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FOR THE PROJECT ENTITLED:

FISHERY INDEPENDENT STOCK ASSESSMENT OF VIRGINIA'S HARD CLAM POPULATION OF THE CHESAPEAKE BAY

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ABSTRACT

The hard clam (Mercenaria mercenaria) is one of the most importnt commercial species harvested in Virginia's Bay waters. As the oyster and other commercially harvested species have declined, a portion of the displaced workforce has joined the clamming fleet. Declining catches have raised concern for both watermen and fishery managers; however, little current information was available for either hard clam standing stock levels or age structure. The current project used a fishery independent stock assessment method using a hydraulic patent tong sampling device to survey hard clams in the James River-Hampton Roads area. When compared with results from previous stock assessment estimates in this area, the current clam densities and standing stocks were not obviously different. Age and size structure has changed since earlier studies, with less larger and older clams in the current population. Declines in the commercial clammer's catch per day may be explained by a decrease in the number of high density clam areas over the many years of fishing. Today's clam populations may be more uniformly distributed, resulting in the individual clammer catching less clams per day because in each patent tong grab there are less clams and the physical limit on the number of tong grabs that can be handled on any one day.

ACKNOWLEDGEMENTS

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INTRODUCTION

The hard clam (Mercenaria mercenaria) is one of the most important commercial species harvested in Virginia's Bay waters. Annually since 1987, dockside values have varied from four to six million dollars, with over a million pounds of meats landed each year. As the oyster and commercial finfish resources have declined, the clam industry has absorbed some of that displaced fishing effort (Figure 1, Table 1). There has been a doubling of the clamming workforce during the past 10 years and this added harvesting pressure on the clam resource has caused concern for fishery managers at the Virginia Marine Resources Commission (VMRC). Catch figures indicate an initial increase in harvest levels following the increase in the workforce; however, since 1990 there has been a decline in harvest and a decrease in the total catch per licensee. Anecdotal information from watermen has also suggested that the fishermen are working longer hours with more sophisticated equipment to catch the same or declining quantities of clams.

A clam management committee at VMRC is currently meeting regularly to discuss and evaluate the regulatory changes necessary to protect the fishery participants and to stabilize the clam resource. Options being considered include limited entry, minimum and maximum size limits on clams, daily time and catch limits, and sanctuary areas. They have been unable to offer significant suggestions for further regulation due partly to the lack of real data on clam stocks. It is extremely difficult to propose and defend new regulatory efforts based only on catch figures without having current information on standing stocks and age structure of hard clam populations.

This project was proposed to begin quantitatively assessing the current status of hard clam resources in Virginia. We have been using a random sampling methodology, employing a hydraulic patent tong to give a fishery independent stock assessment of oysters and we have adapted this procedure to collect similar data for hard clams. Rather than proposing an exhaustive survey to sample from all areas within the Bay, we have initially sought to provide adequate comparative and baseline data for areas where management decisions are urgently needed. Specifically, this project had three goals:

i) Assess the relevant clam survey literature from past projects in the Chesapeake Bay and determine where direct comparisons could be made with current data on clam population numbers.

ii) Map, produce sampling grids with randomly selected samples, and sample the current clam populations on the areas that were identified in the literature search as well as those identified by VMRC as important harvesting areas.

iii) Estimate the current stock densities, age, and size distributions of clam populations for comparison to previous projects, and establish a baseline for evaluating the effects of current or future management decisions.

METHODS

A search of reports on Virginia's clam resources uncovered several hundred locations that had previously been sampled for clam densities (Haven, et al, 1973, Haven and Kendall, 1974; Haven and Kendall, 1975; Haven, et al, 1981; and Kvaternik, 1982). The stock assessment methods varied in these reports, but all could be converted to an estimate for clams per acre or total standing stock. Additionally, some of the reports had information on the size distribution of clams at that time. Using these reports, our efforts began in the lower James River-Hampton Roads area where past data was most complete and an important clam fishery exists today. The entire Hampton Roads and lower James River area was mapped, and gridded with Loran coordinates by the Surveying-Engineering Division of VMRC. Sample locations were randomly selected and marked on a map at a rate of one sample for each 10 acres of submerged bottom. Approximately 25,000 acres were plotted and 2500 samples selected for the area between the Hampton Roads (I-64) Bridge Tunnel and the James River Bridge (Route 17), including most of the Elizabeth and Lafayette Rivers. All potential clam producing areas were included, except for areas that were leased by private individuals. Samples were collected with a hydraulically operated patent tong operated from the 42 foot fiberglass workboat, J. B. Baylor. This type of patent tong separates the closing action of the tong from the retrieval action. In our studies, this has proven to be the most accurate method for consistent bottom penetration for sampling. The open dimensions of the tong were such that it sampled 1 square meter.

On each sampling day, a crew of 6 or 7 people conducted the sampling operation. The boat operator located the sampling location with a Northstar Loran which has been corrected to a known location on each sampling day. At the sampling location, the tong operator lowered the open tong to the bottom, closed the tong, and raised the sampling grab on to a sorting table on the boat with the assistance of a second individual. The entire sample grab, including mud, shells, and clams was processed by hand and running water by the other 3 individuals on the boat. Water depth, bottom consistency, and the length, width, and height of all live clams and clam boxes (emply clam shells with the hinge attached) was recorded. We had originally planned this project for the summer months. Funding was only available in the winter and the sampling process was somewhat more difficult than anticipated. We had estimated that we could sample and process up to 200 patent tong samples per day. The work on the boat was more difficult in the cold and windy conditions of winter and with the cold water, the bottom sediments were harder to sort than originally envisioned resulting in only 100 samples being processed per day. In the 20-day sampling period, approximately 2000 samples were processed and more than 20,000 acres were surveyed. When it became apparent that we could only process 100 samples per day, we concentrated on the most important areas of the Lower James and Hampton Roads and did not attempt to go further in the Bay.

Clam numbers and sizes, as well as the bottom type and depths were archived in a custom database program at VMRC. Clam densities were determined for the entire area and a map of densities was generated. A subsample of clams in each density area was analyzed for the size distributions.

RESULTS AND DISCUSSION

Mean densities of clams are presented in Figure 2. The highest densities of clams were in the center, deeper areas of the lower James River between Newport News Point and the Hampton Roads Bridge Tunnel. Areas were separated for presentation using a combination of depth, density, bottom sediments and similar divisions in previous studies. A general description of each individual area follows:

A. Northern nearshore area between Newport News Point and Hampton Roads Bridge Tunnel, mostly shallow (<8 feet) with sandy bottom and a moderate density of clams (area approximately 2,180 acres; 7,001 clams/acre).

B. Middle area on the north shore between Newport News Point and Hampton Roads Bridge Tunnel at intermediate depths (8 - 18 feet) with sandy or sandy-mud bottom, and moderately high density of clams (2,770 acres; 10,450 clams/acre).

C. North channel edge and channel between Newport News Point and Hampton Roads Bridge Tunnel, sandy or sandy-mud bottom, >18 feet deep, with the second highest density of clams (1,950 acres; 13,193 clams/acre).

D. South side of the channel and part of middle ground area, >18 feet deep, generally sand or sandy-mud, with the highest density of clams (1,040 acres; 15,055 clams/acre).

E. Middle ground area, soft mud to sand, 16 - 25 feet deep, moderately high clam density (1,520 acres; 6,100 clams/acre).

F. Craney Island area - north, east and west of Craney Island with hard sand to soft mud of varying depths. No clams were caught in any of more than 150 sample locations (4,000 acres).

G. Elizabeth River - varying bottom types with low density of clams (3,415 acres; 298 clams/acre).

H. Lafayette River - mostly sand or sandy-mud bottom with a moderate density of clams (580 acres; 5,058 clams/acre).

I. Nearshore area on north side of James River between I-664 and the James River Bridge, mud, mud-sand, and sandy bottom mostly in the channel area adjacent to Newport News Shipyard, moderate clam density (2,150 acres; 6,799 clams/acre).

J. South side of Newport News Channel from I-664 to the James River Bridge, mud to sandy-mud, 10-30 feet deep, low clam density (1,375 acres; 1,781 clams/acre).

K. Middle of James River between I-664 and Cruisers oyster bar, moderate depth, with muddy bottom and low density of clams (1,225 acres; 93 clams/acre).

L. Cruiser's Oyster Bar, old oyster bar with significant shell deposits and low clam density (425 acres; 1,721 clams/acre).

M. Middle of the James River above Cruiser's Rock, moderate depth with mud bottom, zero clams were found in more than 100 samples. (1,400 acres)

N. Middle of the James River next to the James River Bridge, moderate depths with some oyster shell and mud or sandy-mud bottom with low clam density (1,500 acres; 171 clams/acre).

Areas A, B, C, D, E, and I are the main areas for the summer relay clam season in the James River, where in many years more than 50% of the annual harvest of clams in the entire state has originated. This area is closed to harvest except during the summer because of high bacterial levels. Fishing is permitted during the summer in a relay program, whereby, polluted clams are harvested and moved under state supervision to other clean water areas where the clams must remain for 15 days prior to direct marketing. The focus for much of the discussion on clam management has centered on this important area. Accurate figures for harvests for the past 14 years are included in Figure 3. Harvest figures increased from 1986 - 1988, which is mostly attributable to the increase in the patent tong clam fleet presented in Figure 1 and Table 1. Harvests have declined since 1988 and the commercial clammers have indicated that their catch/boat has also declined. Prior to the study, we would have predicted a substantial decrease in the standing stock of clams in these areas from those reported in previous studies. Published results from Haven, et al (1973) and Haven and Kendall (1975) in Figures 4 and 5 show mostly similar distributions and densities of clams to the current project, although there appear to be more high density areas in the earlier studies than in the present study. Methodologies were quite different between studies, with less sites and more replication within sites in the previous studies than the current project. In a later report, Haven, et al (1981) combined data from all their previous reports and produced an estimate of the clam standing stocks in the entire area. This estimate was 565,712 bushels or 141,428,000 clams in the James River-Hampton Roads area. Kvaternik (1982) also estimated the standing stock of clams for this area using the harvest figures and catch per unit effort information with the Leslie method. This method could be quite accurate in this area because of the excellent harvest figures that have been maintained each year with the relay program. For the period from 1978 through 1981, standing stocks varied from 70,290,535 clams to 139,815,328 clams with an average of 99,582,920 clams for the four-year period. If calculations are made with data in the current project, the standing stock would be estimated at approximately 112,000,000 clams. All of these estimates of standing stocks are reasonably similar and do not obviously indicate any major decline in clam populations associated with harvesting activity. Anecdotal information from the commercial fishermen suggests very strongly that their catch per day has indeed declined, especially during the last 5 to 6 years. At first inspection, these results seem to be contradictory; however, inspection of the sampling results in Figures 4 and 5 shows some very densely populated clam areas within the overall area. The patchy nature of high density areas of clams in the past may explain the higher catch rates in previous years. The efficiency of the clam harvester has improved with the use of better depth sounding equipment along with the Loran equipment that allows the watermen to both locate and return to these "patch" high density areas. It is very likely that with the increase in harvester numbers and the increase in efficiency, that the high density spots have mostly been caught and what now remains are relatively uniform concentrations of clams. The density per acre and standing stock for this entire area has remained constant; however, the success of the harvester has declined, because there are less "hot spots" or high density areas and the catch in each patent tong grab has declined and the clammer can only make a certain number of grabs in any one day. The clam populations appear to be healthy and able to maintain a relatively stable population with the observed 15% to 20% annual harvest rate (approximately 15,000,000 - 20,000,000 of a total of 100,000,000 clams).

One change in the harvested clam population that does appear to be occurring is in age structure. Table 2 presents results of the mean size and size frequency of a subsample of clams from several of the sampled areas in the current project. In Table 3, a comparison between 1974 and 1995 data for mean size and size frequency is presented. It would appear that the average size of clams has declined during the past 20 years. Additionally, there are fewer clams in the chowder or larger clam category in the current project. Both of these observations may be cause for concern and should be monitored in later studies. It would appear that very few clams escape harvest and reach the larger size category. Clams are long lived and grow slowly, and may take 12 to 20 years to reach chowder size (Haven, et al, 1975); and therefore, even though the harvest of chowder clams is limited, clams are subject to harvest at smaller sizes for many years. Very small quantities of clam boxes were observed in any of the sample areas which would indicate very little natural mortality besides harvesting. If larger animals are better spawners, over time there may be a reduction in spawning success in future years.

Much of the Elizabeth and Lafayette Rivers were sampled in the current project because there has been some interest in opening this area to harvest and the relay process. Currently these rivers are closed entirely to the harvest of shellfish because of pollution. Stock assessment results provide little evidence of significant clam stocks in the Elizabeth River (Figure 2). A moderate density of clams was present in the Lafayette River; however, the total acreage was small and would not support a very large fishery. The excellent reputation of Virginia's clam products could be jeopardized by the opening of this insignificant clamming area.

CONCLUSION

In conclusion, results in this project indicate that the standing stock of clams in the lower James River-Hampton Roads area appears similar to previously reported levels from studies as long as 25 years ago. A decrease in the success of the clammers as reflected by a decline in the overall harvest and the catch per unit effort may be explained by a change in the distribution of clams on the bottom. Years of harvest may have reduced the "patches" of high density clam areas and resulted in mostly uniform distribution of clams. This seems to indicate that a relatively stable clam population level may be maintained at the same time that the health of an industry is declining.

Secondly, there appear to be changes in size and age structure during this 20-year period resulting in less larger, older clams in the current clam population. These changes have not resulted in a decline in clam populations, but this area should be resurveyed at a later date. Additionally, further sampling of other clam areas should be completed for comparison. If gear and season regulations remain the same, it is unlikely that catch per unit effort will increase substantially over those observed currently. If harvesting pressure is decreased by limiting the participants in the fishery, it would appear likely that densities of clams could increase and allow the catch per day to improve.

Results of this study will be presented to the VMRC Clam Management Committee and to the full Marine Resources Commission.

LITERATURE CITED

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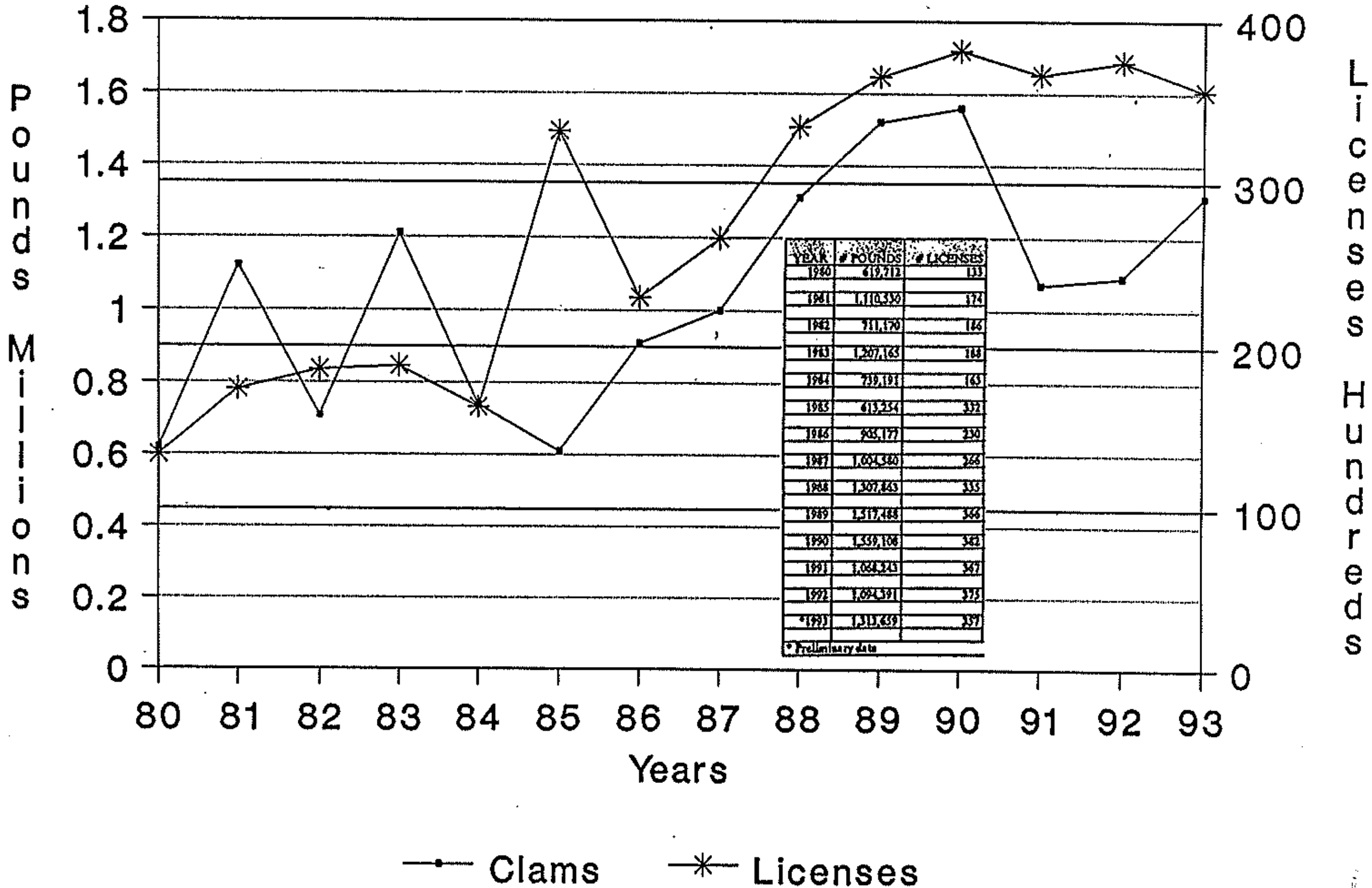
FIGURE 1. HARD CLAM LANDINGS (POUNDS)
NUMBER OF PATENT TONG LICENSES



YEAR	# POUNDS	# LICENSES
1980	619,712	133
1981	1,110,530	174
1982	711,170	186
1983	1,207,165	188
1984	739,191	163
1985	613,254	332
1986	905,177	230
1987	1,004,580	266
1988	1,307,863	335
1989	1,517,488	366
1990	1,559,108	382
1991	1,064,243	367
1992	1,094,391	375
*1993	1,313,659	357

* Preliminary data

*Preliminary data

FIGURE 2

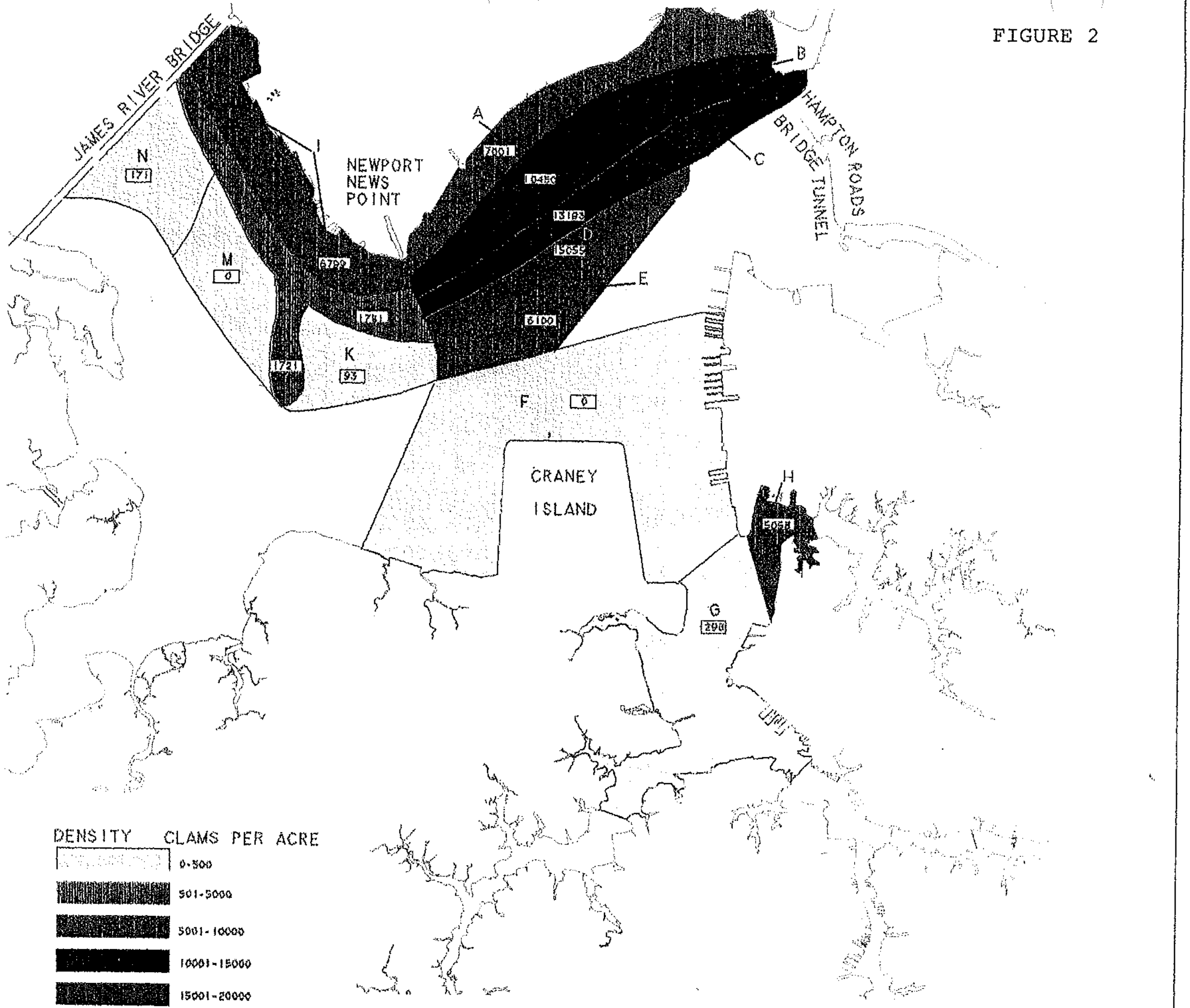

JAMES RIVER BRIDGE
NEWPORT NEWS POINT
HAMPTON ROADS BRIDGE TUNNEL
CRANEY ISLAND
A
B
C
D
E
F
G
H
I
K
M
N
171
0
6799
1781
1721
93
7001
10450
13183
15655
6100
0
5058
298
DENSITY CLAMS PER ACRE
0-500
501-5000
5001-10000
10001-15000
15001-20000

FIGURE 3. CLAMS RELAYED

FROM POLLUTED SHELLFISH AREAS, 1980-1994

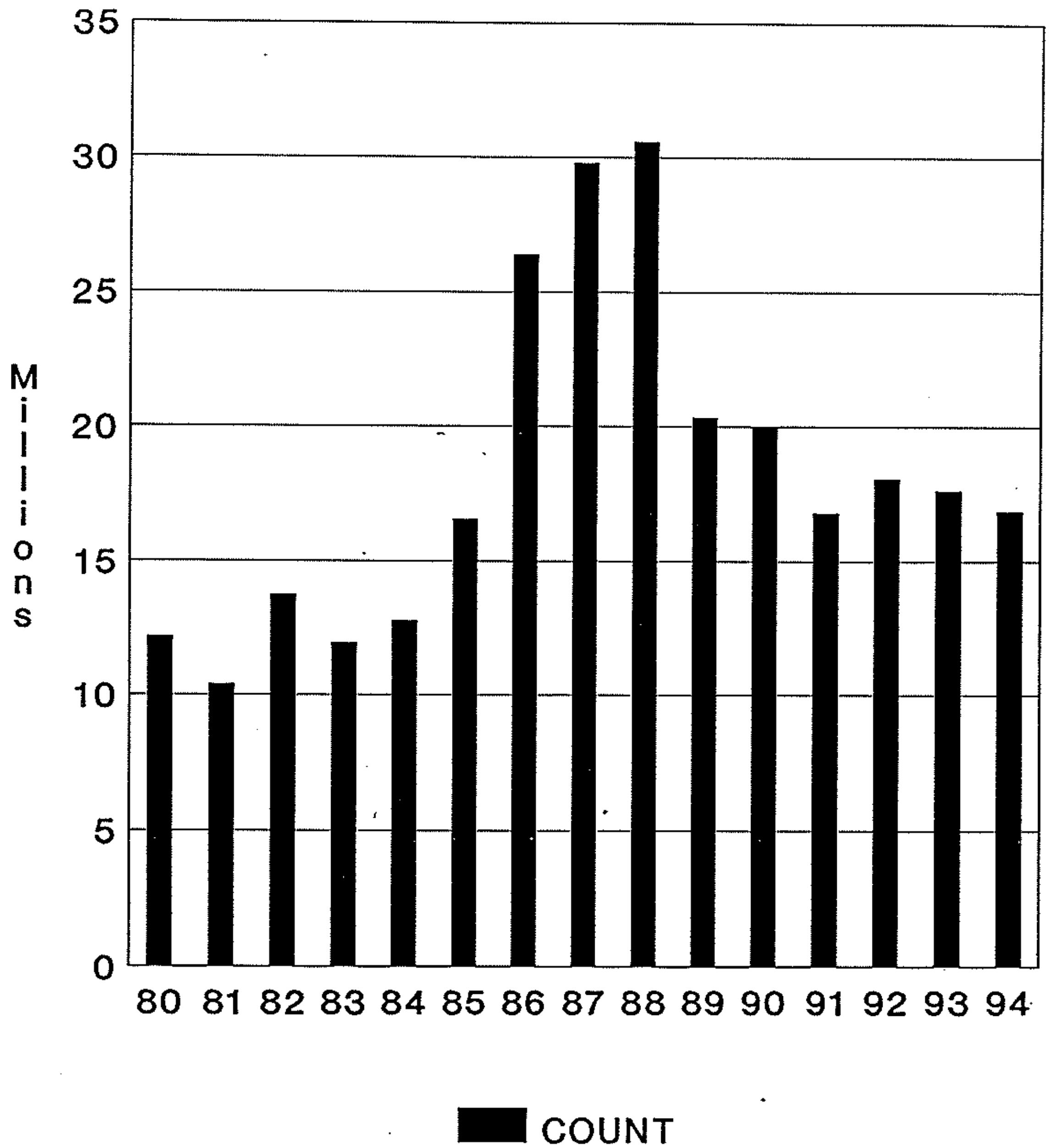


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FIGURE 4. LOCATION OF STATIONS SAMPLED WITH PATENT TONGS FROM CHARTERED VESSEL. ABUNDANCE CODE: HIGH (716,500 CLAMS/ACRE), CLOSED TRIANGLE; MEDIUM (6,900 - 16,500 CLAMS/ACRE), HALF-CLOSED TRIANGLES; LOW (<6,900 CLAMS/ACRE), OPEN TRIANGLES. (ORIGINAL DATA FROM HAVEN, ET AL., 1973)

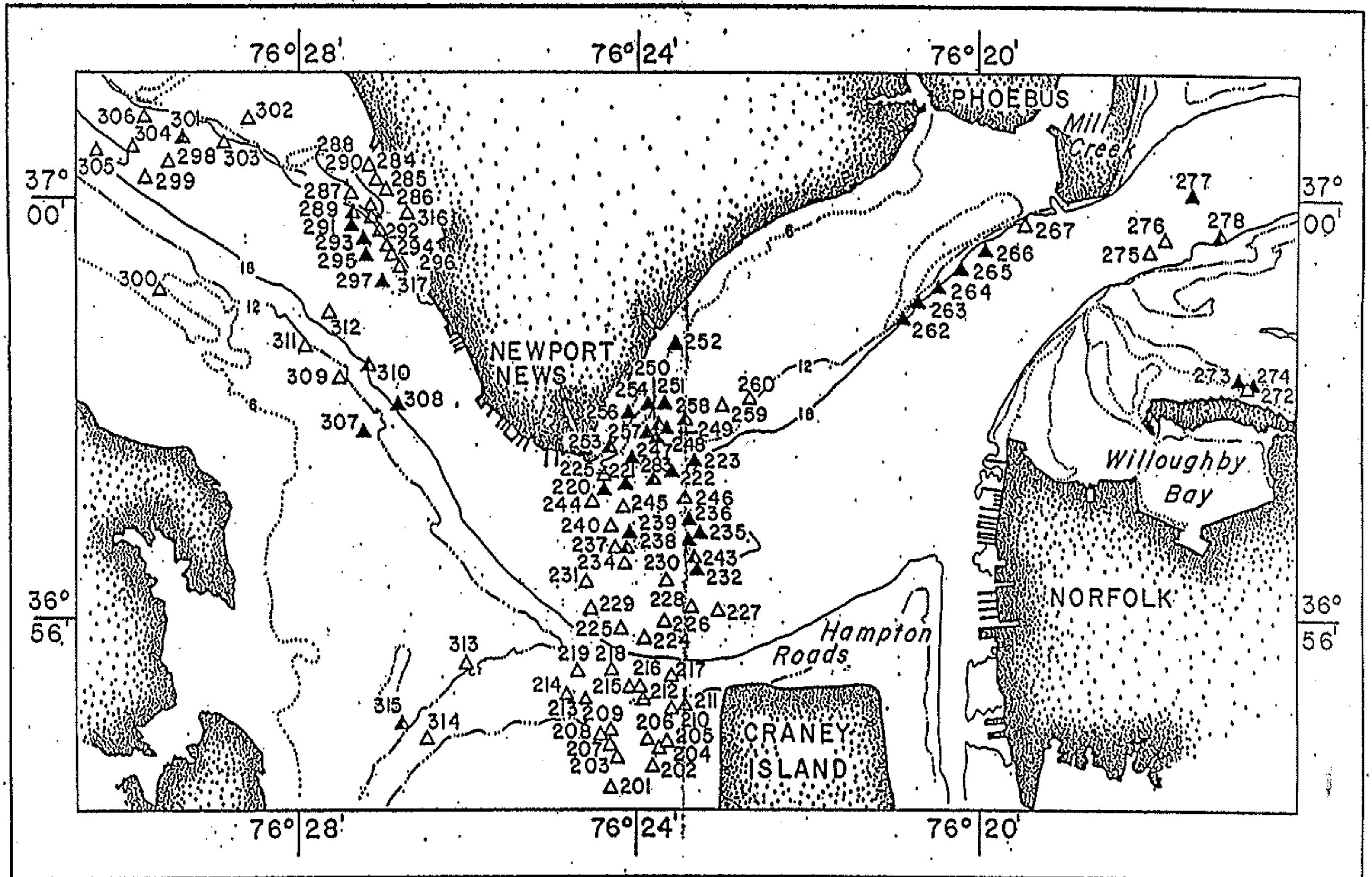
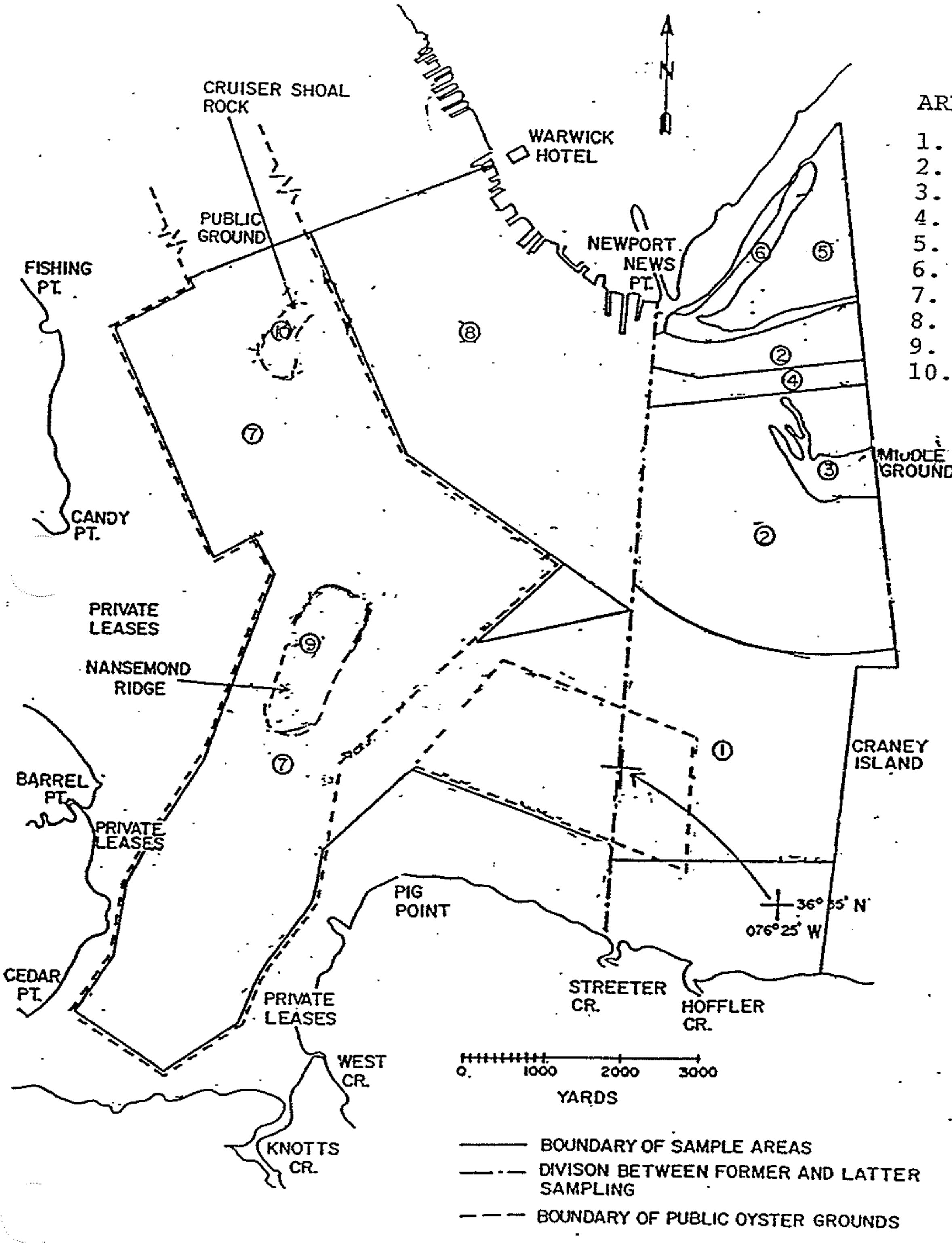


FIGURE 5

DENSITY OF CLAMS PER ACRE IN THE HAMPTON ROADS AREA FROM A REPORT BY HAVEN AND KENDALL, 1975



AREA	CLAMS PER ACRE
1.	90
2.	18,900
3.	17,400
4.	1,800
5.	23,400
6.	9,600
7.	330
8.	3,630
9.	1,650
10.	0

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TABLE 1. HARD CLAMS LANDINGS (POUNDS) NUMBER OF PATENT TONG LICENSES

YEAR	# POUNDS	# LICENSES	#POUNDS PER LICENSE
1980	619,712	133	4,659
1981	1,110,530	174	6,382
1982	711,170	186	3,823
1983	1,207,165	188	6,421
1984	739,191	163	4,535
1985	613,254	332	1,847
1986	905,177	230	3,936
1987	1,004,580	266	3,777
1988	1,307,863	335	3,904
1989	1,517,488	366	4,146
1990	1,559,108	382	4,081
1991	1,068,243	367	2,911
1992	1,094,391	375	2,918
*1993	1,313,659	357	3,680
* Preliminary data			

TABLE 2. MEAN LENGTH AND SIZE FREQUENCY OF HARD CLAMS IN THE HAMPTON ROADS AREA

AREA	SAMPLE SIZE	LENGTH		SIZE FREQUENCY (%)		
		MEAN (mm)	SD	LITTLE NECK $\leq$60mm	CHERRY 61–80mm	CHOWDER $\geq$81mm
A HAMPTON, INSHORE	77	70.7	14.4	17	56	27
B HAMPTON FLATS	60	67.2	16.4	25	50	25
C HAMPTON > 18 feet depth	161	63.5	16.9	37	48	15
D MIDDLE GROUND	143	73.4	10.3	10	65	25
I NEWPORT NEWS CHANNEL	91	52.7	14.3	68	30	2
H LAFAYETTE RIVER	45	63.7	9.4	36	64	0

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TABLE 3. A COMPARISON OF MEAN LENGTH AND SIZE FREQUENCY OF HARD CLAMS FROM 1974 (HAVEN, LOESCH, WHITCOMB, 1974) AND 1995

YEAR	AREA	LENGTH (mm) MEAN (mm)	SIZE FREQUENCY (%) LITTLE NECK	CHERRY	CHOWDER
1995	Hampton, inshore	70.7	17	56	27
1974	Hampton Bar	79.5	10	36	54
1995	Hampton Flats	67.2	25	50	25
1974	Hampton Flats	75.2	12	47	41
1995	Hampton >18 feet	63.5	37	48	15
1974	Hampton >.18 feet	69.4	23	51	25

5/31/95