A Socio-Economic Profile Of The Chesapeake Bay Commercial Blue Crab Fishery

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Executive Summary

In 1999, the Bi-State Blue Crab Advisory Committee commissioned the Survey and Evaluation Research Laboratory at Virginia Commonwealth University to conduct a survey to collect social, demographic, economic and attitudinal data from commercial crabbers in Maryland and Virginia. A total of 2,999 surveys were mailed to a random sample of approximately 4,816 commercial crab license holders. The surveys varied with specific questions related to the type of gear they had a license to fish. There were 1,406 surveys that were returned and useable for analysis. This report provides the key findings from the survey returns.

A profile of the typical crab license holder is that they are male, white, and married, about 50 years of age, and not educated beyond high school. On the other hand, the survey demonstrated that there are numerous subgroups within the commercial crabbing community, with different demographics, and relying on the crab resource in varying degrees. The most striking differences are between full-time and part-time crabbers, with the former being defined as earning at least 50% of their annual income from any kind of fishing activity. The full-time watermen tended to start fishing at an early age (upon or even before graduation from high school). Part-timers were more likely to have started fishing around 30 years of age, and would be found trotlining or operating fewer crab pots than the full-timers.

The age distribution of commercial crabbers is skewed toward older age groups when compared with the general population of workers. In Maryland, 32.4% of the license holders are over 60, and in Virginia it is 27.1%. There is a small percentage of license holders under 30, 3.3% and 7.8% in Maryland and Virginia, respectively. Over the next 10-20 years, a significant number of fishermen will be retiring from the industry, and it is unlikely younger fishermen entering the fishery will replace them one-for-one.

There are three separate jurisdictions from which crabbers can obtain licenses: Maryland, Virginia and the Potomac River. Yet, despite the low cost of licenses, only a handful of crabbers hold licenses in more than one jurisdiction. In Virginia, where there are several license types, full-time watermen are more likely to hold two or more licenses than part-timers.

At the time of the survey in 1999, it appeared that effort in the fishery was intensifying in several ways. A comparison was made to survey data collected by Virginia Tech researchers in 1992 for Virginia crabbers, and it was found that the percentage of full-time crabbers has increased since that survey. Comparison between the surveys also showed that crabbers are fishing more pots, and are more likely, in Virginia to fish both hard crab and peeler pots.

One of the notable differences between the fisheries in the two states has to do with the role of part-timers. In Virginia, 67% of the crabbers are full-time fishermen, and they are responsible for 80% of the hard crab and peeler harvest. In Maryland, there are significantly more part-timers so that full-timers make up only 36% of the crab fishermen, but they are also responsible for taking 80% of the harvest.

Crabbers indicated in the survey by a large percentage (76%), that they were concerned about the future health of the fishery. The concern was least among fishermen who fish a large number of crab pots and crab dredgers. There was limited support for management concepts such as sanctuaries or individual transferable quotas as means to manage the fishery. Most crabbers opposed these regulations.

An overwhelming number (84%) of crabbers felt they had little impact on the regulatory process, which might explain their lack of enthusiasm for specific management measures that were proposed. Also contributing to this lack of enthusiasm is the attitude that current regulations are not adequately enforced, although this feeling varied among the different gear types.

Based on the above findings, as well as others in the report, it is recommended that:

- Maryland, Virginia and the Potomac River Fisheries Commission incorporate a socio-economic component, modeled after this survey, into their regular data collection processes. If feasible, economic data should be collected annually, and socioeconomic and demographic data updated at least every five years. Model economic and socio-demographic surveys are included in the appendix.

- The cost information collected in the survey, although only for one crabbing season, should be used to develop rudimentary bio-economic models of the crab fishery. If data is collected over time, these models can be developed into more sophisticated tools for management analysis.

- Any long-term strategy to reduce latent or real effort from the fishery should consider how the age distribution of license holders could be used to meet effort reduction goals.

- License limitation and effort reduction strategies must be sensitive to the impacts these programs place on small fishing-dependent communities where the citizens have few alternative income opportunities. It appears from the demographic data that fishermen in these communities enter the fishery at a young age and earn most of their income from fishing activities. With experience and time, they become the larger scale fishing operations. Any program that interrupts this cycle may burden these communities unduly and eventually lead to their demise.

- Based on the findings of the Technical Workgroup of the Bi-State Blue Crab Advisory Committee that current fishing mortality needs to be reduced from current levels, the fishery is unable to sustain, over the long run, the numbers of these part-timers and full-timers that are currently employed while ensuring a healthy crab spawning stock.

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Background

It is often said that fisheries management is about the management of people, not of fish. We have recently made significant advances in understanding the population dynamics of the blue crab resource and the effects of fishing on that resource (see, for instance, the Chesapeake Bay Blue Crab Stock Assessment). However, we know surprisingly little about the men and women who make their living harvesting, processing and selling Chesapeake Bay blue crabs. This shortcoming was identified in the 1997 Chesapeake Bay Blue Crab Fishery Management Plan, which called for developing "analytical models and supporting databases to evaluate the social and economic conditions in the fishery and the effects of management and actions on those conditions".

The purposes of this study were to determine what additional information is needed to accurately characterize the Chesapeake Bay blue crab fishery in socio-economic terms and to design a system to capture these data over time using a sample survey process that can be adopted by the state regulatory agencies. Currently, commercial harvest and effort data are gathered by the regulatory agencies in Maryland and Virginia, but data on costs, inputs and prices received are not collected on a uniform basis. By conducting this pilot survey, we were able to obtain a snapshot of the economic conditions in the fishery for a single season.

Another important component of this study was to gather information from the users of the resource on what they felt were the important issues facing the fishery and its management. In concert with other efforts to gather information from stakeholders in the fishery, this survey effort was designed to get input from a large number of commercial crabbers on their ideas about resource management and their proposed solutions to current and future problems and issues confronting the industry.

The first step of this process was to work with personnel from the Virginia Marine Resources Commission (VMRC), Maryland Department of Natural Resources (MD DNR), and the Potomac River Fisheries Commission (PRFC). Contacts were made with fishery management and information systems personnel at each agency. Initial meetings were set up with VMRC and MD DNR and the following issues were discussed:

- Purpose of this study
- Data currently collected for commercial crabbers
- Problems/concerns with current data collection
- Data necessary for characterizing the fishery and evaluating policies
- Experiences with surveying watermen

Information from these initial meetings was used, along with other sources of information, to draft a questionnaire for watermen. Other sources of information included previous surveys of watermen (Rhodes, Shabman 1992, 1994) and input from the Bi-State Blue Crab Committee's Technical Work Group. Fishery managers, watermen, TWG and BBCAC members, and survey research personnel reviewed the initial survey draft. The final survey instrument was drafted in November 1999 and is included in Appendix A.

Crab Licenses

License lists for the calendar year 1999 were received from the three regulatory agencies. These lists were combined and unduplicated according to name and address. A total of 4,816 unduplicated license holders were found. A breakdown, according to jurisdiction and state of residence, is given in Table 1. Overall, 3% of those with Virginia crabbing licenses came from Maryland, while only 1% of those with Maryland crabbing licenses came from Virginia. For the Potomac River, 53% of the license holders were from Maryland, while 47% were from Virginia.

Table 1 – License Holders by Jurisdiction

Licensing Jurisdiction	State of Residence			
	Maryland	Virginia	Other	Total
Virginia Only	37	1726	3	1766 (36.7%)
Virginia & Maryland Only	6	7	0	13 (.3 %)
Virginia and PRFC Only	1	109	0	110 (2.3 %)
Maryland Only	2464	2	15	2481 (51.5 %)
Maryland and PRFC Only	57	0	0	57 (1.2 %)
PRFC Only	228	150	0	378 (7.8%)
Virginia, Maryland & PRFC	9	2		11 (.2%)
Total	2802	1996	18	4816 (100%)

The vast majority of crabbers (96%) crab in only one jurisdiction. Table 2 provides the cost of commercial licenses for the different jurisdictions. The license fees do not appear to be so high that they would discourage a crabber from purchasing multiple licenses. Thus, only a handful of crabbers feel the need to have the flexibility to fish in more than one jurisdiction.

Table 2. Maryland and Virginia commercial crab license fees.

Maryland Commercial Fishing Licenses	Fee in 1999
LCC (Licensed Commercial Crabber)	$ 50
TFL (Tidal Fishing License)	$ 300
CB3 or CB6 (Add on to TFL for 300 or 600 pots)	$ 30

Virginia Commercial Fishing Licenses	Fee in 1999
Commercial License Fee	$ 150
Trapper add on	$ 5
Scraper add on	$ 32
Small potter add on	$ 29
Medium potter add on	$ 48
Large potter add on	$ 100
Peeler potter add on	$ 29
Dredger add on	$ 50

Because of the variety of options available to Virginia watermen in terms of licenses, they are more likely to hold more than one gear license type (with the gear add-on counting as a license type) in their jurisdiction than Marylanders. While 84% of Marylanders hold only one gear license type, 57% of Virginians hold multiple gear license types. When comparing full and part-time fishermen, it is the full-time fishermen that are more likely to hold multiple gear license types (50%) compared to part-time fishermen (19%).

Characteristics of Commercial Blue Crab License Holders

The survey gathered information about the characteristics of the license holders and their crabbing operations. The license holders were categorized by a number of variables, including state, size, type of operation, and percent of income from crabbing and fishing. While not much time series data exists on these characteristics, some results from the 1992 study of Virginia crab potters are presented, when comparable.

Demographics

The majority of commercial crab license holders were male (94%), Caucasian (93%), and married (76%). Figure 1 shows the age distribution of commercial license holders by state. Although more pronounced in Maryland and Virginia, there are a surprising number of older (60 and over) license holders. In Maryland, 32.4% of the license holders are over 60, and in Virginia it is 27.1%. The small percentage of license holders under 30, 3.3% and 7.8% in Maryland and Virginia respectively, has an interesting implication for the future of the fishery and its management. Over the next 10-20 years, a significant number of fishermen will be retiring from the industry, and it is unlikely they will be replaced one-for-one by younger fishermen entering the fishery. Any management program that seeks to reduce fishing effort by retiring licenses over the long run can take advantage of this age distribution in a way that will lessen some of the hardship on the participants.

Figure 1. Age distribution of Maryland and Virginia licensed crabbers.

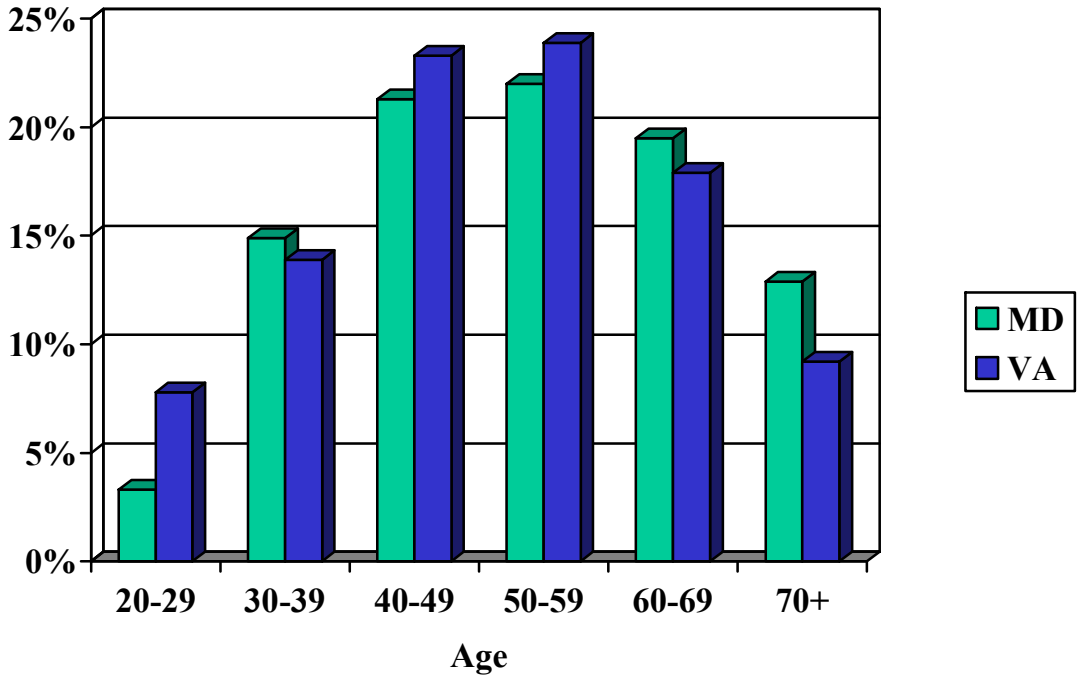


Table 3 gives the breakdowns for educational attainment of commercial crabbers by state. Overall, 22% of commercial license holders had attended some college or graduated.

Table 3. Educational status of Chesapeake Bay commercial crabbers.

	Less than high school	High school graduate	Tech/Vocational school	Some college	College graduate
MD	19.9	43.8	7.8	15.7	6.6
VA	32.2	33.5	6.7	15.5	6.7

Although there is a significant difference between Maryland and Virginia in the number of crabbers who have graduated high school, there is little difference between the states in terms of crabbers who have had some post high school education (30%). This lack of formal education beyond high school severely limits alternative employment opportunities if fishery management actions or other events make it more difficult to earn a living from crabbing.[1]

Figure 2 shows the average years of crabbing experience based on gear license type and state. For pot license holders, the larger the scale of operation, the greater the amount of experience the license holder has. This may be a result of the time it takes to be able to earn enough to invest in the larger rigs necessary for the larger scale potting operations. Another

[1] A fishery management action as used here is intended to include no action or the status quo in terms of management and regulations. In other words, inaction that leads to a significant decline in the health of the blue crab resource could just as well be the source of the decline in earning opportunity from harvest as a new restriction on harvest.

interesting difference is the difference in average years of experience of trotliners in Maryland as compared with Virginia. This difference is reflective of the regulations that do not allow pots to be fished in Maryland tributaries.

Figure 2. Years of experience of licensed crabbers.

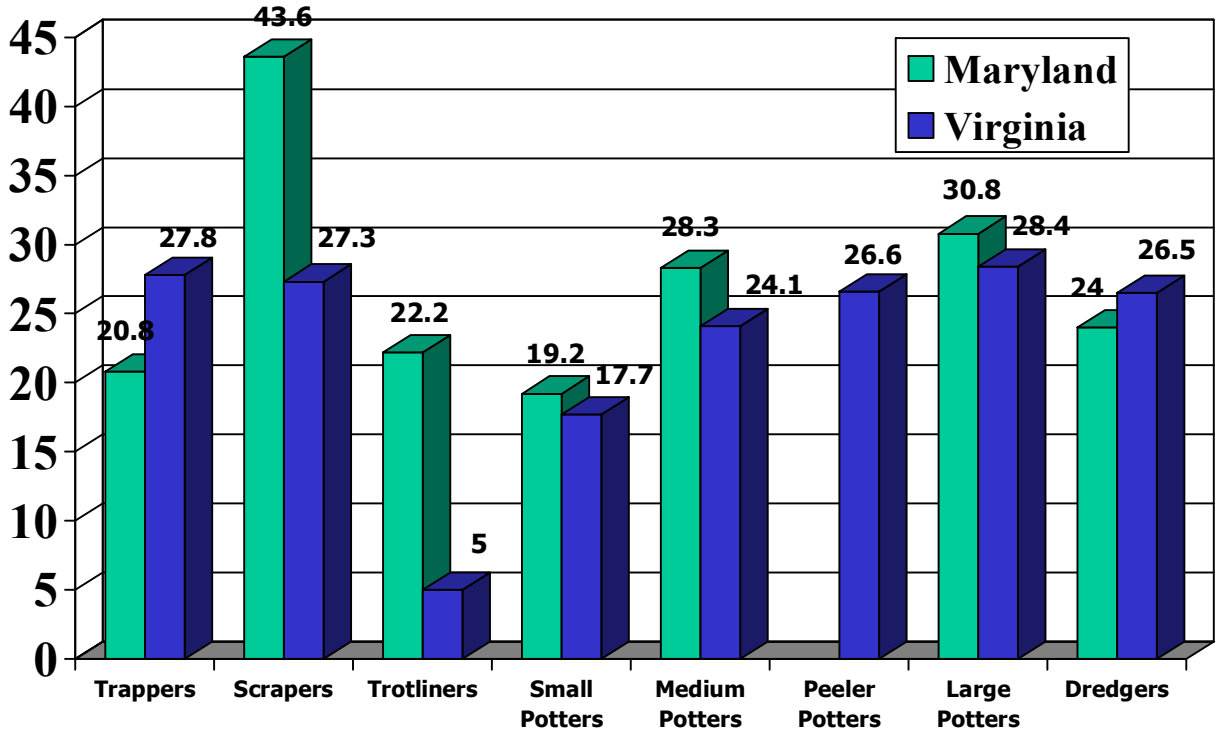
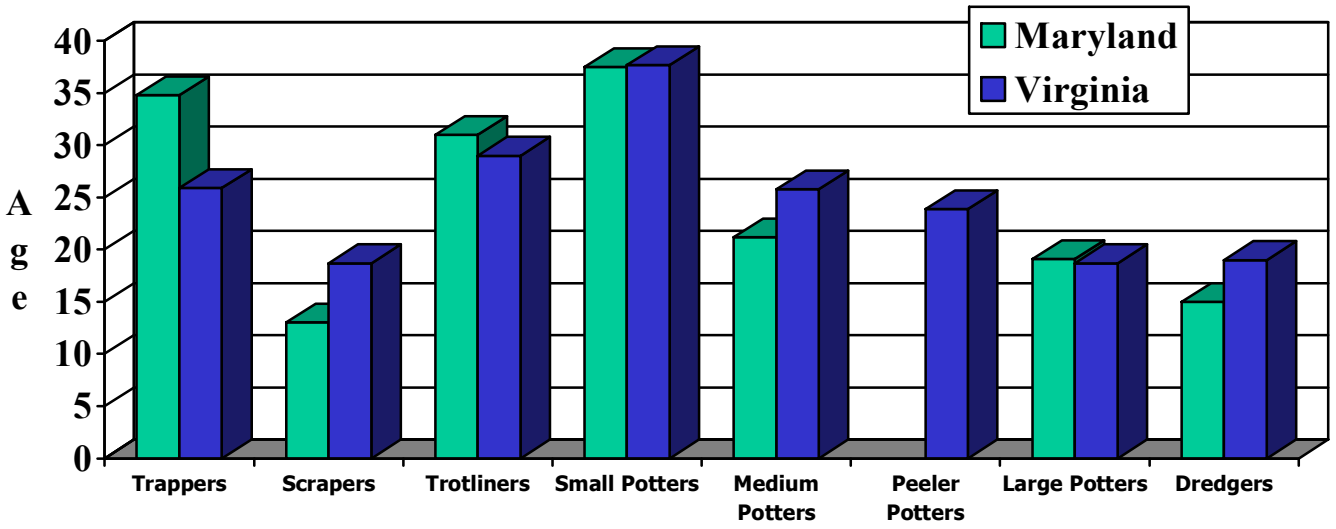


Figure 3 shows the average age when a crabber started crabbing, again broken down by gear type and state. This average age was calculated by subtracting the reported years of experience from the reported age of the watermen. The data demonstrate that those who end up as a large-scale (or even medium scale) potter, started fishing early in their life. Dredgers and scrapers also start very young. The older ages of initiating fishing for small potters, trappers and trotliners, may indicate that these individuals entered the fishery at a later time in their life,

Figure 3. Age when entering the fishery.

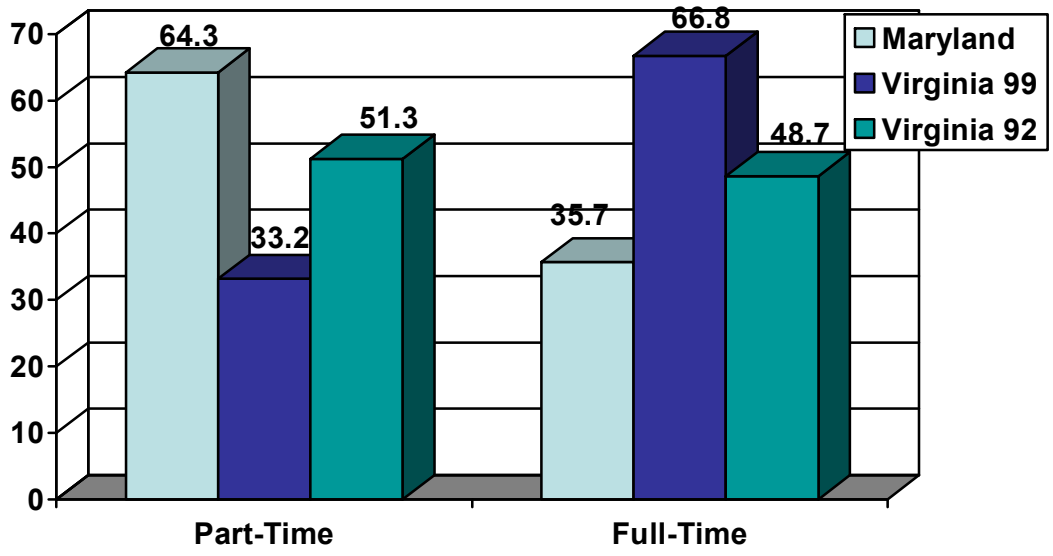


perhaps after pursuing other career choices or the high age might represent retirees who enter the fishery to supplement their income. Clearly, there are different groups within the fishery following different life cycles of employment. The larger scale operations appear to consist mostly of individuals who made an early career choice – perhaps, before or just after finishing high school – to enter the fishery and earn the bulk of their income from crabbing and other fishing income.

Dependence on the Fishery

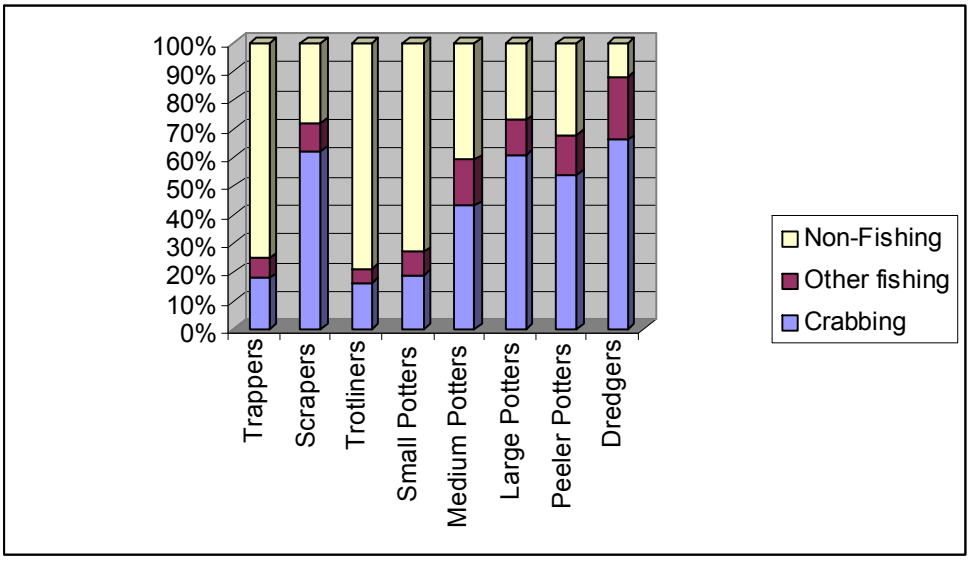
License holders were classified according to the amount of their total household income that was derived from all commercial fishing activities. For this study, those who received 49 percent or less were classified as part-time fishermen, while those who indicated they earned 50 percent or more of their household income from all fishing were considered full-time. Using these categories, there was a significant difference between the states, with Maryland watermen tending to be more part-time, while their Virginia counterparts were more likely to be full-time (see Figure 4). In Virginia, there has actually been an increase since 1992 in the percentage of full-time watermen.

Figure 4 – Full and Part-Time Watermen by State



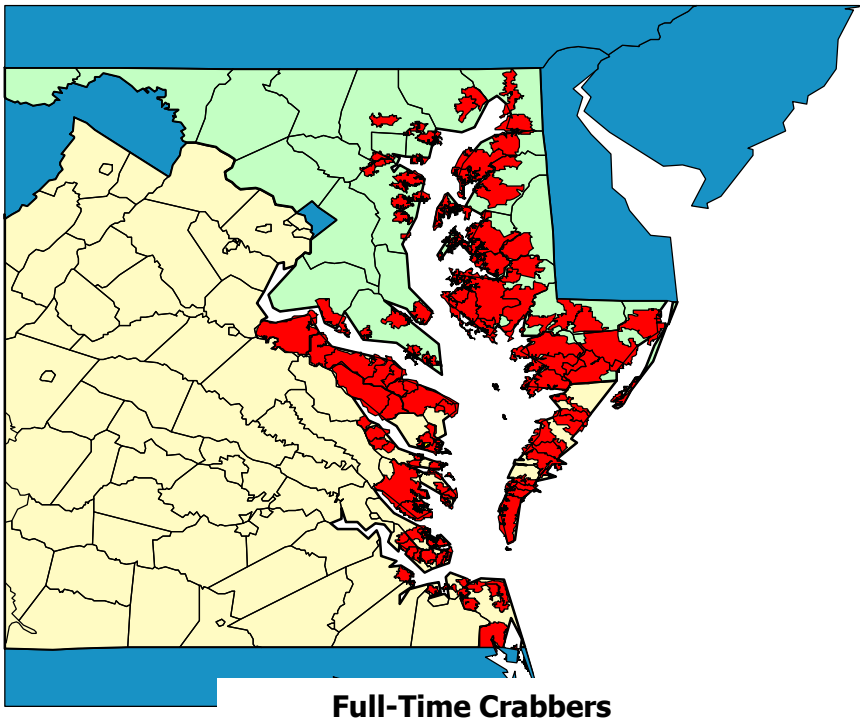
By gear type, crab dredgers in Virginia had the highest percent of income from fishing, averaging 87 % of their income from all fishing activities, while trotliners had the lowest percentage of their income from fishing, with an average of only 20 % (Figure 5).

Figure 5. Percentage of income from crabbing, fishing and other activities.

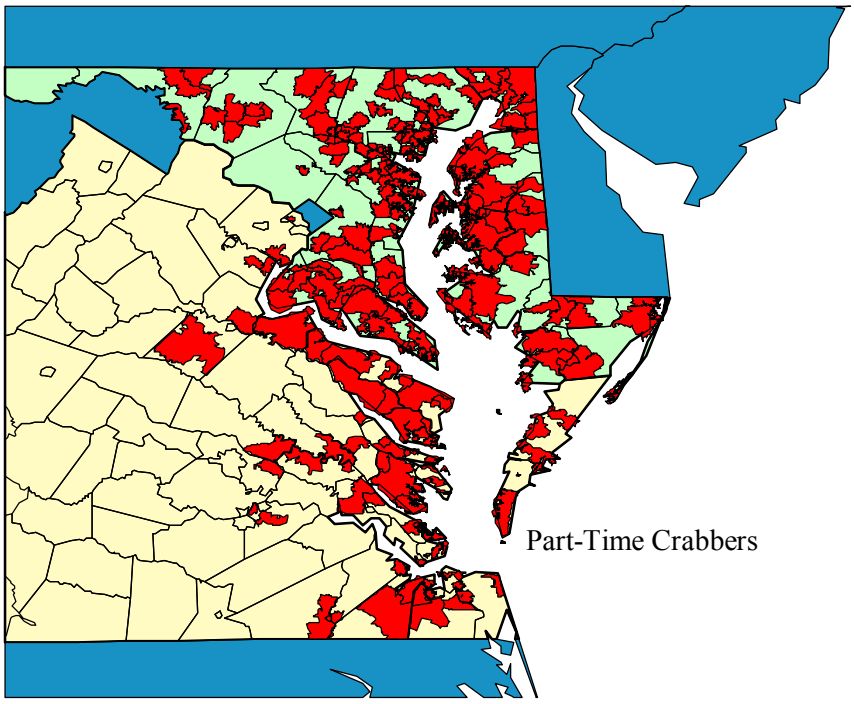


The distribution of dependence on the fishery can also be viewed from a geographic perspective, as seen in the maps in Figure 6 which show the county of residence of full-time and part-timer watermen. Full-timers tend to be the most concentrated group, living very close to the coastlines in both states, while part-timers are more evenly dispersed and tend to live more inland.

Figure 6. County of residence of full and part-time watermen.



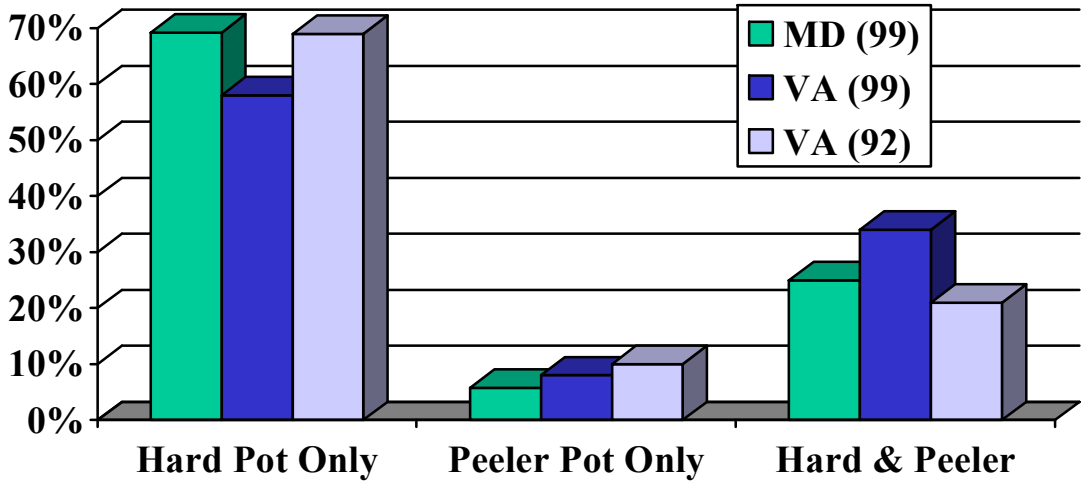
Full-Time Crabbers



Gear Usage and Effort Levels

Pots and trotlines are the most used gears in the two states; with trotlines utilized the most in Maryland (67% as a percentage of all licenses) and pots utilized the most in Virginia (86%). An important trend that has been noted by fishery mangers is the increased use of peeler pots in Virginia. Figure 7 presents a comparison of type of crab pot usage in both states, including comparisons with the 1992 Virginia data. There has been an increase of 13% in those who use both peeler and hard crab pots in Virginia in the last 7 years. In Virginia, hard crab potting only, as a percentage, has declined in Virginia by about 10 percent, while peeler potting only has increased slightly. Thus, the increase in peeler pots appears to be the result of existing pot fishermen starting to use peeler pots, as opposed to these being new entrants into the crab fishery.

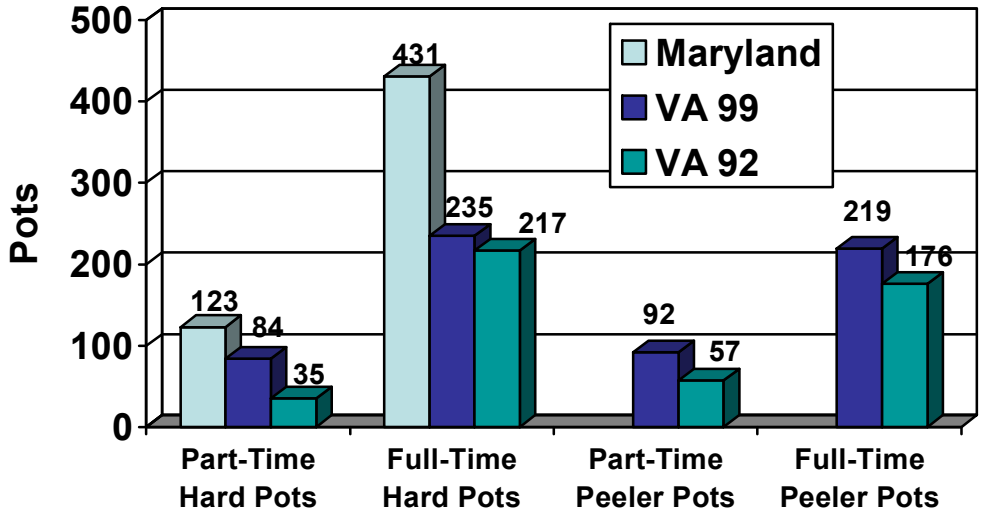
Figure 7. Percentage of licenses for hard and peeler pots.



Increased effort in the peeler fishery can also be seen in the increase in the average amount of gear used per fisherman, broken out by state and dependence on the fishery in Figure 8. Between 1992 and 1999, the average number of peeler pots used by part-time watermen increased from 57 to 92, an increase of 61%. The number increased by 24% for full-time crabbers in Virginia.

Maryland watermen tend be larger scale than their counterparts in Virginia. On average, a Maryland full-time waterman fished 431 hard crab pots per day, compared to only 235 in Virginia in 1999. The same difference can be seen in part-time watermen, with Maryland averaging 123 pots to only 84 in Virginia. The average number of pots per person has increased in Virginia since 1992, for both hard and peeler pots in both income groups.

Figure 8. Average number of pots fished per day.



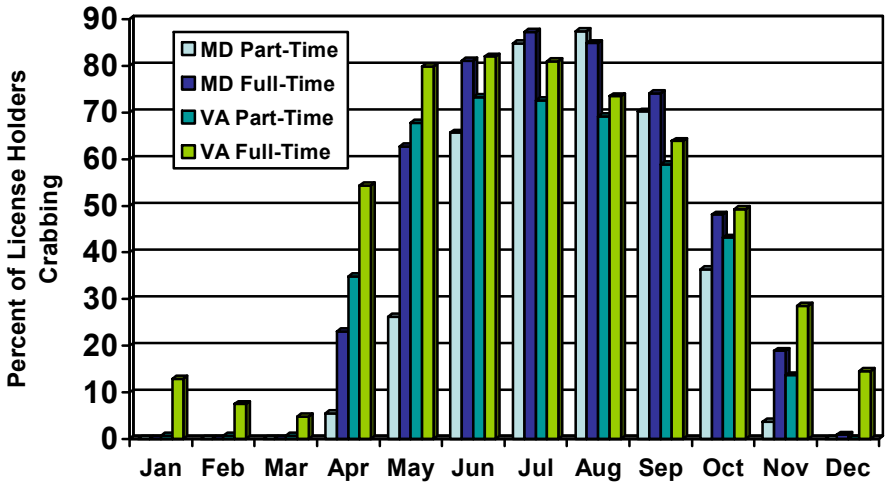
Effort levels in the fishery fluctuate during the season, according to state, gear type and percent of income from fishing. Table 4 gives a breakdown of the average number of months fished and average days fished per season by state and income type.

Table 4. Average number of months and days fished by income type.

	Average Months Fished	Average days fished per season
Maryland Part-Time	3.7	30.1
Maryland Full-Time	4.8	81.4
Virginia Part-Time	4.3	45.6
Virginia Full-Time	5.5	83.6

Figure 9 gives a breakdown of percentages of people crabbing in each month by state and income type. Intensity of license use is greater in Virginia in the early part of the season, whereas, in Maryland, license use exceeds Virginia's in July through September. In Maryland, in 1999, 19% of full-time watermen were still crabbing in November. This group is the one that is most severely impacted by the closure of the crab fishery in Maryland on November 1 in 2001. This closure was a consequence of Maryland being delayed in implementing their effort reduction strategy earlier in the season in order to meet management objectives.

Figure 9. License utilization by month.



Costs of Crabbing

The costs of crabbing include both variable costs, which are incurred only if the crabber chooses to go fishing on a particular day, and fixed costs, those that are incurred regardless of whether or not fishing actually occurs. The main variable costs faced by a crabbing operation include gear, bait, fuel, and labor. Fixed costs include boat and engine maintenance, boat insurance, docking and license fees, and boat depreciation. For this study, fixed costs were allocated according to the percentage of income a waterman derived from crabbing.

Table 3 gives a breakdown of the average amount by state and income type of variable and total costs per day fished. Full-time watermen had total costs per day that were three times the amount for part-timers. Another way of trying to determine costs was to ask the watermen what their minimum daily revenues need to be in order to turn a profit. The interpretation of the response to this question will depend on whether the respondents included the opportunity costs of labor in their calculations. For full-time Maryland watermen the stated minimum revenue was $229, which was just a $1 over the variable costs we calculated from the surveys. For Virginia full-time watermen, the stated minimum earnings per day were $247, which was $32 less than their reported costs.

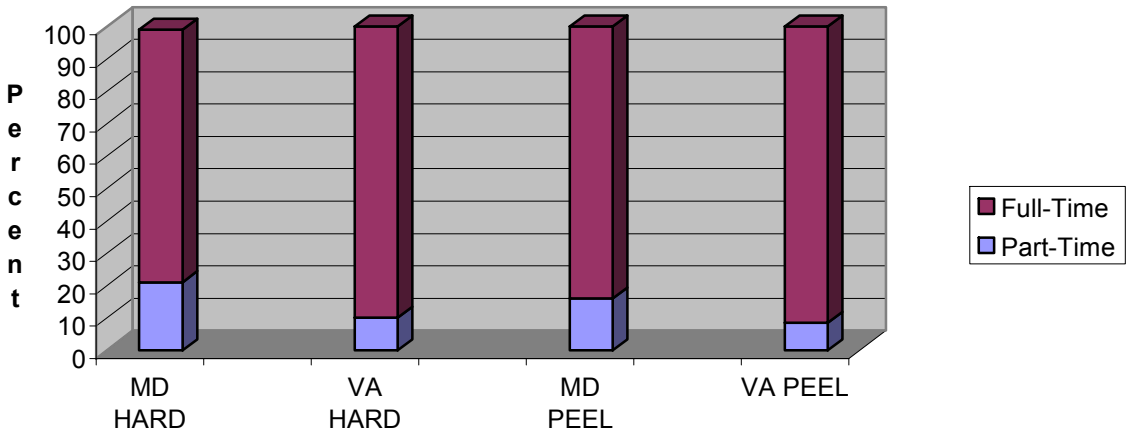
Table 3: Variable and Total Costs by State and Income Dependence

	Maryland		Virginia	
	Part-Time	**Full-Time**	**Part-Time**	**Full-Time**
Average Variable Cost Per Day	$ 70	$ 178	$ 87	$ 198
Average Total Cost Per Day	$ 76	$ 228	$ 94	$ 279

Harvest Levels

Total harvest levels for the fishery are determined by the state agencies from watermen records. In this study, we used that harvest data to determine the percent of catch taken by different sectors of the fishery, which can aid in determining which sectors of the fishery will be affected by policies which limit harvest levels. Figure 10 gives a breakdown of harvest by dependence on the fishery. Overall, full-timers are taking the vast majority of the harvest in both states, for both hard and peeler crabs. The percentage is higher in Virginia, with 90 percent of the hard crab harvest taken by full-time watermen, while in Maryland the full-timers took 78 percent of hard crab harvest, with 21 percent taken by part-timers. The same pattern applies with the peeler fishery, with full-timers taking over 90 percent of the peeler harvest in both states. So while full-timers make up about 67 % of the license holders in Virginia, they take about 90 % of the hard and peeler crab harvest. In Maryland, full-timers make up only 36 % of the license holders, but take about 80 % of the hard and peeler crab harvest. By gear type, pots caught the largest percentage of crabs in both states, with hard crab pots catching 64 % of hard crabs in Maryland and 88 % of hard crabs in Virginia. Trotlines accounted for 33 % of the hard crab catch in Maryland, while dredges caught 10 % of the hard crab catch in Virginia. For peeler/soft crabs, pots were again the dominant gear, with peeler pots taking about 75% of the catch in both states, with scrapes taking most of the remainder.

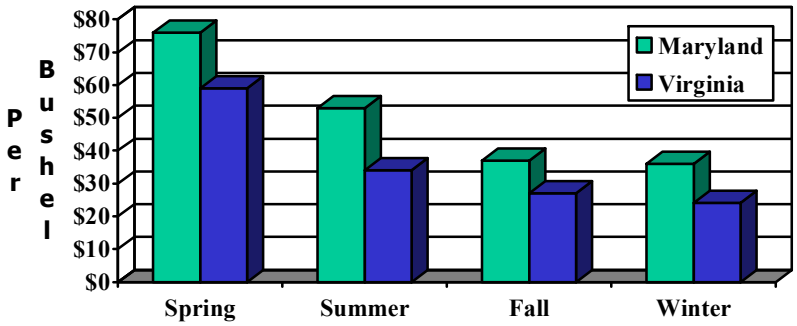
Figure 10. Harvest level by income dependence.



Prices Received

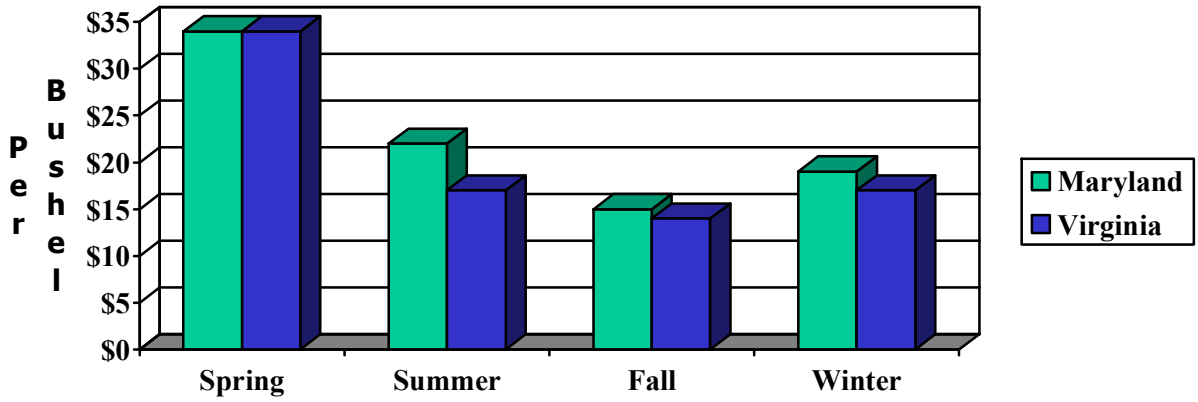
The survey asked questions about prices received by watermen, according to season and the following market categories: #1 Males, #2 Males, Females, Peeler Crabs, Soft Crabs. An analysis of these prices demonstrates that prices tend to be higher in Maryland, where the crabs are generally larger. Also, prices for hard crabs were highest in the spring, while peeler crab prices were highest in the summer in Virginia but in the fall in Maryland. Figure 11 gives a seasonal breakdown of #1 Males prices reported by watermen. For female crabs the price

Figrue 11. Prices received for #1 male crabs.



difference between the two states was not as significant. Winter prices for females were higher than fall prices, averaging $ 19 a bushel in winter in Maryland and $ 17 in Virginia, compared with $ 15 in Maryland and $14 in Virginia in the fall.

Figure 12. Prices received for female crabs.



Marketing Channels

Harvest data were merged with questions on the survey about what percent of the waterman's catch went to different marketing channels in order to determine what percentage of overall catch went to each outlet. Figures 13 and 14 show the marketing channels for both peeler and hard crabs for each state. For peeler crabs, after shedding, a higher percentage of the catch goes directly to the retail market in Virginia (29%) than in Maryland (11%). For both hard and peeler crabs, some of the harvest is kept for personal use. With hard crabs, a larger share of the Maryland harvest (16 %) is going directly to consumers or to restaurants than in Virginia (3%). The Virginia hard crab harvest is fairly equally divided between picking houses and the wholesale market, while over half of the Maryland hard crabs are going to the wholesale market.

Figure 13. Peeler crab marketing channels.

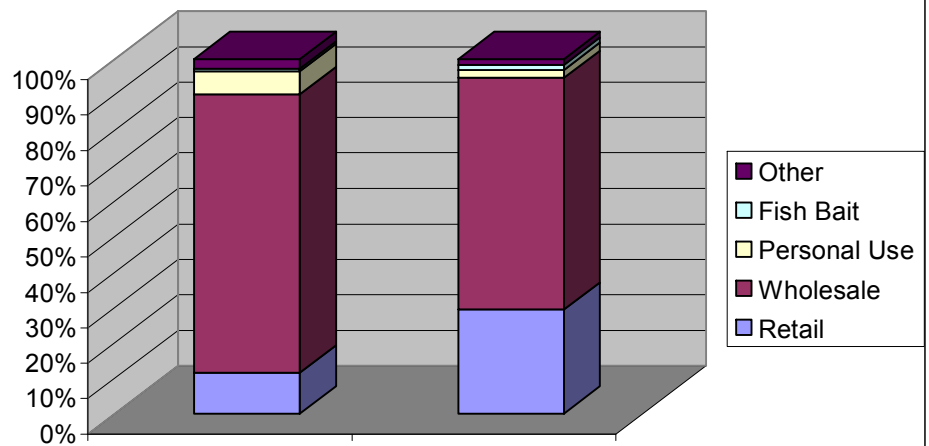
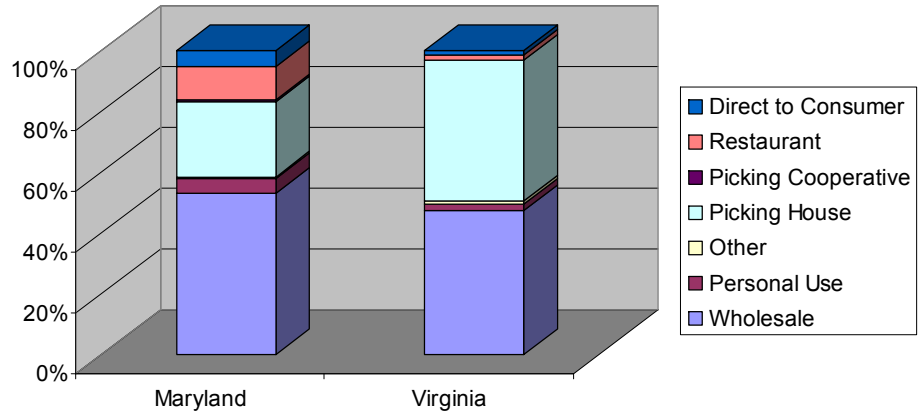


Figure 14. Hard crab marketing channels.



Watermen Attitudes and Policy Suggestions

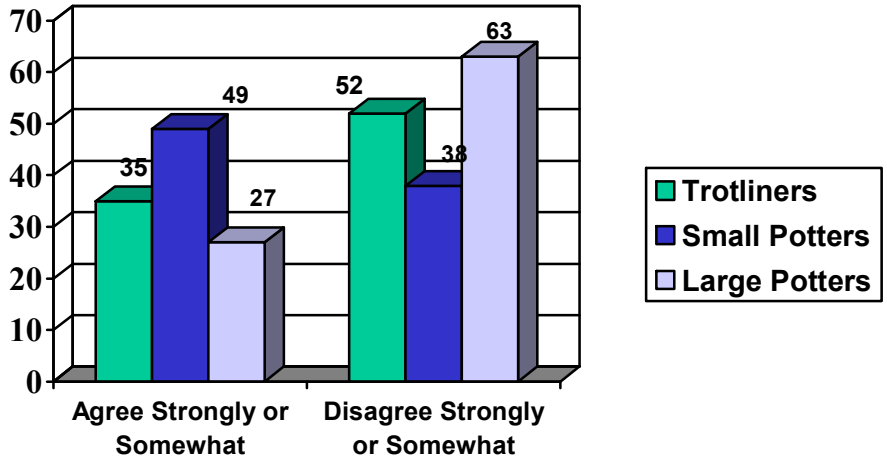
One of the objectives of this study was to get input from watermen about problems and potential solutions in the fishery. The first two pages of the survey asked a number of questions

about fishery issues and also included an open-ended question, phrased as follows, "Please give us your opinion on what should be done, if anything, about the Bay's blue crab fishery. Please be as specific as possible in your recommendations". Watermen responses to these questions have been coded and analyzed and provide a picture of how the fishery is viewed by its users. While there are definite areas where watermen disagree, according to the region where they live, the type of gear they fish, and how much income they derive from crabbing, there are some areas where a majority of them agreed.

Overall, 76% of respondents agreed strongly or somewhat that they were worried about the future of the blue crab in the Chesapeake Bay (Figure 15). Concern was higher for those from Maryland (80%) and for those who got no income from crabbing (89%). Concern was lowest among large crab potters and crab scrapers (55%). Other areas where watermen generally agreed were that crab harvests are affected by land-based impacts on water quality and habitat (77%), and that some regulations should be put on the recreational blue crab harvest in the Bay (67 %).

License holders were divided about what actions should be taken in the fishery. When asked if sanctuaries were a better way to manage the fishery than gear limits, about 51%

Figure 15. Crabber attitude regarding sanctuaries.

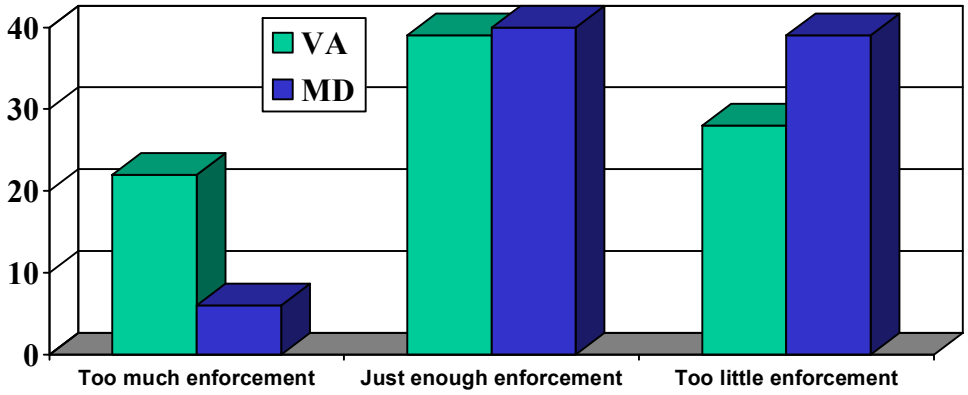


disagreed overall. But support for sanctuaries was higher among small potters and those who got less of their income from crabbing. When asked about a potential Individual Transferable Quota (ITQ) system, 49% opposed this type of management scheme, while 30% agreed it would improve the operation of the fishery. Trotliners (34%) and small potters (33%) were more in favor of an ITQ system than those who fished other gears.

License holders generally felt left out of regulation decisions, with 59% disagreeing that commercial crabbers have influence in the policy-making process. When further questioned, 84% of respondents said they felt they had little or no influence in deciding what types of regulations were put in place for the fishery. Both part and full time crabbers felt they had less influence than those who got no income from crabbing.

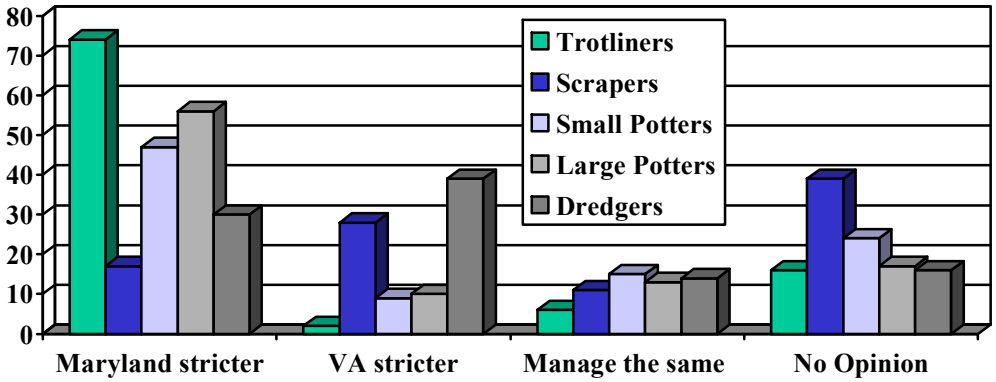
Opinions diverged on enforcement issues. Overall, 60 % of license holders felt that current regulations were adequately enforced, with crab dredgers (71%) agreeing more strongly than peeler potters and trappers (43%). Forty percent of license holders felt there was just enough enforcement in the fishery, with differences between the states on too little and too much enforcement (see Figure 16).

Figure 16. Crabbers opinions regarding adequacy of levels of enforcement.



When asked about differences between the states in managing the fishery, 53% felt that Maryland had stricter regulations, while only 11% indicated Virginia had stricter regulations (Figure 17). There were some differences among gear types on this question. Crab dredgers, who have been the target of many regulations recently in Virginia, were more likely than any other gear type to indicate that Virginia had stricter regulations than Maryland.

Figure 17. Watermen's comparison of managment in Maryland and Virginia.



About 73 % of respondents answered the open-ended question about what to do for the fishery. Overall, the issue raised most often concerned restrictions on female and/or sponge crabs.

Approximately 40 % of all respondents felt there should be some limit on the catching of these crabs. Comments were further categorized into several areas for analysis - gear restrictions, output restrictions, enforcement issues, environmental issues. Gear restrictions were overall the largest comment area, with 21% of respondents recommending restrictions on crab dredging.

There were differences between the states in policy suggestions. While 15.5% of those from Maryland recommended limits on recreational crabbing, only 3.4% of those in Virginia mentioned this issue. Virginia license holders recommended peeler pot restrictions more often (26%) than those in Maryland (4.3%). The appendix gives tables of the open-ended categories by gear type, state, and dependence on the fishery. Some typical crabber comments are listed in the table below.

Watermen Comments

"I think that the sponge crabs are what should be watched more than anything else. When you catch and sell sponge crabs, you are affecting all of the crabs, not just one" - Virginia peeler potter

"Pot limits and old laws need to be enforced. Give new laws time to work, making new laws every year does not make sense….this is no way to make us have to live"
-Virginia crab potter

"Maryland and Virginia need to get together and have the same laws, its not right for one to do one thing and the other to do the opposite"

Enforcement Issues: Another Perspective

In 1994, a Virginia Tech telephone survey of both Virginia marine police and commercial crabbers was conducted to determine the feasibility of implementing different types of policies in the Virginia crab pot fishery. The results of these surveys speak to some of the important issues when considering the effectiveness of new regulations. Seventy-five percent of the Marine police felt that watermen violated fishery regulations without getting caught. When asked about specific policies, 91% felt that a pot limit would be unenforceable, given the diffusion of the fishery. The most easily enforceable policy, according to the Marine Police, was a limit on crabbing hours. The watermen who were interviewed were generally in favor of pot limits, but over 70% of them felt that it could not be adequately enforced. About half of the watermen felt crabbers would not adhere to a time restriction on crabbing and recommended a quota as the most enforceable policy.

Conclusions and Recommendations

Managing a fishery as complicated as the blue crab is difficult enough, but it is made more so when there is little information about the fishermen you are trying to manage. This pilot survey supported by the Bi-State Blue Crab Advisory Committee demonstrated that it is feasible to collect social, demographic, economic and attitudinal information from the watermen community that can be combined with harvest data to develop important and meaningful information to inform fisheries management decisions. The power of this information is much greater when it is collected on a regular and consistent basis so that time series studies can be conducted. It is recommended that Maryland, Virginia and the Potomac River Fisheries Commission incorporate a socio-economic component into their regular data collection processes. A model economic survey for the Bay region is presented in Appendix B of this report. If feasible, data should be collected on at least a bi-annual basis, if not every year.

The cost information collected in the survey, although only for one crabbing season, could be used to develop rudimentary bio-economic models of the crab fishery. These models can then be used to develop estimates of the effects of alternative crabbing regulations on different segments of the industry. If time series economic data is collected, these models can eventually by converted to statistical models, and more sophisticated approaches such as dynamic modeling can be employed to evaluate the impact of different regulatory approaches.

From the demographic information, we learned that the age distribution of blue crab license holders is skewed toward older age groups. This distribution is partly reflective of the license limitation programs that have been instituted by the states in recent years. Any long-term strategy to reduce latent or real effort from the fishery should consider how this age distribution could be used to meet effort reduction goals.

One of the difficulties of using license limitations to control effort is the burden it places on small fishing-dependent communities where the citizens have few alternative income opportunities. It appears from the demographic data that fishermen in these communities enter the fishery at a young age and earn most of their income from fishing activities. With experience and time, they become the larger scale fishing operations. Any program that interrupts this cycle may burden these communities unduly and eventually lead to their demise.

Also present in the fishery are a large number of part-time fishermen and some full-time fishermen that enter the fishery at a later point in their life cycle, perhaps due to early retirement from a non-fishing job, or after having tried alternative income opportunities. In recent years, it has become clear that the fishery is unable to sustain, over the long run, the numbers of these part-timers and full-timers that are currently employed while ensuring a healthy crab spawning stock.

Appendix A - Data Collection and Survey

The gear types that each waterman fished were available, along with size of the operation for those who hard crab potted in Maryland and Virginia. Because watermen can hold licenses for multiple types of gear, the following hierarchy was used in determining what gear type to select for sampling (with 1 being given the highest precedence):

1. Dredge
2. Large potters (more than 300 pots per day)
3. Peeler potters
4. Medium potters (between 100 and 300 pots per day)
5. Small potter (less than 100 pots per day)
6. Trotliners
7. Scrapers
8. Bank trap/channel pound

A small number of license holders did not hold licenses for any of these gear types (n=33) and were eliminated from the study population. Of those 33, 16 were from Virginia and were licensed only for a crab-shed tank. 17 of those not included in the final sample were from Maryland – 10 held licenses only for net rings, 1 for a dip net, and 6 were not able to be identified for type of gear fished, as they did not turn in reporting forms. The total study population then was 4783. For sampling, dredgers, large potters, trappers and scrapers were all sampled at 100 % of the populations because of the small n's. The other 4 categories were sampled according to their proportions in the original sample (minus the 4 groups sampled at 100 %). The total number of watermen sampled was 2999.

Mailing Protocol and Response Rates

Surveys for all gear types except dredgers were mailed out on December 15, 1999. Reminder postcards were mailed out to all respondents after Christmas and a second mailing was done to non-respondents in late January. Surveys for crab dredgers were mailed out at the end of March. A total of 1613 surveys were mailed back. Some of those in the sample were deemed ineligible, either because of an incorrect address, because they were deceased or too ill to complete the survey or because they did not hold a license in 1999. The overall response rate then was 56 percent. A breakdown of response rates by gear types is given in Table A1.

Table A1: Response Rates by Gear Type

Gear Type	Responded	No Response	Ineligible
Trappers	60.3 %	32.9 %	6.8 %
Scrapers	51.2%	45.0 %	3.8 %
Trotliners	66.3%	29.6 %	4.1 %
Small Potters	60.9%	34.6 %	4.5 %
Medium Potters	49.9 %	46.4 %	3.7 %
Large Potters	48.0 %	49.1 %	2.9 %
Peeler Potters	49.2 %	48.0 %	2.8 %
Dredgers	32.2 %	64.4 %	3.4 %
All Gear Types	**53.8 %**	**42.5 %**	**3.7 %**

A total of 1406 surveys were returned and usable. The breakdown of these numbers by gear type is given in Table A2, which also has the weights used in the final dataset for each gear type so that they were representative of the overall population. The post-stratification weight was determined by dividing the percent in the population by the percent in the final sample. Trappers, scrapers, trotliners, large potters, and dredgers were overrepresented in the final sample, so they received weights less than 1. Small potters, medium potters, and peeler potters were underrepresented in the final sample and given weights greater than 1. All of the percentages presented in this paper are based on the weighted dataset, so that the numbers are representative of the gear distribution in the commercial license holding population in the 3 jurisdictions.

Table A2: Sampling Weights

Gear Type	Population		Final Sample		Post Stratification Weight
	Number	Percent	Number	Percent	
Trappers	73	1.526239	42	2.987198	0.510927
Scrapers	80	1.67259	29	2.062589	0.810918
Trotliners	1410	29.47941	444	31.57895	0.933515
Small Potters	482	10.07736	134	9.530583	1.05737
Medium Potters	1326	27.72319	296	21.05263	1.316851
Peeler Potters (VA only)	763	15.95233	203	14.43812	1.104876
Large Potters	444	9.282877	191	13.58464	0.683336
Dredgers	205	4.286013	67	4.765292	0.899423
Total	**4783**	**100**	**1406**	**100**	**1**

Additional Data Sources

In addition to the data collected from the survey, MD DNR and VMRC provided information on monthly harvest and effort levels for calendar year 1999 from their commercial watermen reporting systems. These data included amount of catch in six market categories, number of days fished per month, average number of hours fished per day, and average number of gear units fished per day. The harvest and effort data was matched with the survey respondents and sent to SERL, where a final dataset was created which had monthly gear input and harvest data, along with annual and monthly data from the survey on costs and other inputs. This procedure protected the confidentiality of the respondents.

Appendix B – Model Surveys

Model Survey I
(Note: Will vary by gear type)
Economic Data – To be collected annually, or adapted to work with monthly reporting.

COSTS

1. How much did you pay for crabbing gear in 2002? $_____

2. How much did you pay for boat insurance in 2002? $_____

3. How much did you pay for docking fees for 2002? $_____

4. How much did you pay for interest on your boat loan in 2002? $_____

5. How much did you pay for engine maintenance and repairs in 2002? $_____

6. How much did you pay for boat maintenance and repairs in 2002? $_____

   6a. What percent of the labor for maintenance and repair do you do yourself?_____%

7. What is the total annual amount you paid for bait during the season? $_____

8. How much did you pay for boat fuel in the 2002 crabbing season: $ _____

Model Survey II – Demographic and Socio-Economic - Every 5 years
(Note: will vary by gear type)

DEMOGRAPHICS

1. Years of commercial fishing experience: _____

2. Gender: ☐ Male ☐ Female

3. Race: ☐ Caucasian/White ☐ African American/Black (non-Hispanic) ☐ Hispanic☐
   ☐ Asian/Pacific Islander ☐ American Indian/Alaskan Native☐

4. Age: ____years

5. Highest level of education: ☐ Less than high school
   ☐ High school graduate
   ☐ Technical/Vocational school
   ☐ Some college
   ☐ Bachelor's degree or higher
6. Marital status: ☐ Single ☐ Married ☐ Separated/Divorced ☐ Widowed

7. Number of persons in your household_____

8. What percentage of the total income in your household comes from crabbing? _____%

9. What percentage of the total income in your household comes from other fishing activities? _____%

10. What percentage of the total income in your household comes from non-fishing activities? _____%

VESSEL INFORMATION

1. Age of vessel: _____ years

2. Length of vessel: _____feet

3. Age of engine: _____years

4. Type of engine (check one)
   - ☐ Inboard
   - ☐ Outboard
   - ☐ Inboard/Outboard

5. Estimated fuel use per day crabbing:
   ☐ Gas ☐ Diesel _____ gallons

6. Estimated market value of fishing vessel: $ _____

CRABBING GEAR

1. Please check all crabbing gear types that you use and the percent of your total catch by weight that comes from that gear type:

☐ Hard crab pots ___% of total ☐ Peeler pots ___% of total ☐ Trotlines ___% of total

☐ Scrapes ___% of total ☐ Dredges ___% of total ☐ Bank trap ___% of total

☐ Channel pound net ___% of total

FISHING OPERATION

1. How many pots doyou fish per day (on average) during each of the following seasons?

   SPRING _____ SUMMER _____ FALL _____

2. What is your average cost for buying and preparing one crab pot to go in the water? $_____

3. On average, how many crabbing seasons do your pots last? _____ seasons

4. How many pounds of bait did you use per day (on average) during each season?

   SPRING _____ SUMMER _____ FALL _____

   4a. What percentage of your bait did you buy? _____%
   4b. What type of bait did you use during each season (e.g., menhaden, razor clam, etc.)

   SPRING _____ SUMMER _____ FALL _____

5. How long does your daily crabbing run take on the water?

   SPRING _____hours SUMMER _____hours FALL _____hours

6. How many crewmembers do you have during each of the following seasons?

   SPRING _____ SUMMER _____ FALL _____

   6a. Do you pay your crew by wage or share? ☐ wage ☐ share
   6b. If wage, what is daily wage? $_____/day
   6c. If share, what percent of revenue per crew member _____%