2009 Chesapeake Bay Blue Crab Advisory Report
Approved by the Fisheries Steering Committee: June 22, 2009

In 2006, the NOAA Chesapeake Bay Stock Assessment Committee (CBSAC) adopted the Baywide winter dredge survey (WDS) as the primary indicator of blue crab stock status because it is the most comprehensive and statistically robust of the blue crab surveys conducted in the Bay[1]. The WDS measures the concentration of crabs (number per 1,000 square meters) in Chesapeake Bay. These densities are then adjusted to account for the efficiency of the sampling gear and then expanded to reflect the area of Chesapeake Bay. The WDS provides a precise annual estimate of abundance of over-wintering crabs by age and gender grouping (Sharov et al. 2000).

Abundance

The abundance of spawning age crabs (age 1+) is a key indicator of stock status, and is used to determine if the population is overfished (see control rule section below). At the beginning of the 2009 commercial season, results of the 2008-2009 WDS indicated that the abundance of age 1+ blue crabs was 223 million crabs (Figure 1). This value represents a 70% increase over the 2007-2008 value of 131 million. The abundance of age-1+ crabs in 2008-2009 is above the interim target level of 200 million spawning age crabs (Figure 1). The increase in abundance of spawning-age adults in the 2008-2009 survey was due primarily to an increase in the number of females that are likely to spawn this season (females greater than 60 mm or 2.4 inches carapace width). The estimated abundance of spawning age females in the 2008-2009 survey is 165 million crabs (Figure 2). Male spawning potential (abundance of males greater than 60mm or 2.4 inches carapace width) in 2008-2009 was 59 million crabs (Figure 3).

Recruitment, as measured by the abundance of age 0 crabs (less than 60 mm or 2.4 inches carapace width) did not increase measurably from the 2007-2008 WDS. The estimated abundance of age 0 crabs was 169 million crabs during the 2007-2008 survey and 179 million crabs during the 2008-2009 survey. The abundance of young crabs remains well below the survey average of 258 million crabs (Figure 4).

Data from three supporting blue crab surveys (the Maryland and Virginia trawls and the Calvert Cliffs Pot study) were reviewed. Results of these surveys are presented in Appendix 1 of this report. The results of all three surveys indicate a substantial rise in adult abundance during 2008. The Virginia trawl survey is consistent with the winter dredge survey, showing continued low abundance of age 0 crabs in 2008. However, the results of the 2008 Maryland trawl survey showed a substantial increase in abundance of age 0 crabs.

Harvest

The estimated 2008 Bay-wide crab harvest from the Bay and tributaries was 48.6 million pounds, 11% higher than the record-low 2007 harvest of 43.5 million pounds, but well below the longterm average of 74 million pounds. The 2008 Maryland harvest is estimated to be 29.4 million pounds. The 2008 Virginia harvest was reported to be 16.7 million pounds, and 2.5 million pounds were reported harvested in the jurisdictional waters of the Potomac River Fisheries Commission (Figure 5). Recreational harvest is assumed to be 8% of the total harvest in all years (Ashford and Jones 2002)[2].

A comparison of harvest data in 2008 with those from earlier years gave no indication of changes in the pattern of reporting in either Virginia or in the Potomac River. However, Maryland experienced significant reporting problems in 2008 due to the 2008 management actions, which assigned daily catch limits based on an individual's catch history. Crabbers with no catch history in the most recent 4 years were not permitted to harvest female crabs during Maryland's 2008 fall female crab fishery, which begins September 1 and is historically responsible for 60 to 65% of Maryland's annual female harvest. This management action, combined with the large number of latent crab licenses in Maryland, resulted in inflated catch reports as previously inactive crabbers filed inaccurate, positive catches in order to position themselves for future regulatory action. Other changes in reporting behavior were evident and are outlined in Appendix 2. Maryland's 2008 harvest estimate is derived from weekly CPUE data gathered via Maryland's reference fleet of crabbers, and a concurrent survey that estimates the number of crab pots deployed in Maryland waters (Appendix 2).

Control rule

The control rule, which was adopted by the Bi-State Blue Crab Advisory Committee in 2001[3], and updated in the 2005 stock assessment[4], is the foundation for sustainable management of the blue crab fishery in Chesapeake Bay (Figure 6). The control rule represents the relationship between adult crab abundance (millions of crabs), exploitation (the fraction of crabs removed by the fishery in a year) and management reference points. In 2006 the CBSAC defined the overfished limit to be 86 million age 1+ crabs. This threshold value, observed in the 1999-2000 WDS, is the lowest value in the 20-year WDS time series, and is applied as a proxy based on a lack of historical evidence that a sustainable fishery can be maintained at less than 86 million crabs. The overfishing definition, or exploitation threshold, for this stock, is based on the consensus that a minimum of 10% of the spawning potential of an unfished population must be preserved to minimize the risk of recruitment failure and stock collapse. The target exploitation fraction of 46%, maintained over several years, represents an exploitation fraction that would preserve 20% of the unfished spawning potential.

In January 2008, CBSAC established an interim target of 200 million spawning age (1+) crabs. This target was established based on analyses suggesting that 200 million age 1+ is a minimum level associated with consistently higher levels of recruitment.

Stock Status

The abundance of spawning-age crabs in 2009 exceeded the interim target level for the first time since 1993. The percentage of crabs removed by commercial and recreational fishing (exploitation fraction) in 2008 is estimated to be 48%, which is below the overfishing threshold of 53%, but above the target of 46%. When considering both commercial and recreational harvest, the exploitation fraction has been above the threshold exploitation fraction of 53% in 8 of the last 11 years (Figure 7). Further, the exploitation fraction has not been below the threshold for more than two consecutive years since the mid-1990s.

Recommended harvest and exploitation

The 2008-2009 WDS produced an estimated total abundance at the beginning of the fishing season of 403 million crabs. Based on this abundance, the recommended harvest from Chesapeake Bay that should achieve the 46% target would be approximately 53.7 million pounds – slightly higher than the 2008 harvest of 48.6 million pounds.

Management Advice – Short Term

1) *Maintain conservation measures until full effects of these are known:*
   The 2008 management actions substantially restricted female harvest. Surviving females will begin spawning during the spring of 2009, and the success of this spawn should be reflected in the abundance of age 0 crabs estimated during the 2009-2010 WDS. However, recruitment is strongly influenced by environmental drivers which could prevent an immediate substantial increase in recruitment (age 0 abundance) despite increased adult abundance. Thus, the effectiveness of the conservation measures in the commercial fishery in 2008 will not be fully known until abundances in the 2009-2010 and 2010-2011 WDS are estimated. The CBSAC considers it important that conservation efforts be maintained until their impacts on recruitment and future spawning potential can be assessed.

2) *Latent effort:*
   The conservation effort in 2008 led to an increase in the abundance of mature female crabs in the 2008-2009 WDS. One threat to the sustainability of the crab stock, even under equivalent conservation levels to 2008, is the substantial effort that remains latent in the fishery. The CBSAC recommends that management pursue methods for eliminating latent effort so that it cannot enter the fishery sufficiently rapidly so as to compromise the ability of Bay managers to constrain the fishery to the 46% target removal level. Control of active effort is impeded because of the unknown quantity of latent licenses.

3) *Catch Reports:*
   Implement procedures that allow jurisdictions to validate harvest reports such as expanding the current observer coverage, implementing broader scale effort surveys, or developing logbooks that are linked with dealers as a means for validation. The jurisdictions should explore techniques that would promote reliable and real-time reporting.

4) *Recreational Catch and Effort:*
   Recreational catch and effort remains poorly quantified in Chesapeake Bay. The jurisdictions should consider methods for more precisely calculating recreational catch and effort, possibly through licensing systems.

Management Advice – Long Term

CBSAC recommends two principal strategies for consideration of future management of the blue crab fishery:

1) Catch Control:
A management strategy that sets annual catch levels based on estimates of abundance from the winter dredge could potentially balance annual harvests with highly variable recruitment. If jurisdictions wish to consider such an approach, now is the time to begin work developing a foundation for implementation and enforcement of catch-based management. This would require reliable, real-time reporting. In addition, a limited entry and/or property based approach would require identifying a suitable number of participants.

2) Effort Control:
Controlling effort has been the foundation of crab management in recent years. The principal tools used by managers have been limited entry, size limits, catch limits and seasonal closures. However, the total amount of effort expended in the fishery remains poorly quantified. Thus, the effectiveness of management efforts remains difficult to quantify. As part of a long term management plan, tighter effort controls maybe necessary. Effort monitoring programs could be improved by incorporating pot tagging so that pot effort is measurable and enforceable.

Recommended Analyses:
The last benchmark assessment for blue crabs was completed in 2005 with data through 2003. CBSAC recommends undertaking a new benchmark assessment that advances current knowledge of stock status and fishery performance. Terms of reference could include:

Terms of reference from the 2005 assessment:

- Assess and quantify the life history and vital rates of blue crab in the Chesapeake Bay that are relevant to an assessment of the stock.
- Describe and quantify patterns in fishery-independent surveys.
- Describe and quantify patterns in catch and effort by sector and region
- Develop and implement assessment models for the Chesapeake blue crab fisheries.

Possible additional terms of reference for new benchmark assessment:

- Examine density-dependent exploitation patterns.
- Evaluate the potential for sex-specific biological reference points, including a sex-ratio benchmark.
- Recommend biological reference points.
- Describe and quantify patterns in catch and effort by sector and region, including analysis that examines trends in CPUE.
- Conduct life-history modeling that characterizes sensitivity of population to demographic rates. Some elements to be considered include:
    - Sperm limitation potential.
    - Fecundity and maturity schedules for female crabs.
    - Exploitation rates for different fishery sectors such as peelers.
    - Interactions of life history differences between male and female and different exploitation patterns (both management and market driven) rates.
    - Spatial variation

Critical Data Needs:
It is critical that robust, fishery-dependent data collection programs be maintained and improved for blue crabs throughout the Chesapeake Bay. The WDS remains the core of the assessment of blue crab in the Chesapeake Bay. However, this sampling framework provides an abundance estimate for crabs only for the beginning of the season. A mid-season abundance estimate and a fall recruitment estimate would also be of high utility. Other program should consider the need for improved information on biological characteristics of the harvest and reliable effort data for the commercial and recreational fisheries. A collaborative and coordinated Bay-wide, fishery-independent survey focused on the spring through fall distribution and abundance of blue crabs remains important.

Chesapeake Bay Stock Assessment Committee Members:

Chris Bonzek, VIMS (not present)
Lynn Fegley, Maryland DNR - chair
John Hoenig, VIMS
Tom Miller, CBL
Rob O'Reilly, VMRC
Derek Orner, NMFS/NCBO
Alexei Sharov, Maryland DNR
Josef Idoine, NMFS/NEFSC
Doug Vaughan, NMFS/SEFSC

Also Participating:

Rom Lipcius, VIMS
Eric Johnson, Smithsonian Environmental Research Center
Glenn Davis, Maryland DNR

Literature Cited

1. Sharov, A. F., J. H. Volstad, G. R. Davis, B. K. Davis, R. N. Lipcius, and M. M. Montane. 2003. Abundance and exploitation rate of the blue crab (*Callinectes sapidus*) in Chesapeake Bay. Bulletin of Marine Science **72**:543-565.
2. Ashford, J. R., and C. M. Jones. 2002. Survey of the blue crab recreational fishery in Maryland, 2002. Final Report to the Maryland Department of Natural Resources. Annaplos, MD. 31p.
3. Bi-State Blue Crab Advisory Committee. 2001. Taking Action for the Blue Crab: Managing and Protecting the Stock and its Fisheries. A report to the Chesapeake Bay Commission; Annapolis, Md, Richmond, Va. 24p.
4. Miller, T. J. et al. 2005. Stock Assessment of the Blue Crab in Chesapeake Bay. Technical Report Series No. TS-487-05 of the University of Maryland Center for Environmental Science, 162p.
5. Fogarty, M.F. and T.J. Miller. 2004. Impact of a Change in Reporting Systems in the Maryland Blue Crab Fishery. Fisheries Research. 68:37-43.