

CBSAC Chesapeake Bay Blue Crab Advisory Report 2002

Prepared by the Chesapeake Bay Stock Assessment Committee¹: June 27, 2002

Status of the Stock: Analysis of long term fishery independent surveys conducted in Chesapeake Bay (Maryland and Virginia trawl surveys, Calvert Cliffs crab pot survey and Baywide winter dredge survey) indicate that blue crab abundance is approaching the record low and has been declining in recent years. The current status of the stock was compared to thresholds and targets endorsed by regional management agencies in January 2001. Stock abundance was above the overfished threshold and below the overfishing threshold. The low abundance puts the stock at increased risk for recruitment failure, but stock abundance does not appear to have fallen below abundances observed in past years. However, the low abundance combined with a high exploitation rate indicates a stock condition that warrants concern for the fifth consecutive year ([Figure 1](#)).

The recent trend in fishing mortality rate (F) is not clear. A length-based method of F estimation suggests that F may be declining. Length-based estimates of fishing mortality determined from the Maryland and Virginia trawl surveys, the Calvert Cliffs crab pot survey and the Baywide winter dredge survey declined from $F = 0.91$ in 2000 to $F = 0.81$ in 2001. The estimated 2001 fishing mortality rate is below the overfishing threshold ($F_{10\%} = 1.0$) but above the target ($F_{20\%} = 0.7$) ([Figure 2](#)). In contrast, preliminary estimates of the relative exploitation rate based on the combined Baywide commercial and recreational harvest, and estimated abundances from the Baywide winter dredge survey indicate that the relative exploitation rate may be increasing ([Figure 3](#)). Considerably higher estimates could result if the preliminary estimates of the relative exploitation rate from the winter dredge survey were converted into fishing mortality rates. The CBSAC feels that once details in the methodology of the winter dredge-based approach are finalized, this index of annual exploitation rate will be more reliable than the length-based estimates of F.

The 2001 Chesapeake Bay commercial blue crab harvest of approximately 52 million pounds is well below the time series (1968 - 2001) average of about 75 million pounds ([Figure 4](#)). The low harvest in 2001 was principally a result of low exploitable stock abundance. However, the harvest was also constrained by management measures implemented in Maryland, Virginia and the Potomac River Fisheries Commission prior to and during the 2001 season ([Tables 1 and 2](#)).

It is apparent that F is above the target, recruitment is continuing to decline, female spawning stock biomass is near the historical low established in 2000 and that exploitable stock abundance is below the Blue Crab Decision Rule action threshold. There is a consensus among committee members that the level of risk to the stock and fishery associated with declining recruitment, low female spawning stock size and low exploitable stock size remains high and is increasing. It is important to note that estimation of fishing mortality rates is important for evaluating the

effectiveness of management actions, but it is the spawning stock biomass that is relevant to the assessment of risk of recruitment failure.

Data: Five fishery-independent surveys are used to determine stock status: Virginia trawl survey, Maryland summer trawl survey, Calvert Cliffs crab pot survey, Baywide winter dredge survey and Baywide zooplankton monitoring. The first four sample crabs after settlement, the latter samples megalopal abundance in the water column. Data from the two trawl surveys and the Calvert Cliffs pot survey are based on calendar year collections through 2001. The winter dredge survey data represent seasonal collections through the 2001/02 season. For abundance indices the dredge survey is referred to as 2002 data, but for estimates of fishing mortality rates the dredge survey is referred to as 2001 data since the mortality took place in 2001. Data from the zooplankton monitoring program is based on calendar year collections. All 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 study) used to derive the abundance indices. Sliding monthly cutoff values were used to model the variable growth of age-0 crabs. Age-0 crabs are defined as being less than 50-90 mm depending on month, and age-1+ are all crabs larger than the monthly cutoff values.

Biological Reference Points: A review of targets and thresholds for Chesapeake Bay blue crabs was conducted by an expert panel convened by the Bi-State Blue Crab Advisory Committee in 2000. The panel identified exploitation and abundance thresholds, a precautionary zone in which exploitation is too high at low abundance, and an exploitation target. The overfishing threshold ($F_{10\%} = 1.0$) and target ($F_{20\%} = 0.7$) fishing mortality rates 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. Age-specific partial recruitment was based on the selectivity of the harvest gears and established as 10% (age 0), 75% (age 1), 95% (age 2) and 100% (age 3+). The overfished threshold (B_{low}) is equal to the lowest exploitable stock observed in the fishery independent trawl, pot and dredge surveys conducted in Chesapeake Bay from 1968 - present.

Fishing Mortality: The average length-based fishing mortality rate as determined from the Maryland and Virginia trawl surveys, the Calvert Cliffs crab pot survey and the Baywide winter dredge survey was 0.81 in 2001 (range = 0.67 to 0.86). None of the current length-based fishing mortality rates exceeded the threshold fishing mortality rate $F = 1.0$. One estimate (Calvert Cliffs) was below the target fishing mortality rate $F = 0.7$. It is important to note that the preliminary results of an alternative method of calculating exploitation rate, based on the Baywide winter dredge survey and commercial and recreational harvest data, indicates that the relative exploitation rate has increased in recent years including in the last year ([Figure 3](#)). The methods of estimating fishing mortality rate are discussed below.

Recruitment (1999-01): Results from the Maryland trawl survey indicate that recruitment has been average whereas the Virginia trawl and Baywide winter dredge survey results suggest that

recruitment has been below average in recent years. With data for the three surveys combined, there appears to be a declining trend in recruitment which began in the early 1990s ([Figure 5](#)).

Exploitable Stock Abundance (1999-01): The average exploitable abundance of age 1+ crabs for the last three years was considered to be below average for all four surveys (Maryland and Virginia trawl surveys, Calvert Cliffs pot survey and Baywide winter dredge survey). Data for all surveys combined indicate that the exploitable stock abundance has been declining since the early 1990s and is approaching the historical low ([Figure 6](#)).

Spawning Stock Abundance (1999-01): Mature female spawning stock abundance was below the long-term average for the Virginia trawl survey, but was at average levels for the Baywide winter dredge survey, the Maryland trawl survey and the Calvert Cliffs pot survey. Data for all surveys combined indicate that spawning stock abundance has declined since the early 1990s. It is also important to note that the 2000 and 2001 abundance estimates are the lowest of the time series ([Figure 7](#)).

Harvest: The three-year (1999-2001) average, commercial Baywide harvest (57 million pounds) is below the long term (1968 - 2001) average of about 75 million pounds. The 2001 Baywide harvest of approximately 52 million pounds is below average and is the lowest since the Maryland commercial crab reporting system changed in 1981. For the 1968-2001 period, Baywide commercial harvests exceeded 100 million pounds in 1966, 1981, 1983 and 1993. The 1993 harvest of 113 million pounds is the highest recorded harvest. Based on the historical relationship between winter dredge survey abundance and commercial harvest, we expect the Baywide commercial Chesapeake Bay harvest in 2002 to be less than 60 million pounds in the absence of changes to the regulations.

Management Advice: Based on a review of fishery-independent surveys conducted in Maryland, Virginia and the Potomac River it appears that: (1) there has been a long term decline in recruitment and in the age 1+ component of the stock since the early 1990s; (2) the abundance of age 1+ crabs is approaching a low in abundance not observed since the late-1960s; (3) adult female abundance in 2000 and again in 2001 was below the previous historical low set in 1968; and (4) exploitable stock abundance was below (to the left of) the blue crab action threshold for the fifth consecutive year.

The recent trend in fishing mortality is not clear. The length-based method suggests that fishing mortality may be declining while estimates based on the Baywide winter dredge survey indicate it may be increasing.

There is a consensus among committee members that the level of risk to the stock and fishery associated with declining recruitment, low female spawning stock size and low exploitable stock

size remains high and is increasing. Female spawning stock biomass is near the historical low established in 2000 and exploitable stock abundance is below (to the left of) the Blue Crab Decision Rule action threshold.

The management measures initiated in 2001 to provide additional protection to the blue crab stock were prudent. States should, at a minimum, keep all measures in place until their effects on the stock status can be ascertained.

Special comments:

Improvements in estimation of fishing mortality. The length-based method of calculating mortality rates, used by CBSAC for many years, was selected because it has minimal data requirements. It is based on the assumption that mortality rates are not changing over time. By applying this technique to data obtained over a period of years, it is possible to gauge the average level of mortality even if conditions are changing somewhat. In this respect, the estimator served us well by revealing that fishing mortality rates are high. However, the estimator was never designed to track year to year changes in mortality rates and can give misleading indications when it is used to measure year to year changes. The CBSAC is now examining an alternative approach to estimating mortality rates and relative mortality rates. It is based on catch rates in the winter dredge survey and on estimates of total catch in the Baywide recreational and commercial fisheries. The total catch of crabs divided by a survey index of abundance provides an index or relative measure of the exploitation rate that can be converted into a relative fishing mortality rate. If the efficiency of the survey dredge is determined, then the relative exploitation (or fishing mortality rate) can be converted into an absolute or actual rate. If part of the catch is unknown or undercounted, then the fishing mortality rate will tend to be underestimated. Conversely, if abundance is underestimated, fishing mortality will be overestimated. The CBSAC believes this approach holds promise for the future. When introducing a new method, it is good practice to use the old and new methods side by side for a few years so that when perceptions of stock status change over time, one can examine whether this is due to changing biology or changing methodology. The CBSAC intends to use both methods in future reports.

Critical data needs. As was stated in the 2000 and 2001 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 mortality rates; and (3) the age, size, sex and maturity composition of the harvest and stock.

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Figure 1. Decision Rule showing the precautionary zone based on exploitable abundance and fishing mortality rate.

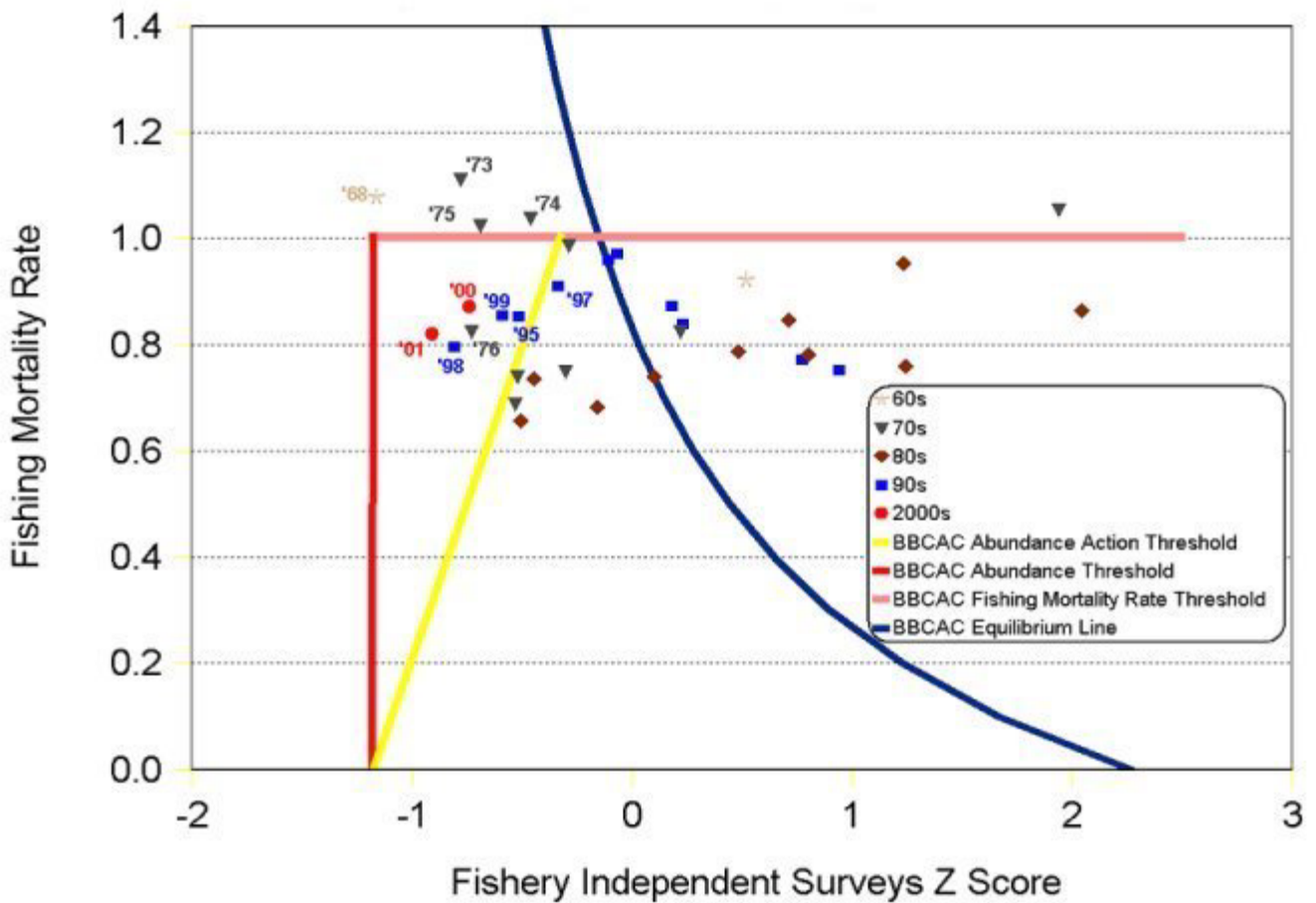


Figure 2. Length-based estimates of fishing mortality rate on the Chesapeake Bay blue crab 1968 to 2001 based on the Maryland and Virginia Trawl surveys, the Baywide winter dredge survey, and the Calvert Cliffs pot study.

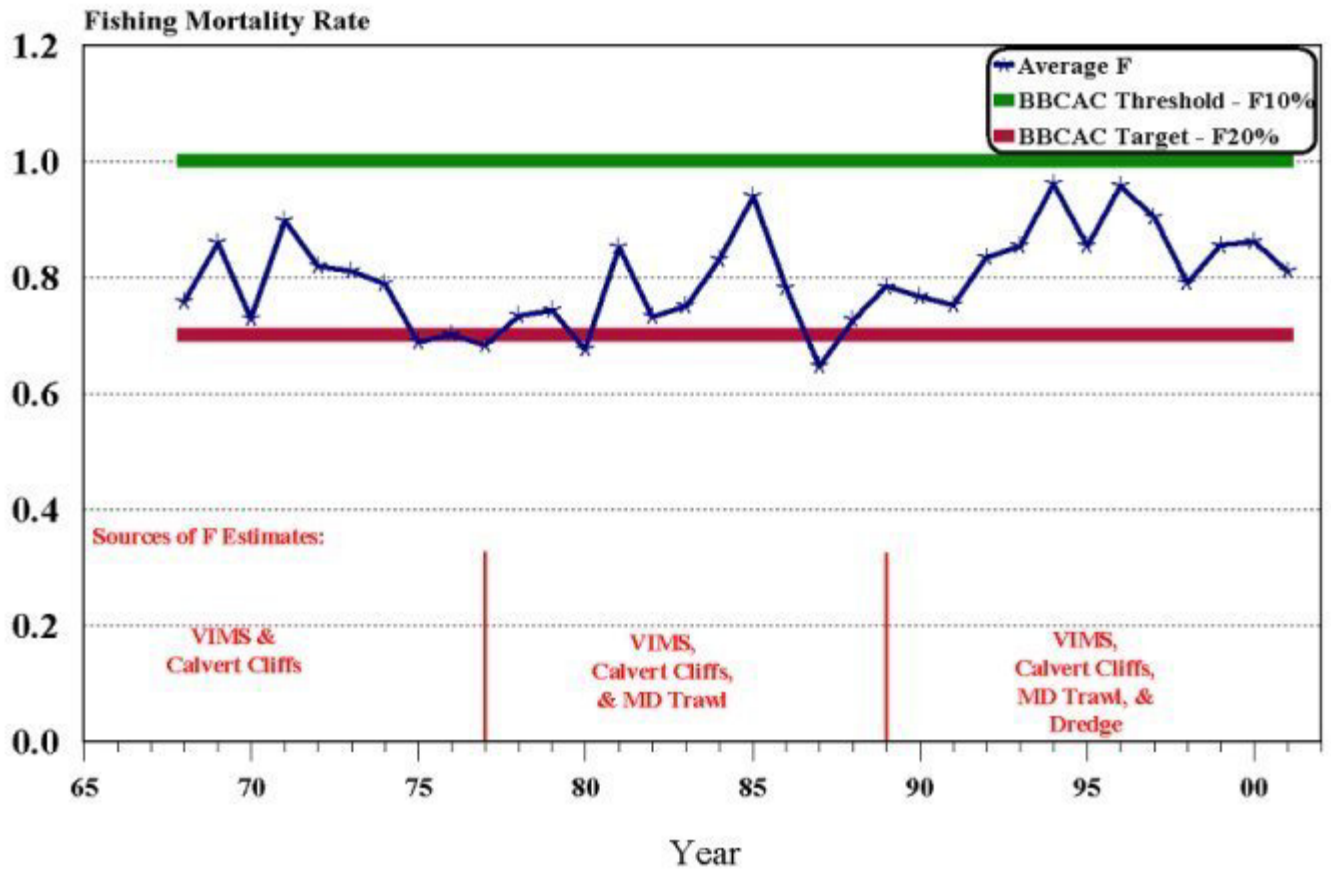


Figure 3. Relative exploitation (U) rate calculated using Baywide winter dredge survey and estimates of commercial and recreational harvest.

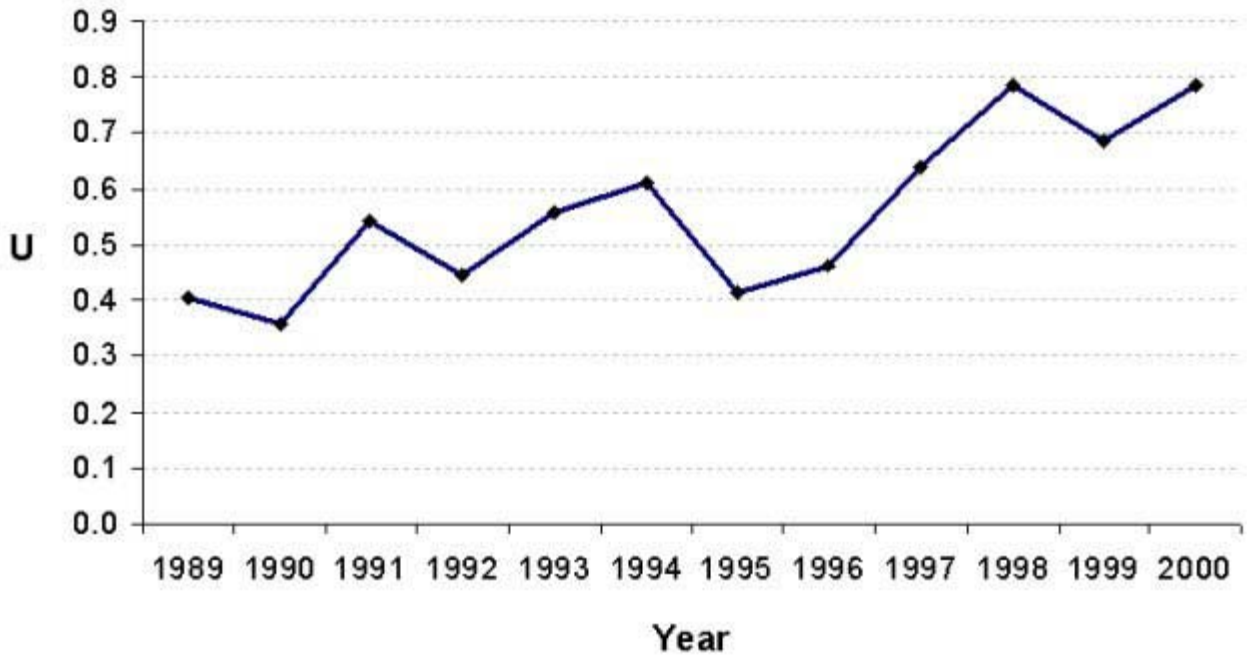


Figure 4. Bay-wide commercial harvest of blue crabs (pounds) from 1945 to 2001.

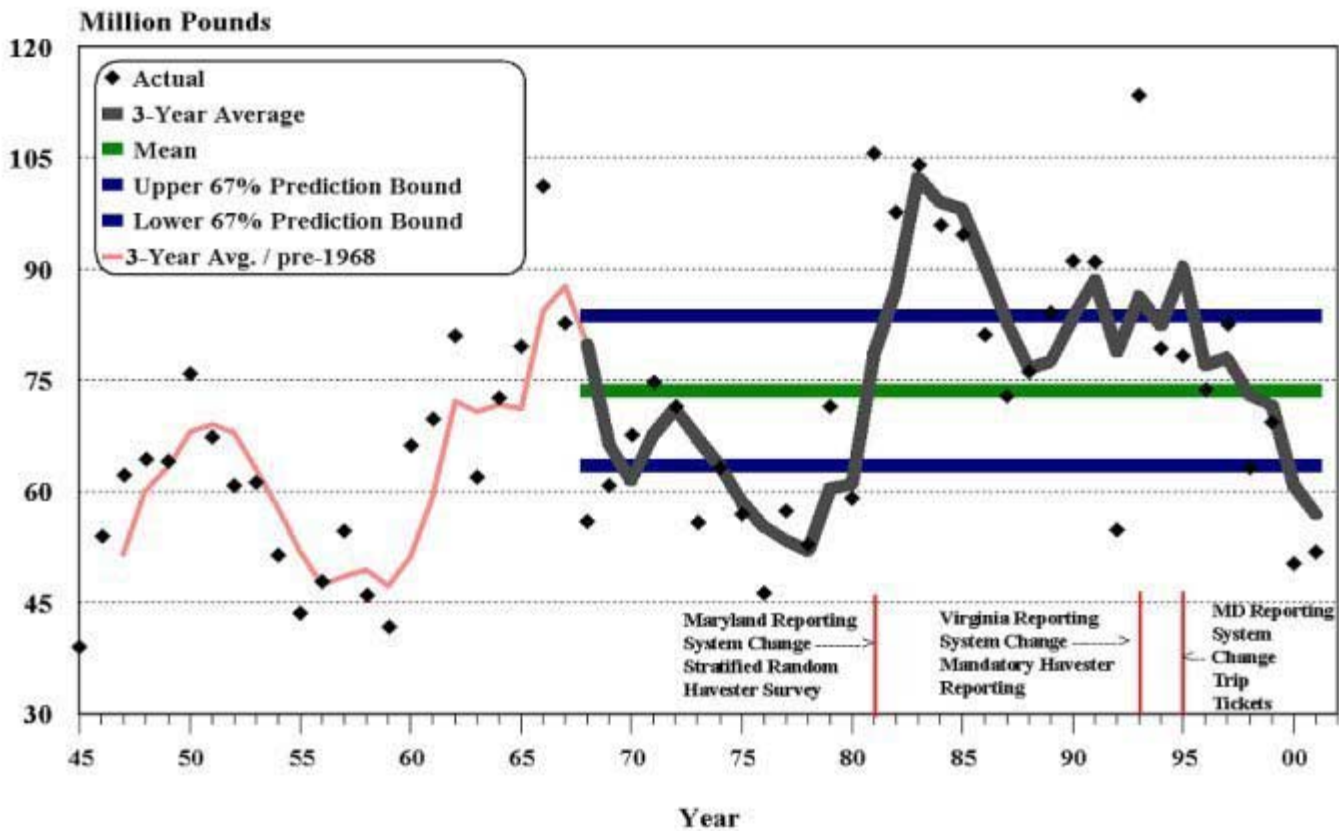


Figure 5. Index of abundance of age 0 blue crabs in the Chesapeake Bay from 1968 to 2001. Index is based on Virginia and Maryland trawl, and Baywide dredge data.

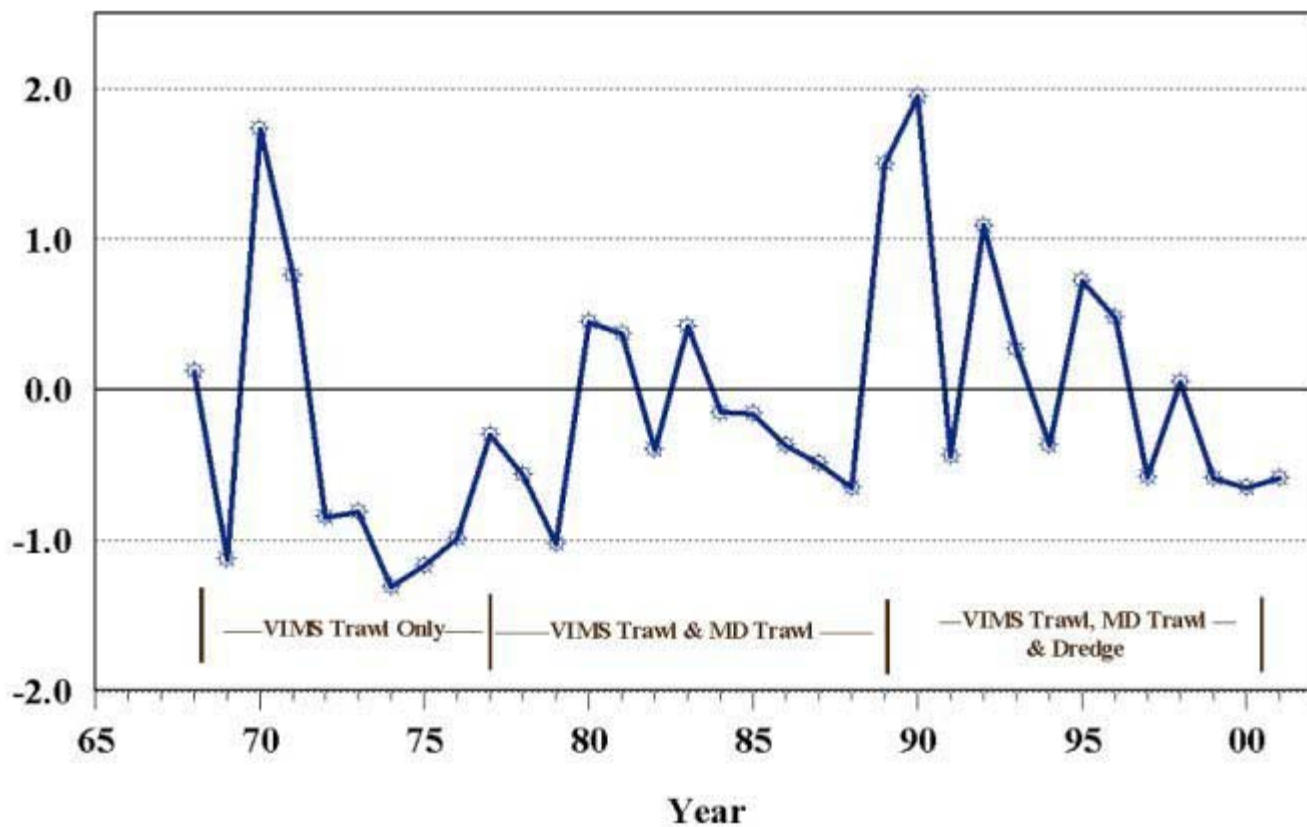


Figure 6. Index of abundance of age 1+ blue crabs in the Chesapeake Bay from 1968 to 2001. Index is based on Virginia and Maryland trawl, Baywide dredge data, and Calvert Cliffs pot data.

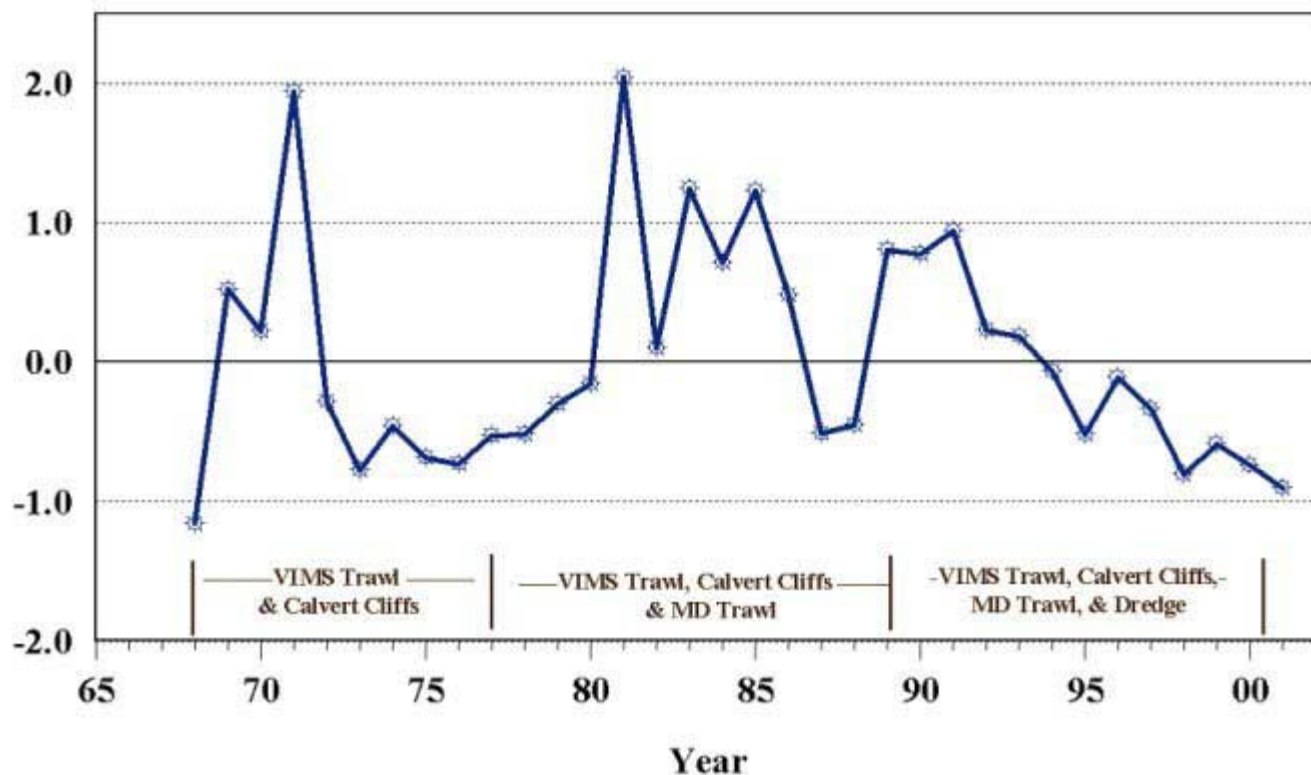


Figure 7. Index of abundance of adult female blue crabs in the Chesapeake Bay from 1968 to 2001. Index is based on Virginia and Maryland trawl, Baywide dredge data, and Calvert Cliffs pot data.

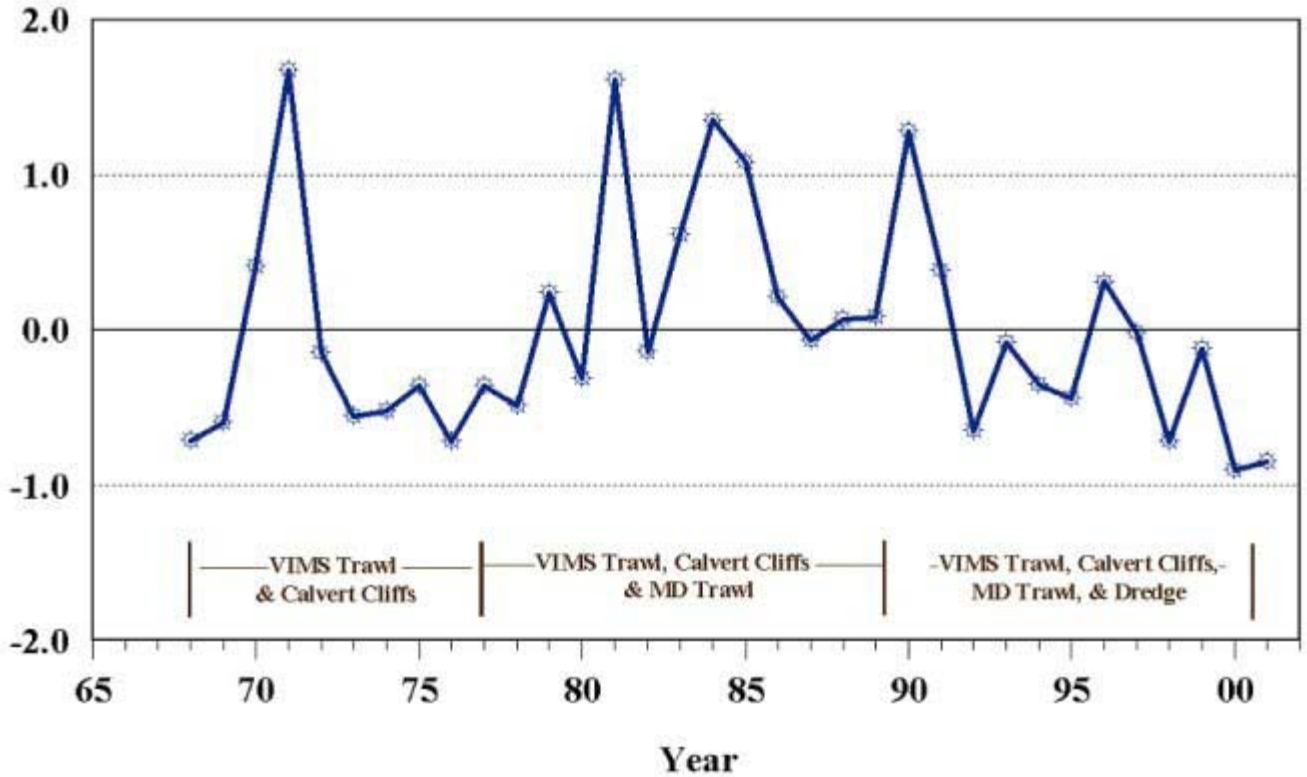


Table 1. Comparison of commercial blue crab regulations in Maryland, Virginia and the Potomac River Fisheries Commission (PRFC). Management actions taken in 2001 which are still in effect and management actions for 2002 are in bold.

	Maryland	Virginia	PRFC
Minimum size			
Hard crab male	5.25" (effective 8-1-02)	5"	5" 5.25"(8/1/02)
Mature female	None	Prohibition on possession of brown through black sign sponge.	None 5.25" (8/1/02)
Peeler	3.5"	3.0"	3" 3.25" (4/1/02)
Soft crab	4.0"	3 ½"	3 ½" None (4/1/02)
Tolerance Limits			
Undersized hard crabs	5/bushel	10/bushel 35/barrel	4/bushel 10 barrel
Peeler tolerance	10/bushel	10/bushel	None
Sponge crabs (catch)	Prohibited	Permitted	Prohibited
Sponge crab (possession)	Prohibited	Permitted	Prohibited
Catch limits	None	17 barrels/boat/day (dredge fishery)	None
Season length	Apr. 1 - December	Apr 1 – Nov. 30	Apr. 1 – Oct. 31

	15	Dec. 1 – Mar 31 (crab dredging)	(hard crabs) 4/1/02 - 11/30/02 May 20– Oct. 31 (peelers) 4/1/02 – 11/30/02
Work day restriction	8 hours	8 hours	No new restrictions
New gear limits	No new limits	Peeler Pot reduction 400 to 300pots	Pot reductions 300 to 270 400 to 360 500 to 450
Area closures	None	Expanded summer main bay sanctuary	None
New work day closure	Tighten existing day off provision		None

Table 2. Comparison of recreational blue crab regulations in Maryland, Virginia and the Potomac River Fisheries Commission (PRFC). Regulations implemented in 2001 and 2002 are in bold. Note that size limits are the same as for the commercial fishery

	Virginia	Maryland	PRFC
Season	April 1 - November 30	April 1 - November 30	April 1- October 31 2001 April 1- November 30, 2002

Daily time limit	None		Bay - ½ hour before sunrise to 5:00 p.m. Trib. - ½ hour before sunrise to sunset		None	
Daily closure	Sunday for licensed potters		Wednesdays		None	
	Without a license	With a license	Without a License	With a License	Without a license	With a (boat) license
Individual daily catch limits			2 dozen hard crabs	1 bushel hard crabs	4 dozen hard crabs	1 bushel hard crab
			1 dozen peeler or soft crabs	2 dozen peeler or soft crabs	2 dozen soft & 2dozen peeler crabs	2 dozen soft & 2 dozen peeler crabs
Daily boat catch limit	1 bushel hard	1 bushel hard	4 dozen hard crabs (2 or more aboard)	1 bushel hard crabs	1 bushel hard crabs	2 bushels hard crab
	2 dozen peelers	2 dozen peelers	1 dozen peelers or soft crabs	2 dozen peelers or soft crabs	3 dozen soft & 3 dozen peeler crabs	4 dozen soft & 4 dozen peeler crabs
Daily boat limits – 2 or more licenses				2 bushel hard crabs	N/A	N/A only 1 lic. per boat permitted

Collapsible traps/net rings		1/license	Combination of 10/person	Combination of 30/person	10 /boat	20 / boat
Trot lines		Max. 300 feet	600 feet/boat	1200 feet/boat	1- 600' / boat	1 – 1,200' per boat
Crab Pots	1/license	5/license	2/pier	2/pier	2/person with max. 2 /pier	5/license
Dip nets and/or handlines					No limit	

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