

2005 Chesapeake Bay Blue Crab Advisory Report

Approved by the Fisheries Steering Committee: June 17, 2005

Status of the Stock: Analysis of long-term fishery-independent surveys conducted in Chesapeake Bay (Maryland and Virginia trawl surveys, Calvert Cliffs peeler pot survey and Baywide winter dredge survey) indicate that overall abundance of blue crabs in 2004 remained low but similar to the 2002 and 2003 abundance levels. While this represents an improvement compared to the near historically low abundance levels occurring in 2000 and 2001, stock abundance levels remain relatively low, and, notably, survey results are not uniform. Also, while the abundance of juvenile (age 0) crabs increased, the abundance of both exploitable crabs (age 1+) and mature female crabs declined slightly in 2004. Relatively low stock levels continue to create a risk of recruitment failure. The current status of the stock was compared to thresholds and targets endorsed by regional management agencies in January 2001. Stock abundance in 2004 was above the overfished threshold, but remained below the Bi-State Blue Crab Advisory Committee (BBCAC) abundance action threshold (Figure 1). Measures of fishing mortality (F) indicate high exploitation rates, and the fishing mortality rate, as measured by the winter dredge survey, was above the action threshold. Fishing mortality has been above the action threshold in every year since 1997, except in 2003. Low abundance, combined with a high exploitation rate, indicated a stock condition that warrants concern for the eighth consecutive year.

Estimated fishing mortality ($F = 1.19$) from the winter dredge survey (the Chesapeake Bay Stock Assessment Committee's [CBSAC] preferred method) increased substantially from 2003 ($F = 0.80$), after decreasing in three of the previous four years (Figure 2 – solid line). As estimated by this method, F was above both the overfishing threshold ($F_{10\%} = 1.0$) and the target ($F_{20\%} = 0.7$). The estimate of F derived from the length-based method ($F = 0.78$) suggests that F has remained relatively stable for several years (Figure 2 – dashed line), and was below the overfishing threshold, but above the target. Continued uncertainty about the appropriate rate of natural mortality (M) and the conversion rates used to change harvest data from pounds to numbers are primary factors contributing to uncertainty in the estimation of fishing mortality rates and biological reference points.

The 2004 Chesapeake Bay commercial harvest of approximately 60 million pounds represents a 25% increase from 2003. This contrasts with a significant downward trend in landings over the previous several years, but the 2004 harvest was well below the time series (1968-2004) average of 73 million pounds (Figure 3). The low harvest in 2004 was principally a result of low exploitable stock abundance. However, the harvest was also constrained by management measures implemented in prior seasons.

Despite uncertainty, it appears that fishing mortality was above the target level. Recruitment improved for the second consecutive year, and was above the long-term average. Female spawning stock biomass was average but declined after three years of moderate increases from previous near historically low levels. However, estimates of female abundance from the Virginia trawl survey have been below average for 11 of the past 14 years, including 2004. Exploitable stock abundance was below the Bi-State Blue Crab Advisory Committee (BBCAC) Decision Rule action threshold. There is a consensus among committee members that harvest restrictions should not be lifted until abundance indices show a significant improving trend, and until stock abundance and fishing mortality rates intersect outside the Control Rule precautionary range (Figure 1).

Data: Four fishery-independent surveys are used to determine stock status: Virginia trawl survey, Maryland summer trawl survey, Calvert Cliffs crab pot survey, and Baywide winter dredge survey. Data from the two trawl surveys and the Calvert Cliffs pot survey are based on calendar year collections through 2004. The winter dredge survey data represent seasonal collections from December 2004 through March 2005. Indices from the winter dredge survey are expressed as estimates of the number of crabs per unit area. All other indices are expressed as the geometric mean catch per unit effort. Modified and standardized width-age cutoff values were used to differentiate age classes for three of the four surveys (Maryland and Virginia trawl and Calvert Cliffs pot survey) used to derive the abundance indices.

Biological Reference Points: A review of targets and thresholds for Chesapeake Bay blue crabs was conducted by an expert panel, convened by the BBCAC, in 2000. The panel identified exploitation and abundance thresholds and an exploitation target. The overfishing threshold ($F_{10\%} = 1.0$) and target fishing mortality rate ($F_{20\%} = 0.7$) refer to the levels of spawning potential which are 10% and 20%, respectively, of the spawning potential expected in a stock on which no fishing occurs. The overfished threshold (B_{low}) is equal to the lowest exploitable stock size observed in the fishery independent trawl, pot, and dredge surveys conducted in Chesapeake Bay from 1968 to the present and corresponds to the 1968 Virginia trawl survey estimate of stock size. There is considerable uncertainty about the appropriate value for natural mortality (M), but it is assumed to be 0.375.

Fishing Mortality: The winter dredge survey estimate of F was 1.19 in 2004. After falling below the BBCAC threshold in 2003, F was estimated to be above that threshold in 2004. This represents the sixth year in the last seven that the dredge survey estimate of F was higher than 1.0 ($F_{10\%}$) and it has been above the target F ($F_{20\%} = 0.70$) since 1997. The length-based F , as determined from the Maryland and Virginia trawl surveys, the Calvert Cliffs crab pot survey, and the Baywide winter dredge survey, was 0.78 in 2004 (range = 0.64 to 0.90). None of the current length-based fishing mortality rates, estimated from individual surveys, exceeded the threshold $F = 1.0$, and one was below the target $F = 0.7$ (Calvert Cliffs).

Recruitment (2002-2004): Recruitment, averaged over the most recent three years, was near the long-term average for the Maryland and Virginia trawl surveys, and, for the first time in five years, was within average bounds for the Baywide winter dredge survey. With data for the three surveys combined, it appears that recruitment improved in 2004 for the second year in a row (Figure 4). Recruitment has stayed within 'normal' bounds (between -1.0 and 1.0 in Figure 4) for 12 years, and in 2004 it exceeded the long-term average level (0-line in Figure 4), for the first time in the past six years.

Exploitable Stock Abundance (2002-2004): The three-year running average abundance of exploitable (age 1+) crabs was below the lower prediction bound (i.e. 'below average'), for two of the four surveys (Maryland and Virginia trawl surveys) and was within the prediction bounds (i.e. 'average') for two surveys (Calvert Cliffs and winter dredge). Data for all surveys combined indicate that the exploitable stock abundance was nearly unchanged, compared with 2003 (Figure 5). Though within 'normal' bounds (between -1.0 and 1.0 in Figure 5), abundance of exploitable blue crabs has been below the long-term average level (0-line in Figure 5) for ten of the past eleven years.

Spawning Stock Abundance (2002-2004): The three-year running average of mature female spawning stock abundance was within the prediction bounds (i.e. 'average') for three of the four fishery independent surveys (Calvert Cliffs, Maryland trawl, winter dredge). The three-year running average for the fourth survey (Virginia trawl survey) was below the prediction bound for the eleventh straight year. Data for all surveys combined indicated that spawning stock abundance was about the same in 2004 as in 2003, ending a three-year upward trend following a historical low in 2000 (Figure 6). Spawning stock abundance has been below the long-term average (0 line in Figure 6) for eleven of the past thirteen years.

Harvest: The three-year average (2002-2004) commercial Baywide harvest (54 million pounds) was 26% below the long-term (1968-2004) average of about 73 million pounds and was considerably below the prediction bounds (Figure 3). The 2004 Baywide harvest of approximately 60 million pounds was below average but represented a 25% one-year increase from 2003. Based on the historical relationship between winter dredge survey abundance and commercial harvest, it is expected that the 2005 Baywide commercial Chesapeake Bay harvest will be higher than the 2004 harvest.

Management Advice: Management measures implemented from 2001 through 2003 to conserve the blue crab stock were necessary, given the persistent condition of low stock abundance. Bay jurisdictions should, at a minimum, keep all current management measures in place. The primary management goal of doubling the blue crab spawning potential has yet to be achieved, and depends on maintaining a fishing mortality rate equal to the BBCAC target of $F = 0.7$.

Special Comments: Previously, the CBSAC suggested that fishing mortality rate estimates based on absolute estimates of abundance from the winter dredge survey and on estimates of total catch in the Baywide recreational and commercial fisheries (direct enumeration of F) were more accurate than F estimates derived from a length-based method. Now, the CBSAC endorses replacement of the length-based method by the direct enumeration method. The CBSAC has determined that the direct enumeration method is better at tracking annual changes in fishing mortality rates than the length-based method. The Control Rule graph (Figure 1) is presented this year with a time-series line connecting each data point. The fact that points on this graph tend to scatter around the equilibrium line is further evidence that the direct enumeration methodology is superior to the length-based method. For comparative purposes, we also include the BBCAC Control Rule graph based on the previous length-based measurements of F (Figure 7). Landings, survey results, and estimates of fishing mortality are summarized below, in tabular form (Table 1).

A comprehensive update of the blue crab stock assessment is nearing completion and will be released in 2005. It is anticipated that the new and updated assessment will include improved analyses, better estimates of blue crab stock parameters, and increasingly effective management.

Critical data needs: As was stated in previous advisory reports, it is critical that a carefully designed, Baywide data collection program be implemented for blue crabs in Chesapeake Bay. The design of the data collection program should be based, in part, on the need for improved information on: (1) harvest and effort data for the commercial and recreational fisheries; (2) growth and natural mortality rates; and (3) the age, size, sex, and maturity composition of the harvest and stock.

We anticipate that a thorough review of the methods of estimating F, M, and biological reference points (thresholds and targets) will be conducted as elements of the new assessment. Such a review is critical to successful future management.

Chesapeake Bay Stock Assessment Committee Members:

Chris Bonzek, VIMS, Chair
 Lynn Fegley, Maryland DNR
 John Hoenig, VIMS
 Tom Miller, CBL
 Rob O'Reilly, VMRC

Derek Orner, NMFS/NCBO
 Alexei Sharov, Maryland DNR
 Mark Terceiro, NMFS/NEFSC
 Doug Vaughan, NMFS/SEFSC

Figure 1. Bi-State Blue Crab Advisory Committee (BBCAC) Control Rule, with Fishing Mortality Rate as Measured by the Winter Dredge Survey.

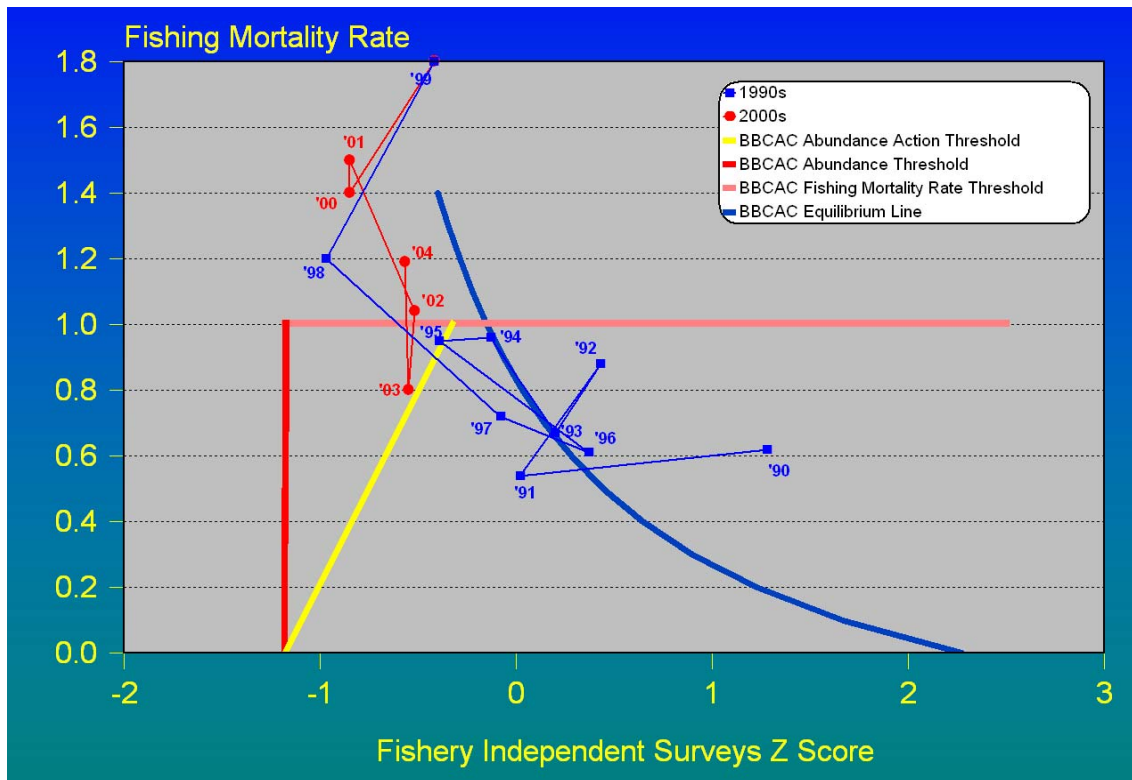


Figure 2. Fishing mortality rate as estimated by two methods, with target and threshold levels (assuming $M = 0.375$).

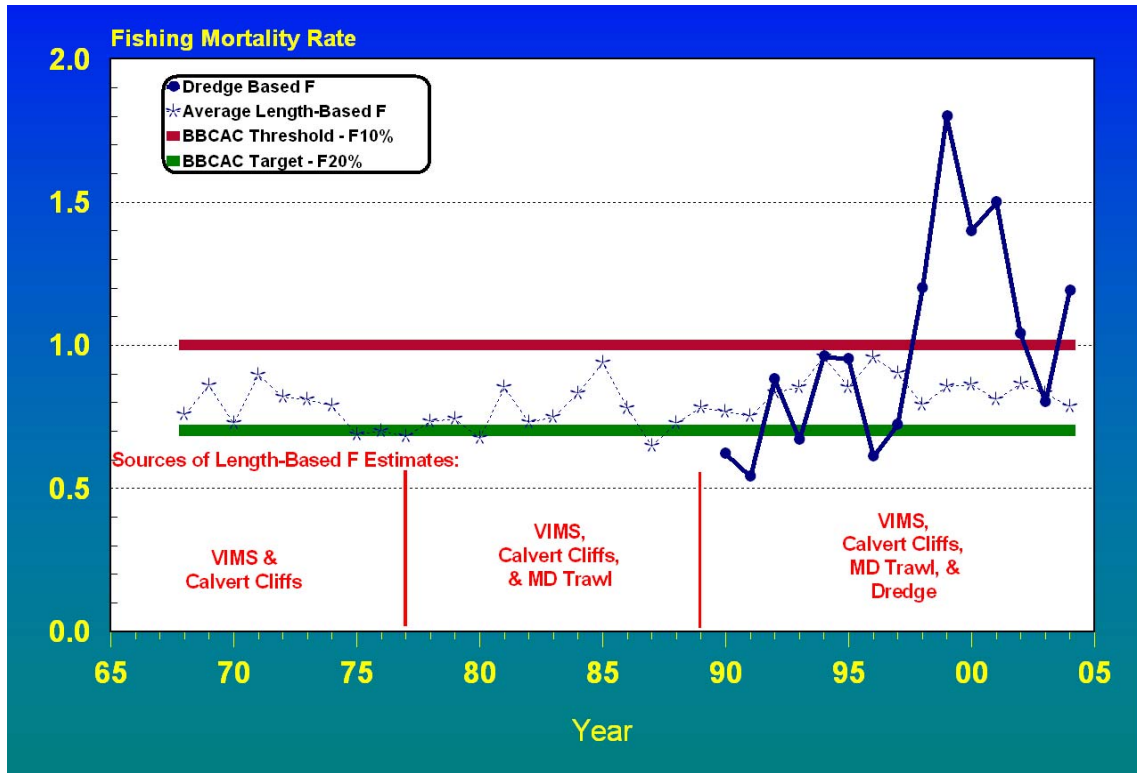


Figure 3. Combined Chesapeake Bay blue crab harvest.

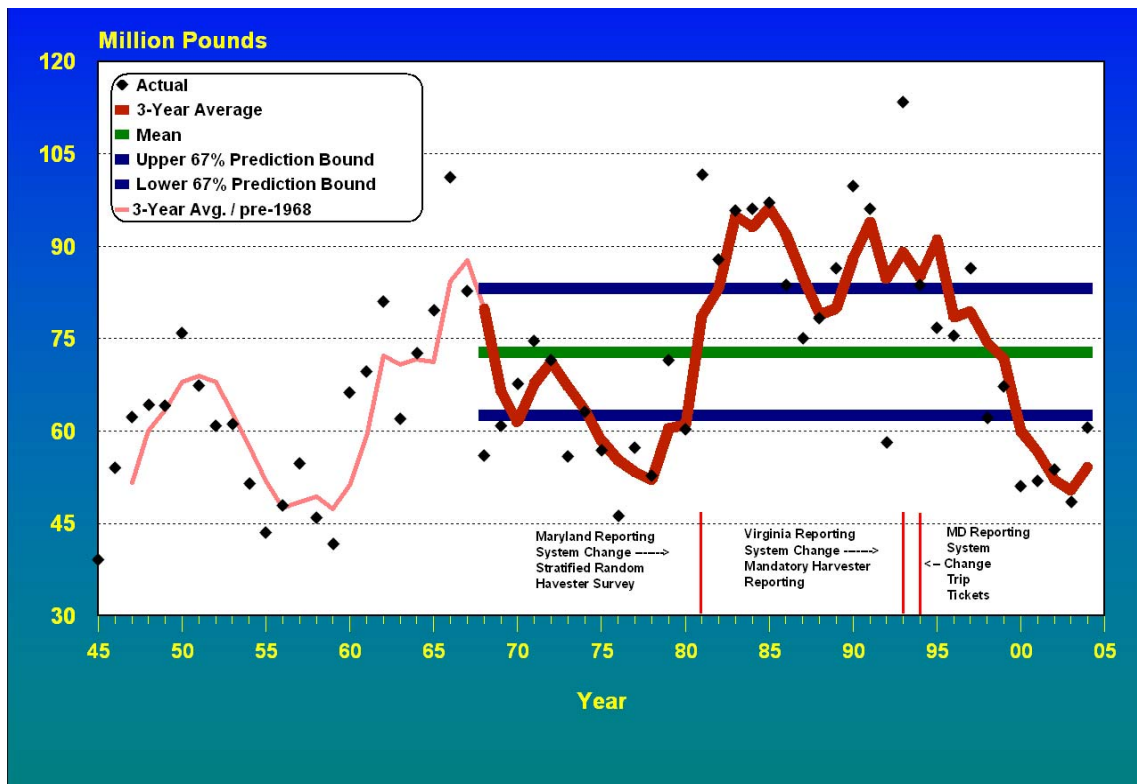


Figure 4. Average of standard normal transformed abundance indices for age 0 (juvenile) blue crabs.

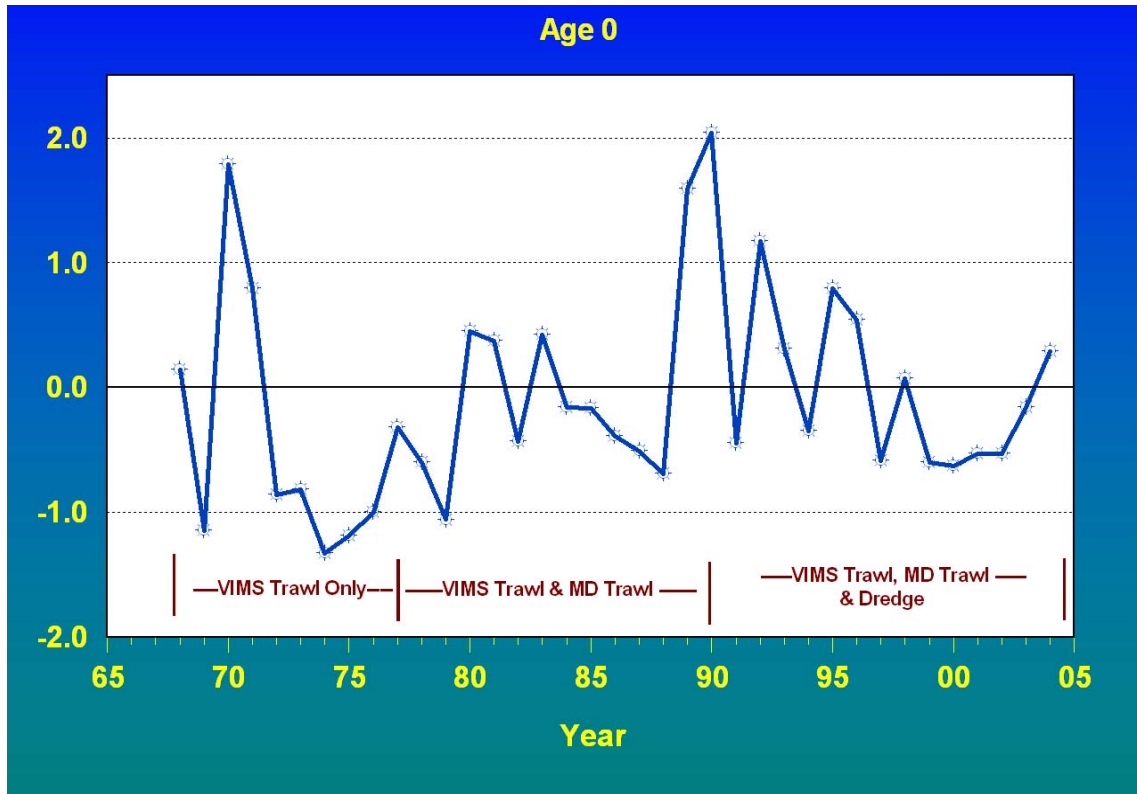


Figure 5. Average of standard normal transformed abundance indices for age 1+ (exploitable) blue crabs.

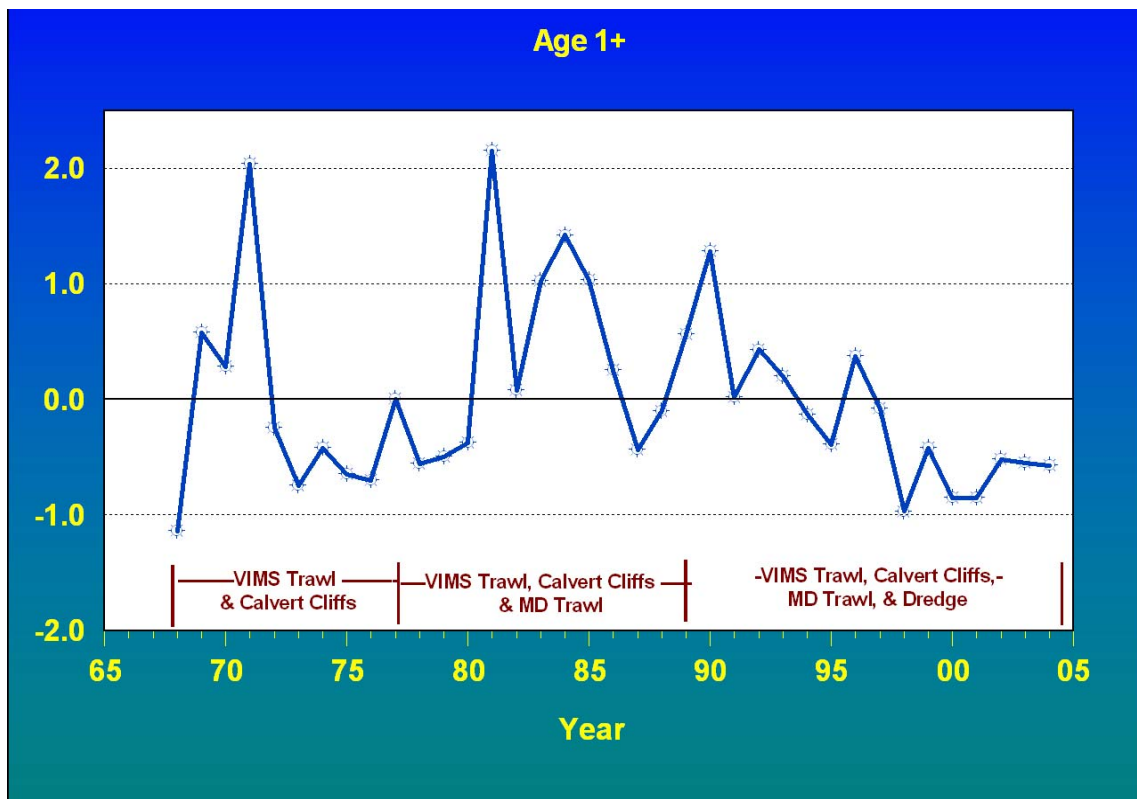


Figure 6. Average of standard normal transformed abundance indices for adult female blue crabs.

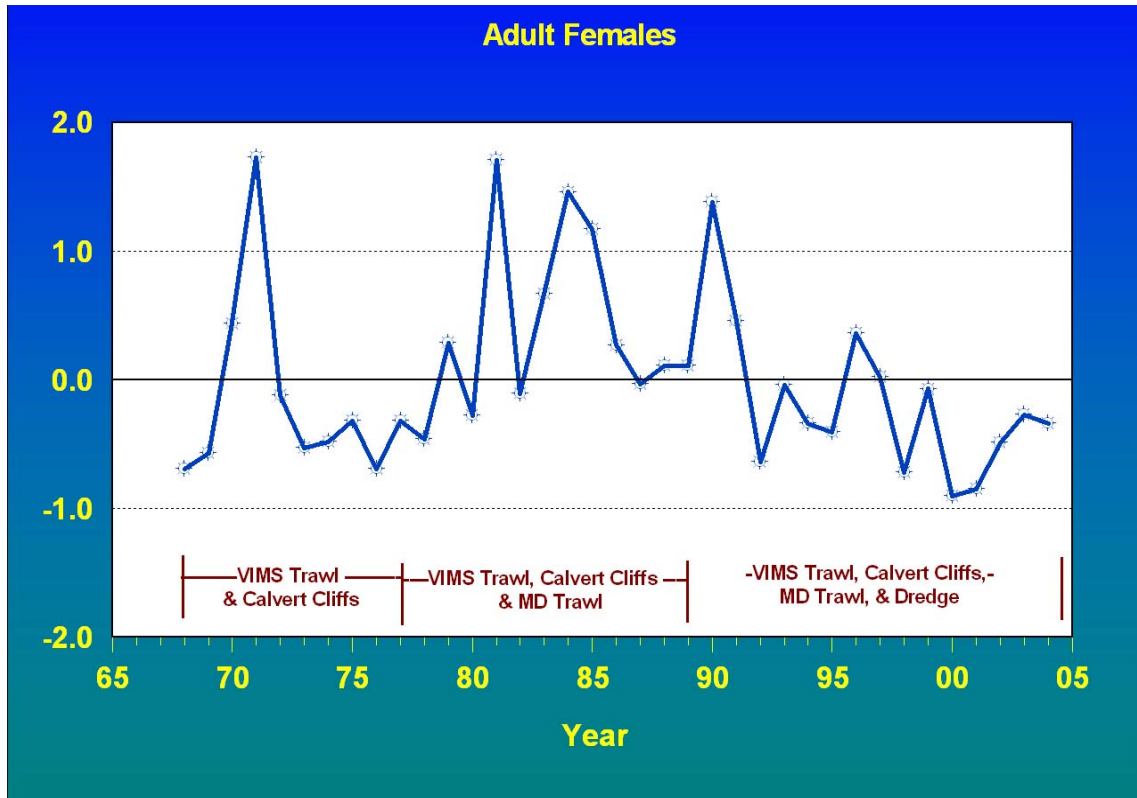


Figure 7. Bi-State Blue Crab Advisory Committee (BBCAC) Control Rule, with Fishing Mortality Rate as measured by the four-survey average of length-based Fs.

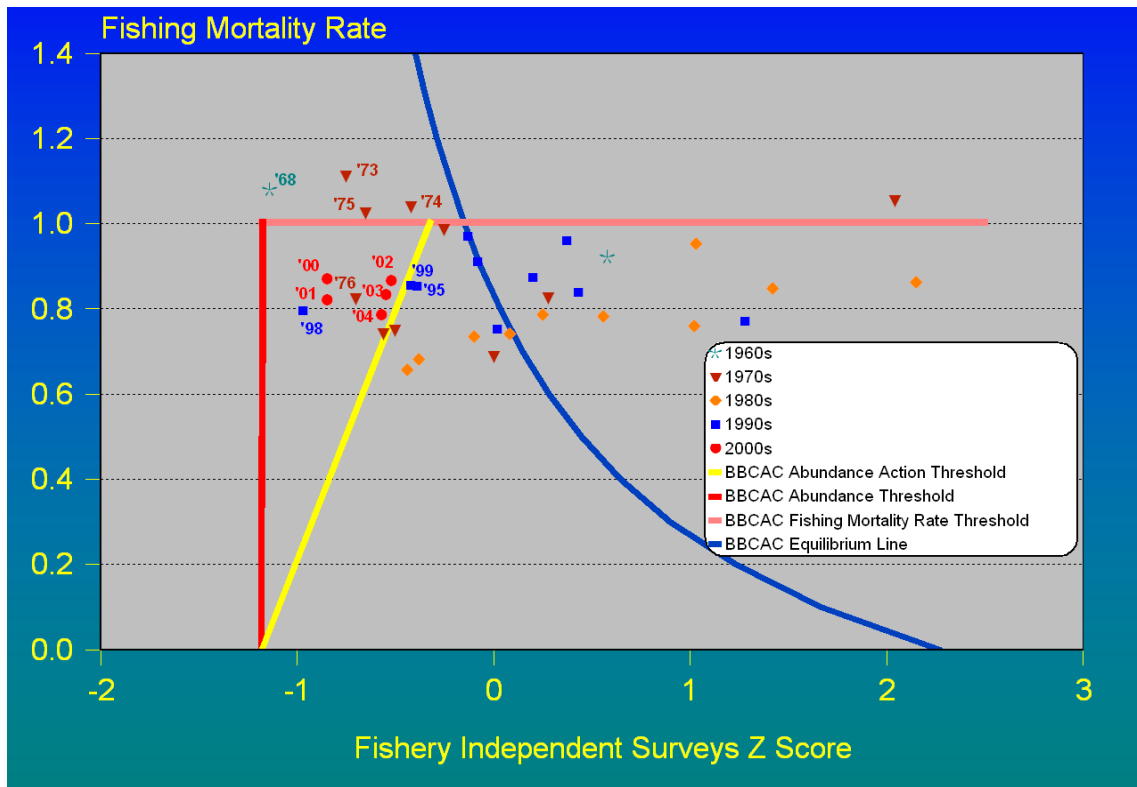


Table 1. Blue crab landings, survey results, and fishing mortality estimates.

Landings (million lbs.)			Surveys				Fishing Mortality	
Juris- diction	2004	2002 - 2004 Average	Survey	Recruits (Age 0)	(Age 1+)	Mature Females	Length Based F	Direct Enumeration F
MD	32.0	27.4	MD Trawl	Average	Below Average	Average	0.81	
VA	25.5	24.2	VA Trawl	Average	Below Average	Below Average	0.90	
Potomac	3.0	2.5	Winter Dredge	Average	Average	Average	0.79	1.19
Total	60.5	54.1	Calvert Cliffs	N/A	Average	Average	0.64	
Trend	Up in 2004 in all three jurisdictions, but below average Bay-wide since 2000.		Trend	Better in 2003 and 2004 than previous several years	Low, but constant for 2002-2004. Has only been overall Above Average once since 1994 (in 1996).	Higher for 2002-2004 than the historical lows of 2000-2001. Has only been overall Above Average twice since 1992 (in 1996 & 1997).	Steady. This method detects trends but is not as reliable for year-specific estimates.	Up significantly in 2004 after decreasing in each previous year since 1999.
Legend: Above Average: Greater than Mean + 1 Standard Error Average: Mean +/- 1 Standard Error Below Average: Less than Mean - 1 Standard Error								