2025 Chesapeake Bay Blue Crab Advisory Report

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EXECUTIVE SUMMARY

Each year, from December to March, the Maryland Department of Natural Resources (MDNR) and the Virginia Institute of Marine Science (VIMS) conduct the Blue Crab Winter Dredge Survey (WDS) to estimate the abundance of blue crabs in Chesapeake Bay. The estimated abundance of mature females from the WDS and female harvest estimates from each jurisdiction are used to assess blue crab stock status relative to female-specific management reference points. The Chesapeake Bay Stock Assessment Committee (CBSAC) meets each spring to review the results of the latest WDS and the previous season's harvest estimates to develop management recommendations for the jurisdictions.

In 2025, the WDS indicated that the total abundance of all crabs (males and females of all ages) was approximately 238 million individuals. Recruitment, or the number of age 0 crabs (less than 60 mm carapace width), was estimated at 103 million. Approximately 108 million mature female crabs (age 1+) were estimated to be present in the Bay at the start of the 2025 crabbing season, which is above the abundance threshold of 72.5 million adult females, but below the target of 196 million. The percentage of female crabs (age 0+) removed by fishing (exploitation rate) in 2024 was estimated at 22%. This exploitation rate is below the management target (28%) and threshold (37%).

Although these results suggest that the blue crab population is not overfished based on the current biological reference points, estimated adult abundance and recruitment remain at or near the lowest levels of their respective time series. Therefore, CBSAC recommends precautionary management measures focused on protecting mature females and juveniles to maintain a healthy spawning stock. Jurisdictions should also consider conservation-minded measures to protect males given that the conservation trigger for male harvest has been exceeded several times in recent years.

To improve understanding of blue crab population dynamics and the fishery, a benchmark stock assessment is currently being conducted. The assessment is taking into account new data and alternative model structures to evaluate and revise the management framework. The assessment is expected to be completed in 2026.

1. INTRODUCTION

1.1 Background

Management of the blue crab stock is coordinated among the jurisdictions by the Sustainable Fisheries Goal Implementation Team (SFGIT). The SFGIT, one of six goal implementation teams within the Chesapeake Bay Program structure, is led by an Executive Committee of senior fisheries managers from the Maryland Department of Natural Resources (MDNR), the Virginia Marine Resources Commission (VMRC), the Potomac River Fisheries Commission (PRFC), the Atlantic States Marine Fisheries Commission, and the DC Department of Energy and Environment.

The Chesapeake Bay Stock Assessment Committee (CBSAC) serves as a technical subcommittee of the SFGIT, and is coordinated by the NOAA Chesapeake Bay Office (NCBO). CBSAC combines the expertise of state resource managers and scientists from agencies and universities around 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 every year since 1997 to review the results of the Blue Crab Winter Dredge Survey (WDS) and the previous season's harvest data to develop management recommendations for the three Chesapeake Bay jurisdictions: the State of Maryland, the Commonwealth of Virginia, and PRFC.

1.2 Management Framework

Three benchmark stock assessments of the Chesapeake Bay blue crab have been conducted since 1997. The most recent benchmark assessment was completed by scientists at the University of Maryland Center for Environmental Science (UMCES), the Virginia Institute of Marine Science (VIMS), and MDNR in 2011 (Miller et al. 2011). The 2011 assessment recommended biomass and exploitation reference points based on maximum sustainable yield (MSY) for female blue crabs only. These female-specific reference points were formally adopted by all three management jurisdictions in December 2011. Management seeks to control the fishery such that the number of adult females in the population remains above the minimum abundance defined by the overfished threshold. Ideally, the fishery should operate to meet target values and should never surpass the exploitation rate threshold and never fall below the abundance threshold. Given recent declines in blue crab abundance and recruitment, a new benchmark stock assessment began in 2024 and is being led by academic partners at the University of Maryland Center for Environmental Science. This collaborative effort with CBSAC members is taking into account new data and alternative model structures to evaluate and revise the management framework. Full stock assessment committee membership is listed in Appendix A. The benchmark is expected to be completed by early 2026.

1.3 Stock Assessment Updates

A complete stock assessment update was conducted in 2017 that utilized the model from the 2011 benchmark and incorporated abundance data through 2017 and harvest data through 2016. 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, but the estimated reference points were slightly different (Table 1). In November 2020, the three jurisdictions formally adopted the new reference points from the 2017 stock assessment update as these estimates constitute the best available science by which the stock should be assessed and managed.

Table 1. Biological reference points generated by the 2011 benchmark stock assessment and the 2017 stock assessment update. The jurisdictions formally adopted the 2017 reference points in November 2020.

Stock Assessment	Female Abundance (Age 1+) (millions)		Female Exploitation Rate (Age 0+) (per year)	
	Target	Threshold	Target	Threshold
2011	215	70	25.5%	34%
2017	196	72.5	28%	37%

In 2020, CBSAC recommended that annual model runs be conducted to monitor model performance and help guide the decision process for timing of the next benchmark stock assessment. These model runs use the same data sources and methodologies set forth by the 2011 benchmark 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 – are also the same. CBSAC will discuss a standard operating procedure (i.e., methods, timeline, etc.) for updating the reference points after the upcoming benchmark stock assessment.

1.4 Data Sources

Blue crab abundance is estimated from the annual Bay-wide Winter Dredge Survey (WDS) conducted by MDNR and VIMS. CBSAC adopted the WDS as the primary indicator of blue crab stock status in 2006 because it is the most comprehensive and statistically robust of the blue crab surveys conducted in the Bay (Sharov et al. 2003). The WDS measures the density of crabs (number/1,000 m^2) at approximately 1,500 sites throughout the Bay each year. The measured densities of crabs are adjusted to account for the efficiency of the sampling gear and expanded to the area of suitable blue crab habitat in Chesapeake Bay (9,812 km^2). This provides an annual estimate of the total number of crabs overwintering in the Bay by age and sex. The survey also provides an estimate of overwintering mortality based on the percentage of dead crabs found in the WDS each year. Blue crab data from summer trawl surveys conducted by MDNR and VIMS also inform the stock assessment model.

Commercial harvest information is collected annually by the three jurisdictions (MDNR, VMRC, PRFC) to determine Bay-wide exploitation rates. The female exploitation rate is calculated as the 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. For this calculation, the juvenile component of the total estimated abundance 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 WDS as the stock assessment that generated the reference points. This assumes that 40% of age 0 crabs are susceptible to the WDS gear, while the remaining 60% of age 0 crabs are in waters too shallow to be sampled by the WDS. Thus, empirical estimates of exploitation can be compared with the target and threshold reference points derived from the assessment model. Note that exploitation rate estimates in this report are preliminary and will be updated when the harvest data are finalized.

2. POPULATION SIZE (ABUNDANCE)

2.1 All Crabs

The WDS estimate of total abundance of all blue crabs (males and females of all ages) in Chesapeake Bay was 238 million in 2025 (Figure 1). This was a decrease from the 2024 estimate of 317 million and is still below the long-term average (geometric mean) for the WDS time series.

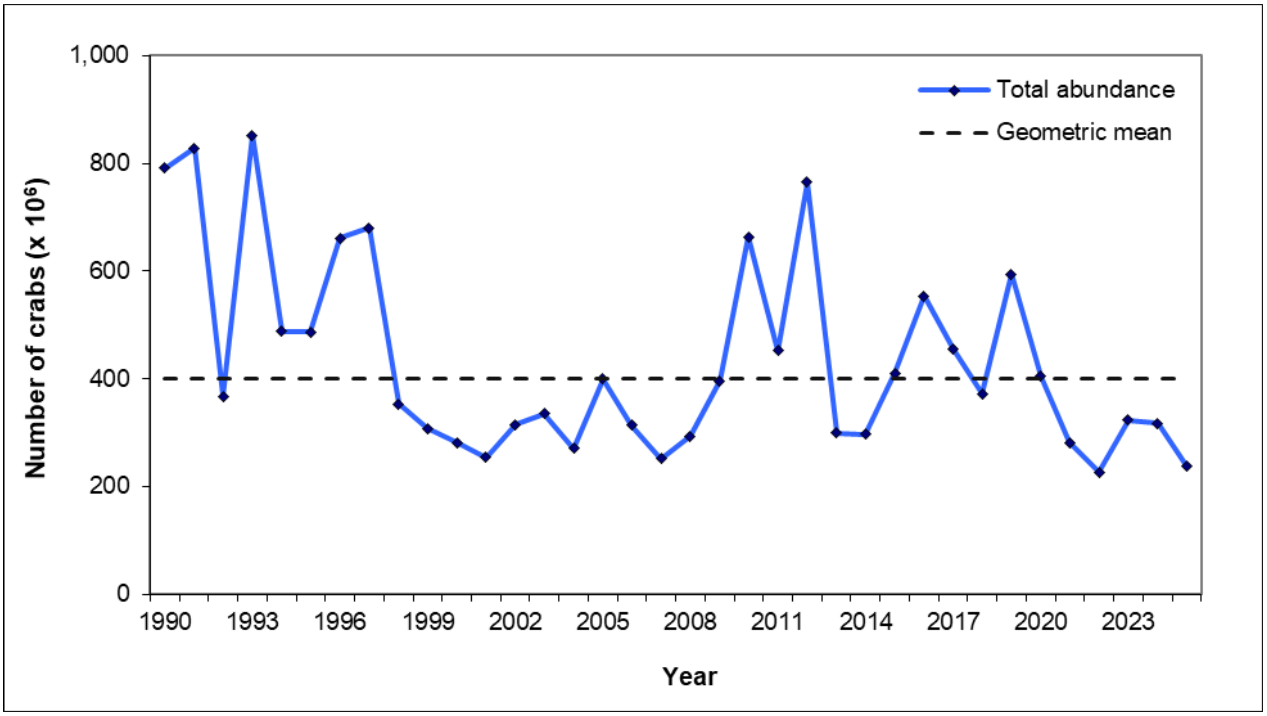


Figure 1. Winter dredge survey estimate of total blue crab abundance in Chesapeake Bay, 1990-2025. This includes male and female crabs of all sizes (age 0+) and is calculated without the catchability adjustment for juveniles.

2.2 Juvenile Crabs (Age 0)

Recruitment is estimated as the number of age 0 crabs (less than 60 mm carapace width) in the WDS. The abundance of juvenile crabs in 2025 was 103 million, an increase from the 2024 estimate of 138 million (Figure 2). However, this year's recruitment estimate was still one of the lowest in the time series and below the average of 203 million juveniles (geometric mean). CBSAC remains concerned about the continued low recruitment despite the adult female abundance remaining above the threshold. Improving understanding of environmental and ecological drivers of blue crab recruitment success was a primary focus of the Blue Crab Science Workshop that CBSAC held in September 2022. A summary of this discussion can be found in the workshop report. Additionally, several research initiatives are underway to better understand the causes of lower recruitment.

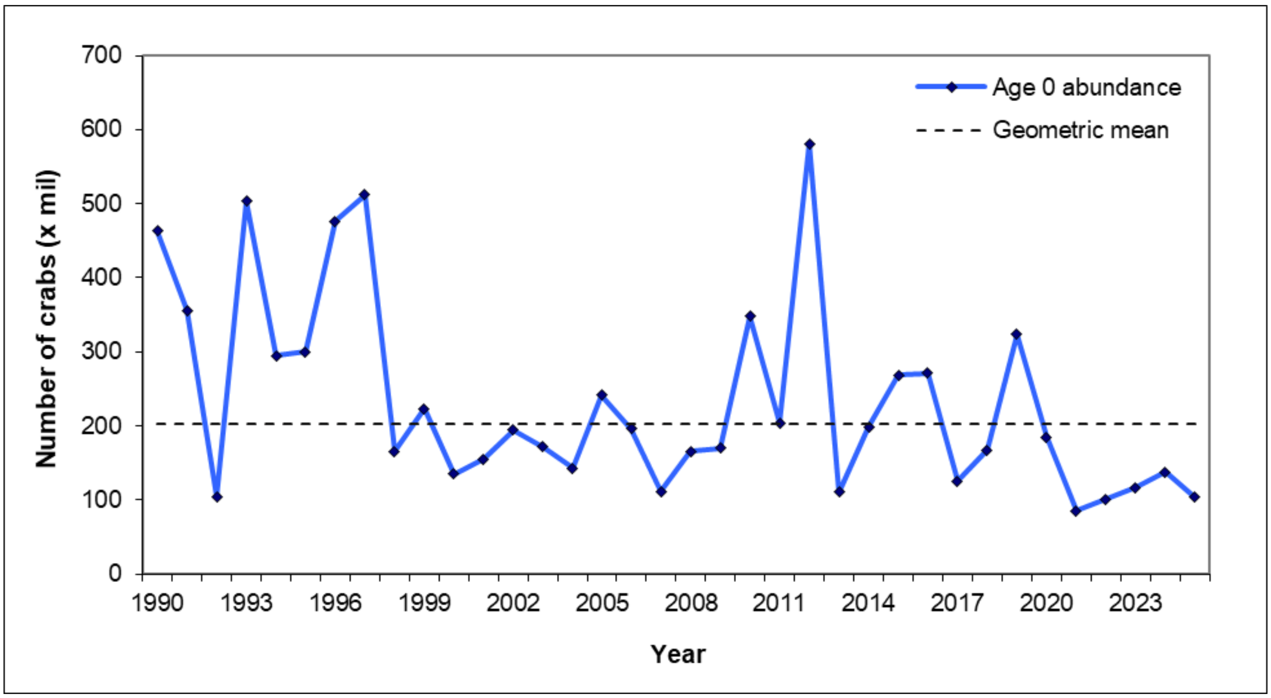


Figure 2. Winter dredge survey estimate of abundance of juvenile blue crabs (age 0), 1990-2025, calculated without the catchability adjustment for juveniles. These are male and female crabs measuring less than 60mm across the carapace.

2.3 Adult Males (Age 1+)

The WDS estimate of age 1+ male crabs (greater than 60 mm carapace width) in 2025 was 26 million, a decrease relative to the 2024 estimate of 46 million adult males (Figure 3). The estimate has remained below the time series average (geometric mean) of 61 million crabs for five consecutive years and is the lowest of the time series.

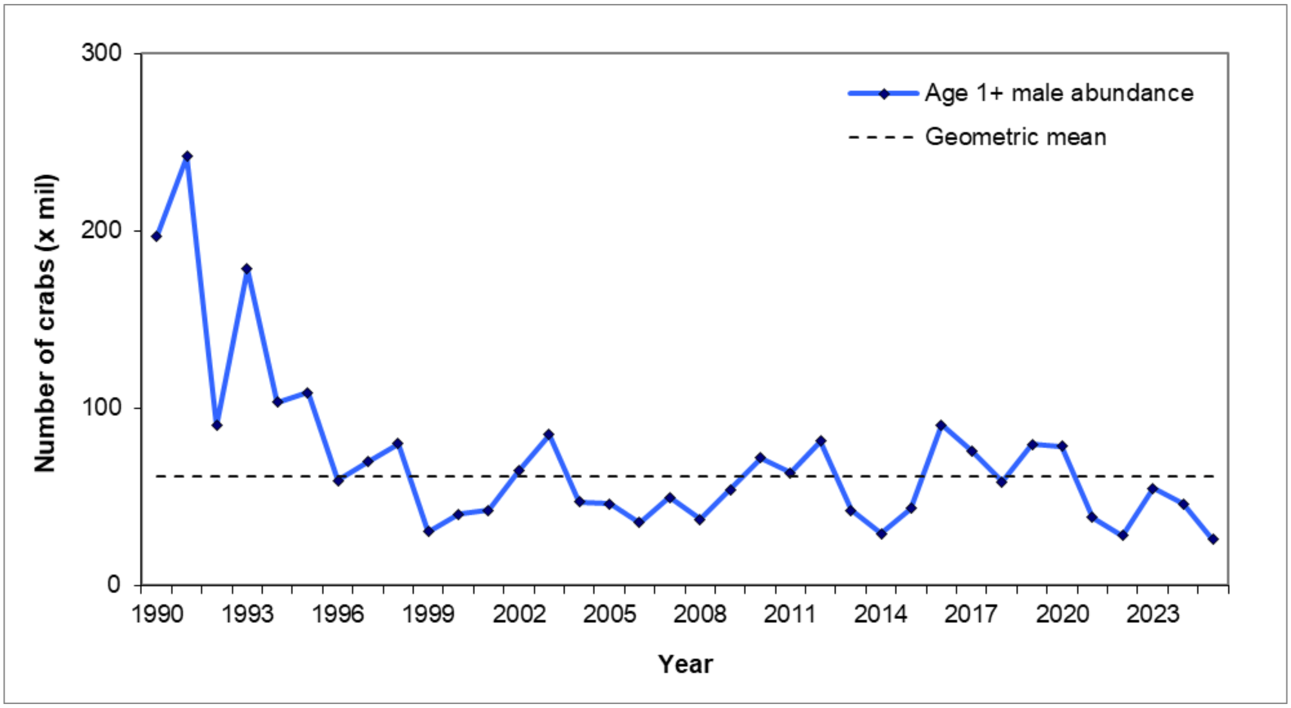


Figure 3. Winter dredge survey estimate of abundance of male blue crabs age one year and older (age 1+), 1990-2025. These are male crabs measuring greater than 60mm across the carapace and are considered the ‘exploitable stock’, capable of mating within the coming year.

2.4 Overwintering Mortality

Winter conditions affect the survival and year-class strength of tropical and subtropical species such as the blue crab. For adult blue crabs, overwintering mortality is highly correlated to temperature and salinity, with mortality increasing at lower temperatures and salinities (Rome et al. 2005). Annual abundance estimates from the WDS are adjusted for loss due to overwintering mortality, which is estimated as the percentage of dead crabs found in the survey. In 2025, overwintering mortality estimates in Chesapeake Bay were higher than in recent years, but, with the exception of adult male blue crabs, remained below the 1996-2025 average (Table 2).

Table 2. Percentage of dead crabs found in the late winter dredge samples each year from 2020 to 2025 and the average for 1996-2025.

Age/Sex Grouping	1996-2025 Average	2020	2021	2022	2023	2024	2025
All Crabs	5.89%	0.36%	2.80%	3.57%	0.24%	1.00%	4.00%
Juveniles	1.06%	0.00%	0.11%	0.39%	0.08%	0.80%	0.20%
Adult Females	7.23%	0.47%	2.12%	6.33%	0.26%	0.00%	5.90%
Adult Males	8.91%	0.78%	8.39%	5.25%	0.71%	5.20%	12.20%

3. HARVEST

3.1 Commercial Harvest

Preliminary reports indicated a decrease in Bay-wide commercial blue crab harvest in 2024, with an estimated total of 42.5 million pounds harvested, which is well below the long-term average of approximately 59 million pounds. This decrease in total commercial harvest was driven by decreases in harvest in Virginia and the Potomac River. Initial harvest estimates for each jurisdiction were: 25.5 million pounds in Maryland, 14.0 million pounds in Virginia, and 3.0 million pounds in the Potomac River (Figure 4).

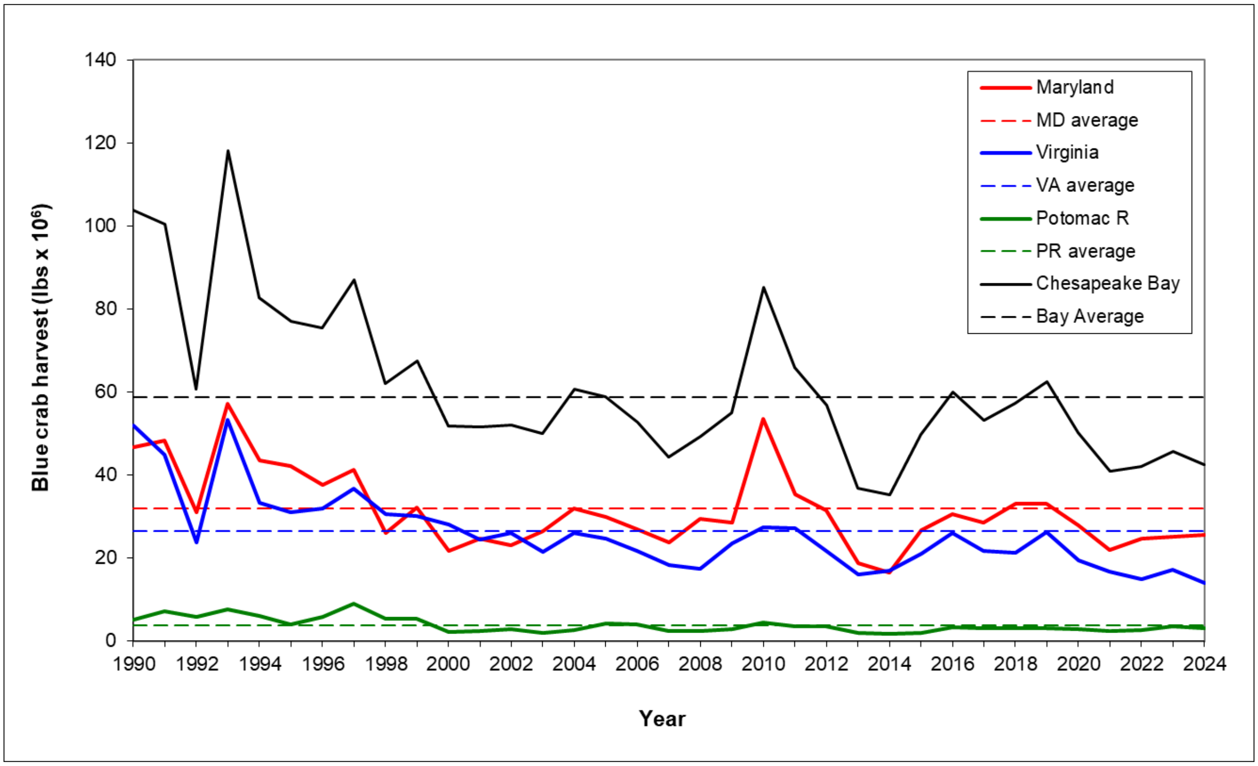


Figure 4. Maryland, Virginia, Potomac River, and bay-wide blue crab landings in millions of pounds (Chesapeake Bay harvest only), all market categories, 1990-2024.

3.2 Recreational Harvest

Recreational blue crab harvest in Chesapeake Bay has been assumed to be approximately 8% of total commercial harvest (Ashford & Jones 2011). In 2009, however, MDNR prohibited the recreational harvest of females such that recreational harvest is better described as 8% of male commercial harvest in this jurisdiction. A recent study conducted by the Smithsonian Environmental Research Center has suggested, when crab movement is accounted for, recreational harvest may be closer to 6.5% of total Maryland commercial harvest (Semmler et al. 2021).

4. STOCK STATUS

4.1 Female-Specific Reference Points

The current blue crab management framework in Chesapeake Bay employs maximum sustainable yield (MSY)-based female-specific targets and thresholds to assess the stock. The exploitation rate (U_{MSY}) is the level of fishing expressed as a percentage of the population harvested each year that achieves the largest average catch that can be sustained over time without risk of stock collapse. Following precedent adopted by the New England and Mid-Atlantic Fishery Management Councils, the 2011 blue crab stock assessment recommended a target exploitation rate that was associated with 75% of the value of U_{MSY} and a threshold exploitation rate equivalent to U_{MSY}. Overfishing occurs when the exploitation rate exceeds this threshold. The adult female (age 1+) abundance reference points were set at levels associated with $N_{0.75*UMSY}$(target) and 50% N_{MSY}(threshold). The stock is considered overfished when the abundance of mature females falls below this threshold.

4.2 Exploitation Rate

The preliminary estimate of the female exploitation rate, or the percentage of all female crabs (age 0+) removed by fishing, was 22% in 2024 (Figure 5). This exploitation rate is below both the target of 28% and the threshold of 37%. However, as more harvest data are finalized, this estimate may change.

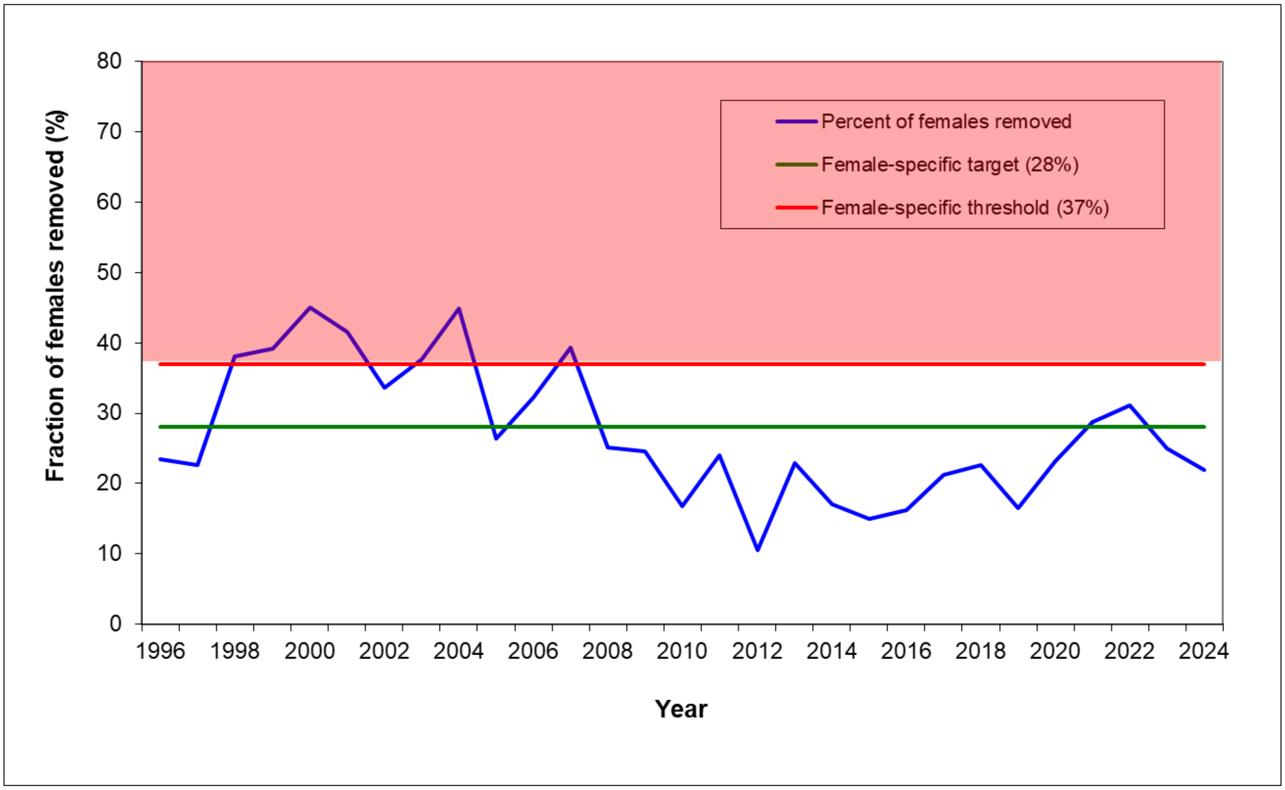


Figure 5. Estimated female exploitation rate relative to the female-specific target (28%) and threshold (37%) exploitation rates, 1996-2024. The female exploitation rate is the number of crabs harvested in a given year divided by the female abundance estimate (age 0+) at the beginning of the year, calculated with the juvenile scalar (section 1.4). The red shaded area represents exploitation rates above the target rate.

4.3 Spawning Stock Abundance

Approximately 108 million age 1+ female crabs were estimated to be present in the Bay at the start of the 2025 crabbing season, which is above the threshold of 72.5 million, but below the target of 196 million (Figure 6). This is the nominal spawning stock, or the number of mature females present in the population that could spawn in the summer prior to the occurrence of fishing and natural mortality. The WDS abundance estimate is below the average abundance since 2008 (after female-specific management measures were enacted). The expectation for a healthy stock would be for the adult female abundance to fluctuate around the target reference point, but abundance has remained below the target since 2017.

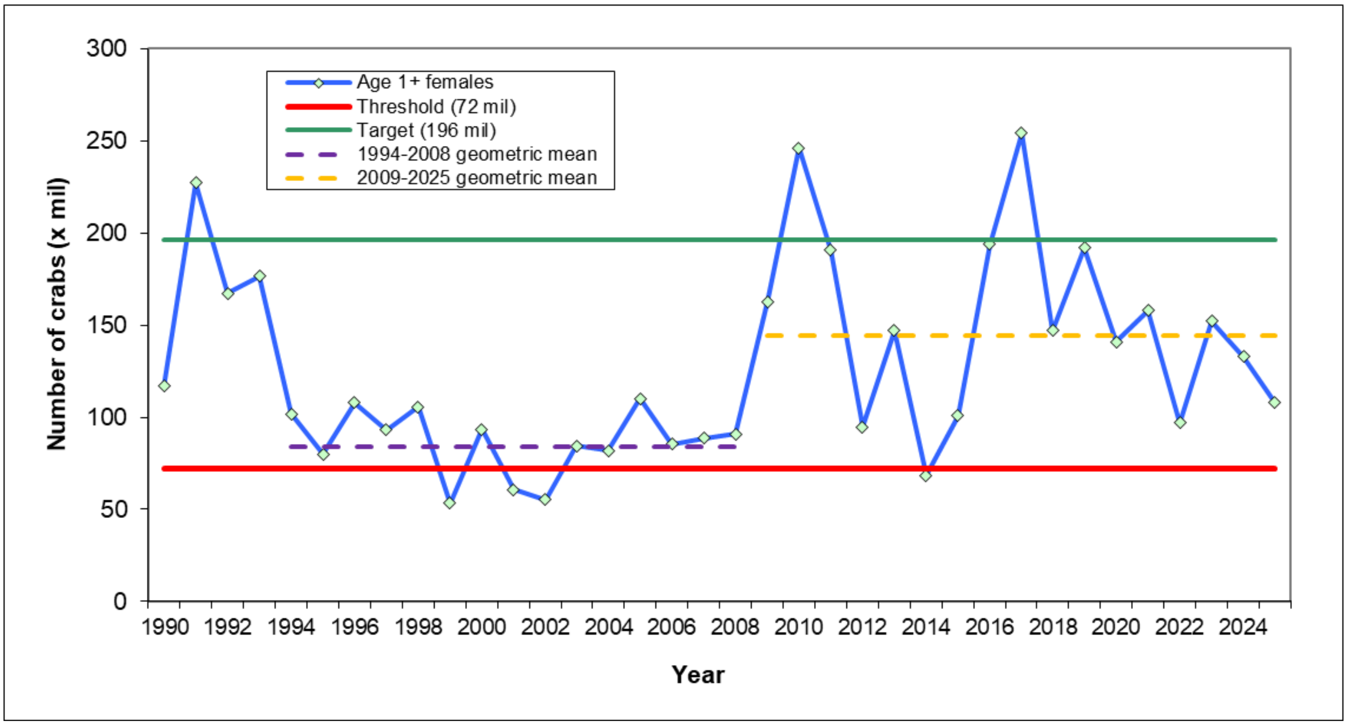


Figure 6. Winter Dredge Survey estimates of abundance for mature female blue crabs (age 1+), 1990-2025, relative to the female-specific reference points. Mature female crabs measured greater than 60 mm (2.4 in) across the carapace and are considered the “exploitable stock” capable of spawning within the year. The dashed lines represent the geometric mean of adult female abundance during two time periods: 2009-2025, after the current management framework was implemented (yellow dashes); and 1994-2008, the period of low abundance which prompted the management changes (purple dashes).

4.4 Stock Status

Each year, the status of the Chesapeake Bay blue crab stock is assessed relative to the female exploitation rate (U) and adult female abundance (N) reference points. Figure 7 shows the status of the blue crab stock relative to these reference points each year since 1990. The 2025 estimate of spawning stock abundance is above the threshold of 72.5 million adult females, but below the target of 196 million. The preliminary estimate of the female exploitation rate in 2024 was 22%, which is below the target (28%) and the threshold (37%). Therefore, the Chesapeake Bay blue crab stock is currently not considered overfished nor is overfishing occurring (Figure 7; Table 3).

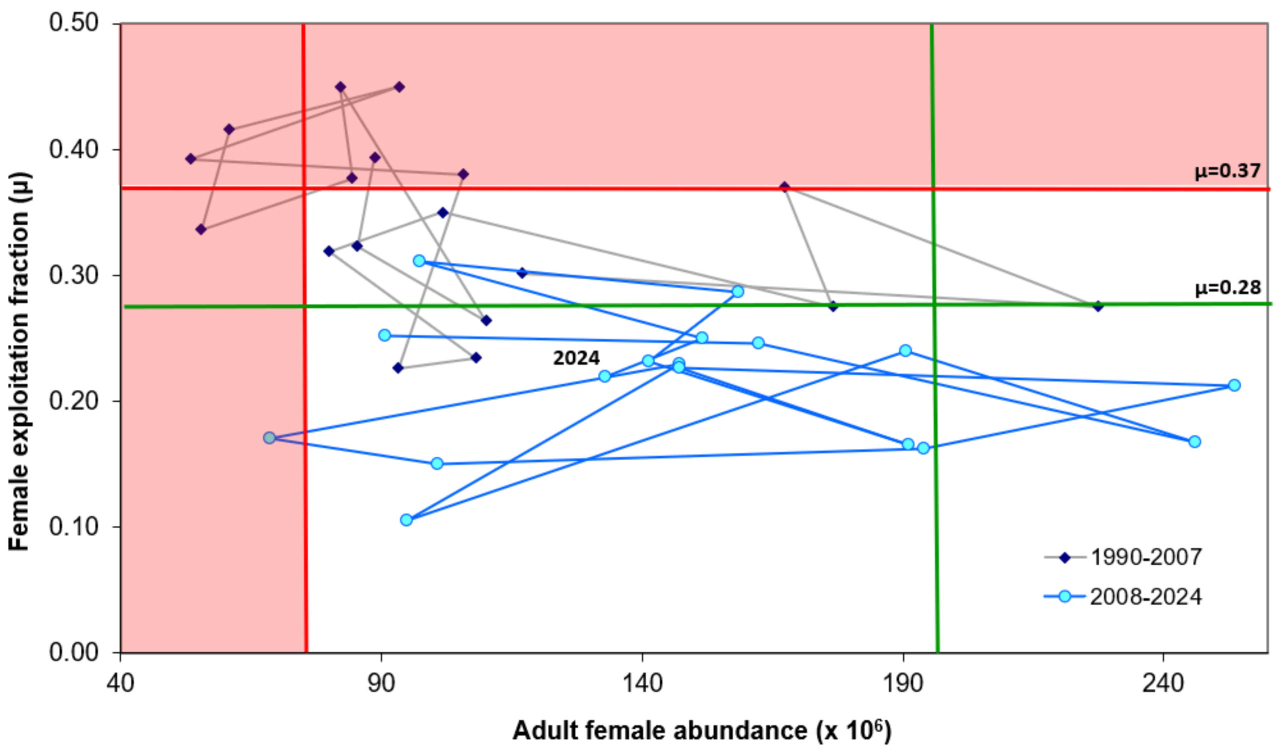


Figure 7. Stock status for the Chesapeake Bay blue crab fishery based on female-specific reference points. In 2024, adult female abundance was above the overfished threshold (72.5 million crabs), and the female-specific exploitation rate was below the exploitation target (37%). The shaded red areas show where the thresholds for the exploitation rate or abundance are exceeded. The intersection of the green lines shows both the abundance and exploitation targets. This figure includes data through 2024; the 2025 data point will be added at the completion of the 2025 fishery. The lines represent the two time periods: 2008-2024, after the current management framework was implemented (blue line); and 1994-2007, the period of low abundance which prompted the management changes (grey line).

Table 3. Blue crab stock status over the last five years, based on the exploitation and abundance reference points for female crabs. Green shading indicates that the threshold was not exceeded.

Control Rule	Reference Points		Stock Status				
	Target	Threshold	2021	2022	2023	2024	2025
Exploitation Rate (percentage of age 0+ females removed)	28%	37% (max)	29%	31%	25%	22%	TBD
Abundance (millions of age 1+ females)	196	72.5 (min)	158	97	152	133	108

4.5 Male Conservation Trigger

Although the current blue crab management framework does not have reference points for males, CBSAC adopted a conservation trigger for male crabs in 2013. 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 1.4), which was the second-highest exploitation rate observed for male crabs since 1990. Choosing the second-highest value in the time series was a precautionary measure to provide a buffer from the maximum observed exploitation rate. This value does not represent a fishing threshold or target, but instead will warn managers that the male component of the stock is being more heavily exploited than has occurred throughout the majority of the time series. The preliminary estimate of the male exploitation rate in 2024 was 30%, which is below the conservation trigger (34%). Since the male exploitation rate has exceeded the conservation trigger several times in recent years, CBSAC remains concerned with consistent high male exploitation (Figure 8) while male abundance remains low (Figure 3). The contribution of male blue crabs to the population is one of the elements being investigated in the ongoing benchmark stock assessment.

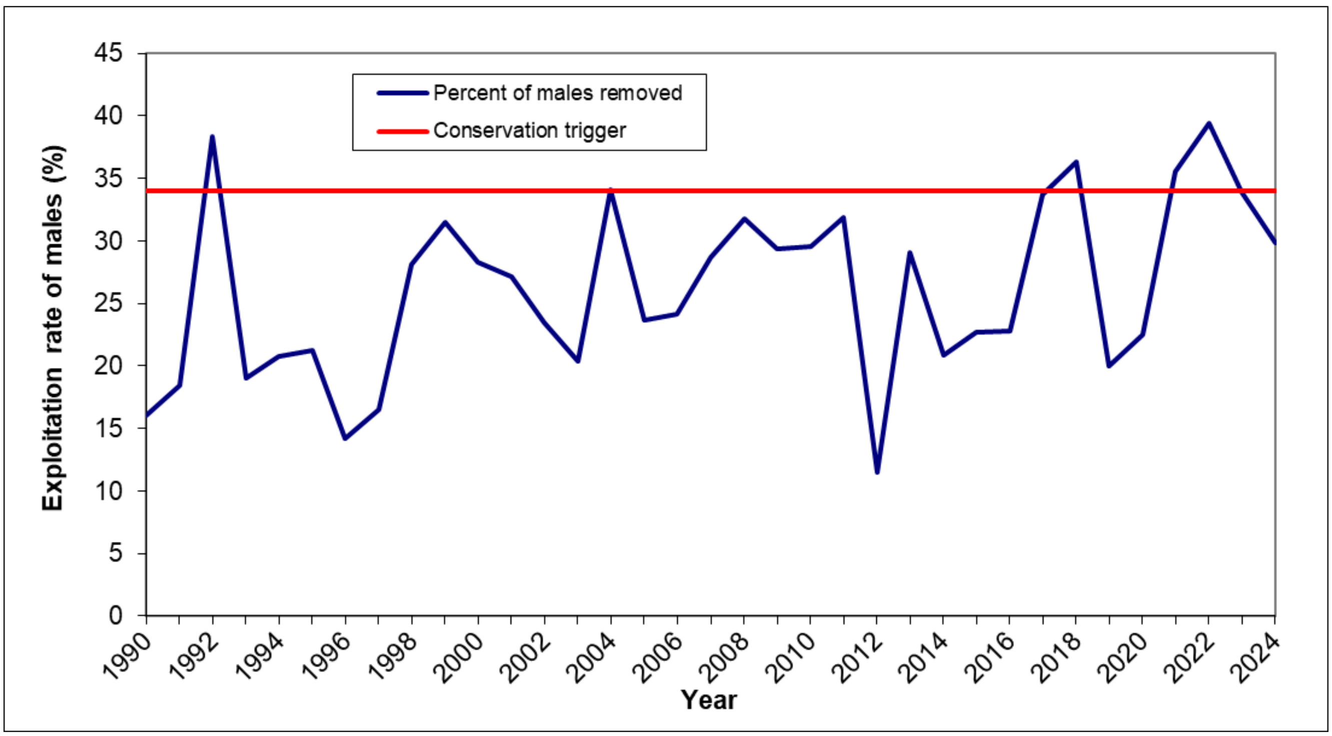
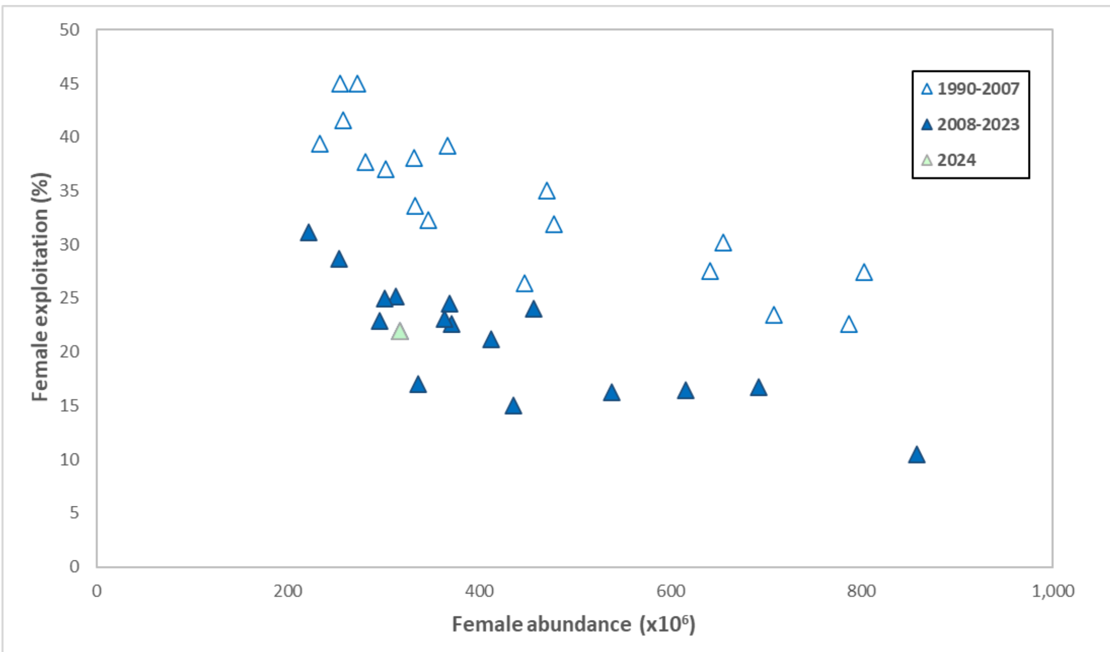


Figure 8. Estimated male exploitation rate relative to the male conservation trigger, 1990-2024. The male exploitation rate is the number of crabs harvested in a given year divided by the male abundance estimate (age 0+) at the beginning of the year, calculated with the juvenile scalar (section 1.4).

4.6 Potential Management Impact

Female exploitation rates from 1990 to 2007 were higher on average than the exploitation rates from 2008 to 2024 (Figure 9a). The lower female exploitation rates over the last two decades coincide with the implementation of female-specific management measures in 2008. Male exploitation rates have not shown the same pattern (Figure 9b). However, female and male exploitation rates tend to be highest when abundance is lowest, which is not a pattern that would likely lead to attainment of target abundance.

a)



b)

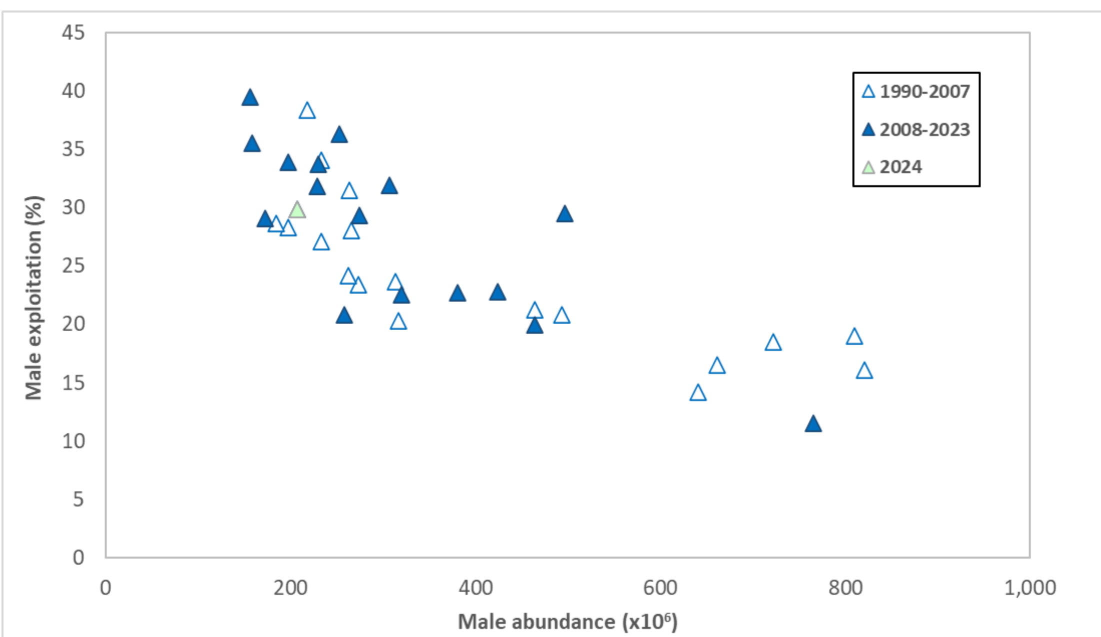


Figure 9. Comparison of female (a) and male (b) exploitation rates during the time periods prior to and after the 2008 implementation of female-specific management measures.

5. MANAGEMENT RECOMMENDATIONS

5.1 Continue Precautionary Management Measures

In 2025, the WDS abundance estimate for mature female blue crabs was above the threshold of 72.5 million crabs. The exploitation rate of females was also below the 37% threshold, which indicates that the blue crab stock is not overfished and overfishing is not occurring based on current biological reference points. However, continued low adult abundance, low recruitment, and high male exploitation rates remain causes for concern. Maintaining a robust spawning stock is necessary to replenish the population with new recruits each year. To promote a productive population and sustainable fishery, CBSAC recommends continued precautionary management measures considering that relatively conservative management has been in place since 2022. Given that the male exploitation rate has exceeded the conservation trigger several times in recent years, CBSAC also recommends that the jurisdictions maintain a precautionary approach with male crabs. See Appendix B for more information about previous changes in harvest regulations by year.

5.2 Conduct a New Benchmark Stock Assessment

Low abundance and recruitment estimates over the last few years have caused concern regarding the appropriateness of the biological reference points for the Chesapeake Bay blue crab population and sparked an interest in conducting a benchmark stock assessment. Maryland and Virginia funded this initiative, which began in 2024. The terms of reference for the stock assessment were approved by the Sustainable Fisheries Goal Implementation Team Executive Committee in March 2023 (see Appendix C). In December 2023, CBSAC held a Blue Crab Assessment Data Workshop to discuss potential data sources for the assessment. Data analyses and model development are currently underway. The assessment is expected to be completed by early 2026.

6. SCIENCE AND DATA NEEDS

CBSAC has identified and prioritized the following science and data needs that will improve management of the Chesapeake Bay blue crab population. To address some of these needs, CBSAC is 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, including the Blue Crab Sustainability Outcome.

6.1 Quantifying Drivers of Blue Crab Population Dynamics

After several years of low abundance and recruitment, CBSAC has made it a priority to better understand environmental and ecological drivers of blue crab population dynamics. This was a major focus of the discussion at CBSAC's 2022 Blue Crab Science Workshop. At the workshop, CBSAC members and other experts discussed factors of interest including habitat availability (e.g., submerged aquatic vegetations, marsh), predation (e.g., red drum, blue catfish), food availability (e.g., clams), environmental conditions (e.g., water temperature, salinity, hypoxia), oceanic conditions (e.g., wind and tidal currents), and disease; and identified data and analytical needs surrounding these drivers. As stated in the workshop report, quantifying the relationships between these factors and blue crab abundance and recruitment is a CBSAC science priority. Several research initiatives are exploring these topics further.

6.2 Population Simulation Model for Management Strategy Evaluation

Researchers at UMCES recently completed a GIT-funded study to develop a spatially-explicit blue crab population simulation model. The simulation model can be used to evaluate performance of the stock assessment model and fishery management under various hypotheses (e.g., differential natural mortality by sex, catchability of the WDS) to 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 are being used to guide the development of new assessment approaches. The final project report can be found on the CBSAC webpage.

A complementary modeling study to the UMCES population simulation modeling is being conducted by researchers from VIMS and William & Mary. This work, partially funded by the National Science Foundation, has developed 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 depensatory exploitation, changes in population dynamics due to climate change, and disease and habitat effects on the blue crab population and fishery.

6.3 Harvest Reporting, Effort, and Catch Composition

Accurate harvest data for the commercial and recreational blue crab fisheries are necessary to obtain the most accurate exploitation rate each year and to better support mid-season management changes. To improve harvest reporting, the jurisdictions have been working to implement new technologies over the past few years. Since pilot efforts were introduced in 2012, MDNR 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. MDNR is continuing to expand the use of this system for the commercial crabbing fleet. VMRC implemented electronic reporting in 2009 as an alternative mandatory harvest reporting option, but growth was initially slow. Participation of commercial crab harvesters increased over time through cooperative work among VMRC, Virginia Sea Grant, and various industry groups. As of 2022, VMRC requires all crab harvest be reported through the online system to increase reporting efficiency. In 2021, PRFC received a grant from the Atlantic Coastal Cooperative Statistics Program to develop a pilot project for electronic harvest reporting, which is now in its fifth year. This e-reporting program is expected to expand to the full crab fishery in 2026. The details of each jurisdiction's harvest reporting efforts and challenges are outlined in CBSAC's Blue Crab Harvest Reporting Document.

In addition to commercial harvest reporting, a survey of recreational catch would be useful to ensure the reliability of recreational removal estimates. The most recent estimate of recreational harvest in Maryland was generated from a tagging study in Maryland waters in 2014-2015, which suggested that recreational harvest was approximately 6.5% of commercial harvest (Semmler et al. 2021). The last available estimates of recreational harvest for Virginia are from 2002. Future surveys should ensure that recreational harvest from the Potomac River is also included. A license or registration for all recreational crabbing in all jurisdictions would greatly increase the accuracy of catch and effort estimates.

Quantifying effort is another important component for understanding fishery dynamics. 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 harvest reporting system or recreational catch survey.

In addition to accurate harvest reporting and quantification of fishing effort, improvements in management could be made using more detailed characterization of catch. Understanding catch composition by size, sex, and growth phase, both spatially and temporally, would help improve the effectiveness of regulations and ensure they are compatible at a Bay-wide level. MDNR collects some size and sex composition data through their Cooperative Data Collection Program, which enlists watermen to voluntarily sample their catch and/or permit an onboard biologist to sample their catch. CBSAC has been working with the jurisdictions to assess the potential of implementing similar fishery-dependent sampling programs at VMRC and PRFC, but resource availability remains a barrier to implementation.

6.4 Efficacy of the Winter Dredge Survey as an Index of Abundance

The WDS is the primary data source used by managers to assess the status of the blue crab stock and make management decisions. Although the WDS is considered one of the most comprehensive and statistically sound fisheries surveys on the east coast (Sharov et al. 2003), there are several aspects of survey design and interpretation that are being explored, which may improve the survey. At least three approaches using WDS data have been proposed to estimate relative blue crab abundance in Chesapeake Bay (Sharov et al. 2003, Jensen & Miller 2005, Liang et al. 2017). Survey design and interpretation are being addressed in the current benchmark stock assessment. The WDS continually includes additional research to address questions about survey effectiveness and remains a reliable approach for providing information on the stock.

6.5 Influence of Male Crabs on Population and Fishery Productivity

A previous study at UMCES suggested that sperm limitation is not a concern for Chesapeake Bay blue crabs under the current management framework (Rains et al. 2018). However, with male exploitation rates exceeding the conservation trigger in recent years, CBSAC is particularly interested in quantifying and better understanding the influence of male crabs on reproductive success, the overall population, and fishery productivity. Male contributions to the blue crab population were evaluated in a recent VIMS study (Schneider et al. 2024), which reinforced the conclusion that sperm limitation is currently not a major issue for the blue crab stock. Because model-derived estimates for male management reference points are not available from the stock assessment, CBSAC may consider developing additional indicators that would determine when male-specific management actions are warranted.

6.6 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 (SERC), a large fraction of juvenile blue crabs in shallow water are not sampled by the WDS (Ralph & Lipcius 2014). Currently, VIMS, MDNR, and the Patuxent Environmental and Aquatic Research Laboratory (PEARL) are evaluating survey data on recruitment as a relative measure of age 0 blue crab abundance and a complement to WDS data on age 0 abundance.

6.7 Blue Crab Data Hub

To assist in stock assessments and analyses, CBSAC has discussed the creation of a data hub focused on Chesapeake Bay blue crab data. A hub would provide a consistent data platform for all research and minimize the lengthy QA/QC process undertaken before any analyses can begin. The current benchmark stock assessment has been aggregating baywide data for use in the stock assessment. The following steps would be necessary to implement a long-term data hub:

1) Create a data policy workgroup to develop policies that ensure all interests are protected;
2) Determine the best database design and structure; and
3) QA/QC all data prior to uploading into the database.

CBSAC recognizes the benefit of capitalizing on the momentum of the benchmark stock assessment and has begun populating a data hub with the data sets that are being compiled, subjected to QA/QC processes, and will be documented as part of the assessment process. A workgroup will be convened in 2025 to draft the data policy and an update will be provided at the Spring 2026 CBSAC meeting.

6.8 Application of Fishery-Independent Survey Data

CBSAC continues to review existing fishery-independent survey data to identify potential applications that will address questions about blue crab population dynamics and complement 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. Additional data sources were identified and discussed at the 2022 Blue Crab Science Workshop and 2023 Blue Crab Assessment Data Workshop, and are listed as an appendix in the workshop report. These data sources (and others) are being considered in the ongoing benchmark stock assessment.

6.9 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 are key sources of uncertainty**.** Ongoing studies and the benchmark stock assessment are examining blue crab age structure, reproduction, and other biological parameters of the Chesapeake Bay population.

Additional Online Resources

Maryland Department of Natural Resources:
https://dnr.maryland.gov/fisheries/pages/blue-crab/index.aspx
Potomac River Fisheries Commission: http://prfc.us/
Virginia Marine Resources Commission: https://mrc.virginia.gov/
Virginia Institute of Marine Science:
https://www.vims.edu/research/units/programs/bc_winter_dredge/index.php
Chesapeake Bay Program: https://www.chesapeakebay.net/issues/blue_crabs
Chesapeake Bay Stock Assessment Committee:
https://www.chesapeakebay.net/who/group/chesapeake_bay_stock_assessment_committee

Chesapeake Bay Stock Assessment Committee Membership

CBSAC Members	Organization/Affiliation
Ingrid Braun-Ricks (Chair)	Potomac River Fisheries Commission
Christina Garvey (Program Coordinator)	NOAA Chesapeake Bay Office/Chesapeake Research Consortium
Bruce Vogt	NOAA Chesapeake Bay Office
Alexa Galvan	Virginia Marine Resource Commission
Brooke Lowman	Virginia Marine Resource Commission
Mandy Bromilow	Maryland Department of Natural Resources
Glenn Davis	Maryland Department of Natural Resources
Alexei Sharov	Maryland Department of Natural Resources
Mike Wilberg	UMCES, Chesapeake Biological Laboratory
Tom Miller	UMCES, Chesapeake Biological Laboratory
Rom Lipcius	Virginia Institute of Marine Science, William & Mary
Mike Seebo	Virginia Institute of Marine Science, William & Mary
Tom Ihde	Morgan State University, PEARL
Daniel Hennen	NOAA Northeast Fisheries Science
Amy Schueller	NOAA Southeast Fisheries Science Center

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Appendix

Appendix A. Blue Crab Stock Assessment Committee Members

BCSAC Members	**Organization/Affiliation**
Mike Wilberg (Lead)	University of Maryland Center for Environmental Science
Tom Miller	University of Maryland Center for Environmental Science
Dong Liang	University of Maryland Center for Environmental Science
Madison Sholes	University of Maryland Center for Environmental Science
Maya Drzewicki	University of Maryland Center for Environmental Science
Rob Latour	Virginia Institute of Marine Science
Rom Lipcius	Virginia Institute of Marine Science
Troy Tuckey	Virginia Institute of Marine Science
Gabby Saluta	Virginia Institute of Marine Science
Mike Seebo	Virginia Institute of Marine Science
Zoe Benson	Virginia Institute of Marine Science
Gina Ralph	Virginia Institute of Marine Science
Jim Gartland	Virginia Institute of Marine Science
Matt Ogburn	Smithsonian Environmental Research Center
Rob Aguilar	Smithsonian Environmental Research Center
Kiera Hegley	Smithsonian Environmental Research Center
Tom Ihde	Morgan State University
Amanda Bevans	Morgan State University
Ingrid Braun-Ricks	Potomac River Fisheries Commission
Glenn Davis	Maryland Department of Natural Resources
Mandy Bromilow	Maryland Department of Natural Resources
Alexei Sharov	Maryland Department of Natural Resources
Mavin Mace III	Maryland Department of Natural Resources
Alexa Galvan	Virginia Marine Resources Commission
Brooke Lowman	Virginia Marine Resources Commission

Appendix B. Summary of changes in female blue crab harvest regulations in the three Chesapeake Bay jurisdictions (MDNR, VMRC, PRFC) since implementation of the female-specific management framework in 2008. Abundance estimates for all crabs, juvenile crabs (age 0), and adult females (age 1+) and the female exploitation rate are also provided for each year.

Year	Total Abundance (millions)	Juvenile Abundance (millions)	Adult Female Abundance (millions)	Female Exploitation Rate	MDNR	VMRC	PRFC
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.

Year	Total Abundance (millions)	Juvenile Abundance (millions)	Adult Female Abundance (millions)	Female Exploitation Rate	MDNR	VMRC	PRFC
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.

Year	Total Abundance (millions)	Juvenile Abundance (millions)	Adult Female Abundance (millions)	Female Exploitation Rate	MDNR	VMRC	PRFC
2014	297	198	68.5	17%	Daily bushel limits the same as 2013; additional vessel bushel limit reduction of 12%. periods:	10% reduction: reduced pot bushel and vessel limits. Continued closure of winter dredge fishery.	10% reduction: closed mature female hard crab season on Nov 20 and extended closure Sept 12-Oct 2 above St. Clements Isl./Hollis Marsh; Oct 3-23 below St. Clements Isl./Hollis Marsh.
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.

Year	Total Abundance (millions)	Juvenile Abundance (millions)	Adult Female Abundance (millions)	Female Exploitation Rate	MD DNR	VMRC	PRFC
2019	594	324	191	17%	Increased bushel limits for July - Nov. Season remained open through Nov 30.	Increased Nov bushel limits to the same limits as Apr-Oct. Continued closure of dredge fishery.	Status quo.
2020	405	185	141	23%	Increased bushel limits for one week in Nov in response to impacts related to COVID-19.	Extended hard crab pot season to Dec 19 in response to impacts related to COVID-19. Continued closure of dredge fishery.	Status quo.
2021	282	86	158	29%	Status quo.	Shortened hard crab pot season to November 30. Continued closure of dredge fishery.	Status quo.
2022	227	101	97	31%	Reduced female bushel limits. Enacted male bushel limits in Aug-Sep. Shortened the male season to Nov 30. Reduced the recreational boat limit to one bushel.	Extended spring and fall low bushel limits for hard crab pots. Shortened the season for all other gears by two weeks in both spring and fall.	Reduced female bushel limits. Set male bushel limits.
2023	323	116	152	25%	Increased female catch limits in Jul-Oct. Maintained status quo for males.	Increased spring and fall low bushel limits for certain crab pot licenses for equity. Extended the hard crab pot season through Dec. 16.	Increased female bushel limits to 2021 levels, status quo for male bushel limits.
2024	317	138	108	22%	Maintained status quo for female and male bushel limits.	Maintained status quo season and bushel limits. Expanded daily time limit on crabbing.	Female bushel limits decreased in Jul-Aug., & increased in Oct-Nov. Maintained status quo for males. New recreational license structure.

Appendix C. Blue Crab Stock Assessment Terms of Reference

TOR 1: Critically review and estimate life history parameters and vital rates of blue crab in the Chesapeake Bay that are relevant to the stock assessment. In particular, the assessment should evaluate the extent and scale of interannual variation in life history parameters and vital rates of blue crab in the Chesapeake Bay.

We will conduct a literature review and independent analyses to address this TOR.

TOR 2: Describe and quantify patterns in fishery-independent surveys to develop indices of abundance and characterize the size composition of the population. Analyses should include: (1) A comprehensive evaluation of the utility of fishery-independent surveys to inform the stock assessment; (2) Consideration of index standardization which may include effects of environmental and abiotic factors on survey catches; and (3) Characterization of uncertainty in indices of abundance.

We will gather all available surveys. Previous efforts have considered surveys that may have blue crab data that is useful to help inform blue crab population dynamics. These surveys include the Winter Dredge Survey (WDS), ChesMMAP, the VIMS trawl survey, the Maryland trawl survey, the striped bass young-of-the-year seine surveys, and the Abbe pot survey. We will conduct analyses to develop standardized indices and characterize uncertainty in the indices. These index data will also be used to develop observations of sex composition and the distribution of carapace widths of blue crabs.

TOR 3: Describe and quantify patterns in catch, effort, and CPUE. Analyses should include: (1) Estimation of catch and effort for each jurisdiction; (2) Evaluation of the utility of a commercial CPUE index in the assessment; (3) Examination of the impacts of reporting changes and trends in CPUE; (4) Evaluation and quantification of bycatch and/or discard mortality, and recreational harvest using available data from the jurisdictions; and (5) Characterization of uncertainty in the data.

We will characterize catch and effort on a monthly basis for multiple regions within the bay. This characterization will allow us to consider stock assessment models that operate at different temporal or spatial scales. Recreational harvest data are limited, but we will consider the estimates provided by Jones et al. in the 1990s and Semmler et al. from the 2010s. We anticipate that the final year of catch data used in the assessment will be 2023 or 2024.

TOR 4: Evaluate the feasibility of, and if possible, implement blue crab stock assessment models that operate on sub-annual time steps and/or at spatial resolutions lower than that of the entire Chesapeake Bay to better represent population dynamics.

We will develop state-space stock assessment models that operate on subannual time steps. Initially, we will consider a monthly time step throughout the portion of the year when the fishery occurs and a winter time step for the period when the fishery is not operating. We will also consider spatial models that break the Bay into multiple regions. The model will also estimate candidate biological reference points (BRPs) for recruitment, abundance of males, abundance of females, and exploitation rates for each category. We will consider approaches that use spawning potential ratio and maximum sustainable yield to guide reference point development.

TOR 5: Characterize uncertainty in assessment estimates (mortality and abundance).

We will implement the model using either frequentist (maximum marginal likelihood) or Bayesian approaches. Either approach will allow the estimate of uncertainty in abundance, recruitment, mortality rates, and stock assessment model parameters.

TOR 6: Update the sex-specific catch survey models used in the 2011 benchmark stock assessment with relevant new data. Characterize major changes in assumptions between the 2011 assessment model and the 2023 model.

The sex-specific catch-survey model from the 2011 benchmark stock assessment will be updated with new index and catch time series. We will characterize the major changes between the 2011 assessment model and our new models developed for the benchmark stock assessment.

TOR 7: Based on assessment model results recommend appropriate biological reference points for management. To extent possible, evaluate the appropriateness and utility of (1) Aggregate bay wide reference points; (2) Sex specific reference points; and (3) Recruitment reference points.

As noted for TOR 4, the assessment model will estimate BRPs that can be used as reference points for management. We will develop candidate BRPs for aggregated abundance at the Bay-wide scale, sex-specific BRPs for abundance and exploitation rates, and BRPs for recruitment.

TOR 8: Evaluate stock status relative to recommended reference points.

The estimated abundance and exploitation rates from TORs 4 and 6 will be compared to the estimated BRPs estimated in TORs 6 and 7 to generate estimates of stock status.

TOR 9: Identify relevant ecosystem and climate influences (such as habitat, environmental drivers, prey availability, and predation/cannibalism) on the population dynamics and fisheries and, to the extent possible, explore other analyses that support the assessment.

We will conduct a range of analyses to explore the effects of potential environmental drivers on Chesapeake Bay blue crab population dynamics. These analyses can be categorized as analyses that are done outside the stock assessment models and those that are conducted by including environmental variables in the stock assessment model. For example, we will consider the effects of blue catfish (*Ictalurus furcatus*) predation on blue crabs using generalized linear models of blue crab recruitment in the fall months in the VIMS trawl survey as a function of catch-per-unit-effort (CPUE) of blue catfish in the VIMS trawl survey in the Virginia tributaries to the Chesapeake Bay. This type of analysis will allow testing of environmental effects on recruitment. An example of an environmental driver that may be included in the stock assessment model is winter severity on blue crab survival. The WDS has documented winter kills of blue crabs in years with low water temperatures, particularly in Maryland. We will consider including a winter natural mortality variable in the stock assessment model that is related to winter temperature to capture this effect. Other variables will be explored in a similar manner.

TOR 10: Identify existing data sources and gaps, and, to the extent possible, characterize the uncertainty in the relevant sources of data.

We will be considering a wide range of potential data sources available for the Chesapeake Bay Blue Crab stock assessment. A part of that consideration will be to document potential uses of each data set as well as their limitations. The uncertainty of each data set will be characterized.

TOR 11: Report on the status of research recommendations from the most recent benchmark assessment. Identify and prioritize research recommendations for future work.

The stock assessment team will develop a prioritized list of research recommendations based on the benchmark stock assessment.

Appendix D. Estimated abundance of blue crabs from the Chesapeake Bay-wide Winter Dredge Survey, total commercial harvest, and female exploitation rate, 1990-2025*. Juvenile crabs are age 0 and adult crabs are age 1+.

WDS Year (Year Ended)	Total Crab Abundance (millions)	Juvenile Crab Abundance (millions)	Adult Crab Abundance (millions)	Adult Female Abundance (millions)	Total Commercial Harvest (millions of pounds)	Female Exploitation Rate (%)
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	59	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	69	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	42	19
2021	282	86	197	158	36	26
2022	227	101	125	97	42	31
2023	323	116	206	152	45	25
2024	317	138	179	133	43	22
2025	238	103	134	108	TBD	TBD

*2025 estimates of commercial harvest and female exploitation rate will be determined after the 2025 harvest season.