical estimate of exploitation uses the same assumption about juvenile susceptibility to the survey as the stock assessment that generated the reference points. Thus, the empirical estimates of exploitation rate can be compared with the target and threshold reference points derived from the assessment model.

Crab abundance is estimated from the WDS each year. The current framework recommends monitoring the abundance of spawning-age female crabs (age 1+) 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.

2. POPULATION SIZE (ABUNDANCE)

2.1 All Crabs (both sexes, all ages)

Based on survey estimates, the total abundance of all crabs (males and females of all ages) was 405 million (Figure 1). This was a decrease from last year's estimate of 594 million crabs, below the long-term average (geometric mean¹), but near the median of observed values (400 million) over the last 30 years.

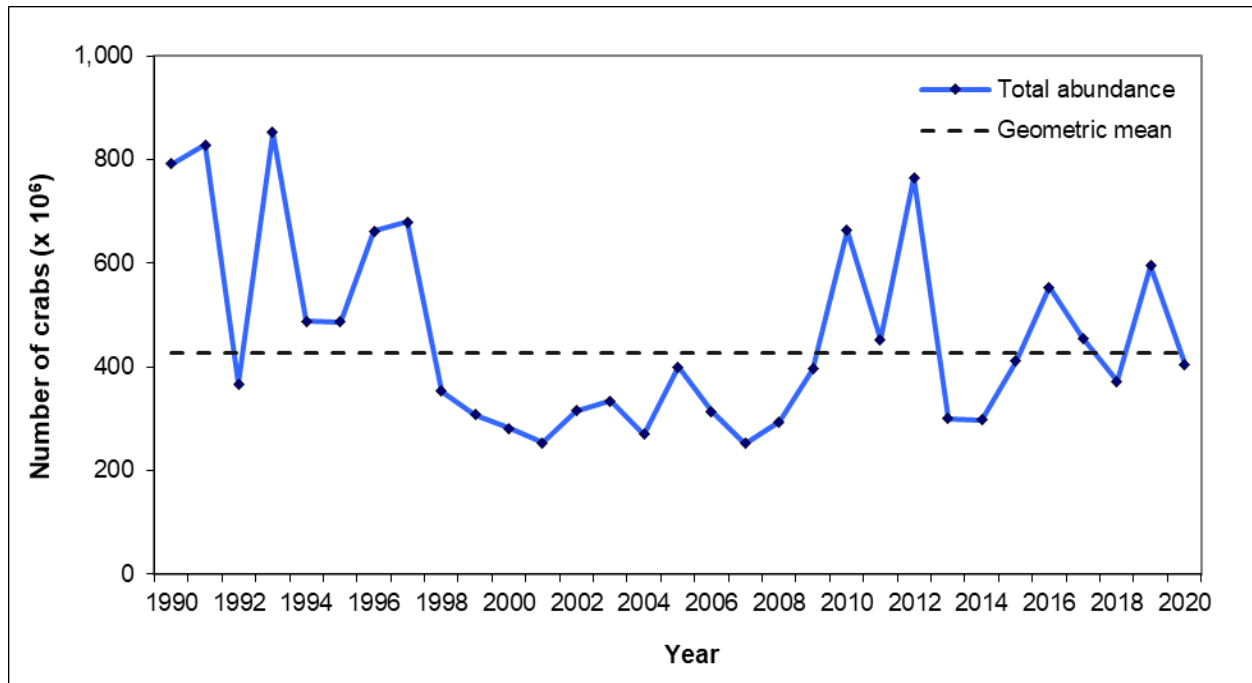


Figure 1. Winter dredge survey estimate of abundance of all crabs (both sexes, all ages) in Chesapeake Bay, 1990-2020.

2.2 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. Based on survey estimates, the abundance of age 0 crabs in 2020 was 185 million, a decrease from the 2019 abundance of 324 million crabs (Figure 2). This year's estimate was below the time series average of 224 million crabs (geometric mean).

¹ A geometric mean ($GM_{\bar{x}} = \sqrt[n]{\sum x_1, x_2, \dots, x_n}$) was used because it is not as sensitive to fluctuation from a single large value.

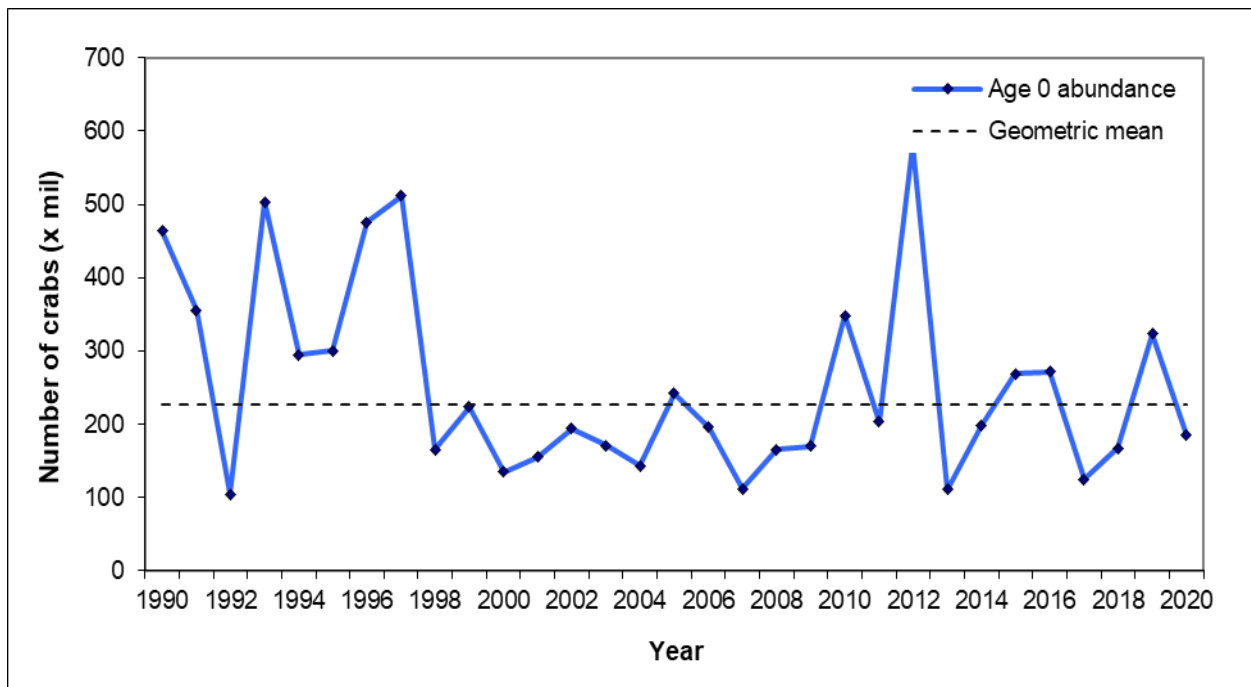


Figure 2. Winter dredge survey estimate of abundance of juvenile blue crabs (age 0), 1990-2020, calculated without the catchability adjustment for juveniles (section 1.2). These are male and female crabs measuring less than 60 mm across the carapace.

2.3 Age 1+ Male

The survey estimate of age 1+ male crabs (greater than 60 mm or 2.4 inches carapace width) in 2020 was 79 million crabs, almost unchanged from the 2019 estimate of 80 million adult male crabs (Figure 3). Age 1+ male abundance was above the time series geometric mean of 66 million, but does not exhibit the same amount of variation that has been observed in female abundance.

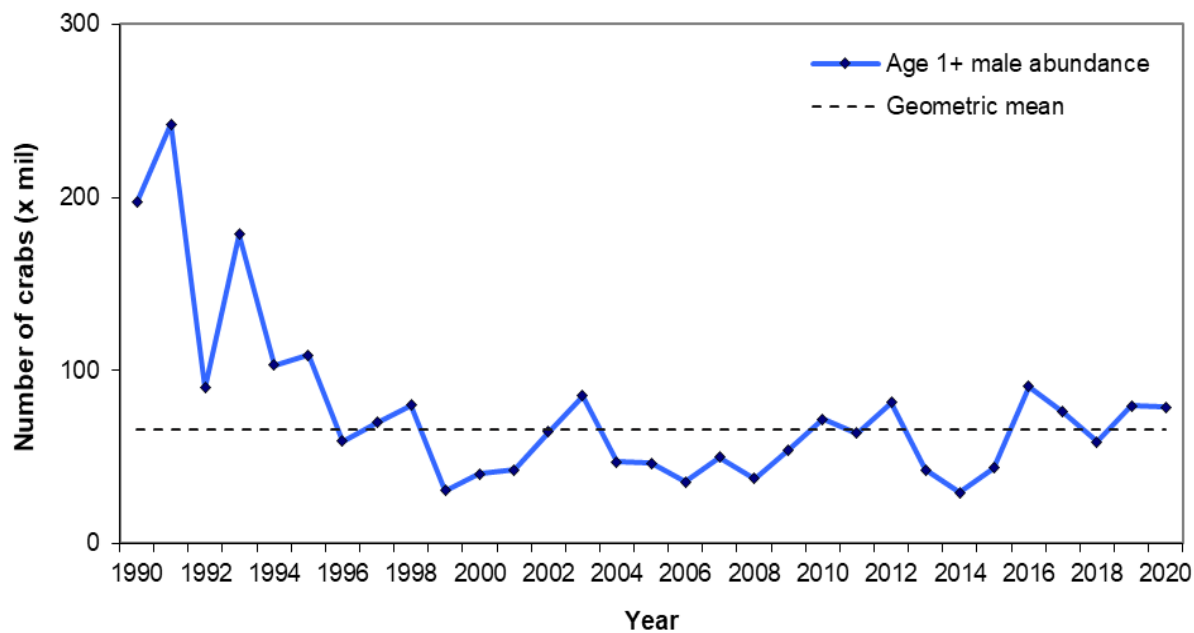


Figure 3. Winter dredge survey estimate of abundance of adult male blue crabs (age 1+), 1990-2020. These are male crabs measuring greater than 60 mm across the carapace and are considered the “exploitable stock” capable of mating within the year.

2.4 Overwintering Mortality

Overwintering mortality estimates in 2020 were the lowest observed in the time series (Table 1).

Table 1. Percent dead crabs found in late winter dredge samples each year from 2015-2020 and the average for 1996-2020.

Bay-wide Age/sex group	1996-2020 average	2015	2016	2017	2018	2019	2020
All crabs	4.53%	15.68%	1.95%	1.15%	6.37%	1.80%	0.36%
Juveniles	1.18%	10.84%	0.50%	0.00%	0.87%	0.15%	0.00%
Adult Females	8.07%	19.25%	2.99%	1.37%	11.06%	1.87%	0.47%
Adult males	9.29%	28.11%	1.06%	2.29%	13.66%	7.83%	0.78%

3. HARVEST

3.1 Commercial and Recreational Harvest

Chesapeake Bay commercial blue crab harvest rose slightly in 2019. The three management jurisdictions loosened harvest measures from those in place during 2018. The 2019 commercial harvest for both males and females from the Bay and its tributaries was reported as 32 million pounds in Maryland, 25.8 million pounds in Virginia, and 3.1 million pounds in the Potomac River. Relative to 2018, annual female harvest increased in all three jurisdictions, while male harvest was stable. The 2019 Bay-wide commercial harvest of approximately 61 million pounds was below the 1990-2018 average (Figures 4-5).

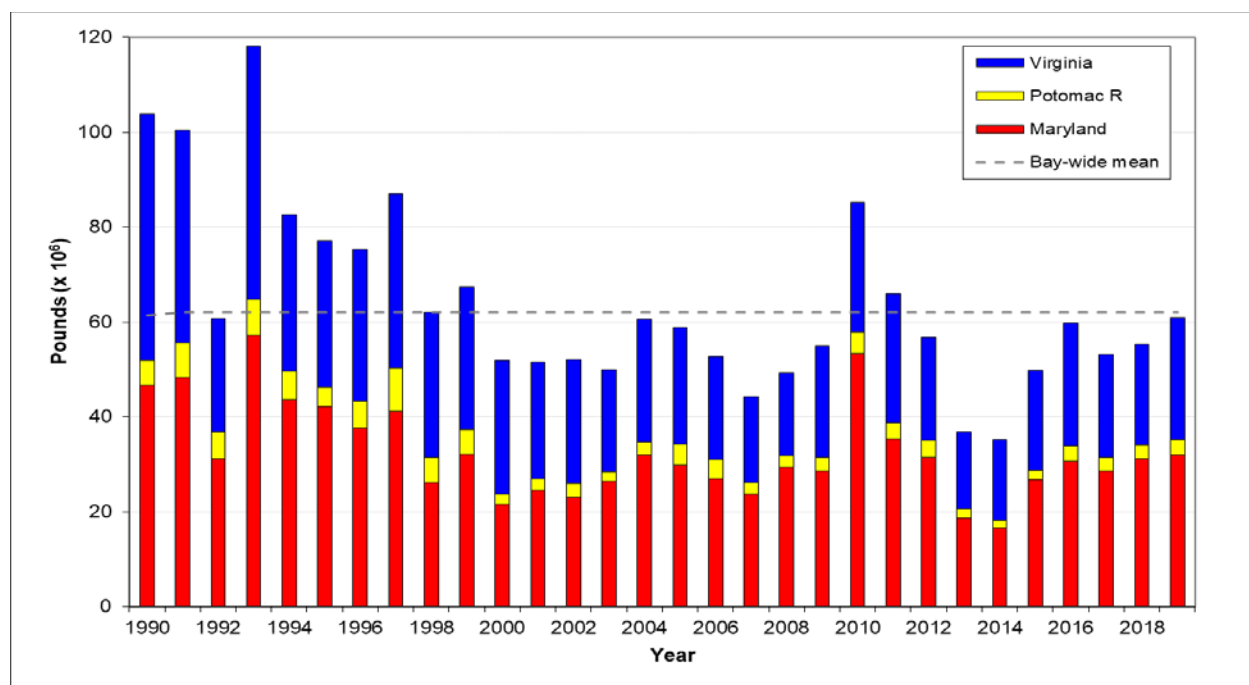


Figure 4. Total commercial blue crab landings (all market categories) in Chesapeake Bay, 1990-2019.

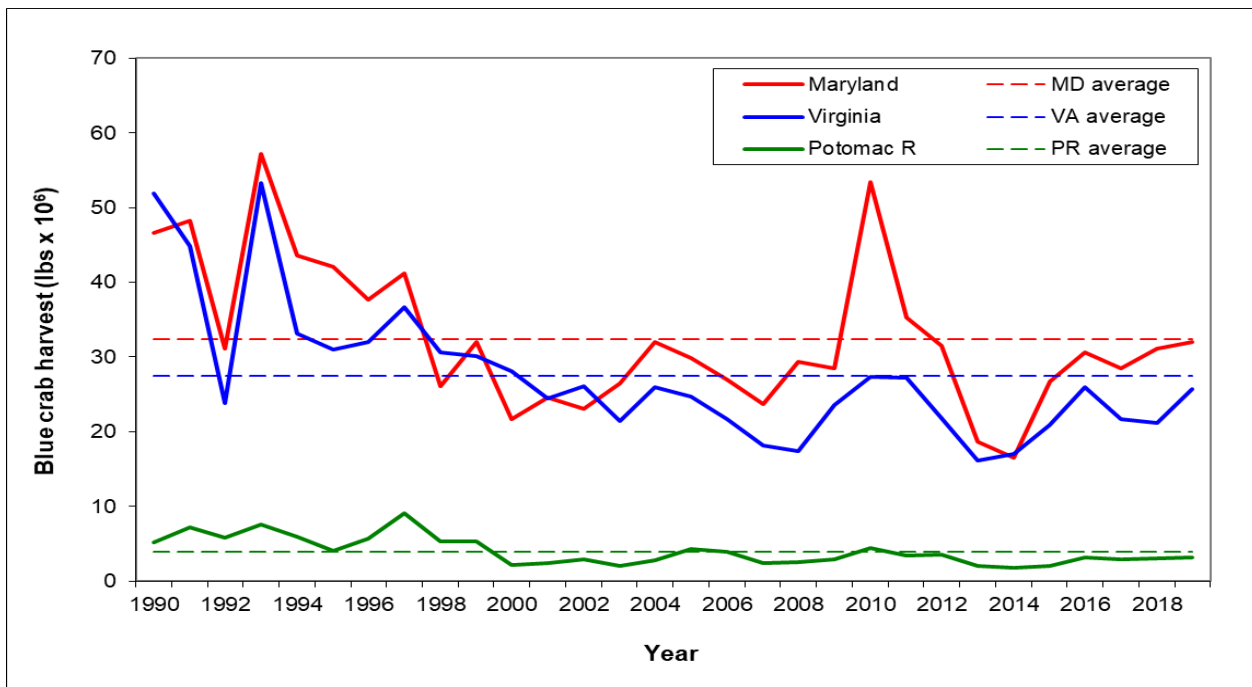


Figure 5. Maryland, Virginia, and Potomac River commercial blue crab harvest in millions of pounds from Chesapeake Bay (all market categories), 1990-2019.

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 commercial male harvest in those jurisdictions. Bay-wide recreational harvest in 2019 was estimated as 3.8 million pounds, similar to the 2018 recreational harvest estimate of 3.4 million pounds. Combining the commercial and recreational harvest, approximately 64.7 million pounds of blue crabs were harvested from Chesapeake Bay and its tributaries during the 2019 crabbing season.

4. STOCK STATUS

4.1 Female Reference Points

The 2011 benchmark stock assessment recommended a control rule based on biological reference points for the female component of the population. The current female-specific targets and thresholds were developed using an MSY approach. 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 $N_{0.75*U_{MSY}}$ (target) and 50% N_{MSY} (threshold).

4.2 Exploitation Fraction

The percentage of all female crabs (ages 0+) removed by fishing (exploitation fraction) in 2019 was approximately 17%. This exploitation fraction is below the target of 25.5% and the threshold of 34% for the 12th consecutive year since 2008, when female-specific management measures were implemented (Figure 6).

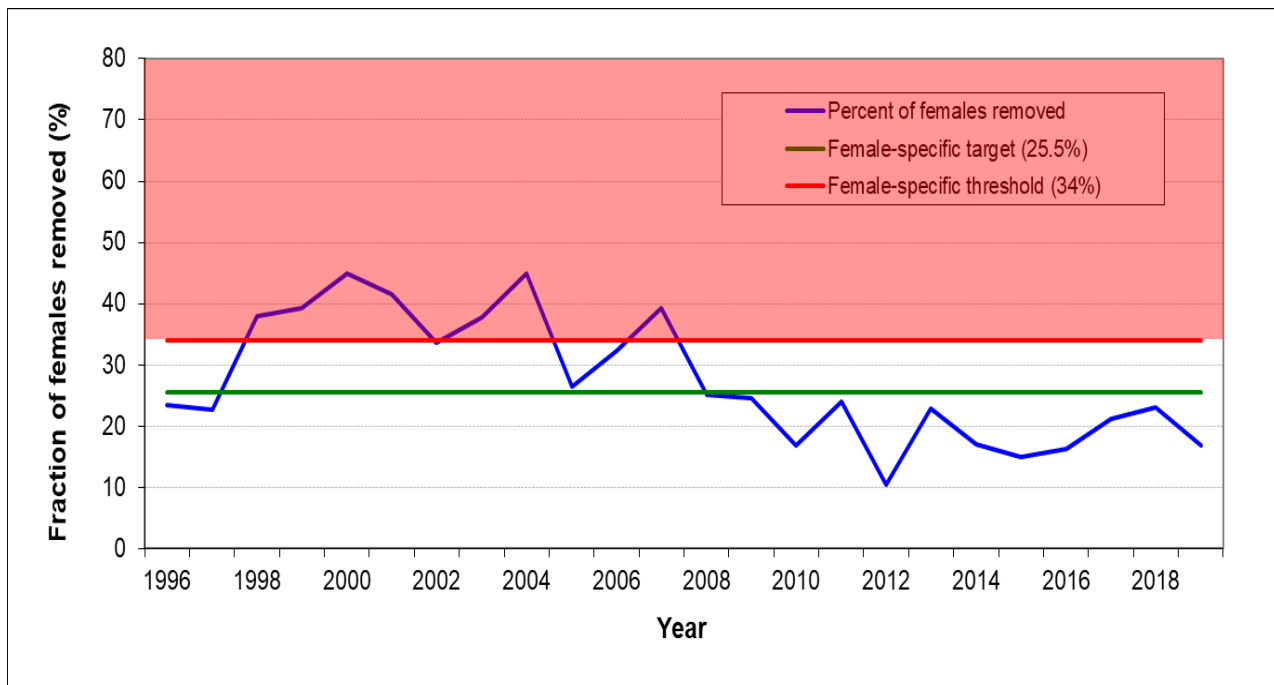


Figure 6. The percentage of all female blue crabs removed from the population each year by fishing relative to the female-specific target (25.5%) and threshold (34%) exploitation rates, 1990-2019. Exploitation rate (proportion removed) is the number of female crabs harvested within a year divided by the female population (age 0+) estimated by the WDS at the beginning of the year.

4.3 Spawning Stock Abundance

The abundance reference point for the spawning stock was set with a threshold abundance of 70 million spawning-age (age 1+) female crabs and a target abundance of 215 million. Approximately 141 million age 1+ female crabs were estimated to be present in the Bay at the start of the 2020 crabbing season. This was slightly below the average abundance since 2009 (after female-specific management measures were enacted), but much higher than the average abundance for the 14-year period preceding those measures (Figure 7). The 2020 abundance of spawning-age female crabs is above the threshold, but below the target.

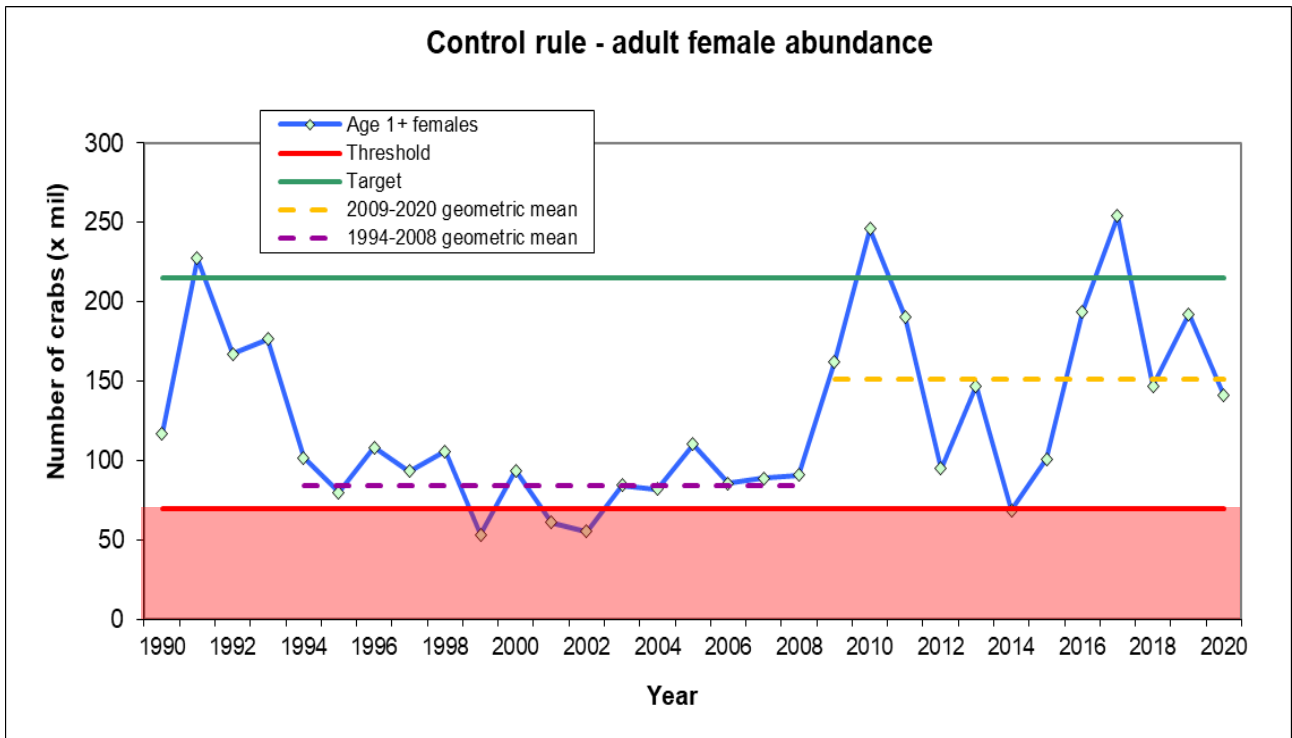


Figure 7. Winter dredge survey estimate of abundance of spawning-age female blue crabs (age 1+), 1990-2020, relative to female-specific reference points. These are female crabs measuring greater than 60 mm across the carapace and are considered the “exploitable stock” capable of spawning within the year. The dashed lines represent the geometric mean of adult female abundance during two time periods: 2009-2020, after the current management framework was enacted; and 1994-2008, the period of low abundance which prompted the management changes.

4.4 Stock Status

Figure 8 shows the status of the blue crab stock each year relative to both the female age 0+ exploitation (μ) reference points and the female age 1+ abundance (N) reference points (sections 4.2 and 4.3). The red areas show where the thresholds for the female exploitation fraction and/or female abundance are exceeded. The intersection of the green lines shows where both the abundance and exploitation fraction targets would be reached. The figure includes data through 2019; 2020 data will be added at the completion of the 2020 fishery.

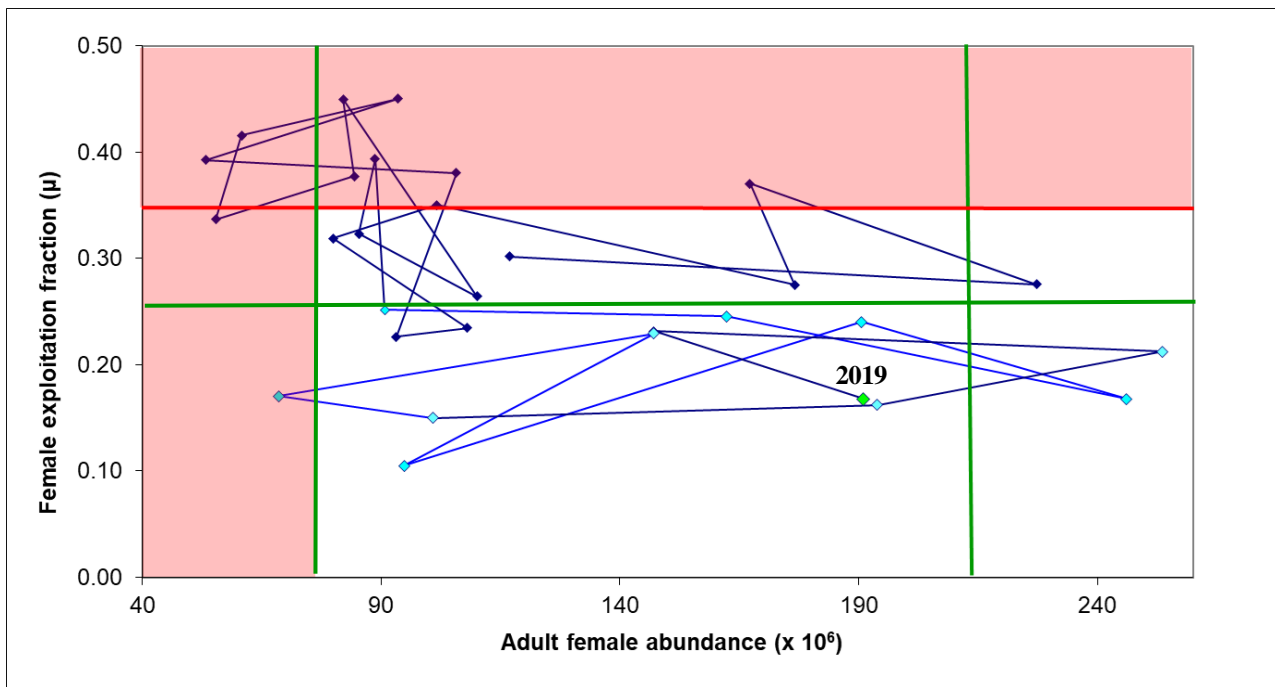


Figure 8. Status of the stock for the Chesapeake Bay blue crab fishery prior to and after implementation of initial female-specific management measures in 2008. The current female-specific management framework was formally adopted in 2011. In 2019, adult female abundance (N) was 191 million, which was below the 215 million target and above the 70 million threshold. The 2019 female exploitation fraction (U) was 17%, which was below the 25.5% target and 34% threshold.

The Chesapeake Bay blue crab stock is currently **not depleted and overfishing is not occurring** (Table 2). The 2020 estimated abundance of the spawning stock is above the threshold of 70 million age 1+ female crabs, but below the target of 215 million adult females, as outlined in the current management framework. The 2019 exploitation fraction of 17% was below the target (25.5%) and threshold (34%). Abundance, harvest, and exploitation of all crabs are summarized in Appendix A and in the preceding sections.

Table 2. Stock status based on reference points for age 0+ (exploitation fraction) and age 1+ (abundance) female crabs. Recent stock status levels that did not exceed threshold values are shown in green, whereas exploitation values or abundance estimates exceeding thresholds are shown in red.

Control Rule	Reference Points			Stock Status						
	Period	Target	Threshold	2014	2015	2016	2017	2018	2019	2020
Exploitation Fraction (age 0+ female crabs)	Current, Female-Specific	25.5%	34% (max)	17%	15%	16%	21%	23%	17%	TBD
Abundance (millions of age 1+ female crabs)	Current, Female-Specific	215	70 (min)	68.5	101	194	254	147	191	141

4.5 Male Conservation Trigger

In 2013, CBSAC recommended a conservation trigger for male blue crabs based on the history of male exploitation. Under this trigger, conservation measures should be considered for male crabs if the male exploitation rate exceeds 34% (calculated with the juvenile scalar as described in section 1.2), which is the second-highest exploitation fraction observed for male crabs since 1990. Choosing the second-highest value in the time series ensures a buffer from the maximum observed value of exploitation. It should be noted that this value does not represent a fishing threshold or target. Rather, this trigger will ensure that the male component of the stock is not more heavily exploited than has occurred in 24 of the last 26 years. The 2019 male exploitation fraction was estimated at 18%, below the male exploitation rate conservation trigger (Figure 9). No further management action is needed at this time.

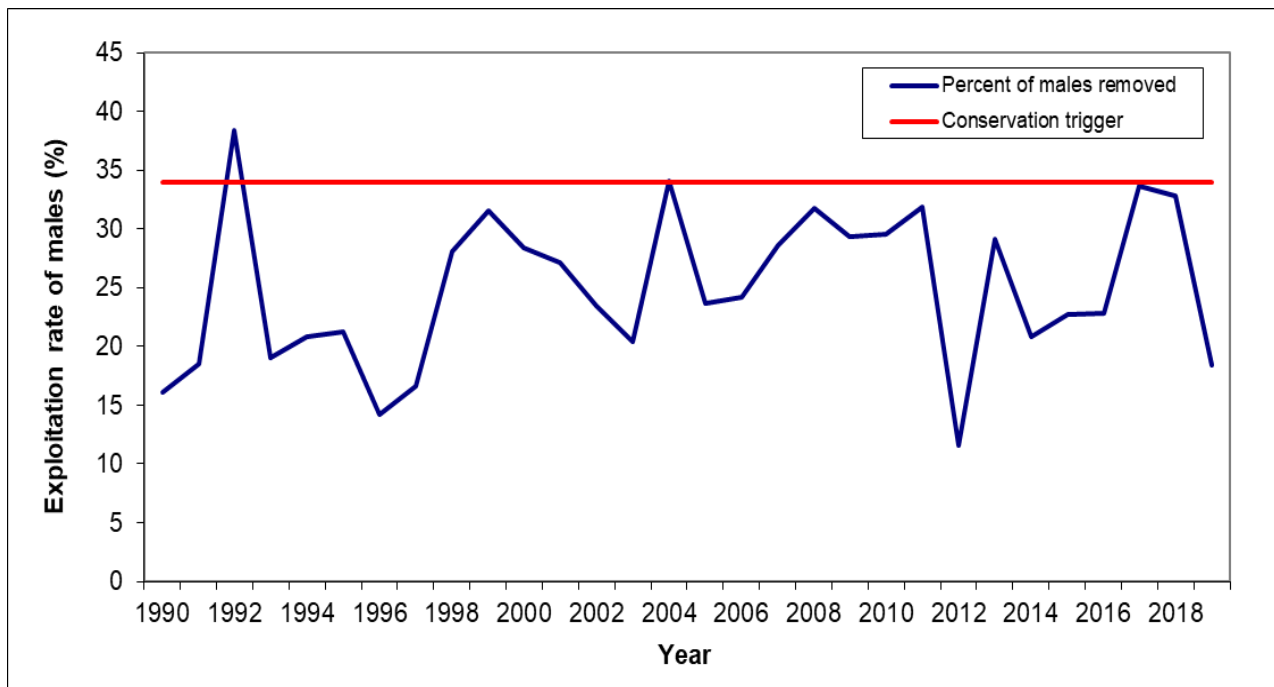


Figure 9. The percentage of male crabs removed from the population each year by fishing, 1990-2019. Exploitation rate (proportion removed) is the number of male crabs harvested within a year divided by the male population estimate (age 0+) at the beginning of the year, calculated with the juvenile scalar.

4.6 Potential Management Impact

Female exploitation fractions from 1990-2007 were much higher than the exploitation fractions from 2008-2019. These lower female exploitation fractions in recent years illustrate the influence of the female-specific management measures implemented by the jurisdictions starting in 2008. Male exploitation fractions have not shown the same pattern (Figure 10). Additionally, the rapid increase in female abundance from 2008-2010, and again from 2014-2016, indicate that the current management framework has allowed the stock to regain some of its natural resilience to environmental changes.

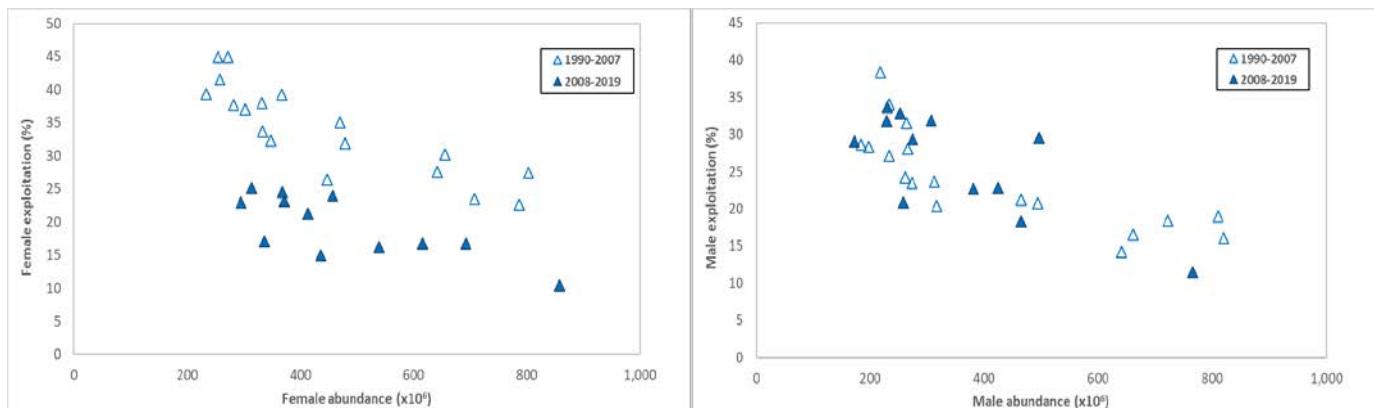


Figure 10. Female (left) and male (right) exploitation rate comparison of the time periods prior to and after the 2008 implementation of female-specific management measures.

5. MODEL UPDATE

After an update to the 2011 benchmark assessment was completed in 2017^x, CBSAC decided that annual model updates should be conducted to determine the status of the stock, monitor model performance, and help guide the decision process for timing of the next benchmark stock assessment.

Input data for the model included each jurisdiction's commercial landing reports, the Bay-wide winter dredge survey, VIMS trawl indices, and MD DNR trawl indices. The model update used the same methodology set forth by the 2011 benchmark stock assessment. The population and fishery parameters incorporated into the model – natural mortality, recruitment sex ratio, fraction of juveniles recruited to the fishery, recreational harvest fraction – were also the same. No changes were made to the sex-specific catch, multiple survey analysis (SSCMSA) model.

Among the model outputs were estimates of female abundance, female exploitation, and harvest and biological reference points. Temporal patterns for all estimates were similar for all three runs of the SSCMA model – the 2011 benchmark assessment, the 2017 update, and the current update.

Both the female abundance and exploitation reference points were slightly lower for the most recent model run than in 2017 (Table 3). Relative to the 2011 benchmark assessment, both the 2017 and 2019 updates produced lower target abundance and higher target and threshold exploitation.

Table 3. Biological reference points from the three runs of the SSCMSA model – the 2011 benchmark assessment, the 2017 update, and the current update. The abundance reference points are for adult female crabs (millions of crabs); the exploitation reference points represent the fraction of female crabs (age 0+) removed from the population by the fishery.

	Abundance		Exploitation fraction	
	Target	Threshold	Target	Threshold
2011 Assessment	215 mil	70 mil	25.5 %	34%
2017 Update	196 mil	72.5 mil	28%	37%
2019 Update	191 mil	70 mil	27%	36%

The updated model-generated estimates of female abundance exhibited the same pattern as previous runs, and has underestimated abundance since 2015 (Figure 11).

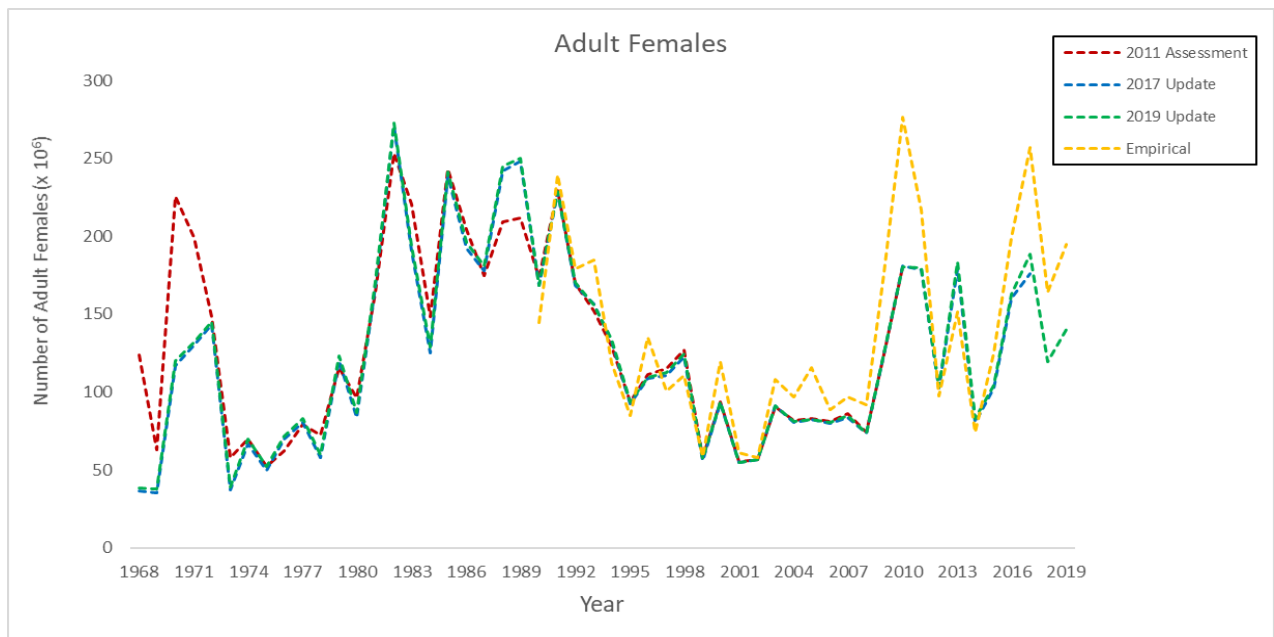


Figure 11. Time series of abundance estimates for adult females (age 1+), as predicted by the base runs of the SSCMSA in 2011, 2017, and 2019.

Model estimates of female exploitation continued to be in agreement and have been nearly identical since 1995. Between 1999 and 2009, there were, sometimes, large differences between model estimates of exploitation and empirically-estimated values (Figure 12). Since 2010, both time series have been in agreement.

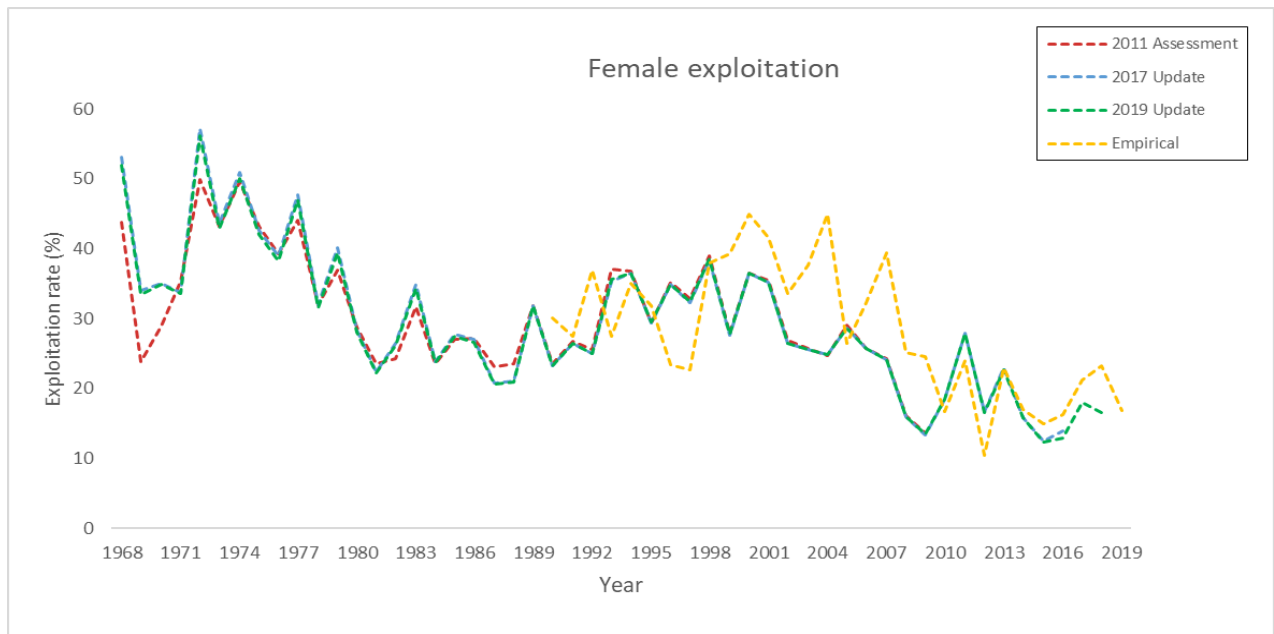


Figure 12. Time series of female exploitation rate estimates, as predicted by the base runs of the SSCMSA in 2011, 2017, and 2019.

Despite the general agreement in the model estimates across all three runs, there is still tension in the model's ability to fit estimates of sex-specific harvest to reported harvest, as the model continues to underestimate female harvest and overestimate male harvest. Therefore, model improvement should continue to be a CBSAC priority.

Given the updated biological reference points, the fishery has been operating under the exploitation target since 2005 and has not exceeded the threshold since 2001. Adult female abundance has not reached the target since 1991 and has not been below the threshold since 2002. Model-estimated adult female abundance in 2018 was 119.5 million, while exploitation was estimated to be 16.6%. Female harvest in 2018 was estimated to be 76 million individuals. The results show that the population was not depleted or being overfished.

6. MANAGEMENT ADVICE

6.1 Monitor Fishery Performance and Stock Status Relative to Reference Points

The female exploitation fraction in 2019 was below the target of 25.5% for the 12th consecutive year. The abundance of adult female crabs decreased in 2020, but remained above the threshold. The abundance of juveniles decreased and was below the long-term average. Based on analysis of the 2020 winter dredge survey results, CBSAC concludes that substantial changes in management are not necessary. Past harvest regulations are summarized in Appendix B.

Large variations in recruitment (age 0 abundance) are a characteristic of blue crab biology and not unexpected. However, it should be the goal of management to maintain a robust spawning stock, thereby increasing the resiliency of the population to downturns in recruitment.

6.2 Catch Reports and Quantifying Effort

CBSAC recommends that the jurisdictions continue implementing procedures that provide accurate accountability of all commercial and recreational harvest. All three Chesapeake Bay management jurisdictions have programs in place to gather more accurate catch and effort information from commercial and recreational harvesters. Most blue crab regulations focus on effort control in the form of limited entry, size limits, daily time limits, pot limits, spatial closures, spatial gear restrictions, and seasonal closures. To determine the efficacy of these management measures, detailed effort data that reveal the spatial and temporal patterns of gear-specific effort should be included in any system used to improve harvest data and reporting. Maryland, Virginia, and PRFC all require daily harvest reports to be submitted on a regular basis, and are collaborating with industry groups to pursue new reporting technologies. Maryland has implemented an 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 and plans to transition all crab harvesters to the online system in 2021. PRFC is exploring the use of electronic reporting to potentially begin in the next few years.

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

7. CRITICAL DATA AND ANALYSIS NEEDS

CBSAC has identified the following prioritized list of fishery-dependent and fishery-independent data needs as well as the benefits provided to management.

In addition to specific data needs, CBSAC recognizes the importance of future stock assessments in providing in-depth analyses of the Chesapeake Bay blue crab population and scientific guidance to managers. MD DNR conducted a stock assessment update in 2017 using the 2011 stock assessment model, which CBSAC recommends be considered for adoption, providing a new framework for management. CBSAC now conducts annual runs of the stock assessment model to aid in determining stock status. Given new information and issues with fishery performance, improvements to the current model should be pursued.

CBSAC is currently pursuing funding opportunities through the Chesapeake Bay Program's Goal Implementation Team (GIT) Project Initiative, which provides funds to advance Bay Program goals and outcomes stipulated by the [2014 Chesapeake Bay Watershed Agreement](#), including the Blue Crab Abundance and Management Outcomes. The projects being put forth for FY2020 are summarized in sections 7.1 and 7.2.

7.1 Population Simulation Model for Management Strategy Evaluation

CBSAC is interested in developing a spatially-explicit blue crab population simulation model that can be used to evaluate stock assessment model and management performance under various hypotheses (e.g. differential natural mortality by sex and catchability of the winter dredge survey). This work would provide a better understanding of the current assessment model performance and a foundation for management strategy evaluation by which alternative management approaches for the blue crab population can be compared. The results of this modeling exercise could confirm the robustness of the current stock assessment and management framework or identify the need to adjust the framework through a benchmark stock assessment.

This proposed project will complement current efforts by VIMS researchers to develop a stage-structured population dynamics model, which is being calibrated with WDS and VIMS Trawl Survey data. The VIMS model is being used to examine the effects of compensatory exploitation, changes in reproductive output due to climate change, and habitat effects on the blue crab population and fishery. This year the model is also being made spatially-explicit.

7.2 Quantifying Environmental Factors Related to Recruitment Variability and Productivity

CBSAC recommends continued examination of the environmental factors that may contribute to interannual recruitment variability and changes in productivity over time. Using prior GIT funding, researchers at the Chesapeake Biological Laboratory (UMCES) developed a Bayesian statistical framework for evaluating the simultaneous impacts of multiple biotic and abiotic factors affecting blue crab recruitment and abundance in Chesapeake Bay. The results of this work were presented at the Fisheries GIT Summer 2019 Meeting in Cambridge, Maryland. This proposed project would use a similar methodology and existing data to conduct additional analyses to examine the impact of environmental factors on recruitment success (i.e. number of recruits per spawner) in the Chesapeake Bay blue crab population. This research would improve understanding of blue crab population dynamics in the Bay, particularly the stock-recruitment relationship. Emphasis should be two-fold: prediction of future recruitment success based on environmental conditions during the year, and documenting environmental changes over time that may have affected productivity.

This proposed project will also complement current work underway at VIMS. Researchers at VIMS have completed an examination of the reliability of the VIMS SAV Aerial Survey to assess habitat effects on blue crab recruitment, and found that it is not a reliable measure of SAV availability due to discrepancies in the timing of the SAV survey (and the seasonality of SAV) and blue crab recruitment. VIMS is now assessing the efficacy of other spatial mapping platforms to examine habitat effects on the blue crab population. VIMS is also continuing analyses of environmental effects on blue crab productivity using WDS and VIMS Trawl Survey data.

7.3 Efficacy of WDS as an Index of Abundance

The winter dredge survey is a key tool used by managers for determining the status of the stock and management decisions. It is also utilized by researchers in stock assessments for setting targets and thresholds. There are several aspects of survey design and interpretation that should be further explored and improved upon. At least three approaches using winter dredge data have been proposed to estimate relative abundance (Sharov et al 1993; Jensen and Miller 2005; and Liang et al 2018). The relative reliability of the means and variances of abundance estimated from these different approaches have never been evaluated. In partnership with CBSAC, researchers at the University of Maryland Center for Environmental Science (UMCES) are currently working with graduate students to conduct this analysis, and expect it to be completed in Fall 2020.

7.4 Increased Accountability and Harvest Reporting for 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 midseason management changes.

The jurisdictions have been working to implement new harvest reporting technologies over the past few years. Since pilot efforts were introduced in 2012, MD DNR has been using an electronic reporting system that allows commercial crabbers to enter each day's harvest from their vessel. The system includes

random daily catch verification and a “hail-in, hail-out” protocol. Maryland is continuing to expand the use of this system for the commercial crabbing fleet. Virginia implemented electronic reporting in 2009 as an alternative mandatory harvest reporting option, but growth has been slow. Through cooperative work among VMRC, Virginia Sea Grant, and various industry groups, promotional products were produced and participation of commercial crab harvesters has increased. To increase reporting efficiency, Virginia plans to require all crab harvest be reported through the online system beginning in 2021. There is interest in electronic harvest reporting among PRFC stakeholders, and it is possible that PRFC will consider using an electronic reporting system in the next few years.

CBSAC also recommends conducting a survey of recreational catch and effort to ensure the reliability of estimates of recreational removals. The last available estimate for Maryland waters was that for 2011^{5,6,7,8}. The last available estimate for Virginia was 2002⁵. Future surveys should ensure that recreational harvest from the Potomac River is also included. A license for recreational crabbing in all jurisdictions would greatly increase the accuracy of catch and effort estimates.

7.5 Improving Recruitment Estimates Using a Shallow Water Survey

Based on the 2011 stock assessment and field experiments by VIMS and the Smithsonian Environmental Research Center, a large fraction of juvenile blue crabs in shallow water is not sampled by the WDS⁹. VIMS was actively pursuing funding at the state level to conduct a shallow water survey concurrent with the Virginia WDS to assess the potential for interannual bias in the fraction of juveniles not sampled by the WDS; however, this effort has stopped temporarily due to COVID-19 effects on the state budget. CBSAC will discuss applying this effort Bay-wide based on funding and findings if a Virginia survey is conducted in the future. In the meantime, VIMS is evaluating trawl survey and WDS data as a relative measure of age 0 abundance.

7.6 Blue Crab Data Hub

To assist in stock assessments and analyses, CBSAC recommends exploring the creation of a data hub focused on Chesapeake Bay blue crab data. This would provide a consistent data platform for all research and minimize the lengthy QA/QC process undertaken before any analyses can begin. Several steps would be necessary to implement such a data hub:

- A) Data policy workgroup to develop policies to ensure all interests are protected
- B) Determine best database design and structure
- C) Data QA/QC prior to loading into database

7.7 Application of Fishery-Independent Survey Data

CBSAC recommends continued review of existing fishery-independent survey data and potential application to provide additional information on the blue crab population, complementing the population estimates from the WDS. Characterizing the seasonal distribution, spatial patterns in recruitment and production, and sex-specific abundance of blue crabs remains important.

7.8 Investigation of the Influence of Male Abundance on Population and Fishery Productivity

CBSAC recommends continued examination to quantify and better understand the influence of male crabs on reproductive success, the overall population, and fishery productivity. In lieu of biological metrics to determine the stock status of male blue crabs, CBSAC recommends investigating if a set of indicators that would help to determine when management adjustments specific to male crabs would be warranted. Researchers at VIMS are currently examining nemertean presence in the gills of female crabs as an indicator of reproduction after their first spawning season, which would consequently indicate increased susceptibility to sperm limitation.

7.9 Fishery-Dependent Data

A verifiable electronic reporting system would collect much of the fishery-dependent data needed to improve management. In lieu of such a system, improvements in management could be made via a more detailed characterization of the catch. Mandatory harvest reporting is currently the only fishery-dependent data in Virginia and the Potomac River. Understanding catch composition by size, sex, and growth phase, both spatially and temporally, as well as effort characterization (section 6.2), would help improve the effectiveness of regulations and ensure they are compatible at a Bay-wide level. VMRC conducted short-term fishery-dependent sampling in 2016-2017 to provide some characterization of commercial harvest. CBSAC recommends that the jurisdictions consider options for future fishery-dependent sampling programs.

7.10 Other Sources of Mortality

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

7.11 Biological Parameters

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

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Alexa Kretsch	Virginia Marine Resources Commission
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Appendix A. Estimated abundance of blue crabs from the Chesapeake Bay-wide 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 Mature Crabs in Millions (Both Sexes)	Number of Mature Female Crabs in Millions	Bay-wide Commercial Harvest (Millions of Pounds)	Percentage of Female Crabs Harvested
1990	791	463	276	117	104	43
1991	828	356	457	227	100	40
1992	367	105	251	167	61	63
1993	852	503	347	177	118	28
1994	487	295	190	102	84	36
1995	487	300	183	80	79	36
1996	661	476	146	108	78	25
1997	680	512	165	93	89	24
1998	353	166	187	106	66	43
1999	308	223	86	53	70	42
2000	281	135	146	93	54	49
2001	254	156	101	61	54	42
2002	315	194	121	55	54	37
2003	334	172	171	84	49.5	36
2004	270	143	122	82	60	46
2005	400	243	156	110	58.5	27
2006	313	197	120	85	52	31
2007	251	112	139	89	43	38
2008	293	166	128	91	49	25
2009	396	171	220	162	54	24
2010	663	340	310	246	85	16
2011	452	204	255	191	67	24
2012	765	581	175	95	56	10
2013	300	111	180	147	37	23
2014	297	198	99	68.5	35	17
2015	411	269	143	101	50	15
2016	553	271	284	194	60	16
2017	455	125	330	254	53	21
2018	371	167	206	147	55	23
2019	594	324	271	191	61	17
2020	405	185	220	141	TBD	TBD

*2020 Bay-wide commercial harvest and exploitation rate are preliminary (TBD = to be determined)
 Bay-wide harvest totals and female exploitation rates listed on this page for 2010 and prior were updated in 2016 to reflect final Bay-wide harvest totals. Previous reports listed preliminary harvest data on this page.

Attachment 2

Appendix B. Summary of female blue crab harvest regulations in the Chesapeake Bay jurisdictions 2008-2019.

Starting in 2008, the jurisdictions (Maryland, Virginia, Potomac River Fisheries Commission) implemented female-specific management measures for the Chesapeake Bay blue crab fishery. The jurisdictions adopted the current female-specific reference points with targets and thresholds for spawning-age (age 1+) female abundance and female exploitation rate in December 2011. The chart below summarizes changes in spawning-age female management regulations each year from 2008-2019.

Year	All Crabs	Age 0 Juv Crabs	Age 1+ Female Crabs	% Female Crabs Harvested	Maryland Female Harvest Regulations	Virginia Female Harvest Regulations	Potomac River Fisheries Commission Female Harvest Regulations
2008	293	166	91	21%	34% reduction: restricted access to female fishery from Sept 1 to Oct 22 based on harvest history; created tiered bushel limits for females based on harvest history	34% reduction: closed winter dredge fishery; closed the fall season for females early on Oct 27 (five weeks early); eliminated the five-pot recreational crab license; required two additional/larger cull rings; reduced # pots per license by 15% as of May 1 and another 15% next year; reduced # peeler pots per license by 30% on May 1.	34% reduction: closed the mature female hard crab season early on Oct 22; established separate female daily bushel limits Sept 1 to Oct 22 for areas upstream of St. Clements Isl. And areas downstream of St. Clements Isl; reduced peeler & soft shell seasons; established that all hard males, hard females, peelers and soft shell crabs kept separate on catcher's boat.
2009	396	171	162	24%	Open access, with industry input created season-long bushel limits that vary by license type and through the season/ Created a 15-day June (1-15) closure and a 9 day fall (9/26 - 10/4) closure to female harvest	Closed crab sanctuary from May 1- Sept 15 (closed loopholes that prevented a uniform May 1 closure for entire sanctuary). Nov 21 harvest closure; waived proposed 15% reduction of pots per license class; reinstated 5-pot recreational license; continued closure of winter dredge fishery.	Maintained 2008 season dates. Did not continue female daily bushel limits from 2008.

Attachment 2

Year	All Crabs	Age 0 Juv Crabs	Age 1+ Female Crabs	%Female Crabs Harvested	Maryland Female Harvest Regulations	Virginia Female Harvest Regulations	Potomac River Fisheries Commission Female Harvest Regulations
2010	663	340	246	16%	Same bushels limits as 2009, but eliminated the 9-day fall closure based on industry input	Continued moratorium on sale of new licenses; relaxed dark sponge crab regulation to allow possession as of July 1 (instead of July 16); continued closure of winter dredge fishery	Established three mature female hard crab closure periods: Sept 22-28 above 301 bridge; Sept 29-Oct 6 from 301 bridge to St. Clements Isl./Hollis Marsh; Oct 7-13 below St. Clements Isl./Hollis Marsh. Closed season Nov 30.
2011	452	204	191	24%	Increased bushel limits	Closed sanctuary May 16 instead of May 1; continued closure of winter dredge fishery.	Refined mature female closed seasons: Sept 20-30 above St. Clements Isl./Hollis Marsh; Oct 4-14 below St. Clements Isl./Hollis Marsh.
2012	765	581	95	10%	Decreased bushel limits to compensate for removal of June closure, which added 15 days (based on industry advice). 6-day emergency extension to offset days lost to Hurricane Sandy.	Extended fall season until Dec 15; 6-day emergency extension to offset days lost to Hurricane Sandy; continued closure of winter dredge fishery.	Maintained 2011 mature female closed seasons.
2013	300	111	147	23%	Decreased bushel limits.	Implemented daily bushel limits to offset 2012 fall extension; extended fall pot season to Dec 15; continue closure of winter dredge fishery.	Refined mature female closed seasons: Sept 18-Oct 2 above St. Clements Isl./Hollis Marsh; Oct 3-17 below St. Clements Isl./Hollis Marsh.
2014	297	198	68.5	17%	Daily bushel limits the same as 2013; additional vessel bushel limit reduction of 12%.	10% reduction: reduced pot bushel and vessel limits; continued closure of winter dredge fishery.	10% reduction: Closed mature female hard crab season Nov 20 and extended closure periods: Sept 12-Oct 2 above St. Clements Isl./Hollis Marsh; Oct 3-23 below St. Clements Isl./Hollis Marsh.

Attachment 2

Year	All Crabs	Age 0 Juv Crabs	Age 1+ Female Crabs	%Female Crabs Harvested	Maryland Female Harvest Regulations	Virginia Female Harvest Regulations	Potomac River Fisheries Commission Female Harvest Regulations
2015	411	269	101	15%	Increase in min. peeler size April-July 14 due to low 2014 adult females. Daily bushel limited increased ~20% Sept-Nov 10 based on adult female increased abundance in 2015.	Maintained 2014 daily bushel limits; continued closure of winter dredge fishery. Redefined the blue crab sanctuary into 5 areas with separate closure dates	Set female daily bushel limits from April-June.
2016	553	271	194	16%	Extended season to Nov 30, adding 20 days. Increased bushel limits in Sept and Oct.	Extended season 3 weeks to Dec 20; maintained 2014 bushel limits; continued closure of winter dredge fishery.	Extended fall season through Dec 10. Set female daily bushel limits starting in July for the whole season.
2017	455	125	254	21%	Shortened season to Nov 20. Reduced bushel limits.	Shortened season to Nov 30. Continued closure of dredge fishery. Reduced Nov bushel limits.	Shortened season to Nov 30. Reduced bushel limits.
2018	372	167	147	23	Extended season to Nov 30. Reduced bushel limits.	Continued closure of dredge fishery and Nov bushel limits. Added hard crab allowance for scrapers.	Status quo
2019	594	324	191	17	Increased bushel limits for July - Nov. Season remained open through Nov 30.	Increased November bushel limits to the same limits as April-October.	Status quo

Additional Online Resources

Maryland Department of Natural Resources: <http://dnr.maryland.gov/fisheries/Pages/default.aspx>

Potomac River Fisheries Commission: <http://prfc.us/>

Virginia Marine Resources Commission: <http://www.mrc.state.va.us/>

Chesapeake Bay Program: https://www.chesapeakebay.net/issues/blue_crabs

Attachment 3

October 19, 2020

Fisheries GIT Members,

The Chesapeake Bay Stock Assessment Committee (CBSAC) formally recommends that the management jurisdictions responsible for the Chesapeake Bay blue crab stock adopt the updated biological reference points (BRPs) generated by the 2017 blue crab stock assessment update. CBSAC is of the opinion that these new reference points constitute the best available science by which the stock should be assessed and managed.

The current management framework for blue crabs in Chesapeake Bay was developed based on the results of a peer-reviewed benchmark stock assessment that was completed in 2011 by scientists at the University of Maryland Center for Environmental Science. The 2011 benchmark stock assessment implemented a sex-specific catch, multiple survey model (SSCMSM) to generate reference points that could be used to define and assess stock status. The BRPs were developed using a maximum sustainable yield (MSY) approach and include thresholds and targets for adult (age 1+) female abundance and female (age 0+) exploitation rate (i.e. the proportion of females harvested from the population in a given year; Table 1). Since 2012, the status of the Chesapeake Bay blue crab population has been assessed by evaluating empirical estimates of abundance and exploitation relative to these female-specific BRPs.

In 2017, fisheries experts at the Maryland Department of Natural Resources initiated a stock assessment update to evaluate the performance of the stock assessment model with new model inputs. The same SSCMSM approach was used with abundance data through 2017 and harvest data through 2016. The final report of the stock assessment model update was completed and distributed in 2019. The results of the update showed similar scale and trends in estimated abundance compared to the 2011 benchmark assessment, indicating appropriate model structure and stability. However, the updated BRPs were slightly different, presenting a less conservative framework to assess stock status (Table 1).

Table 1. BRPs generated by the 2011 benchmark stock assessment and the 2017 stock assessment update.

Stock Assessment	Female Abundance (Age 1+) (millions)		Female Exploitation Rate (Age 0+)	
	Target	Threshold	Target	Threshold
2011	215	70	25.5%	34%
2017	196	72	28%	37%

The less conservative BRPs may cause concerns about increased exploitation of the blue crab stock. However, the updated BRPs were generated using the same SSCMSM model and MSY approach as the 2011 benchmark stock assessment; therefore, the additional data through 2016-17 and the model results indicate that the population has become more resilient and can be fished sustainably at slightly higher rates. Committed to using the best available science for assessment and management of blue crabs in Chesapeake Bay, CBSAC recommends that these new data are included and the BRPs adopted to ensure an appropriate management framework based on the current stock status.



Glenn Davis

Attachment 4

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.) established 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 5

ACTIONS TO PROMOTE REBUILDING OF CHESAPEAKE BAY BLUE CRAB STOCK **(2008 through 2020)**

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 the 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 (2004-2007) 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 the 2009/10 winter dredge fishery season.
- Lowered percentage reduction of crab pots from 30% (2008) to 15% (2009).
- Reestablished 5-pot recreational crab pot license but prohibited harvest on Sunday and from Sept 16 - May 31.
- Right to hold revocation hearing for crab licensee after two crab violations by authorized agent (agents cannot be licensed for any crab fishing gear).

May 2010

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

Attachment 5

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

November 2012

- Closed the 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 the 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.

Attachment 5

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

Attachment 5

June 2016

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

May 2016

- Closed the 2017/18 winter dredge fishery season to allow for continued rebuilding of the spawning stock biomass.
- Reestablished the traditional crab pot harvest season
- Added additional time for lower bushel limits

June 2017

- Closed the 2017/18 winter dredge fishery season to allow for continued rebuilding of the spawning-stock biomass and guard against over-depletion of an expected low 2018 spawning stock
- The Commission further reduced crab pot bushel and vessel possession limits for two additional weeks in November 2017 and March 2018, as an effort to conserve juvenile crabs from the winter of 2017 for the 2018 spawning potential
- The Commission adopted an earlier closure of November 30, for the crab pot fishery, as compared to the 2017 closure of December 20. Similarly, the early March 1, 2017 opening of the crab pot season was pushed back to March 17 in 2018, in order to conserve part of the 2018 spawning stock in late 2017 and early 2018.

June 2018

- Closed the 2018/19 winter dredge fishery season to allow for continued rebuilding of the spawning-stock biomass

June 2019

- Closed the 2019/20 winter dredge fishery season to allow for the continued rebuilding of the spawning stock biomass
- The Commission increased crab pot bushel limits for November 2019 to match bushel limits from April to October and kept the reduced bushel limits for March 2020.

June 2020

- Closed the 2020-21 winter dredge fishery season to allow for the continued rebuilding of the spawning stock biomass.

October 2020

- The Commission extended the 2020 hard crab pot season through December 19, 2020 to offset economic effects of the COVID-19 pandemic.