

Blue Crab Abundance and Management Outcomes

Management Strategy



Introduction

The blue crab (*Callinectes sapidus*) is an icon for the Chesapeake Bay region. The blue crab commercial and recreational fisheries are some of the most economically valuable fishery sectors in the Bay. Blue crab is also an important component of the Chesapeake Bay ecosystem. Sound management is critical to ensure the sustainability of this resource. The Chesapeake Bay blue crab fishery is managed by three jurisdictions: the State of Maryland, the Commonwealth of Virginia, and the Potomac River Fisheries Commission.

Jurisdictions and blue crab fishery stakeholders have recently explored tools, such as electronic harvest reporting protocols, to improve management of the fishery. The Blue Crab Management Outcome promotes continuing these discussions, as well as evaluating the possibility of a Baywide allocation among jurisdictions as part of the management framework for the fishery. The fisheries managers and stakeholders considered 2018 an appropriate target date for this evaluation because the intervening time allows them to address the science and management questions associated with developing a jurisdictional allocation. Further, the next benchmark stock assessment is expected in 2016-2017 and the results of this effort may present new data analyses and inform any changes to the current management.

I. Goal, Outcome and Baseline

This management strategy identifies approaches for achieving the following goal and outcome:

Sustainable Fisheries Goal: Protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Bay.

Blue Crab Abundance Outcome: Maintain a sustainable blue crab population based on the current 2012 target of 215 million adult females. Refine population targets through 2025 based on best available science.

Blue Crab Management Outcome: Manage for a stable and productive crab fishery including working with the industry, recreational crabbers and other stakeholders to improve commercial and recreational harvest accountability. By 2018, evaluate the establishment of a Bay-wide, allocation-based management framework with annual levels set by the jurisdictions for the purpose of accounting for and adjusting harvest by each jurisdiction.

Baseline and Current Condition:

Abundance

The [2011 benchmark blue crab stock assessment](#) recommended female-specific reference points with an abundance target of 215 million spawning-age (1+ years old) females. This target abundance is associated with a recommended target exploitation rate. The 2011 benchmark assessment also recommended a threshold, or “minimum safe level”, of 70 million spawning-age female crabs. These reference points were developed and recommended based on widespread convention in fisheries management. The stock assessment recommended that reference points be specific to adult (age 1+) female crabs as they represent the spawning stock. The jurisdictions have been operating under these female-specific reference points since they were adopted in 2012.

Management: Allocation-Based Framework

Jurisdictions and partners will evaluate the possibility of an allocation-based management framework, which refers to the development of one or more methods to allocate an annual total allowable catch (TAC) of female and male crabs for the Chesapeake Bay blue crab fishery among the three management jurisdictions—Virginia, Maryland and the Potomac River Fisheries Commission. A TAC is the total number/pounds of crabs that can be harvested by recreational and commercial fisheries in the Chesapeake Bay each year. A jurisdictional allocation is the percentage of the TAC assigned to each of the Bay management jurisdictions based on mutually agreed-upon criteria that can be modified by jurisdictional agreements.

If an allocation-based management framework was considered for the future fishery, each management jurisdiction would be responsible for implementing management actions to ensure their jurisdictional allocation would not be exceeded. The allocation framework would be based on updates from the upcoming 2016 blue crab benchmark stock assessment, which will provide updates to the current female reference points and information/recommendations on developing make reference points moving forward.

II. Participating Partners

The following partners have participated in the development of this strategy. A workplan to accompany this management strategy will be completed six months after this document is finalized. It will identify specific partner commitments for implementing the strategy.

Chesapeake Bay Watershed Agreement Signatories

- State of Maryland
- Commonwealth of Virginia
- District of Columbia
- Federal Agencies (National Oceanic and Atmospheric Administration)
- Chesapeake Bay Commission

Key Participants

The Maryland Department of Natural Resources (MDNR), Virginia Marine Resources Commission (VMRC), and the Potomac River Fisheries Commission (PRFC) are the management agencies for the Chesapeake Bay blue crab fishery. Management is coordinated among these jurisdictions by the Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team (Fisheries GIT) which seeks scientific advice from the Chesapeake Bay Stock Assessment Committee (CBSAC). CBSAC 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 the Chesapeake Bay jurisdictions. CBSAC combines the expertise of state biologists and scientists from the Chesapeake Bay region with federal fisheries scientists from the NOAA National Marine Fisheries Service's Northeast and Southeast Fisheries Science Centers. CBSAC presents their annual findings and recommendations in the form of an annual advisory report to the full Fisheries GIT.

In addition to data analysis and management recommendations, CBSAC also provides research recommendations in their annual report. Targeted research is essential to better understand the blue crab population and fisheries.

Stakeholder Engagement

Each management jurisdiction actively engages commercial and recreational harvesters through established blue crab stakeholder committees and advisory groups, including the:

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| - Maryland Blue Crab Industry Advisory Committee | - Maryland Tidal Fisheries Advisory Commission |
| - Maryland Blue Crab Industry Design Team | - Potomac River Crab Advisory Committee |
| - Maryland Sport Fisheries Advisory Commission | - Virginia Marine Resources Commission Crab Management Advisory Committee |
| | - Virginia Blue Crab Industry Panel |

III. Factors Influencing

The Chesapeake Bay blue crab population and associated fisheries are impacted by a variety of ecosystem factors and natural variability in population dynamics. Many of these factors cannot be controlled or managed by the jurisdictions; instead managers and scientists rely on the best available data to understand the impacts of these factors and make informed management decisions.

The following are natural and human factors that influence the partnership's ability to attain this outcome. Harvest and fishery conditions were identified as a top priority factors to consider since harvest and effort controls are regulated by the fishery management agencies. Regarding ecosystem factors that can affect blue crab abundance, habitat loss was identified as the top priority, followed closely by predation.

Harvest Impacts and Fishery Conditions

Blue crabs continue to support a valuable commercial and recreational fishery in the Bay. The blue crab fishery is complex, with multiple commercial and recreational gear types, various season lengths and regulations in three management jurisdictions. Fishing practices and the resulting harvest vary because of the complex ways crabs migrate and disperse throughout the Bay. Harvest regulations may affect fishermen in one area differently than in another area, and regulation changes can alter fishery impacts on the blue crab population. In addition to understanding Baywide fishing effort, knowing how harvest levels change from year-to-year and within each year is important to inform management decisions. Improving commercial and recreational harvest reporting would provide managers with a more accurate estimate of harvest each year and better support mid-season management changes. The profitability of the fishery varies depending on many factors including price fluctuations over time and space, as well as the operating and related costs (license fees, fuel, crew, bait, etc.).

Data Gaps

Resource managers make management decisions based on the best available data, and must make assumptions when data are unavailable. Key data gaps for blue crabs in the Chesapeake Bay include accurate harvest and effort reporting, summer abundance and spawning stock data, recreational harvest and effort, natural mortality, reproductive limitations and success, and other factors. As managers begin to evaluate options for an allocation-based jurisdictional framework, the need to better understand the spatial distribution of exploitable stock and to receive timely and accurate harvest and effort data will become more important. Filling these data gaps would reduce uncertainty associated with management decisions. Availability of funding, coordination, and data analysis resources will affect how and when these data gaps can be addressed.

Population Dynamics

The blue crab exhibits highly variable population dynamics, in part because of its complex life history during which different life stages occupy different habitats. Blue crabs produce many offspring in multiple broods released over two or more years, but survival of larvae in the ocean is unpredictable. Recruitment of young crabs into the Bay fluctuates widely from year to year, and is influenced a variety of oceanic and climatic conditions that influence larval survival in the ocean waters and the ability of larvae to be transported back into the Bay via winds and currents. Larval abundance is also dependent on the abundance of spawning females although a high abundance of spawning age females does not guarantee consistently high reproduction. Once young crabs arrive back in the Bay, many factors continue to influence their survival, including:

- Predator and prey abundance
- Competition
- Salinity
- Temperature
- Hypoxia
- Habitat quality
- Overwintering mortality
- Disease

Ecosystem Factors (in priority order)Habitat Loss

Juvenile and molting adult blue crabs obtain refuge from predation by use of key habitats that provide structural complexity or are inaccessible to predators. Loss of submerged aquatic vegetation (SAV) limits primary nurseries in the Chesapeake Bay and potentially affects blue crabs by concentrating recruiting individuals in limited nursery habitats. The unvegetated bottom adjoining salt marshes also provides crucial resources for juvenile blue crabs. The loss of shallow water habitats along natural marshes and forested areas because of shoreline hardening has affected benthic communities and habitats in the nearshore areas. This results in loss of shallow-water refuge and benthic prey provided by marsh edges and other shallow habitats.

Predation and Prey Availability

Predation is a limiting factor on blue crab population size in Chesapeake Bay and affects population dynamics, survival, and reproduction. Predation varies seasonally, spatially, and among habitats and affects the smallest and earliest life history stages most greatly. The highest mortality from predation likely occurs during the larval stage when the blue crab larvae are outside the Bay in the ocean. Juvenile and adult blue crab mortality is contingent upon predation by a variety of finfish, birds and other species in the Bay. Cannibalism is also major source of mortality, especially for juvenile crabs as their smaller size increases their susceptibility to cannibalism and predation.

Blue crabs feed on benthic prey that can be limited by environmental conditions such as long periods of severe hypoxia. Eutrophication, habitat alteration and abundance of crab competitor species impact benthic prey abundance and may limit availability to blue crabs.

Dissolved Oxygen

Responses to low dissolved oxygen (DO) by blue crabs is determined in part by the severity of such events and the crab's tolerance to low oxygen levels. Hypoxic and anoxic zones have been increasing, due in part to nutrient loading from land-based sources, including an increase in impervious surfaces in the Bay watershed. Typically, blue crabs move out of deeper water affected by low DO and into shallow areas during hypoxia or anoxia. In doing so, they become more concentrated in the shallows and are more susceptible to fishing gear, density-dependent predation and agonistic interactions. Low DO may also interfere with the dispersal of juvenile blue crabs into the estuary and with mature females migrating to the mouth of the Bay to spawn.

Disease

Blue crabs are known to harbor a variety of pathogens that can be fatal to the crabs, but are not harmful to humans. *Hematodinium perezii* is commonly found infecting crabs during fall in high salinity areas of the lower Chesapeake Bay. In contrast, reo-like virus can be found Baywide and is often observed infecting crabs that die in crab shedding facilities. The effects of these and other diseases on the Baywide crab population remain poorly understood and potentially could make a large contribution to mortality in the fishery as well as affected ecosystems.

Climate Change

Climate change is predicted to have a wide range of effects on the blue crab in Chesapeake Bay, including blue crab mortality, habitat availability, and weather effects on recruitment dynamics.

Temperature changes could affect the mortality rates of blue crabs during the winter and change the species assemblage of blue crab predators and prey in the ecosystem. Sea level rise and changes in temperature and salinity may affect the marsh, benthic and SAV habitats that serve as important blue crab nursery and foraging areas, but these impacts may be complex and difficult to predict as the correlation is highly variable and changes along with interactions between abiotic factors. With warming temperatures and changing precipitation, low DO areas are likely to increase in extent and duration, which could reduce foraging resources and limit the available suitable habitat for blue crabs.

IV. Current Efforts and Gaps

Stock Assessments and Annual Surveys

Currently, blue crabs are managed in a Baywide manner in which the jurisdictions work collectively to ensure that fishing levels stay at or near the established target. Blue crab management in Chesapeake Bay is guided by comprehensive stock assessments that are done approximately every five years. Stock assessments are complex mathematical analyses that combine the most recent information (catch and effort, survey data) on a given fishery to answer important questions about the health and management of an exploited species. Stock assessments inform managers about levels of fishing pressure that will ensure maintenance of a healthy population and provide guidance on the abundance of spawning-age animals necessary to ensure the population can sustain itself. A stock assessment also provides estimates of fishing pressure and stock abundance relative to the estimated benchmarks for a healthy population. These benchmarks are known as biological reference points. The most recent Chesapeake Bay blue crab stock assessment, conducted in 2011, was conducted by scientists from the University of Maryland Center for Environmental Studies, the Maryland Department of Natural Resources, the Virginia Marine Resources Commission, and the Virginia Institute of Marine Science. The assessment was peer reviewed by international fisheries scientists from the Center of Independent Experts (CIE).

The annual Bay wide Winter Dredge Survey is the only comprehensive Bay wide survey designed specifically to estimate the number of blue crabs present in the Bay by gender and size class. The survey has been conducted since 1990 and is conducted in winter when blue crabs are not highly mobile. The survey is the cornerstone of the periodic, comprehensive stock assessments and provides an annual measure of population health. Other efforts are ongoing to gather the best possible data about the blue crab population. Both the State of Maryland and the Virginia Institute of Marine Science conduct trawl surveys during the summer and fall. These surveys have been conducted annually since the 1970s and provide valuable ancillary information about growth and distribution of crabs in the Bay.

Successful management of the Chesapeake Bay blue crab fishery requires annual monitoring of population status and exploitation relative to the benchmarks (biological reference points) produced by the periodic stock assessments. This annual review of the blue crab population is conducted by CBSAC, which reviews the Winter Dredge Survey results, summer trawl survey data, and harvest estimates in order to assess the status of the blue crab population and exploitation using reference

points, currently the female-specific targets and thresholds. This information is published in an annual [Chesapeake Bay Blue Crab Advisory Report](#) and [Figures](#).

Harvest and Effort Data Reporting

High-quality harvest and effort data are essential for crafting effective and equitable management approaches, as well as for making decisions about jurisdictional allocation. As such, all Chesapeake Bay management jurisdictions have ongoing efforts to improve the quality of catch and fishing effort information submitted by commercial and recreational harvesters. Maryland, Virginia, and PRFC all require daily harvest reports to be submitted on a regular basis that include information on the water body fished, the gear type used, the amount of gear, sex and size specific harvest amounts, where catch was landed in and who the harvest was sold to. The three jurisdictions are also pursuing new reporting technologies and analyses:

Maryland

- In the past, the State of Maryland has conducted effort surveys which provide estimates of the number of pots deployed each month in Maryland waters. This survey, combined with data from the Maryland reference fleet (Cooperative Blue Crab Data Collection Program) which provides number of crabs caught per pot has allowed Maryland to quantify the magnitude of bias in harvest reports during the years when both surveys were conducted. The reference fleet provides valuable information about fishing effort, the biological characteristics of the catch, including size, sex, and life stage composition.
- Since 2012, Maryland has been conducting a pilot electronic reporting system that allows commercial crabbers to enter each day's harvest from their vessel. The system also provides opportunity for roving monitors to meet crabbers as they arrive at the dock and verify the electronically reported harvest. This results in more timely, accurate, and verifiable harvest data that are essential for a robust stock assessment. Maryland is continuing to expand the use of this system for the commercial crabbing fleet.

Potomac River Fisheries Commission

- Electronic reporting has not been used to date, but PRFC is going to start exploring such. There is interest among our stakeholders, and there it is possible that PRFC may begin using an electronic reporting system by 2016.

Virginia

- Regarding online reporting for blue crabs, VMRC worked with the Virginia Blue Crab Industry Panel, the Virginia Watermen's Association and Virginia Sea Grant to promote VMRC online reporting as an option for submitting mandatory harvest reports. Through this cooperative work, an informational flyer, a visual guide and online tutorial were produced. Since this work began the number of crabbers submitting electronic reports has increased significantly.

Gaps: Reduce Uncertainty

A key to improving fishery management is reducing the uncertainty in the data upon which management is based. Identifying areas of uncertainty and developing strategies to address them are ongoing priorities of the Chesapeake Bay management jurisdictions. The annual CBSAC Blue Crab Advisory Reports contain advice to the Chesapeake Bay management jurisdictions on priority areas of uncertainty. Currently, priorities are focused on studies that would reduce uncertainty in estimates of crab abundance generated by the Baywide Winter Dredge Survey. Specifically, the CBSAC has recommended work to acquire a better understanding of the effectiveness of the dredge gear at sampling crabs of various sizes in differing sediment types. The CBSAC has also recommended that the jurisdictions continue to advance methods to improve the accuracy of commercial harvest reports and to better understand recreational harvest in the jurisdictions.

Reducing uncertainty leads to management improvements on all levels: more robust reference points that establish target levels of fishing and abundance and more accurate estimates of stock abundance. In turn, increased confidence in reference points and in population estimates can facilitate management decisions such as the development of a TAC for blue crabs and an allocation of that TAC among the jurisdictions. Reducing uncertainty in all data sources will allow for the calculation of a precise TAC and will allow the jurisdictions to consider an array of options when evaluating allocation and the performance of the respective fisheries.

In addition, effective blue crab management requires an assessment of the economic value generated by the commercial and recreational sectors of the fishery and how these are impacted by regulatory changes and stock fluctuations regionally and throughout the crabbing season. In order to predict these impacts, it is necessary to understand how economic incentives interact with regulations and stock fluctuations to influence the supply responses of harvesters. Similarly, managers require access to economic information in order to fully evaluate allocation in terms of economic efficiency and benefit. Finally, given that maximizing economic welfare may not be the only consideration behind the management of the resource, understanding the costs associated with trading off economic benefits for alternative objectives, will inform adaptive management decisions.

V. Management Approaches

The partnership will work together to carry out the following actions and strategies to achieve the blue crab abundance and management outcomes. These approaches seek to address the factors affecting the ability to meet the outcomes and the gaps identified above.

- Planning and Implementing the Benchmark Stock Assessment

Planning for the 2016-17 benchmark stock assessment began during fall 2014, when the CBSAC discussed current available data sources and research needs. From the results of the previous 2011 stock assessment model, a female-specific exploitation rate and female-specific abundance reference points were developed. The next benchmark stock assessment will address the Terms of Reference (TORs) that include development of both female and male reference points for holistic management of this stock. Male and female reference points are important because the availability, abundance, and harvest of male and female blue crabs varies spatially throughout

the Chesapeake Bay, with more female blue crabs being harvested in the lower Bay (Virginia), and more male blue crabs being harvested in the upper Bay (Maryland).

The TORs have been drafted for the next benchmark assessment. The TORs address specific needs of the Bay jurisdictions for future management, including issues specific to fishery sectors (recreational, commercial, gear-specific) and uncertainty associated with blue crab predator-prey interactions. The TORs, once approved by the Fisheries GIT, will be resubmitted to the CBSAC to develop a cost estimate for accomplishing the benchmark assessment. Funding availability will determine whether the benchmark assessment will be conducted and finalized in 2016 or 2017.

- Evaluation of an Allocation-based Jurisdictional Management Framework

Jurisdictions will evaluate the overall benefits of a shift to a Baywide Allocation-based Management Framework as well the fundamental steps that would be needed to develop a total allowable catch (TAC) and jurisdictional allocation. The establishment and allocation of a TAC would allow each jurisdiction to manage their particular fisheries to achieve their allocated portion of the annual catch. It would also effectively hold each jurisdiction accountable for their management actions and could provide the jurisdictions with greater ability to independently manage this shared resource. Allocation of a TAC, however, does have pros and cons that will be carefully considered by the jurisdictions during the evaluation.

A fundamental step toward developing a Baywide TAC is the successful completion of the planned benchmark stock assessment and successfully addressing the TORs. Reliable, accurate data is critical for success for an allocation management framework. The steps are as follows:

- a. Calculate a Baywide TAC of blue crabs based on the results of the annual Bay-wide Winter Dredge Survey as well as any other surveys with improved estimates of removals.
 - i. For female crabs: empirically derived TAC using the annual estimate of the exploitable female stock (age 0-plus) and the current reference points, with the understanding that exploitation rate does not include removals from discards.
 - ii. Options for male TAC (biological reference points are not currently identified) include using current conservation triggers, male-female ratios, or use information from new stock assessment.
 - iii. Consider management and scientific uncertainty in the above options.
 - iv. Consider how often TAC is calculated
- b. Develop and explore options for allocating a percentage of the Bay wide TAC to jurisdictions. Options could include using historical data and possibly weighting this data to account for the shift to female-centric management. Other options could incorporate the seasonal availability of crabs to various fishing sectors (male, female, soft and peeler fisheries) as well as socio-economics.
 - i. Consider under what circumstances it would be necessary to reallocate (new jurisdiction percentages).
- c. Develop and implement a Management Plan based on the reference points developed through the benchmark stock assessment, the TAC and jurisdictional allocation.

Cross-Outcome Collaboration and Multiple Benefits

More information can be found in the “Factors Influencing” section on pages 4-7.

- Forage: Understanding the status of the forage base will help determine the extent to which blue crab is prey for key predator species and how this contributes to blue crab mortality rates.
- Climate change: Monitoring and quantifying climate change impacts would help managers and scientists better predict the effects on blue crab mortality.
- Fish Habitat and SAV: Improving and/or protecting important habitats that blue crabs rely on will promote survival of blue crabs, especially juveniles that rely on habitats such as SAV for refuge from predators.
- Water quality: Improvements in water quality and decreased nutrient loading could improve suitable habitat available to blue crabs that are currently uninhabitable because of low dissolved oxygen levels from eutrophication.

VI. Monitoring Progress

The Winter Dredge Survey produces estimates of blue crab abundance in the Chesapeake Bay each year. This abundance estimate is paired with harvest data from the management jurisdictions to calculate the percentage of the crab population that is removed by harvest each year. See the “Assessing Progress” section below for more detail on how these estimates are used to determine the status of the blue crab population.

VII. Assessing Progress

Monitoring and assessing progress toward the Blue Crab Abundance Outcome will occur through the CBSAC’s annual review of blue crab survey data and through its annual determination of population status relative to biological reference points. In particular, the jurisdictions will closely monitor annual estimates of fishing pressure. It is the maintenance of fishing pressure at or near target levels that maximizes the probability of achieving and maintaining the target abundance level. The continuation of the annual Baywide Winter Dredge Survey will be essential for the monitoring of the stock and for determining whether management changes are needed to maintain fishing at target levels.

It is anticipated that a new benchmark assessment will occur in 2016, pending identification of funding. If the new benchmark stock assessment produces refined estimates of biological reference points (fishing levels and abundance) the jurisdictions will assess fishery performance relative to these new benchmarks.

Progress toward the evaluation of potentially implementing a jurisdictional allocation based on a total allowable catch will be monitored through regular communications among the jurisdictions, outputs of CBSAC reports which identify data uncertainty and through focused interactions with stakeholder advisory groups such as Maryland’s Blue Crab Industry Advisory Committee, Blue Crab Design Team and Tidal Fisheries Advisory Commission; Potomac River Crab Advisory Committee; Virginia Marine Resources Commission Crab Management Advisory Committee, and Virginia Blue Crab Industry Panel.

VIII. Adaptively Manage

The partnership will use the following approaches to ensure adaptive management:

- CBSAC will continue to estimate the population of blue crabs by incorporating new data when available, maintaining a risk averse approach, and providing recommendations to managers prior to the start of the crabbing season each year.
- CBSAC also continuously strives to increase both the accuracy and precision of the Winter Dredge Survey which remains the primary tool by which abundance estimates are calculated.
- Scientists who work on the benchmark stock assessments update stock assessment models and incorporate the best available data to address priority research and management needs.
- When the abundance estimate falls below the population threshold (currently 70 million age 1+ females), management jurisdictions discuss and coordinate appropriate management action to address the decrease in abundance.

IX. Biennial Workplan

Biennial workplans for each management strategy will be developed by December 2015. They will include the following information:

- Each key action
- Timeline for the action
- Expected outcome
- Partners responsible for each action
- Estimated resources

References

Blue Crab Species Team. 2009. Ecosystem-Based Fisheries Management for the Chesapeake Bay: Blue Crab Species Team Background and Issue Briefs. Maryland Sea Grant. [Link](#)

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