# Review of the Soft and Peeler Fishery for Blue Crab in the Chesapeake Bay

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## Background

The blue crab (*Callinectes sapidus*) is an important member of estuarine communities throughout its range from Brazil to Nova Scotia, Canada. Often, the blue crab is a dominant estuarine benthic predator and scavenger. It is an opportunistic predator with a highly variable diet that may include a wide range of taxa including bivalves, crustaceans and fish. Besides its ecological importance, the blue crab supports important commercial fisheries throughout its range. Food and Agriculture Organization of the United Nations (FAO) statistics indicate that the worldwide catch of blue crab averaged 110,000 metric tonnes (MT) from 1989-1998, representing 26.5% of the total landings of swimming crabs (*Portunus sp.* and *Callinectes sp.*) worldwide (FAO 2000). In the U.S., important coastal and estuarine fisheries for blue crab occur from the Gulf of Mexico, along the Atlantic coast and as far north as New England. National Marine Fisheries Service (NMFS) statistics indicate that, between 1994 and 1997, the national average annual landings of blue crab were close to 102,000 MT, with about 35% coming from the Chesapeake Bay (NMFS 1999). However, commercial landings in Chesapeake Bay have exhibited a declining trend since 1981, prompting concern over the sustainability of the blue crab stock and its attendant fishery (Miller 2001).

Several assessments of the blue crab population and its attendant fishery have been conducted in the last thirteen years (Rothschild et al 1988; Rugolo et al. 1997; Miller and Houde 1999; Miller 2001). These have all concluded that the fishery is likely exploiting the stock at a higher rate than would be desirable. Earlier stock assessments recommended that exploitation not be allowed to increase. The more recent efforts have recommended cutbacks in the rate of exploitation. Recent management efforts have focused on reducing exploitation rates to a target level of $F_{20\%} = 0.7$. To achieve this goal, management agencies in the Chesapeake Bay are considering a range of input controls including the amount and duration of deployment of gear, seasonal closures and size limits.

However, management of the blue crab stock in the Chesapeake Bay is complicated by the fact that the fishery is diverse. Several commercial sectors in the blue crab fishery are recognized: pot, peeler pot, scrape, trap, trot line and dredge fisheries (Fig. 1). NMFS data show that of the average total harvested biomass, 58.3% is harvested in crab pots (includes both hard and peeler fisheries), 19.0% is harvested in dredges, 6.6 % is harvested in the baited line fishery and 1.3% is also caught in the mixed species pound net fishery. Additionally, there is a large, but poorly assessed recreational fishery that may contribute substantially to the removals of blue crab from the Chesapeake Bay (Miller et al. 2001). Not only is there a diversity in the gear types, there is also diversity in the market outlets. Several categories of marketed crabs can be recognized based on size and status: #1 males, #2 males, females, mixed and soft and peeler. This diversity in the sectors within the fishery has largely been ignored in management decisions which have focused heavily on the dominant hard shell sector (#1%, #2%, and & caught in the pot fishery). This approach is reasonable if the hard shell sector of the market is substantially larger than the other

sectors, and/or if the relative contribution of each sector is constant over time. Recent evidence suggests that the fishery that exploits smaller crabs for the soft and peeler market is sizeable and growing in importance in several areas (R. O Reilly, Virginia Marine Resources Commission, personal communication).

The Bi-State Blue Crab Advisory Committee (BBCAC) was formed in 1996 by the Chesapeake Bay Commission, with the support of the governors and legislatures of Maryland and Virginia, to provide independent advice to the three regional management jurisdictions (MD, VA and the Potomac River Fisheries Commission). The BBCAC established a Technical Work Group (TWG) to provide scientific advice on the biological and economic consequences of alternative management scenarios. As a part of this process, the TWG sponsored a one-day workshop to review and assess the importance of improved understanding of the soft and peeler component of the blue crab fishery in the Chesapeake Bay. The workshop focused on compiling, analyzing and reviewing the information pertaining to the soft and peeler fishery. This report summarizes the conclusions of the workshop and presents recommendations for future study and analysis.

## Status and Trends in Commercial Harvest of Soft and Peeler

Commercial catch and effort data were made available by both Maryland, Virginia and the Potomac River Fisheries Commission. Data on the trends in the weight of crab harvested in the three jurisdictions (Fig. 2), suggests that the hard shell fishery dominates the soft and peeler component. However, hard shell and soft and peeler crabs differ substantially in size. Thus, an equal weight of landings does not imply an equal impact on the crab population that sustains the fishery. In order to compare the consequences to the population dynamics of blue crabs, weight must be converted to numbers. To convert the reported harvest weights, the following conversions were applied: peeler - 0.2083 pounds per crab; hard - 0.35 pounds per crab; dredge - 0.3 pounds per crab. When converted to numbers, the data indicate that an average of 244.5 million crabs were harvested each year from the Chesapeake Bay between 1981 and 2000 (Table 1). Of this total, 229.7 million (94%) were in the hard shell sector and 14.7 million (6%) were in the soft and peeler sector. However, these average figures do not adequately characterize patterns in the landings as they fail to reflect temporal patterns. The proportion of the total harvest represented by the soft and peeler sector has varied over the last 20 years (Fig. 3). For Maryland landings, there is evidence of an initial decline in the contribution of the soft and peeler sector to the total landings from 1981 - 1988, followed by an increasing trend thereafter. In the last year examined (2000), soft and peeler landings represented 10.9% of the total commercial landings in the state. For Virginia, the data suggest a consistent increasing trend over the 20-year period, from an initial level for soft and peeler landings of 2% of the total harvest, to 11.5% by 2000. Data for the Potomac River indicate that the overall contribution of soft and peelers to the total commercial crab harvest in the river is lower than in the other two jurisdictions, and that the temporal pattern for the river is more similar to that observed in the Maryland data than that observed in the Virginia data.

The data presented above are for the catch of soft and peelers in the Chesapeake Bay. Following harvest, crabs are held and shedded until they attain the appropriate stage for marketing. Concern was expressed over the accuracy of the data given that many operators capture and shed and market the crabs. Consequently, it is not possible to compare reported catch and sales to check for under-reporting biases. In addition, there are few data relating to mortality following harvest in the shedding operations. The level of mortality does not directly impact the estimated catches, in that the catch is reported prior to shedding and not after; however, high levels of mortality likely result in higher harvest than would otherwise have been the case.

The data were disaggregated to examine trends within regions over time (Fig. 4). It is clear when landings are associated with the region of the Bay from which they originated that mid-Bay waters dominate the catch of soft and peeler crabs. Moreover, the regions that dominate the catch, both Pokomoke & Tangier sounds region in Maryland and the Chesapeake Bay system region in Virginia, exhibit a similar pattern in landings over time (Fig. 4). It is also clear from the data that other regions, particularly those in Virginia, exhibit an increasing trend in their landings over time.

The data were also examined on a seasonal basis (Fig. 5). On average, May was the most productive month over the 20-year period examined, particularly so in Virginia. In Maryland, landings in May - July were broadly similar. Indeed, when Maryland landings were examined on a yearly basis, May did not always dominate the seasonal time series. For example, June was the most productive month in Maryland in 1985, 1988, 1990, 1997 and 1999. Similarly, July was the most productive month in Maryland in 1989 and 1996. Despite these differences among years and regions, it is clear from these data that the soft and peeler fishery is concentrated at the beginning of the season. We noted, therefore, that early season regulations would be needed to regulate the soft and peeler industry.

## Biological Characteristics

Few data were available to quantify the biological characteristics of the harvest. Yet such data are essential should management agencies seek to impose size-based management regulations.

Maryland Department of Natural Resources conducted a cooperative monitoring program with commercial peeler pot fishers in 2001 in selected eastern tributaries and sounds. The carapace widths of crabs were measured from both baited and unbaited pots. All crabs were sexed. Normal distributions were fitted to all carapace width frequency distributions using a maximum likelihood criterion. All size distributions were well described by a normal distribution (Fig. 6). The expected mean size of crabs in the peeler pot sample was 98 mm. The expected variance was 9.1 mm. The size distributions of females appeared more normally distributed than

those of males. For females, the expected mean size of crabs in the peeler fishery increased when the pot was baited, and the expected variance decreased. Only a small number of male crabs were caught in baited pots, making comparisons difficult.

Information on the size distribution of crabs at the beginning of the peeler pot fishery is available from the winter dredge survey and may shed light on differing patterns of availability. However, there is little data from the fishery currently available.

## Status and Trends in Effort

All three jurisdictions collect data on the effort deployed by requiring fishers to report the number of pots fished. There was no strong temporal trend in these data (Fig. 7). However, seasonally, most gear is deployed in May - August., with peak deployment in June and July.

Virginia Marine Resource Commission made available data for both catch and effort for its peeler pot fishery. These data indicated a pattern of increasing effort over time, particularly during the early months of the season (Fig. 8). Most striking is the increase in peeler pot effort in May (Fig. 8), from a low at the beginning of the time series (1994) of 0.5 million pot.days to a high in 2001 of 2.06 million pot.days, a 412% increase. However, despite this strong trend in effort, catch per unit effort for this fishery has varied without trend over the same period. Thus fishers are deploying more gear, but catching relatively fewer crabs per deployment.

## Trends in Exploitation Rate

Two separate and independent analyses were presented during the charrette that estimated the exploitation rate in the soft and peeler fishery. Davis and Sharov estimated exploitation rates by comparing the numerical landings of soft and peelers to the abundance in the winter dredge survey. In contrast, Bonzek and O Reilly estimated exploitation rates by comparing the numerical landings of soft and peeler to abundance in the Virginia trawl survey. Both analyses drew the similar conclusion that exploitation rates in the soft and peeler fishery have been increasing consistently over the last 20 years.

## Conclusions

1. The soft and peeler sector is an important component of the overall commercial blue crab fishery. Yet, the contribution of the fishery to the overall dynamics of the stock has not been given adequate attention. It is particularly important that increased research and management attention be given to this sector of the fishery because:
   The effort in the soft and peeler fishery is increasing.
   The proportion of the total blue crab harvest taken in the soft and peeler sector is increasing.

Crabs harvested in the soft and peeler fishery are typically harvested before the peak harvests in other fisheries, and thus these crabs are no longer available for other fishery sectors.

2. There are several components in the blue crab fishery. In the Chesapeake Bay, traditional management approaches have not addressed allocations among the different components. This approach has been successful because harvests have not been limited and thus, individual fishers have been free to decide how and when they harvest. However, with increasing pressure on the resource, and the relative increase in the size of the soft and peeler harvest, allocation issues are likely to become important.

3. There are strong temporal and spatial patterns in the harvest of soft and peelers across the Chesapeake Bay. Catches occur principally in the early part of the commercial fishing season and are concentrated in the May - July period. Additionally, catches are concentrated in Pokomoke and Tangier sounds and the northern area of the Virginia portion of the Chesapeake Bay. Thus, although management of the blue crab must be conducted on a Baywide basis, regulation of the soft and peeler fishery will involve a restricted temporal and spatial domain.

4. Exploitation rates in the soft and peeler fishery have been increasing over the past 20 years.

5. There are few data on the biological characteristics of the catch. Preliminary evidence suggests that the expected average size of a soft and peeler crab is 101 mm cw (3.9").

6. Mortality during the shedding operation is poorly understood. While this mortality does not bias our estimates of catch, reducing the mortality may lead to a reduced pressure on the resource.

## Recommendations

1. Management agencies should improve collection of catch and, particularly, effort data in the soft and peeler fishery. Improved data are required to enable management agencies to adequately reflect the impact of the soft and peeler fishery on the overall dynamics of the crab population in Chesapeake Bay.

2. Management agencies should improve collection of biological characteristics of the catch. Improved information on the characteristics of crabs harvested in the soft and peeler fishery will lead to increases in our knowledge of the impact of this component on overall population structure. Moreover, if management agencies wish to explore size-based regulation of the fishery, information on the characteristics of the catch is essential.

3. Analyses of the exploitation rate in the soft and peeler fishery presented at the charrette by Davis and Sharov, and independently by Bonzek and O Reilly, should be prepared for peer-review. It was the consensus of the charrette that these analyses are of high utility to management decisions.

4. To ensure equity among user groups and a fair allocation of the resources, more attention to early season regulations may be required.

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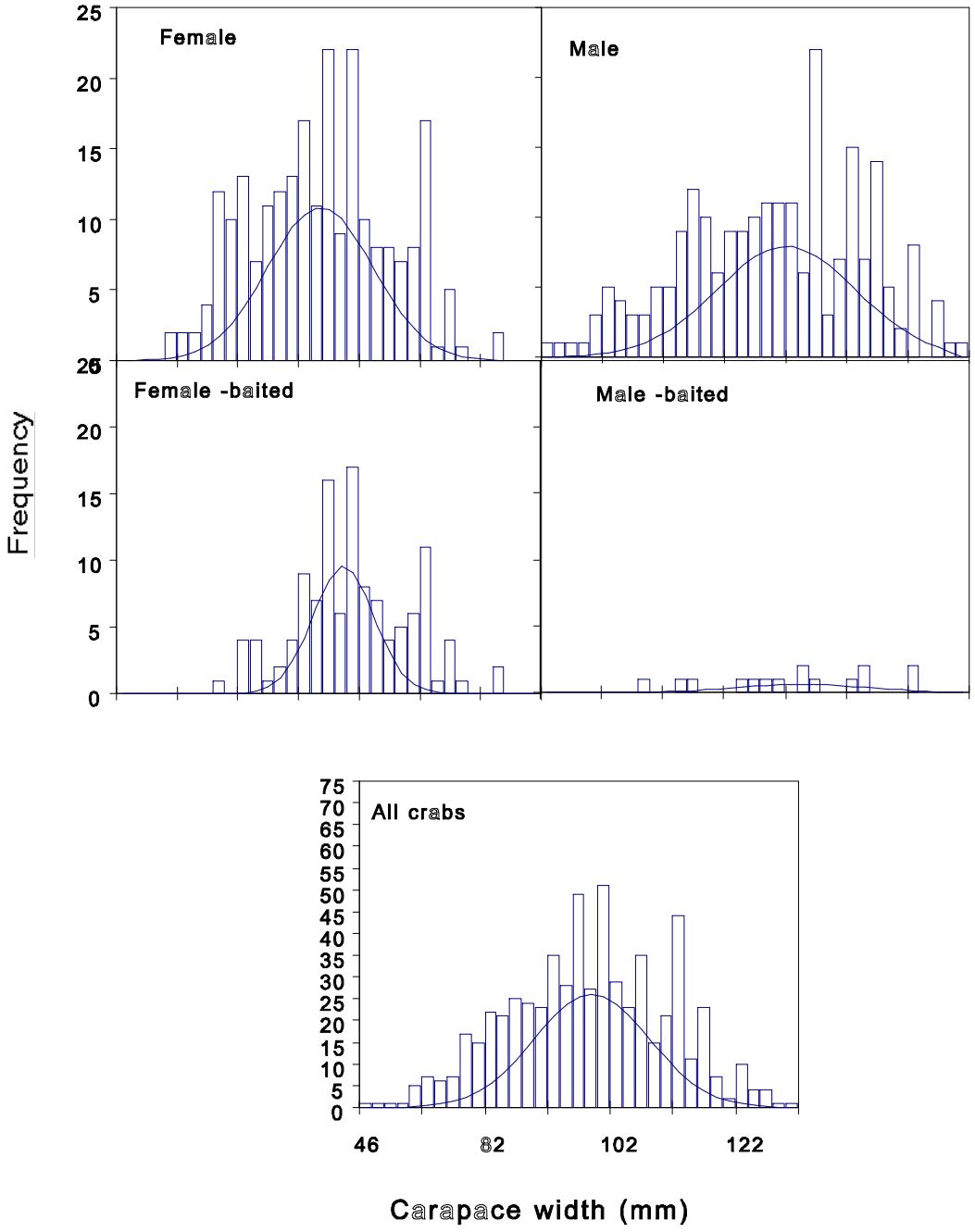
Table 1. The distribution of crab harvest in different sectors and jurisdictions for the period 1980 -2000. Data are reported as the number of crabs (millions) harvested in the calendar year indicated. The averages reported are for the 1981- 2000 period to avoid potential biases introduced by the 1981 reporting change in MD.

| | VA | | | MD | | | PRFC | | | Bay-Wide | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Hard | Peeler | Total | Hard | Peeler | Total | Hard | Peeler | Total | Hard | Peeler | Total |
| 1980 | 89.665 | 1.887 | 91.552 | 68.185 | 5.178 | 73.364 | 9.777 | 0.253 | 10.031 | 167.628 | 7.319 | 174.947 |
| 1981 | 105.161 | 2.247 | 107.409 | 162.298 | 10.342 | 172.640 | 14.753 | 0.312 | 15.065 | 282.213 | 12.901 | 295.114 |
| 1982 | 113.038 | 3.491 | 116.529 | 116.685 | 11.540 | 128.225 | 11.706 | 0.365 | 12.071 | 241.429 | 15.396 | 256.825 |
| 1983 | 111.028 | 2.666 | 113.694 | 135.954 | 18.248 | 154.202 | 13.601 | 0.663 | 14.264 | 260.582 | 21.577 | 282.159 |
| 1984 | 121.247 | 3.483 | 124.731 | 133.720 | 9.452 | 143.172 | 11.163 | 0.321 | 11.484 | 266.130 | 13.256 | 279.386 |
| 1985 | 98.387 | 4.491 | 102.878 | 150.716 | 13.330 | 164.046 | 16.989 | 0.457 | 17.446 | 266.092 | 18.278 | 284.370 |
| 1986 | 88.115 | 2.542 | 90.657 | 128.386 | 7.098 | 135.484 | 16.588 | 0.274 | 16.861 | 233.088 | 9.913 | 243.002 |
| 1987 | 77.600 | 1.722 | 79.322 | 116.738 | 8.591 | 125.329 | 13.511 | 0.301 | 13.811 | 207.848 | 10.614 | 218.462 |
| 1988 | 87.609 | 4.503 | 92.112 | 115.904 | 5.314 | 121.218 | 14.065 | 0.227 | 14.291 | 217.578 | 10.044 | 227.622 |
| 1989 | 107.041 | 5.832 | 112.873 | 117.509 | 5.876 | 123.386 | 15.081 | 0.207 | 15.288 | 239.632 | 11.915 | 251.547 |
| 1990 | 138.431 | 4.226 | 142.657 | 124.796 | 6.798 | 131.593 | 14.746 | 0.304 | 15.051 | 277.973 | 11.328 | 289.301 |
| 1991 | 114.113 | 6.325 | 120.438 | 130.716 | 8.353 | 139.070 | 20.504 | 0.227 | 20.731 | 265.333 | 14.906 | 280.239 |
| 1992 | 59.699 | 2.271 | 61.970 | 84.728 | 5.776 | 90.504 | 16.437 | 0.274 | 16.711 | 160.864 | 8.320 | 169.184 |
| 1993 | 134.971 | 8.028 | 143.000 | 157.137 | 8.752 | 165.889 | 21.357 | 0.358 | 21.715 | 313.465 | 17.138 | 330.603 |
| 1994 | 91.091 | 6.982 | 98.073 | 121.621 | 8.045 | 129.666 | 16.901 | 0.270 | 17.172 | 229.613 | 15.297 | 244.910 |
| 1995 | 84.701 | 8.415 | 93.116 | 112.970 | 7.843 | 120.813 | 11.357 | 0.358 | 11.714 | 209.028 | 16.616 | 225.644 |
| 1996 | 88.445 | 8.276 | 96.720 | 100.791 | 8.371 | 109.162 | 16.031 | 0.369 | 16.400 | 205.267 | 17.016 | 222.283 |
| 1997 | 99.891 | 10.154 | 110.045 | 110.469 | 7.181 | 117.650 | 25.634 | 0.427 | 26.061 | 235.994 | 17.762 | 253.756 |
| 1998 | 81.614 | 11.701 | 93.314 | 69.846 | 5.911 | 75.758 | 14.841 | 0.444 | 15.285 | 166.301 | 18.056 | 184.357 |
| 1999 | 80.543 | 10.157 | 90.700 | 85.960 | 7.125 | 93.085 | 14.890 | 0.370 | 15.261 | 181.393 | 17.653 | 199.045 |
| 2000 | 75.834 | 9.818 | 85.652 | 53.674 | 6.542 | 60.216 | 5.852 | 0.398 | 6.250 | 135.360 | 16.758 | 152.118 |
| Average | 97.928 | 5.867 | 103.794 | 116.531 | 8.524 | 125.055 | 15.300 | 0.346 | 15.647 | 229.759 | 14.737 | 244.496 |


Female
Male
Female -baited
Male -baited
All crabs
Frequency
Carapace width (mm)
46
82
102
122