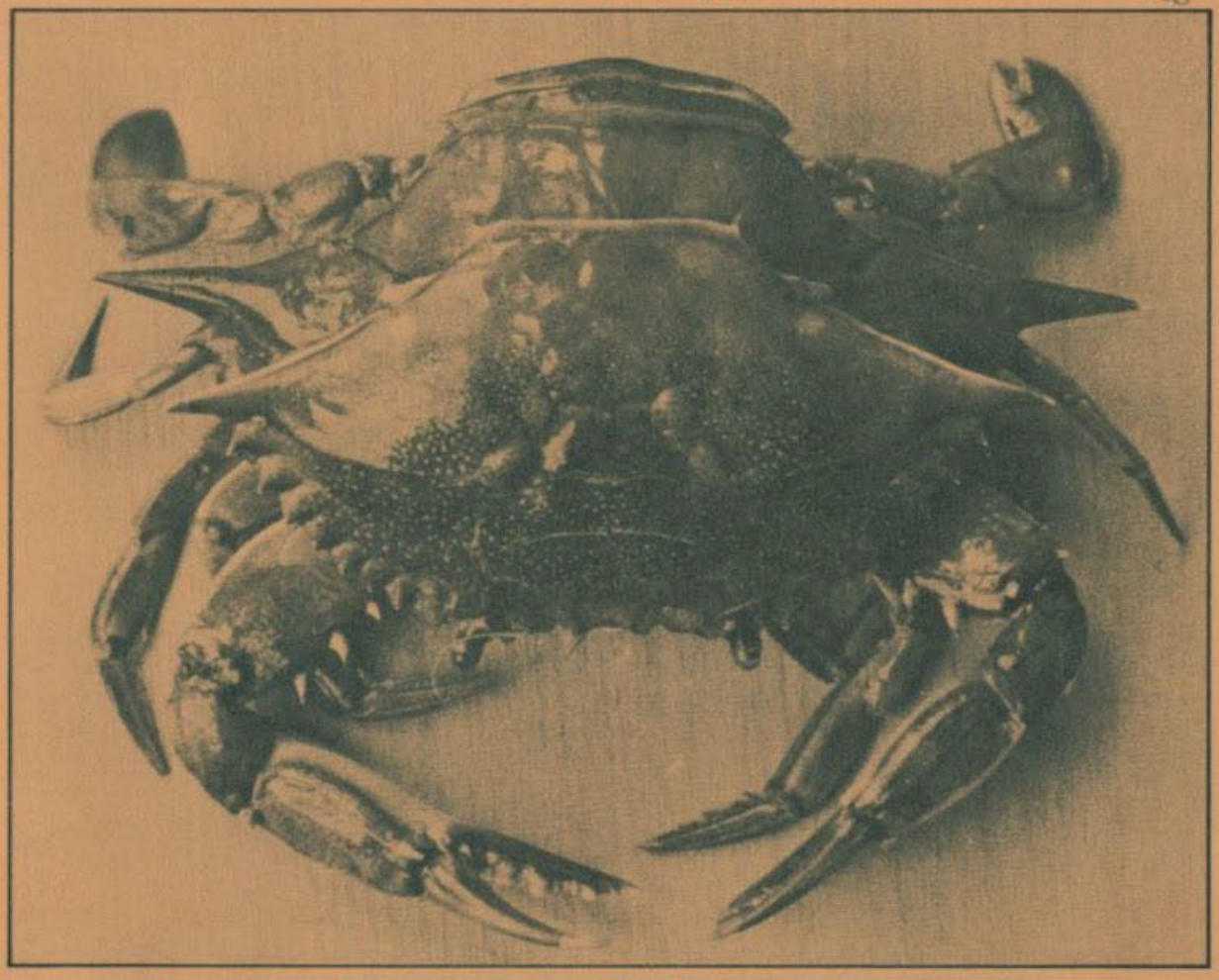
PROCEEDINGS OF WORKSHOP ON SOFT SHELL BLUE CRABS

September 22, 1979
Charleston, South Carolina

David M. Cupka
W. A. Van Engel



SOUTH CAROLINA MARINE RESOURCES CENTER TECHNICAL REPORT NUMBER 48

VIRGINIA INSTITUTE OF MARINE SCIENCE CONTRIBUTION NUMBER 1003

South Carolina Marine Resources Division
P.O. Box 12559, Charleston, South Carolina 29412

College of William and Mary
Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

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September 22, 1979
Charleston, South Carolina

Edited by:

David M. Cupka
South Carolina Wildlife and Marine Resources Department

and

W. A. Van Engel
Virginia Institute of Marine Science

Sponsored by:

Coastal Plains Regional Commission

and

South Carolina Wildlife and Marine Resources Department
Marine Resources Division

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P.O. Box 12559
Charleston, South Carolina 29412
Technical Report Number 48

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PREFACE

The Workshop on Soft Shell Blue Crabs was held on September 22, 1979 at the Marine Resources Center of the South Carolina Wildlife and Marine Resources Department in Charleston, South Carolina.

The purposes of the workshop were to describe current research and development activities relative to soft shell blue crabs in the Coastal Plains Region; to review existing laws and regulations in regards to soft shell crab fisheries and shedding operations; and to discuss methods for harvesting, handling, shedding and marketing soft shell blue crabs.

There has been tremendous interest expressed by commercial fishermen and others in the development of a viable soft shell crab industry in many parts of the Coastal Plains Region. Because of this interest and because of the significant economic potential which could be realized by the development of such an industry, it was felt that a workshop such as that recorded in these proceedings would be most beneficial and productive.

We wish to express our appreciation to those individuals and agencies whose participation made the workshop a success. We especially wish to acknowledge the following: Col. Beverly Snow, Executive Director of the Coastal Plains Center for Marine Development Services, and his staff, for their support of the workshop as part of the Cooperative Projects Program of the Coastal Plains Regional Commission; the staff of the Marine Resources Center who contributed in various capacities; the speakers and the panel members and to all participants who contributed to the workshop planning and discussions.

David M. Cupka
W. A. Van Engel
Editors

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WELCOMING ADDRESS

Dr. Edwin B. Joseph
Director
Marine Resources Division
South Carolina Wildlife and Marine Resources Department

Ladies and gentlemen, it's a pleasure for us to host this regional workshop on soft shell crab production and problems attendant to the soft shell crab fishery.

I'd like to acknowledge, first of all, that this workshop is made possible by the Coastal Plains Regional Commission and specifically the Coastal Plains Center for Marine Development Services which is an activity of the Commission located in Wilmington, North Carolina.

When we have workshops like this, I think most of us come hoping to learn something; and we certainly hope that's going to be the case today. I'm especially pleased to see so many industry people, some of whom I've known before in other areas. We know we have brought some very talented, very knowledgeable industry people together. We hope they'll learn something also.

The problems we've had locally, and I don't want to emphasize local too much because this is a regional workshop, is trying to adapt known techniques from other areas to a somewhat different environment. So, I'm sure that the individuals who either are in the industry or are hoping to get into the industry from this coastline will have a good deal to gain from this association.

So, let me just say that we're very happy to have you here. We hope we have a successful meeting and one that is successful from your standpoint.

INTRODUCTORY REMARKS

David M. Cupka
Assistant Director
Office of Conservation, Management and Marketing
Marine Resources Division
South Carolina Wildlife and Marine Resources Department

I would like to add my welcome to that of Dr. Joseph to what we hope will be a most informative and beneficial meeting on the soft shell crab resources of the Coastal Plains Region. For those of you who haven't been to the South Carolina Marine Resources Center before, I hope that sometime during today's meeting, you'll get an opportunity to see our facilities.

I would also like to recognize a few individuals and organizations that have played an important part in today's workshop before actually getting into the workshop itself. As Dr. Joseph mentioned, the workshop is being sponsored jointly by the Coastal Plains Center for Marine Development Services under its Cooperative Projects Program and by the South Carolina Wildlife and Marine Resources Department. Colonel Bev Snow, who is here with us this morning, is the director of the Coastal Plains Center for Marine Development Services. Col. Snow has been most helpful and has assisted us in putting together today's program. In addition to funding the workshop, the Center has provided assistance in publicizing this workshop throughout the region and we are most appreciative of this support.

I'd also like to recognize the Coastal Plains Regional Commission. The Commission has always been most helpful to our endeavors here and it is supporting a significant portion of our current soft shell crab research here in South Carolina. We'll be hearing more about that during this morning's program.

Mr. Willard Van Engel of the Virginia Institute of Marine Sciences will be taking a very active part in today's workshop. In addition to making a presentation this morning and in chairing our panel sessions later during the meeting, Van has been extremely helpful to me in organizing this meeting and in making arrangements for some of our panel members to be here today.

I would also like to thank our panel members, Mr. Gerald Horst of Gretna, Louisiana; Mr. Murray Bridges of Kitty Hawk, North Carolina; and Mr. George Spence of Quinby, Virginia. When I first began organizing this workshop, it became apparent early that what was needed was an industry oriented workshop in which industry members who have experience with the soft shell crab fishery would participate and share their experiences with the workshop attendees. I admit that at first I was somewhat apprehensive about finding industry members who would be willing to travel to South Carolina and who would be willing to share their experiences with us. However, in contacting the prospective panel members, not a one of them had any hesitation about participating in today's program; and I feel that this says a lot about these individuals which we are most fortunate to have with us today on our panel.

I want to thank Dr. Steve Otwell, Dr. Jim Bishop and Mr. Charles Bearden who will make presentations on soft shell crab development in Florida and in South Carolina and on the laws and regulations which impact on the soft shell crab industry in the Coastal Plains Region.

The efforts of Miss Pat Godsell and Mrs. Hope Mixson, who were kind enough to work the registration desk this morning and who have taken care of the one hundred and one details which are so vital to putting together a workshop of this type, also need to be recognized.

About a year ago, we noticed a tremendous increase in interest relative to soft shell crabs here in South Carolina. Discussions with people from other states in the Coastal Plains Region seemed to indicate a similar interest being expressed in some of these states as well. In reviewing the literature, we found that very little had been recorded relative to the soft shell crab industry. Faced with this paucity of written information and with requests from individuals in our state who were interested in perhaps getting into the soft shell crab business, we put together a very general publication on establishing a soft shell crab operation.[1] This publication certainly doesn't answer all the questions; but, hopefully, today's workshop and the proceedings from this workshop will start to fill some of the information gaps.

We feel that the key to a viable soft shell crab industry in our region is in the supply of peeler crabs through the harvesting sector of the industry. This is not to say that there aren't problems associated with the shedding and handling of peeler crabs or in the area of marketing which need to be addressed; but we feel that many of these are technical problems which in time will be resolved. The supply, though, as I mentioned, is the key to the whole thing and is one reason why so much of our initial effort here in South Carolina has been directed towards developing and assessing various harvesting techniques which might be applicable to this area. We have certainly been encouraged by some of the preliminary work which has been done in our state and we are hopeful that today's workshop will help to stimulate and foster a viable and expanded soft shell crab industry in the Coastal Plains Region.

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[1] Bearden, C. M., D. M. Cupka, C. H. Farmer, J. D. Whitaker and J. S. Hopkins. 1979. Information on establishing a soft shell crab operation in South Carolina. S.C. Wildl. Mar. Res. Dept., Educ. Rept. No. 10, 21p.

CURRENT RESEARCH AND DEVELOPMENT ACTIVITIES

IN SOUTH CAROLINA

Dr. James M. Bishop
Mr. Eugene Olmi
Marine Resources Research Institute
and
Mr. J. David Whitaker
Office of Conservation, Management and Marketing
South Carolina Wildlife and Marine Resources Department

Introduction

Blue crabs support the second most important fishery in South Carolina, and landings in 1978 totalled nearly 9.5 million pounds valued at $1,853,000 (Fisheries Statistics Section, S.C. Wildlife and Marine Resources Department, pers. commun., 7 January 1980). These crabs are marketed live as well as processed, both in South Carolina and out-of-state. The only aspect of the industry that is not viable within the state is the production of soft shell crabs. Formerly, a soft shell crab fishery was pursued, however, it has been dormant since 1957. The number of crabbers has increased 150% (from 203 to 508) in the ensuing years, but with little or no interest in capturing, identifying, handling, or shedding peeler crabs, so this expertise is largely lacking among South Carolina crabbers.

Recently there has been considerable interest in re-establishing the local production of soft shell crabs (Bearden et al., 1979). Reasons for this renewed interest include economics, a crowded hard crab fishery, and the availability of the resource. The success of any soft shell crab operation depends on the ability to obtain a relatively consistent and sufficient supply of peelers. Because very little is known about pre-molt crabs in the state, a sampling program was designed which would provide information on their availability, distribution, and abundance.

Materials and Methods

Three stations in each of three areas of the Ashley River, Charleston County, South Carolina, were established to comparatively test 5 types of gear (Fig. 1). Each gear type was deployed at every station establishing a 3 (area) x 5 (gear type) factorial arrangement with three replicates.

Tested gear consisted of bush lines (Jaworski, 1972), peeler pots (Warner, 1976), artifical habitat pots, crab fykes (Young, 1955), and the standard crab pot with two entrances (Van Engel, 1962). Two "bushes" were fished on each bush line. Peeler pots and artificial habitat pots were constructed similar to the commercial pot, but 1" wire mesh was substituted for 1½" mesh. One-inch wide plastic flagging tape was interwoven among the wire mesh on all sides

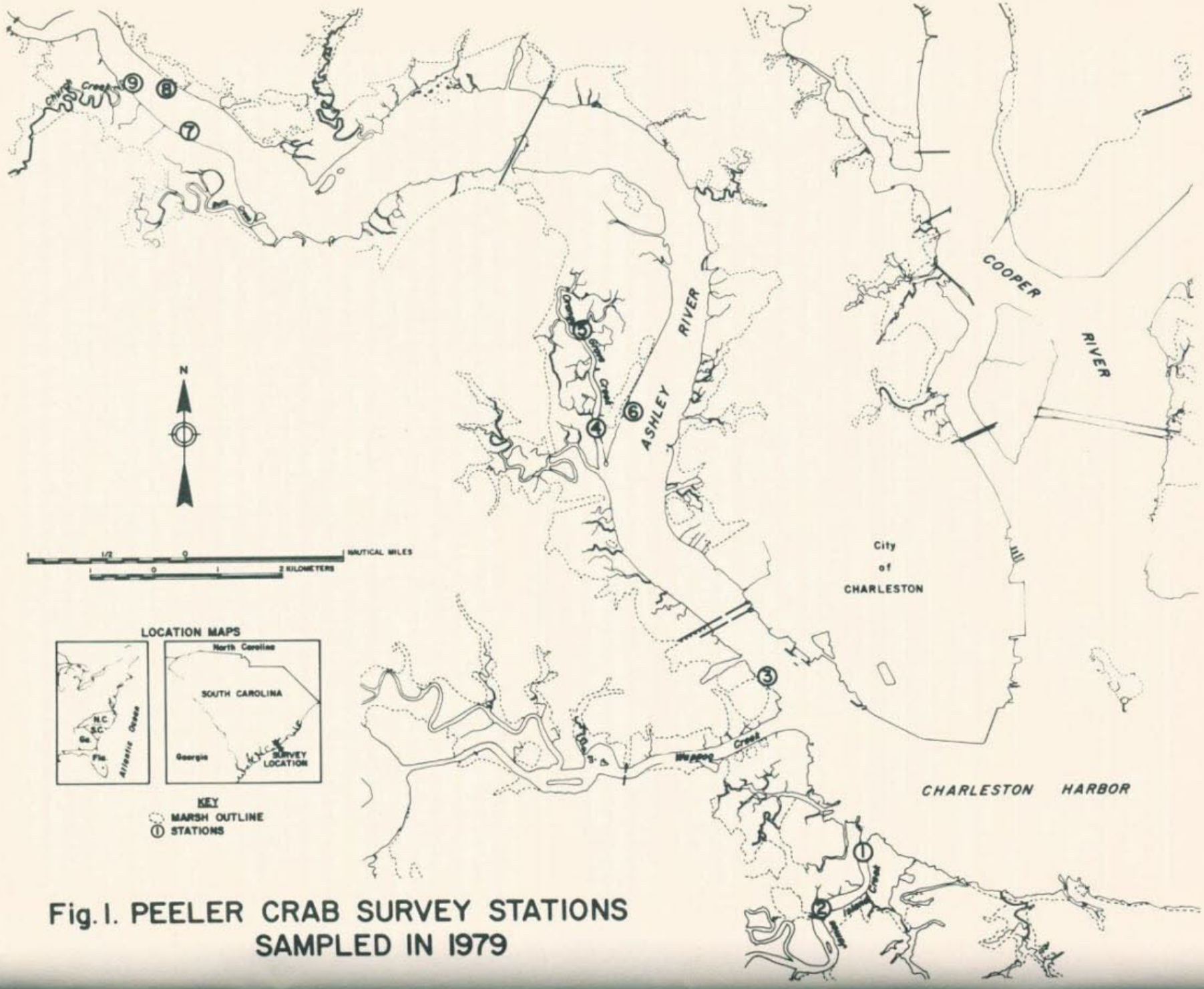

Fig. 1. PEELER CRAB SURVEY STATIONS SAMPLED IN 1979

except the bottom of the artificial habitat pot. Crab fyke hedgings (i.e., wire fence leads) were placed perpendicular to tidal current flow between the estuarine edge of the Spartina marsh and the low water line. Lengths varied from 40' to 90' depending on location. Width, depth and height of the fyke's trap portion was 4' x 3' x 4', respectively. One-inch wire mesh was used for crab fyke construction. Crab fykes, bush lines, and artificial habitat pots were fished unbaited, peeler pots were "baited" with two marked "jimmie" (large male) crabs, and commercial pots were baited with frozen whole menhaden.

All gear was reset each Monday and fished daily Tuesday through Friday. Jimmie crabs in the peeler pots were replaced as necessary, and the commercial pots were baited daily Monday through Thursday. Bottom water temperature and refractive index (for salinity) were recorded at each station as crabs were collected. Crabs captured by each piece of gear were bagged, labelled, and returned to the laboratory for work-up. Recorded data for each crab included station, gear type, salinity, temperature, lunar day, total width, sex, and molt sign. Pre-molt sign categories follow those discussed by Van Engel (1958), and the term peeler is used to denote pink and red sign crabs and busters. Except for the crab fykes, fishing efforts began 18 April 1979 and data analyses for this report continue through 24 August. On 25 April a storm damaged the fykes. Repairs were completed by 31 May and fishing initiated 01 June. Gear-day is used as a measure of fishing effort, and one gear-day implies one unit of gear fishing one 24-hour day.

Results

As of 24 August, a total of 9,141 crabs was captured by all fishing methods. Crab fykes were fished a total of 30 times (fyke days) and captured 93 crabs of which 11 were peelers.

Of the remaining 9,048 crabs, 751 were determined to be peelers. Commercial pots and bush lines captured the fewest peelers while artificial habitat pots accounted for almost half (Table 1). Males outnumbered females 2:1 in artificial habitat pots, but in commercial pots, female peelers dominated males by almost 6:1 (Table 1). Mean total widths between sexes captured by each gear type were similar, and the smallest crabs (83-84 mm) were captured in bush lines and the largest (109-110 mm) in commercial pots (Table 1).

Table 1. Total number of peelers captured by gear. Mean width in mm.

	Bush Line	Artificial Habitat	Peeler Pot	Commercial Pot
Number	109	359	175	108
Percent ♂ & ♀	54 & 46	65 & 35	53 & 47	15 & 85
Mean Width ♂ & ♀	84 & 83	93 & 87	100 & 104	109 & 110

Peeler capture success was greatest (0.64 per pot-day) in artificial habitat pots and least (0.17 per bush-line day) in bush lines (Table 2).

Table 2. Daily catch by gear. One gear day equals one piece of gear fished one 24-hour day.

Gear	Bush Line	Artificial Habitat	Peeler Pot	Commercial Pot
Total Peelers	109	359	175	108
Total Crabs	252	894	705	7197
Gear-Days	624	561	589	578
Peelers/Day	0.17	0.64	0.30	0.19
Crabs/Day	0.40	1.59	1.20	12.45

All gear types were most successful (0.21-0.81 peelers per gear type per day) in the intermediate section of the river (Stations 4-6), but the artificial habitat pot was the most successful (0.51-0.81 peelers per pot-day) gear type in each of the three sampled areas (Table 3).

Table 3. Peeler catch per day by gear and area.

	Gear				
Ashley River	Bush Line	Artificial Habitat	Peeler Pot	Commercial Pot	Average
Lower	0.13	0.59	0.22	0.15	0.26
Intermediate	0.21	0.81	0.45	0.25	0.43
Upper	0.18	0.51	0.21	0.14	0.26
Average	0.17	0.64	0.30	0.19	

Success of each gear type varied considerably from week to week (Fig. 2). In general, catch success for peeler pots and commercial pots followed similar patterns with greatest peaks occurring in April and May. Bush lines were the least successful during the spring and peaked the week of 3-6 July capturing an average of 0.44 crabs per bush-line day. Artificial habitat pots captured peelers more successfully and consistently than other tested gear during every week except 18-20 April. All gear showed a marked decrease in capture rates during the week of 10-13 July (Fig. 2).

Mean salinities ($\pm$ 1 std. dev.) at the lower, intermediate, and upper river stations were 12.8 $\pm$ 3.1, 12.4 $\pm$ 3.4, and 6.2 $\pm$ 4.4 °/oo, respectively. Corresponding temperatures averaged 25.6 $\pm$ 2.8, 25.9 $\pm$ 2.9, and 26.1 $\pm$ 2.7°C.

Discussion

Comparing success of fishing procedures on a gear-day basis may not be representative of equal effort in each case. The decision to use two bushes per bush line and equating a bush-line day to a pot day was based on the time required to fish that piece of gear. In general, individual gear types took about equal time to fish; commercial pots required slightly more time because of larger hard crab catches and the need for baiting. Different mesh sizes of the gear also contributed to differences in catch-effort. A number of small crabs was attracted to the bushes and efforts were made to capture all observed; however, many of the smaller crabs escaped through the net mesh. Peeler pots and artificial habitat pots were constructed of one-inch wire mesh and captured smaller crabs than the commercial pot with 1½-inch mesh. Mesh size is believed responsible for the different mean widths of peelers captured by the tested gear (Table 1). Nevertheless, the primary purpose of this program was to determine the best technique(s) of capturing peeler crabs, so comparing results on a gear-day basis is not considered to be an unrealistic evaluation of their efficacy.

Crab fykes were the least adaptable gear tested because tidal currents damaged the hedging and frequently dislocated the trap portion. The hedgings intercepted flotsam and marsh debris, and the resulting drag from tidal currents caused chronic repair problems. In time, the fykes became unrepairable and were abandoned for the remainder of the experiment. Because days fished were so few, their effectiveness for capturing peeler crabs cannot be judged fairly. If the crab fyke can be redesigned to withstand South Carolina's tidal currents and amplitudes, it may prove to be an effective piece of gear.

Bush lines are the primary method employed in Louisiana to capture peelers. Their success in South Carolina was not as encouraging as other tested methods, but bushes did attract peelers. The overall catch of 0.17 peelers per bush-line day was low, but when a crab was captured in a bush, its chance of being a peeler was high. Forty-three percent of the crabs collected in bushes were peelers, the highest such percentage for any gear type tested. This technique is not as promising as our results show, however, because many crabs captured in bushes were small. Currents, wind, and wave action combine to make dip-netting crabs from bushes difficult. Except for the crab fyke, this method was considered to be the least promising.

The artificial habitat pot was developed on the basis that crabs seek shelter in which to molt. This pot was not only the most consistent producer

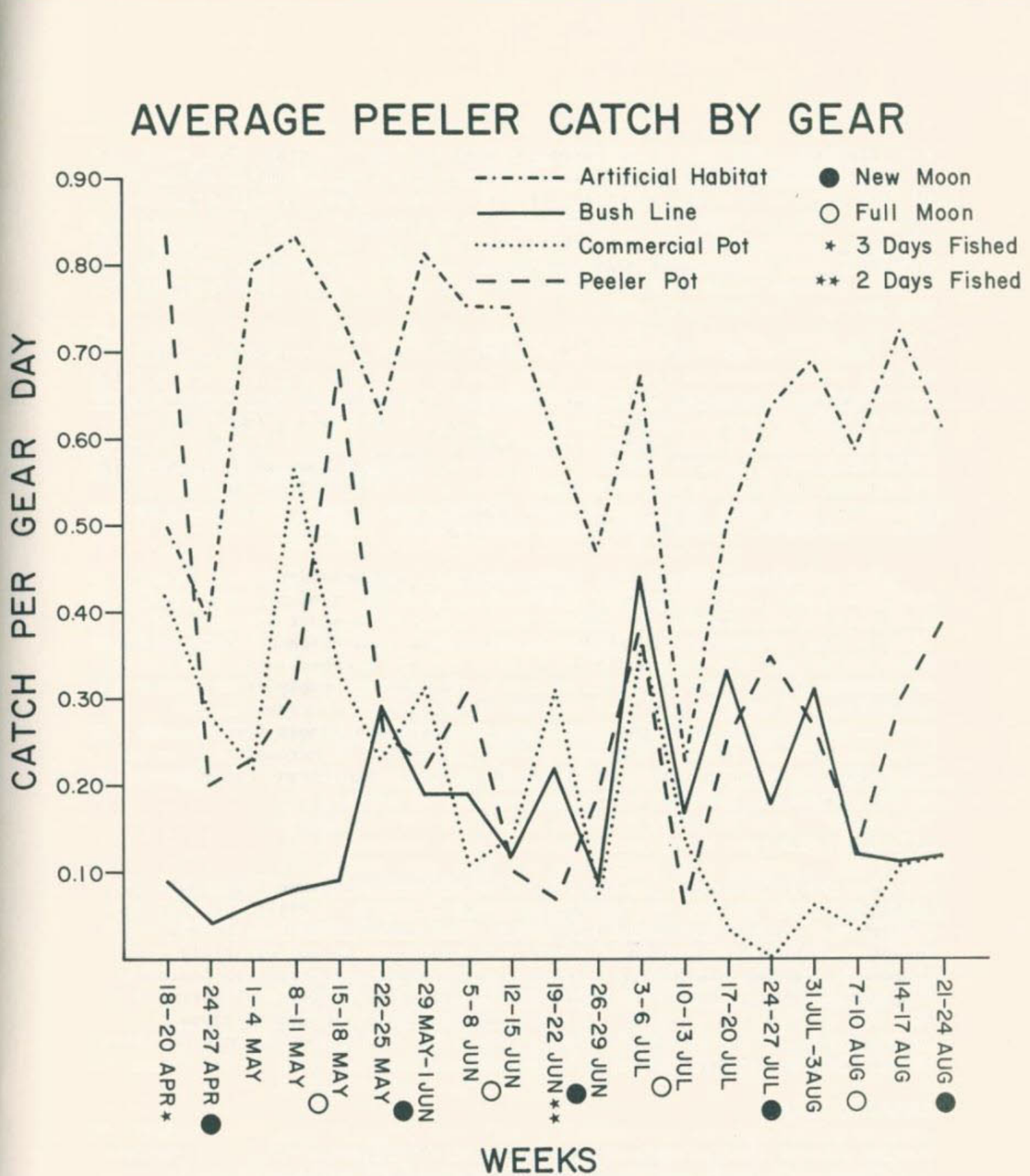

Fig. 2. AVERAGE PEELER CATCH BY GEAR.

over time (Fig. 2), but it captured the most peelers in total numbers (Table 1) and the most per pot day (Table 2). Perhaps the most significant aspect of this gear is that it captured male peelers about twice as often as female peelers. This is important because the state's commercial landings consisted of approximately 72% male crabs, but pilot shedding facilities relied almost exclusively on preterminal-molt females for peelers. It is believed that the overall average catch of 0.64 peelers per pot day could be improved by fishing this gear in selected areas.

Peeler pots and commercial pots showed moderate success during April and May which coincided with the spring run of preterminal-molt females (Fig. 2). Numbers of male and female peelers from the peeler pots were about equal because subsequent to the spring run, the peeler pots became fouled and captured predominately male peelers which were probably seeking shelter to molt. Crabs exhibiting pink or red molt sign do not feed, so commercial pots would be expected to capture very few peelers. Most of the peelers captured in commercial pots were preterminal-molt females which were carried into the pots by intermolt jimmies after they had paired.

Soft shell crab facilities in South Carolina depended exclusively on commercial hard crab fishermen in 1979 for their source of peelers. Commercial pots capture peelers in numbers for a relatively short period of time (Fig. 2) and consequently most operations ceased production by June. Crabs continue to grow and molt and be harvested through October in South Carolina, so shedding facilities should be able to expand considerably their period of operation. If methods can be developed to effectively harvest peelers, particularly males, after the spring run of preterminal-molt females, and if these methods are adopted and employed by commercial fishermen, then we believe that soft shell crab production will make a significant contribution to the state's crab fishery.

Acknowledgements

We especially thank G. Michael Johnson for contributing invaluable assistance in all aspects of this project, and Victor G. Burrell, Jr. for the conception of the artificial habitat pot. We thank Kathleen M. Nolan, Robert M. Gallahorn, Rosamond B. Bentz, Elizabeth C. Roland for field work; Lourene M. Rigsbee and Nickie J. Kopacka for computer processing; Louise H. Hodges for typing; and Karen R. Swanson for drafting. Financial assistance for this project was provided, in part, by the Coastal Plains Regional Commission Grant No. 10940032. Contribution No. 115 from the South Carolina Marine Resources Center.

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Questions, Answers and Comments

Mr. Amason: Were you baiting these various types of gear and, if so, what bait were you using?

Dr. Bishop: The only gear that we baited was the commercial pot; the peeler pots, of course, had two jimmie crabs in each pot.

Mr. Amason: How about your artificial habitats?

Dr. Bishop: They were not baited.

Mr. Amason: Why do artificial habitat pots capture male peelers?

Dr. Bishop: Dr. Vic Burrell conceived of the idea of an artificial habitat pot because of the success of the bush line used in Louisiana. Bushes provide peelers a secluded place to molt. The artificial habitat also provides a concealed area and that's why we believe that they are attracting male peelers. The literature on crustaceans states that most brachyurans molt at low tide. A number of the crabbers have told us that male peeler crabs move to pools in intertidal creeks at low tide. They also told us that crabs bury in the substrate and molt; but I do not see how they can molt in the mud. We plan to search some of these intertidal pools for peeler crab presence as soon as we have time.

Mr. Horst: What was the material that was interwoven in the mesh of artificial habitat pots?

Dr. Bishop: Blue flagging tape from a forestry or an engineering supply. We're trying to do away with the tape because it is a very tedious task to weave it among the pot mesh. I think that a smaller pot may be just as effective without the tape. We are currently testing an experimental pot that is smaller in size, lacks the partition between upper and lower chambers, and has four entrances instead of two. Its height is considerably reduced so several more pots could be constructed from a roll of wire. Our current thinking is that 300

artificial habitat pots may be deployed by a single fisherman, and that 100 could be fished every third day.

Mr. Horst: If you ran them every three days, how many crabs would you find that had already shed?

Dr. Bishop: You're going to lose some. We did not fish our gear on weekends, and on Mondays we captured substantially more peelers in our artificial habitat pots than other days of the week. You'll lose a few but I don't know if it's worth checking all of them daily.

Mr. Amason: But this smaller pot is still enclosed?

Dr. Bishop: That's correct.

Mr. Amason: Is it necessary to enclose the mesh?

Dr. Bishop: That's one of the things we want to look at next year to determine if the tape is necessary.

Mr. Amason: Is the only difference between your peeler pot and artificial habitat pot and the commercial pot the size of the mesh? Are general sizes and shapes of all three similar?

Dr. Bishop: Yes, the three pots are similar in size and shape.

Mr. Amason: You just used one inch mesh instead of inch and a half?

Dr. Bishop: Yes.

Mr. Amason: Then, you're only looking for the female peeler crabs in peeler pots?

Dr. Bishop: That's correct for peeler pots which are effective in the spring only. I have been told that in Maryland, as many as seven or eight jimmie crabs minus their claws are placed in each pot.

Mr. Amason: We could not get one of those to catch a peeler.

Dr. Bishop: Well, I can't imagine them not working. The blue crab exhibits this behavior pattern throughout its range.

Mr. Amason: I can't either, but we have not been successful with peeler pots in Georgia.

Dr. Bishop: Well, it may be your fishing location. In certain sections of the river, we do better than in others. Even between stations within the same area, we got vastly different results.

Dr. Otwell: When you started putting your artificial habitats out and had

trouble with the current, losing traps and what have you, you were forced to put them someplace else to get out of this swift current?

Dr. Bishop: No, what we did was instead of enclosing the entire pot, we enclosed every row of mesh below the partition and every other one above the partition. This reduced the amount of current drag.

Dr. Otwell: At what depth did you set the artificial habitat pots?

Dr. Bishop: We were trying to stay out of the way of commercial crabbers and recreational boaters, so we fished our gear just below subtide mark, i.e., as close to the edge as we could.

Dr. Joseph: Jim, you might make a brief comment on the kind of tides that we're confronted with in South Carolina and Georgia. Some of our visitors from the Gulf coast and Chesapeake Bay may not appreciate the scope of the problem.

Dr. Bishop: Mean tidal amplitude in Charleston Harbor is approximately five feet and near Brunswick, Georgia tides approach nine feet. In Chesapeake Bay where peeler pounds (crab fykes) are deployed, fishermen don't bother to tie the trap to the pound; they just set the trap adjacent to the pound. It takes a matter of a few minutes to dump the trap's contents in the boat and reset it. It took us thirty and forty minutes to run each of our peeler pounds.

CURRENT DEVELOPMENT ACTIVITIES IN FLORIDA*

Dr. W. Steven Otwell
University of Florida

Introduction

There is a growing interest in the production of soft shelled blue crabs in the southeastern states which are currently producing minimal amounts of soft crabs, i.e., South Carolina, Georgia and Florida. Recent attempts to introduce soft crab fisheries in Florida began with an extensive review of traditional methods of peeler harvesting and shedding. Most importantly, the review included an economic analysis of past and present soft crab productions and values.

Economic Analysis

Production of blue crabs in the United States has fluctuated during 1950 to 1978, but the total annual production of hard blue crabs since 1970 has averaged over 137 million pounds (Figure 1). Since 1950 the production of soft crabs has continually decreased. The major decline in production occurred in the 1960's and ended in the steady state annual soft crab production of 2.6 million pounds in the 1970's. Thus, annual soft crab production has been approximately 2 percent of the respective hard crab landings. As soft crab production decreased, the value of soft crabs continually increased. (Soft crabs are typically sold by the dozen. The Statistics Branch of the National Marine Fisheries Service records soft crab value per pound, using 2.5 pounds per dozen as a conversion factor.) The value for soft crabs increased about one cent per pound from 1950 through the 1960's. In the 1970's the value of soft crabs increased from forty cents to one dollar and four cents per pound. For a potential soft crab producer, these trends indicate a favorable market situation.

Analysis of soft crab production by state indicates there are six traditional soft crab producing states, i.e., New Jersey, Delaware, Maryland, Virginia, North Carolina and Louisiana. Over 90 percent of all the soft crabs are produced in the Chesapeake Bay region, Virginia and Maryland. The largest soft crab production is recorded in Maryland, yet Virginia records the largest production of hard blue crabs. This may indicate the importance of the gentle sloping, grassy areas of the northern Chesapeake Bay as habitats for peelers.

In the 1970's the value for soft crabs was higher in the southern states, North Carolina and Louisiana (Figure 2). Producers speculate the higher

*Data, Figures and Tables used in this presentation were taken from portions of the Florida Sea Grant Report No. 31, Development of Soft Crab Fisheries in Florida, 1980.

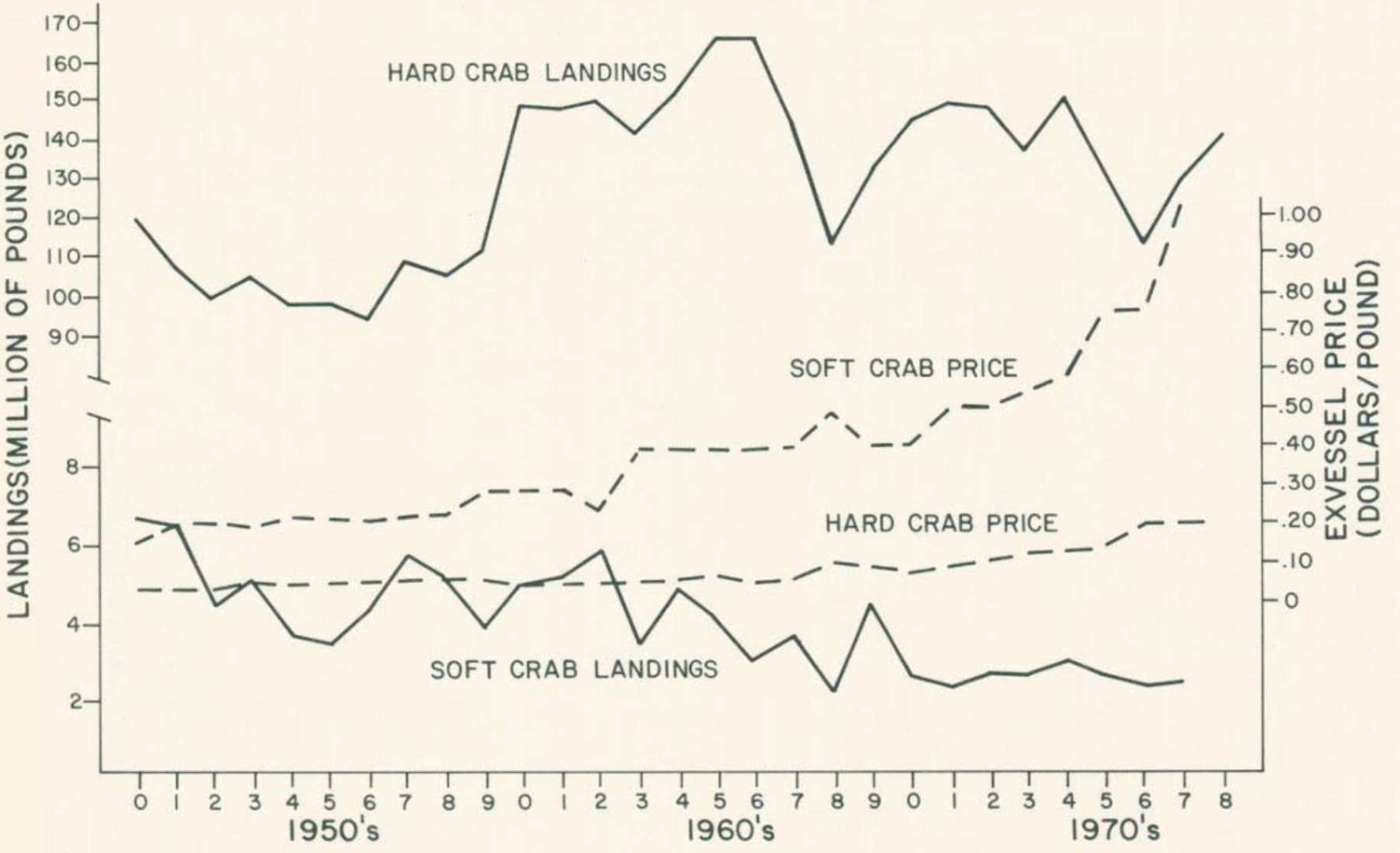

Figure 1. Landings and exvessel price of soft and hard blue crabs in the United States, 1950-1978.

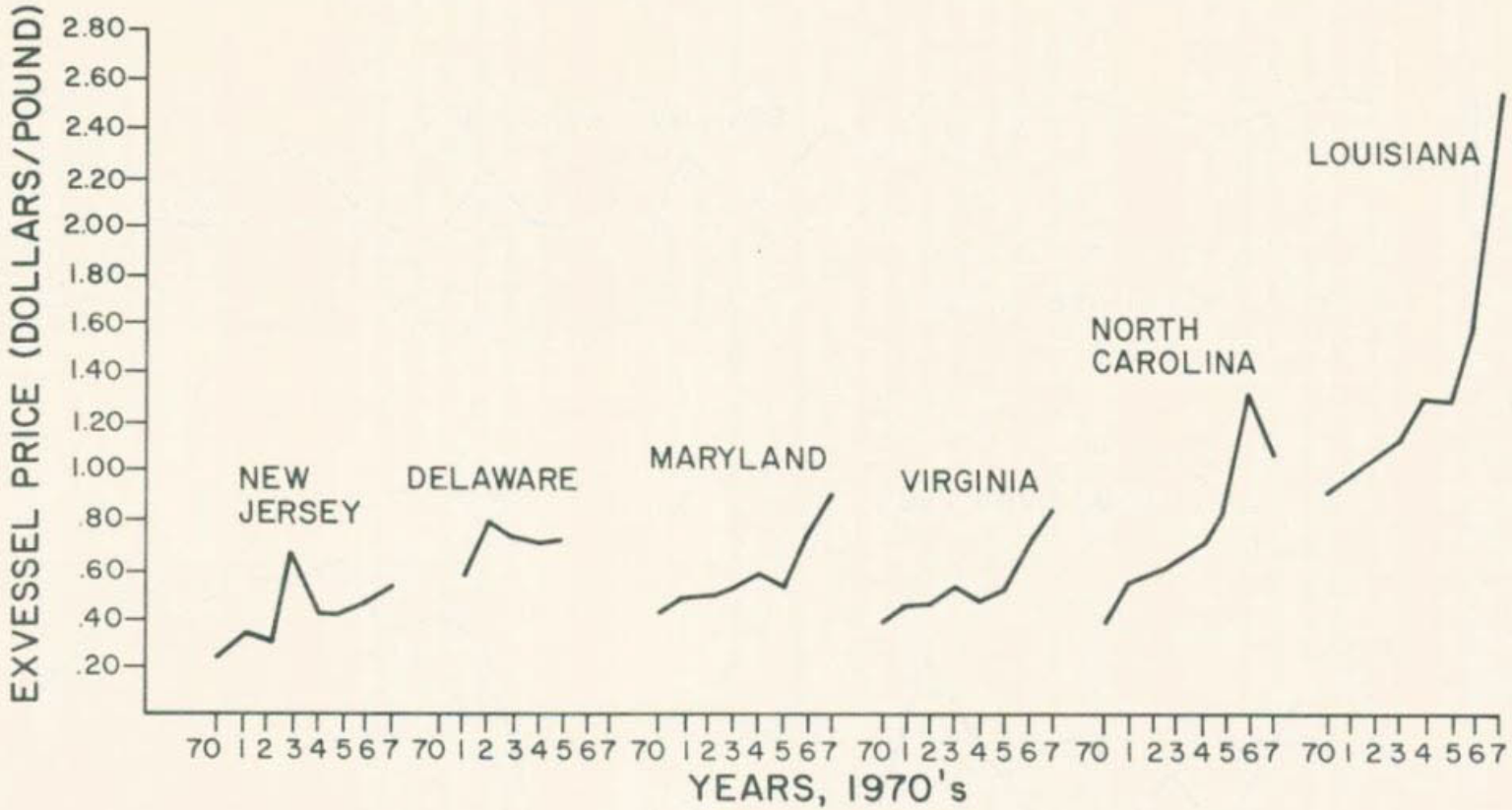

Figure 2. Exvessel price in dollars per pound of soft crabs in New Jersey, Delaware, Maryland, Virginia, North Carolina, and Louisiana, 1970-1977.

prices are due to the larger size of southern crabs. Likewise, the longer shedding season, a more direct marketing scheme, and the greater demand for the limited southern supply would affect the price for southern production.

The market value for soft crabs can depend on size and season (Table 1). Various grades for soft crabs, i.e., medium, hotel primes, primes, jumbos, and whales, vary in size (carapace width) from 3½ inches to over 5½ inches. The larger crabs are more valuable, yet some connoisseurs argue that the smaller soft crabs taste better. The value per size category tends to decrease as the summer progresses or supply increases. Current 1979 market prices of 10 to 15 dollars per dozen for large soft crabs have stimulated the interest of potential producers.

Florida Situation

In Florida, the production of soft crabs is minimal, yet the annual hard crab landings in the 1970's was the third largest recorded, following Virginia and Maryland. Thus the development of soft crab fisheries in Florida warranted further consideration. Soft crab fisheries offer an opportunity for the small scale fisherman to expand his operations at a minimal cost.

Current fishery regulations enforced by the Florida Department of Natural Resources actually encourage the development of a soft crab fishery. The blue crab harvesting regulation states that no crabber may have in possession more than 10 percent of his harvest which is less than 5 inches wide, unless the crabber has a special permit to harvest crabs for a soft shell operation. The special permit can be obtained through a simple application.

Soft Crab Project

To demonstrate the feasibility of producing Florida soft crabs, a project was conducted in October through December 1978 on the St. Johns River near Palatka, Florida. This location was chosen due to the availability of crabs, the prolonged period of seasonal warm river temperatures due to the south to north river flow, and most importantly, the economic need of the local fishermen. Typical St. Johns River fishermen harvest eels and catfish. These fisheries are most active from January through March and September through December. Thus a soft crab fishery from May through September would compliment the existing fisheries.

The soft crab project was supported by limited funds for only three months. Thus a simple, basic shedding system with floating boxes was designed to demonstrate and learn about the actual shedding process. All peeler crabs were harvested from existing common crab traps. Two local crabbers were contracted to harvest peelers and run the shedding operation. This arrangement provided an educational experience which could be shared by local fishermen.

The shedding floats (4 x 12 feet) were constructed with pine (Figure 3). Three floats were built to hold the suspected peelers prior to sorting for 'true' peelers which were relocated in a fourth float designated the buster pen. Only peelers which showed signs of the near molt condition were placed in the buster pen. All floats were anchored in a line floating near shore in 3 to 5 feet water depth. These wooden floats remained sturdy and floating at the proper depth (9 inches) during the entire three months of the project.

Table 1. Northern Chesapeake Bay Region wholesale soft crab prices by common market category, 1978.

Grades	Size (inches)[a]	Color Code[b]	Wholesale Value[c]		
			June	July	August
			Dollars Per Dozen		
Whales (slabs)	> 5.5		10.00	9.50	7.50
Jumbos	5.0-5.5	red	9.00	8.50	6.50
Primes	4.5-5.0	orange	7.00	6.50	4.00
Hotel Primes	4.0-4.5	yellow	5.00	4.00	3.00
Mediums	3.5[d]-4.0	green	3.00	2.00	1.50

a. Distance measured between lateral spine tips of carapace.

b. Box color codes used to indicate grade.

c. Wholesale value is direct sales price paid to the primary producer or operator of the shedding facility.

d. 3.5 inches is the minimum legal size width for marketing soft-crabs in Maryland.

Source: Personal communication: University of Maryland's Seafood Laboratory in Crisfield, MD.

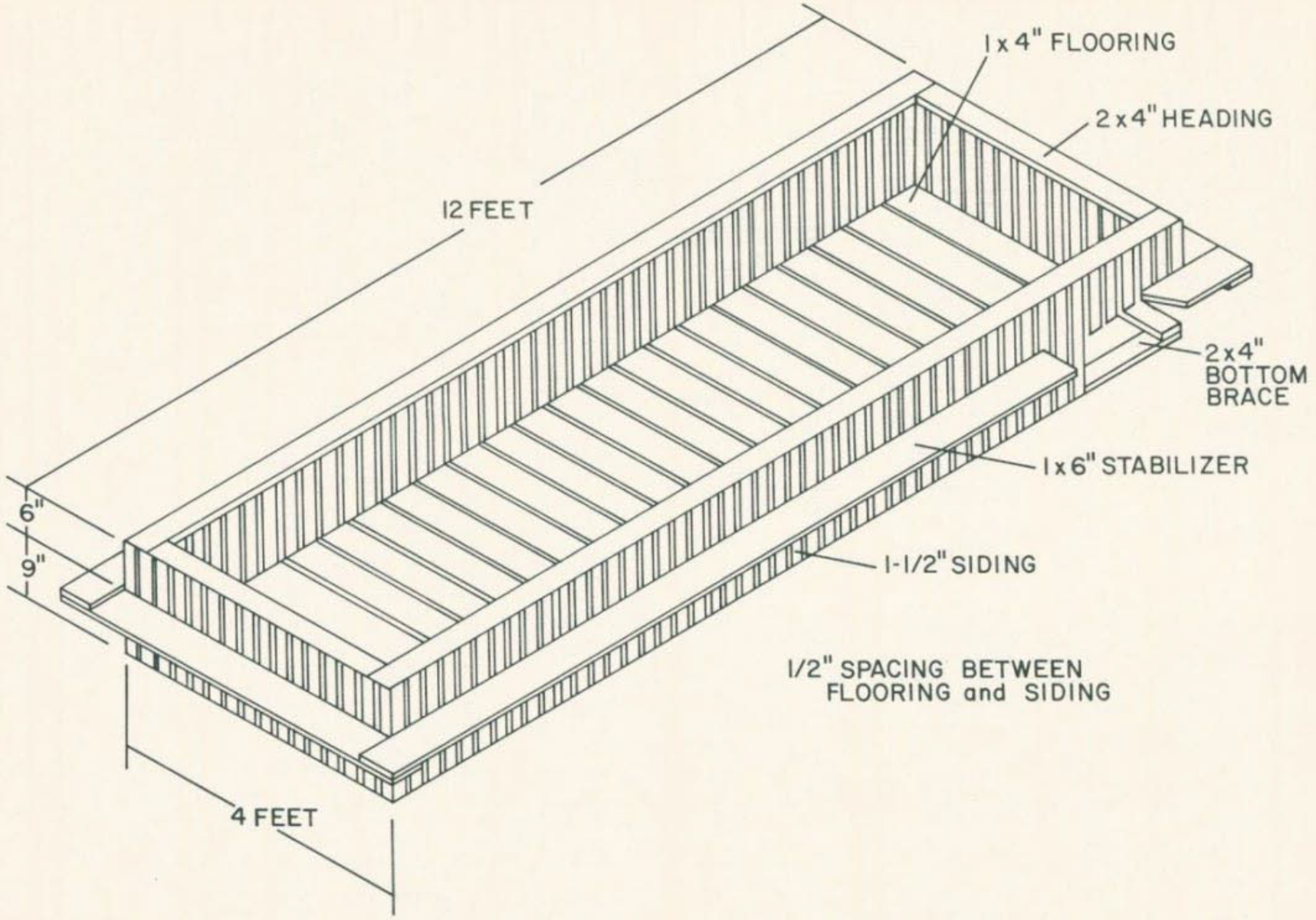

Figure 3. Three dimensional drawing of a floating box used for shedding blue crabs.

The initial disappointing result was the difficulty in obtaining and/or identifying true peeler crabs. This problem was partially due to the initial inability of the crabbers to identify the signs indicating the pre-molt condition. The traditional pre-molt color signs in the paddle fin were not as obvious as experienced in other regions. The crabs were harvested from a region of the St. Johns River immediately south of the bridge (Route 100) to Palatka, Florida. Water analysis confirmed the water from this region and at the shedding facility was fresh (less than 4 parts per thousand salinity). The water chemistry and/or some unique attribute of the crabs from this region may have influenced the color development of the pre-molt signs.

More signs of the pre-molt condition had to be used to help identify peelers. The most obvious sign was the purple-pink discoloration on the triangular apron of the immature female crab. The abdomen of most male peeler crabs would appear to have a slight yellowish tint. This sign is best learned by comparing the abdomen colors of a freshly shed soft crab with that of the vacant shell. Non-color signs of pre-molt were the increased definitions of the epimeral lines or 'hinge' lines on the sides of the sternum just below the crab's mouth. This epimeral line is the 'hinge' connecting the upper shell carapace with the sternum when the crab 'busts' from the hard shell. Likewise, the lines on the top side of one of the inner segments (merus) of the claw appear more prominent in the pre-molt condition. These lines, commonly called the trap-door, will crack open to provide extra space for extraction of the large pincher segment (propodus) during extraction of the new claw. Thus, combinations of color and non-color signs were used to identify peeler crabs.

Once the peelers were properly identified, the remaining shedding operations progressed successfully. Despite minor predation problems due to water birds (egret) and limited cannibalism, the shedding continued into December until water temperatures dropped below 70°F (21°C). Above this temperature the crabs would feed on gizzard shad scraps and molt as described in traditional systems.

The most promising result was the large size of the soft crabs produced. Average size (carapace width) of all soft crabs produced during the three months was 5.4 inches (13.8 cm) with an average body weight of 4.5 ounces (127.6 grams). The largest soft crab produced was a male, 8.2 inches (20.8 cm) wide and weighing 10.8 ounces (306 grams). The smallest hard crab to shed was a 3.0 inches wide female which yielded a 3.8 inches wide soft crab weighing 1.4 ounces (40 grams). The average soft crab yield was 19.5 percent increase in width and 50.9 percent increase in weight.

Our conclusions indicated there is definite potential for development of soft crab fisheries in Florida, specifically on the St. Johns River. Peeler crabs are available, they can be harvested with traditional crab traps fished in the usual manner, but the peelers from certain regions can be difficult to identify. Additional pre-molt signs were identified to assist in harvesting peelers. The soft crabs were produced in basic, inexpensive wooden floats during the fall-winter months, October-December. The average size produced was equal to the most valuable, large size category presently marketed in the Chesapeake Bay region. This project demonstrated the requirements for a soft crab fishery and encouraged local small scale fishermen to participate in this new, low capital intensive fishery.

Developing Soft Crab Operations in Florida

During the soft crab project the investigators offered assistance to various individuals throughout Florida who were trying to initiate a shedding operation in their local region. This work included assistance to producers using closed and open flow systems.

A new open flow shedding system on the Gulf coast in Citrus County was designed with a series of shedding tables housed under a roof for protection from rain and sun. Water was pumped from the adjacent brackish water supply over the tables and returned to the marsh. The roof was equipped with lighting to permit 24 hours operation. Peelers were supplied by local crabbers fishing typical crab pots. The peelers were placed in an organized series of shedding tables depending on their progressive signs of pre-molting. The pink-to-red coloration in the paddle fin was an obvious indicator of the pre-molt condition. 'Buster' crabs were surrounded by a small wire enclosure to prevent damage due to predation. Resulting soft crabs were cleaned, packaged in saran wrap and frozen.

The owner of this open system was advised to use an alternate method for aeration of the table water. Properly arranged inlets placed near the water surface were more effective for water circulation and aeration, and less irritating to the crabs than the previous overhead drip-and-splash system. Also, he was instructed to build his temporary holding floats with wooden slats rather than with chicken wire which damaged the crabs during sorting.

A closed flow (recirculation) system was designed by another producer in Citrus County located about five miles from an available supply of brackish water. Periodically the producer would transport water to the closed system where it recirculated over a series of shedding tables (6 tables) and through filters made with crushed shell and equipped with a pump which drew water from the bottom of the box. This filtered water was pumped onto the tables which were constructed with wood and fitted with a porous false bottom (peg-board) which permitted the water to flow through into an underlying layer (3-4 inches) of crushed oyster shell. The secondary oyster shell filter partially cleaned the water before it flowed, by gravity, on return to the primary box filter, thus completing the cycle. The entire flow design was constructed such that each table could be emptied without disrupting the flow to the other tables.

Water in the closed system was aerated by specially designed pipe inlets placed below the surface of the water in each table. As water was pumped from the primary filter onto the tables, air was sucked through an opening in the tubing into the water flow and agitated the water surface. This water injection system did not irritate the crabs, in fact, the crabs gathered about the pipe inlets.

The shedding tables were organized for sorting peelers by the progressive signs of the pre-molt condition. The typical pink-to-red color signs in the paddle fin were used to grade peelers. 'Buster' crabs were protected by small circular wire enclosures. Resulting soft crabs were cleaned, wrapped in saran, and frozen.

Thus the development of soft crab fisheries in Florida is progressing and our advisory program intends to continue our support of this progress. In the

spring of 1980 a series of soft crab workshops will be conducted about the state to encourage more soft crab activity. I thank you for your time and consideration and I would be glad to answer questions.

Questions, Answers and Comments

Dr. Burrell: Steve, I'm wondering about the number of crabs or the density of crabs you put in those flow-through systems. Do you have any idea about it?

Dr. Otwell: OK, first of all, let me introduce two men who worked with me and the man who worked closely with that system, Mike Oesterling and Don Sweat from the Marine Advisory program in Florida. Mike may be able to answer that better.

Mr. Oesterling: In the closed system, the producer was putting close to two hundred crabs in each one of his tanks and he had very little cannibalism.

Mr. Sweat: Those tanks were four by eight with cheap plywood on the bottom.

Dr. Burrell: I want to make one observation, too. I think it should be made at this time. In South Carolina we have a little problem when you start looking at an orange crab. I don't know if any of you have picked up an orange crab or a yellow crab, but this is not a good sign in South Carolina whereas it's apparently a good sign in Florida. When you get a yellow crab, this is probably a bad sign. Generally, the crabs we get with this yellow coloration are old crabs and will probably never shed; and also this color apron is not reliable. It does work in some cases but it is not a reliable sign. So, I would caution the South Carolina people on that.

Dr. Otwell: Good point, extremely good point; it depends on the habitat you're in; and also, a point which I made is that we did not rely on just one sign. You can't just rely on one technique. If you've got a combination of things to look at, it's helpful.

Mr. Paparella: What controls did you use chemically in that closed system as far as determining how long you can go before you get toxic substance built up?

Dr. Otwell: He has, believe it or not, just from an aquarium shop, a little kit which measures ammonia and nitrates and what have you.

Mr. Paparella: What did he measure?

Dr. Otwell: The water in the system. Nitrates and ammonia both.

Mr. Paparella: How high did you get in nitrates?

Dr. Otwell: His ammonia was never any problem. I can't remember any numbers on nitrates. Mike Oesterling, do you remember?

Mr. Oesterling: He never took any numbers. He had the little color codes that he would put the chemicals in with his water sample and read the colors. He sampled his water about once a day after he put new green crabs into the system. Incidentally, he hasn't changed his filter beds in over four months.

Mr. Paparella: Does he have a protein skimmer?

Dr. Otwell: No. I can't go down there and tell that man how he's supposed to run his closed system when he's been doing it for four months. It's crystal clear and the best one I've ever seen. He didn't need our help.

Mr. Amason: You say he transported in sea water?

Dr. Otwell: Yes and he would transport brackish water.

Mr. Osterling: Three hundred gallons a week.

Dr. Otwell: He didn't change the whole system, he just added.

Speaker from the audience: Steve, you might point out that the fellow with the closed system used the paddle signs.

Dr. Otwell: I said he did have the color signs. He didn't have to rely on these other things we were forced to look at in the St. Johns River, in the fresh water region of the St. Johns River.

Dr. Bishop: I have one comment to make. In the St. Johns River, there are a lot of grass beds. The situation is similar to the Maryland side of the Chesapeake Bay where most of the soft crabs live. A crab scrape or some dipnetting at night or something like that might be very productive for peelers in the St. Johns River, in the grass beds if you can see them. The grass might be so thick that you can't see them.

Dr. Otwell: There are some regions that do have grass beds but a lot of the St. Johns doesn't and some people have wanted to use that little roller trawl like they use in the Chesapeake Bay to actually scoop, or scrape, if you will, to get some of them; but then there's a lot of controversy about tearing up grass beds and the largemouth bass won't have any place to go. So, there's a lot more involved than just getting the peelers.

Speaker from the audience: Did you catch the peelers in a standard commercial type pot?

Dr. Otwell: Just a regular standard commercial pot, yes sir.

Mr. Bridges: On that recirculating system, did he have any way of cooling his water?

Dr. Otwell: No, he didn't.

Mr. Bridges: The reason why I asked, I tried that and I had problems with my water heating up from the atmosphere.

Dr. Otwell: Then you get an oxygen problem, you're exactly right.

Mr. Bridges: I didn't get an oxygen problem but the water got too hot and I lost a lot of crabs in it.

Dr. Otwell: Correct me if I'm wrong, but I'm thinking about 85 degrees Fahrenheit. If you get up in that range, that's going to be dangerous to shedding operations.

BIOLOGICAL ASPECTS OF BLUE CRAB SHEDDING

Mr. W. A. Van Engel
Virginia Institute of Marine Science

What I'd like to emphasize is that it is not difficult to shed crabs. Don't get scared by the complexity of the system. There are easy and sensible ways of doing lots of things. There have been recent advances in how to get away from such things as expensive shoreline property or polluted water. We don't have all the answers; but we've seen that many of you who have been shedding crabs have solved your own problems. I'd like to say to those of you who have not had much experience to go at it slowly and simply; there are reasonable, sensible answers to a lot of the problems.

I think that perhaps some of you ought to know a little bit about the biology of the crab that causes and brings about molting. Molting of the crab is controlled primarily by two hormones. One is produced in a gland called the X-organ and is stored in a place called the sinus gland and we sometimes put these together and call it the X-organ, sinus gland complex and that's located in the eye stalk. Those who have been thinking about hormonal control of molting believe that sunlight or certainly solar radiation may have an effect on controlling the molting cycle. This X-organ is connected to the nervous system of the crab; and so we call this part of the neurosecretory system.

This substance produced by the X-organ and stored in the sinus gland is a molt inhibitor, it prevents molting. It's a brake on the molting system.

There is a molt promoter which is produced in the Y-gland. This does not have nervous control. It is under glandular control. The Y-gland is located just behind and to one side of the eyes but inside the body of the crab. It is bathed in the body fluids of the crab.

Now, we don't know too much about what actually stimulates these glands to produce the hormonal substances except that we believe that the Y-gland is producing this substance almost all the time; but that the molt-inhibiting hormone acts as a brake and suppresses it.

In some crustaceans the X-organ, sinus gland complex has been removed successfully by cutting off the eye stalks. Then molting is speeded up, promoted, because the Y-gland goes on with its normal function.

Working with the blue crab you will find out that it doesn't do what other crabs do except bite you. We find that cutting off the eye stalks of a blue crab quickens death. It is a wasteful practice. It has not been demonstrated to be acting the same way in blue crabs as it does, say, in crayfishes or some of the other crab type crustaceans. We really don't know how these things interact, how they're stimulated to produce their hormones, except that

we believe that light is a factor in molting control. Now, there has not been a lot of experimental work on the effect of light on molting and there are some differences of opinion as to whether you should have a shed roof over a shedding operation or a closed shed to exclude sunlight and keep out the bright sunlight. It is also uncertain whether you should have a light pink or a dark bottom and sides in the shedding tanks. You know in the natural environment you have muddy bottoms and dark bottoms and grassy bottoms where crabs are found; and if you follow nature's plan you should duplicate that with a darker background in the shedding tanks. However, this becomes an inconvenience when you want to look at the crabs in the tanks. So, there are a lot of people who paint the tanks light colored. I don't have any hard and fast rules about this kind of effect of light on molting and it's control but I suggest that if you have an opportunity and are willing to try this in your own shedding systems, to have some tanks that are light painted and some that are dark and see if either one makes a difference in moltng control.

One of the things we hear a lot about is air in the system and oxygen in the system. We know that in molting a crab has to have oxygen. When we measure the general levels of oxygen consumption, we find that oxygen consumption prior to molt, just before the molt, is very high. When the crab is actively molting and coming out of the shell, oxygen consumption, oxygen need, oxygen use by the crab is very low, its minimal. It stays very low during the shedding process and then rises very high after shedding. What this says is that during the actual shedding process, the crab is without oxygen. It cannot use oxygen. The tissues are so arranged that it cannot absorb oxygen. This becomes a very critical time, then, for a soft crab. The crab is undergoing anaerobic respiration, respiration in the absence of oxygen. If this is prolonged, then a crab dies. In this activity, getting out of the shell, a very, very large amount of energy is consumed by the crab. It is building up what we call an oxygen debt. It requires a tremendous amount of oxygen to get back into a normal existence. So, oxygen consumption after molting is very high.

Of course, when a crab is taken out of the water, as a soft crab, you're arresting, you're stopping most of the physiological processes. The crab lives, because it can again absorb oxygen through the tissues of the body.

Now, what has this got to do with aeration in your shedding systems. There have been mentioned a couple of problems. One is whether it is detrimental to the system to force air into it by what they call injection by Bernoulli suction which pulls air into a pipe as the water passes through it and the water comes out with an added amount of air. In another type of valve the water is jetted across an air space and forced through a narrow opening; the water picks up air as it goes through that jet. There are other aeration systems which don't use either of these valves; for example, where the water comes out of an overhead showerhead and splashes on the surface of the water.

For many years we have been looking at all kinds of systems that have been developed by Virginia watermen. Watermen are very ingenious; they try all kinds of things. They do what they find is either the least expensive or the most efficient. For the last two years, we've been looking very intensively at two shedding systems which use open flow, continuously running water; and my feeling is that, no matter what system you use for introducing air, that none of these has been demonstrated to be very detrimental or better

than another system. That whether you have a shower, a Bernoulli system or an air jet system, they seem to be adequate.

Problems with insufficient oxygen occur when there is not enough water flow; and water flow rate seems to be the most important thing that you have to worry about in setting up a system. You need a certain flow of water to carry waste products away from the crab and you need a certain flow rate to bring in clean water with plenty of oxygen. Now, the best way to look at the problem is to determine the flow rate in the tanks that you are using. I find that if you have an adequate flow rate that you can usually get plenty of oxygen and plenty of good carry off of wastes. The easiest way to do this is to just follow a little formula. You take the area of your tank, the length times the width (let's say it's a four by eight, and that's thirty-two square feet) and then you multiply that by the depth. Now, we have been strongly recommending that water tanks contain no more than about four inches of water, about a third of foot of water. So, you multiply length times width times depth; you have something over ten cubic feet of water in the tank. Now, since there is seven and a half gallons per cubic foot, you have close to about eighty gallons in a four by eight tank. If you have a four by four tank, it contains 40 gallons. Now, what you want to try and achieve in a flow rate is to get all that water in and out of the system at least three times an hour. So, you need a system that will give you at least two hundred and forty gallons in that tank in an hour. If you have anything less than that, you've got problems. You have an accumulation of waste products and you have insufficient oxygen coming to the crabs. Some people do not have enough flow rate because they're carrying from six to twelve inches of water in a tank. That isn't necessary. You get a very good absorption of oxygen at the surface of the water. I'd say that in numerous water systems that I have seen, shedders have adequately controlled water flow, getting rid of the wastes and supplying oxygen.

Now, it has been observed that if you put air under pressure into water you may get gas bubble disease in crabs. This might occur at a time when the crabs are in the buster stage. There is an accumulation of nitrogen in the crab blood as a result of air being forced into water at higher than normal pressures. For this reason, I would not recommend compressed air systems being used, because I think that they could more likely lead to gas bubble disease and more air into the system than is desirable. I know of one man that has tried a compressed air system. I don't believe that he has any evidence that his oxygen content is any higher.

Realize, that when we're talking about oxygen, that cold fresh water contains the largest amount of oxygen per unit volume of water. High salinity water at a high temperature contains much less oxygen. For example, if you're shedding in a system where the salinity is about thirty to thirty-five parts per thousand, and it can be done, you might find as little as four units of oxygen (4 parts per million) being retained under saturated conditions in that water. Comparably, in a fresh water low temperature situation, you can get ten or twelve units of oxygen in that water under saturation. So, if you have a means of finding out how much oxygen is in your water, you also need to know how close it is to saturation. Now, just because somebody says you've got five parts per million of oxygen in your water, don't get scared and think that's too low. It may be all that the water will hold. What you want to

avoid is getting less than three units, then that begins to get intolerable. If you get down below three units of oxygen per unit volume of water then you're getting in trouble because your crabs are going to start suffocating.

One of the things that I realize is difficult for crabbers to do is to do their own water testing. It can become an expensive operation if you have a chemist do it. It becomes an expensive operation for a laboratory if it does the tests for you. We will do some at our lab on occasion if we want to see how a system is operating, but generally we find that the biggest problem that a waterman has is that he thinks that his oxygen is too low; we usually find out that his oxygen is pretty well controlled. Secondly, he's concerned about temperature; and I have some information that I might pass on about control. Thirdly, it's a question of salinity. Generally, it's a bad practice to transport crabs from one area where you caught them to the area you're shedding when the difference in salinity is more than ten parts per thousand. There are no hard and fast rules on this. I'd say that if you were in an area with ten parts per thousand of salinity you could get crabs from five to fifteen and bring them into your system. So, you're going five parts per thousand either way. But don't go and shed in the upper parts of the river where the salinity is around five and haul crabs from a pound net or from trawlers where they're catching crabs at twenty-five or thirty parts per thousand because that won't work. There are very expensive electronic instruments for determining conductivity of the water, which is another measure for salinity. But someone recently alerted me to a reasonably priced glass hydrometer-thermometer and to a plastic hydrometer. They are used in fish aquariums. If anybody wants to know where you can get these things, write to me.

We don't know a lot of things that are needed to keep crabs alive, to carry them through shedding. One of the subjects that we need to look into is the matter of feeding, that is, whether white sign and pink sign crabs should be fed before they go into the red sign stage. We don't know this. We're going to do some work on it this next year in Virginia. We think that perhaps some simply haven't got enough energy to get through a shedding stage. They may be lacking in glycogen storage. Certainly we don't know a great deal about the physiology of crabs; some scientists might study aspects of physiology that would help you in shedding crabs. I would suggest that some of you might do a lot of experimenting on your own time. You don't need the scientists to do it for you. A lot of you do it anyway. If you have some white sign and some pink sign crabs and you know you're going to have to hold them anywhere from four to ten days, put them off in a tank somewhere and feed them some scrap fish and see if you can't get those crabs to shed better than they had been doing without food, keeping in mind that you have a problem of accumulation of wastes and that you need an open, continuous flow system. Say, set up one tank without food and set up one tank with food. This is what we would do; and it doesn't take a lot of preparation to set up that kind of a study.

Mention was made of the problem of wastes accumulation in recirculated water systems. There are recirculated water systems which are so-called in name only. They're convenient in that you don't have to set up along a shore line, you don't have to buy expensive waterfront property. You may haul your water from some distance away. You may use well water or tap water or something like that; but the thing is that you can set your plant up twenty miles away from the waterfront and have a successful operation provided you do certain things. The simplest thing to do would be to replace your total water

supply every two or three days. Get a water tank truck and haul water in it. This is, of course, a problem. It's tedious. It's a problem getting a water supply that's good and it's an expense getting a water tank truck that will do the job for you. Ideally, it would be nice if you had a system that ran longer than two or three days. If you want a system that runs longer, then what you need to do is have two things - a filtering system to get rid of some of the accumulated wastes and a system to buffer the products of crab excretion. Oyster shell is a good substance for neutralizing the acidity of the water; but you still need a filter for taking care of some of the more solid waste products. If you go into a longer term system, you need to develop a biological filter. We're getting complicated now. You need to develop a biological filter which has a bacterial load in it like your city water treatment plants. The bacteria utilize the nitrogen products and purify the water. To my knowledge, these systems are rare. When you're handling large volumes of crabs, you can do anything you want if you transport your water every two or three days; but if you want to handle large volumes of crabs, it's very difficult to have a long term running recirculated water system. There's a lot of problems and we don't know all the answers.

I know I've covered a lot of things. What I want to say is this, that if you're interested in shedding crabs, there are ways of doing it fairly simply on a small scale and you shouldn't be scared about all the complications that could arise. Common sense should generally tell you what should be done. There are some people who have worked on these problems in different areas. I would like to introduce Mike Paparella from Maryland who has been working very well with some of the Maryland and some of the Virginia shedding plants. He has a pamphlet that he's written on some of the problems in shedding. He covers some of them very generally; but he knows some of the answers and if you want to talk with him, get with him sometime during the meeting.

We don't know all the answers. We've got a lot to learn; and we're not trying to put you off by saying we don't know what causes the problems; but I think you need to understand what the crab needs and what the crab is producing. Now, it's going to need oxygen. It's going to need the right salinity. It's going to need a flow rate to get rid of the wastes. There are various ways of handling them and just don't think that it's real easy; but don't think they are impossible to handle. I know I've been pretty rambling and general on this; but I've tried to assure you by my casualness that it isn't so greatly complicated.

Questions, Answers and Comments

Mr. Amason: If you are working with a closed system, what do you call a large quantity of crabs?

Mr. Van Engel: All right, let's talk about small quantities. We have held in a recirculated system for three or four months between forty and eighty crabs in a four by eight tank. I'm talking about commercial quantities, two to four hundred.

Mr. Amason: Also, this year is my first year in trying this. Where we lost most of our crabs, they were dying about half way through the shed. Is this a common experience?

Mr. Llewellyn: I also have an operation here on Johns Island. I want to tell you a way you can save them. When the crab comes half way out and hangs up and dies, you can revive that crab with closed heart massage. Put your finger in the center of it and pump that heart and they'll come right out. It's unbelievable.

Mr. Van Engel: See, there are all kinds of ways of solving your problems. It is difficult to find an answer for your particular problem and it could be a number of different things. It may be the crabs to begin with. It may be the way you are handling them. Are you nicking the crabs, are you breaking the claws? Oh, this is one thing I want to say. At VIMS, we've been looking at the problem of breaking the claws and bacterial contamination of the blood. We think there's pretty good evidence that when crabs are nicked and broken, or whether they're spiked by another crab, or when you puncture them, you are giving that crab an opportunity to become infected with bacteria. The aquatic environment is loaded with bacteria. We are now trying to find out whether these bacteria are really damaging the crab. We know they're in the blood and we would strongly urge that you not nick the crabs, not break the claws; or if you do so, do it very gently and do one dislocation. Don't tear the tissues and cause the crab to bleed.

Mr. Amason: Our experience on that is that we get a smaller death rate if we do a good job of grading the crabs. Don't nick them, or break them or anything, just grade them.

Mr. Van Engel: Grade them very well, right.

Mr. Osterling: I have an observation on your comment about light versus dark colored background in the tanks. A lot of the people we were working with did exactly that. They painted some tanks white and left the others brown. They have since painted the white tanks brown.

Mr. Van Engel: Thank you. My feeling, from the little work we've done, is that if you paint the bottom and the sides of the tank with white enamel, and then have it open to the sunlight, or if you put your overhead lights on it and keep them on twenty-four hours, because it's convenient or something like that, you're really aggravating the crabs. I don't believe that's appeared in the literature.

Mr. Amason: Just as an observation and this is purely unscientific. I have my tanks in a closed room and I believe that they shed better with the lights off.

Mr. Van Engel: Off, yes. I think you're right. Mike Paparella showed me a water cooling tower that he has on the eastern shore of Virginia and I believe there is somewhere between five and eight degrees Fahrenheit drop in temperature when you use it. It's a fairly simple thing. Mr. Bridges, you might want to

try this. We're thinking about building one. You've seen water cooling towers at hotels or restaurants which are similar. What you do is pump the water to the top of a tower and around the top of that through PVC pipe with lots of holes in it. Then the water falls down the four sides across wooden slats, into a catch basin on the bottom and from there you pump it back into your water system. We're going to try that. We think it's got great possibilities, particularly where you get temperatures of eighty-five degrees Fahrenheit and higher. We think that the best shedding occurs in the spring when the temperatures start to get up to seventy and that fluctuating water temperatures are very damaging. So, we like Mike's idea about a water cooling tower. I know a fellow who has built one up on the Rappahannock River in Virginia.

Now, one other thing that Mike Paparella is emphasizing is a protein skimmer. If you're going to use a recirculated water system, start thinking protein skimmers. The one I'm familiar with is built adjacent to a catch basin and it's ten feet tall. It consists of 8 or 10 inch diameter PVC pipe with an air injection valve at the base. The water is foamed with air. The foam comes off the top and is lead down to the ground and wasted away. The proper sequence of transport is to carry waste water from the tanks to a collecting basin, through gravel or oyster shell filters, then to the protein skimmer and finally to the water cooling tower before leading the water back to the shedding tanks. If you want to get into recirculating water systems that are going to last some length of time, you might as well do it correctly.

Speaker from the audience: What is the size of the cooling tanks we've been discussing?

Mr. Paparella: My cooling tank measures four feet by eight feet and stands about ten feet tall.

Speaker from the audience: Would it be possible to have a system like that and have trays built in with oyster shells or dolomite or something like that and drop the water on top and just let it trickle all the way through and that would solve the cooling problem and your biological filtering problems and everything?

Mr. Van Engel: Anything is possible. But I don't know whether your system would work. The principal here is to have the water trickle over the water tower slats. As the water passes over these slats some water evaporates and heat is lost (latent heat of vaporization).

Mr. Paparella: It also aerates the water.

Mr. Van Engel: Good point. Water takes up oxygen and gets rid of ammonia. I would certainly try this first without the oyster shells;

or put the oyster shell outside the tanks and let the tank's water pass through it.

Speak from the audience: I wanted to try the cooling tower and wondered if I could use a commercial refrigeration tower. I adapted one that was a three by three, instead of ten feet high, and it worked real well except I had to change my valves on the inside tank because I was getting too much air in the system. That's the only thing I had to change.

Mr. Van Engel: How did you know you had too much air?

Speaker from the audience: Foam was coming off, almost pure foam when it came out. I had to change that but it brought the temperature down.

Mr. Van Engel: It might be better if you ran it through a protein skimmer first.

Speaker from the audience: Well, at that time I didn't know about that. I had an oyster shell filter, gravity fed under the water cooler, which delivered water to a booster pump which pumped it into eight, 4 x 8 foot tanks. It worked real well as far as temperatures was concerned, but we had trouble with too much air in the system.

Mr. Van Engel: What temperature did you maintain?

Speaker from the audience: We tried to maintain seventy degrees Fahrenheit. This was early last spring and we did not get into the late part of the summer.

CURRENT REGULATIONS IN THE COASTAL PLAINS REGION RELATED TO SOFT SHELL CRABS AND THEIR HARVEST

Mr. Charles M. Bearden
Director
Office of Conservation, Management and Marketing
Marine Resources Division
South Carolina Wildlife and Marine Resources Department

I'm not going to attempt to go into a great amount of detail on the laws and regulations in the five states. I'm sure that the laws and regulations are probably among the dullest subjects we're going to cover here today; but we did think it was important to include a discussion of the laws and regulations. If you'll notice in your package of information that you got at the registration desk, we included a summary of the various laws and regulations in the five state area. I would like to point out that this is not a final production, but rather a discussion draft. I'm sure that some of you will probably find some revisions needed in this and we hope that out of the workshop we can make the necessary changes and come up with a final version later on.

There are a number of grey areas in some of the states pertaining to laws and regulations, particularly with respect to types of fishing gear and fishing methods and the areas that these can be used in taking peeler crabs.

As you might expect, the laws and regulations in the five coastal plains states from Virginia to Florida vary considerably and from state to state. These variations, of course, are due in part to different environmental conditions and different political climates in the various states.

Just going briefly over some of the various types of laws and regulations, all of the states require licenses for the catching and handling of crabs, and for dealing in crabs generally. Three states I've found in particular, South Carolina, Georgia and Florida, do have specific permit requirements in addition to the licenses. They have specific permit requirements for the persons engaged in catching and dealing in peeler crabs and soft shell crabs. Here in South Carolina this past year, a new law was passed which now requires a permit for persons engaged in the catching, possession and handling of soft shell and peeler crabs.

All five of the states have a minimum size limit on crabs (hard crabs). Of course, they all provide exceptions for peeler crabs. Only one of the states has a minimum size limit on peelers and this is Georgia, which has a three inch minimum size limit. There are a couple of other states outside the coastal plains region that have minimum size limits. I think Maryland has a three inch minimum. I think that the managers in most of the states don't feel that a minimum size limit is really necessary. They feel that this controls itself and consequently the market and other conditions as well as the fishing gear that's used for taking peelers.

As far as limited entry, one state, Virginia, prohibits nonresidents from obtaining crabbing licenses in that state and South Carolina this past year just passed a reciprocity law which prohibits Virginians from obtaining crabbing licenses in South Carolina. This is just a "turnabout is fair play" type thing.

When we get into the types of fishing equipment, methods and areas for taking peelers and soft shell crabs, there is considerable variation among the five states. In Virginia, the principal legal gears are the crab pound, the scrape and various types of crab pots. North Carolina allows the use of otter trawls which are illegal for taking peeler crabs in most of the other states in inside waters. In North Carolina, you can use an otter trawl, provided the mesh size is no smaller than two inch stretched and it's no larger than twenty-five feet across the mouth. And I understand from talking with some of the North Carolina people that this is a very effective way of taking peelers. Like I say, the trawl is illegal in a lot of the other states. Some of the states that have shrimp don't allow any trawling inside of any of the nursery areas so they don't allow any type of otter trawling inside. In South Carolina, right now the principal legal method of taking peelers is pots. As I said, we do have a new law in the state which allows our Division to issue permits to individuals engaged in catching peelers and these permits specify the area and type of gear that they can use and so we can allow people to use things like peeler pounds, scrapes and other gear under permit. In Georgia, pots again are the primary legal method of catching peelers. Georgia is pretty restrictive as to other types of gear that can be used. I know that trawls are strictly illegal in Georgia in inside waters for the use of taking peeler crabs, etc. Scrapes, in my interpretation of the Georgia law, would probably be illegal, too. Any kind of device pulled behind a boat would be illegal. There's nothing in Georgia law pertaining to peeler pounds. I'm assuming they would not be legal, but that could be open for interpretation. In Florida, as I understand it, pots are used primarily, and here again, the law has some grey areas. I assume in Florida in most areas, trawls would be illegal where peelers occur. So, we have a lot of variation, and some grey areas concerning methods and areas for taking peeler crabs.

One other thing I noticed is that in some of the states, particularly Georgia and South Carolina, there's a problem area with the laws and regulations. In both of these states we have arbitrary salt water/fresh water dividing lines set up along the coastal rivers; and in many cases, these lines are just arbitrary lines for enforcement and regulatory purposes and they extend far seaward of where a true salt water/fresh water line based on average salinity patterns would occur. Of course some of these areas would be, we feel, prime areas for taking peelers but would be closed to taking peelers with most methods above the fresh water/salt water dividing line. So, this may create some problems in the future.

That's basically a summary of the pertinent laws and regulations and as I said, there's a good bit of variation from state to state. There are some grey areas that I think need clarification, particularly in some of the more southern states. I would appreciate receiving any comments you might have on these laws and regulations.

Questions, Answers and Comments

Mr. Parker: How about the peeler crabs taken by shrimp trawlers working in outside waters, would you interpret these as being legally harvested?

Mr. Bearden: I would think their harvest would be legal in the states we've been discussing. However, in most areas I wouldn't think you would find a whole lot of peelers taken on these trawlers.

Dr. Otwell: What's the situation in South Carolina, say, if peeler pounds could be used here, about putting stakes out in the water, would it be legal?

Mr. Bearden: Yes, it would be legal. We have had a few people who have used peeler pounds. This gear type really hasn't been tested or evaluated here to any great extent other than the work which Dr. Bishop has done. He's found that they are not really feasible in areas where we have a strong current. You could put peeler pounds in feasible areas but it might require some clarification with the Corps of Engineers if you were going to do so on a permanent basis. We haven't had a lot of experience with peeler pounds yet but I would assume since they're more of a temporary nature, they wouldn't require a permit.

Summary of Laws and Regulations Pertaining to Peeler and Soft Shell Crabs - Atlantic Coast States, Virginia to Florida (These laws and regulations are current as of November 1980. They are subject to change, however, and persons should check with local authorities to determine their current status.)

State laws and regulations pertaining to peeler and soft shell blue crabs along the Atlantic coast of the U.S. vary considerably from state to state. Current laws and regulations are generally aimed at providing for the protection of undersized crabs and controlling fishing effort through restriction on gear, fishing areas, catch and season.

All five states (Virginia, North Carolina, South Carolina, Georgia and Florida) have a 5-inch minimum size limit on hard crabs taken for direct market or consumption as such, but all provide exceptions for the taking of peeler crabs for shedding into soft shell crabs. Only one of the States (Georgia) currently has a minimum size limit on peeler crabs - 3 inches, carapace width. Regulations concerning fishing methods, gear and areas vary greatly among the states.

The following is a summary of the license and tax requirements, size and catch limits, and regulations on fishing methods and areas currently in effect in each of the five state which apply to peeler and soft shell crabs.

I. VIRGINIA

A. Licenses and Taxes

(1) Commercial fisheries

Nets, regular trotlines, hand rakes, - $8.00
Patent trotlines - $31.00
Crab pot boat operator - $29.00
Crab pot boat operator and assistants - $48.00
Dredge or scrape boat - $58.00
Crab trap or pound - $5.00
Hand scrape - $16.00

(2) Crab Purchaser

Business license - $25.00
Vessel or vehicle license - $15.00

B. Laws and Regulations

1. General: Peeler crab is defined by law as a blue crab having a soft shell fully developed under the hard shell, or a crab on which there is a pink or white rim on the edge of the back fin.

Non-residents cannot fish for crabs commercially.

2. Size and Catch Limits

Unlawful to catch or possess hard crabs less than five inches across the shell. Tolerance limit of 10% allowed. Adult female crabs, peeler crabs, and soft crabs are exempt from these limits.

3. Restrictions on Fishing Methods, Gear and Areas

(a) Scrapes or dredges - Unlawful for catching crabs between April 1 and December 1. Commission may open season 15 days earlier or extend season by 15 days. No scrapes or dredges allowed in any rivers, inlets or creeks except on ocean side of Accomack and Northampton counties. (These provisions do not apply to the use of scrapes for taking peeler or soft crabs.)

(b) Crab traps or pounds - Unlawful to set traps or pounds within 100 yards of another such device. All traps or pounds must be removed by December 1. Crab pounds require special permit specifying location to be used.

(c) Crab pots - It is unlawful to place or maintain any crab pot in a navigable channel marked with official U.S. navigation aids.

(d) Taking crabs on Sunday or at night between one hour after sunset and one hour before sunrise in any waters in the state is unlawful. Does not apply to peeler pounds or floats or peeler crabs taken from pots (5% tolerance limit of hard crabs allowed).

(e) Catch limits or quotas - The Commission may limit the amount of crabs taken by any boat in any one day whenever it determines such regulation is in the interest of conservation and/or the crabbing industry.

II. NORTH CAROLINA

A. Licenses and Taxes

(1) Commercial fishing vessel

Vessels without motors - $1.00
Vessels with motors, less than 18' - $3.00
Vessels with motors, 18-26' - $.50/ft.
Vessels with motors, over 26' - $.75/ft.

(2) Unprocessed Crab Dealer - $5.00

(3) Taxes

Soft crabs - $.02/dozen

B. Laws and Regulations

1. General: No general provisions for soft crab operation.

2. Size and Catch Limits - Unlawful to take, buy or possess any hard crabs measuring less than 5 inches across shell, spike to spike, except peelers (10% tolerance limit in any quantity of crabs is allowed).

3. Restrictions on Fishing Methods, Gear and Areas

(a) Scrapes and dredges - Unlawful to take crabs by such devices between April 1 and November 30.

(b) Trawls - Trawls used for taking peeler crabs must have a mesh length of no less than 2 inches and cannot be more than 25 ft. in corkline length. (Corkline length provisions not applicable in Dare and Currituck counties.)

(c) No crab trawling is allowed between one hour after sunset on Saturday, and one hour before sunset on Sunday, except in the Atlantic Ocean.

(d) Patent dipper - Mesh length of such devices must be no less than 3 inches in length.

(e) Crab pots - No crab pots may be set in any marked navigation channel. Director may designate open areas for crab pot fishing during May 1 through November 1 of each year.

III. SOUTH CAROLINA

A. Licenses and Taxes

(1) Crab pots

Residents - $10.00/100
Nonresidents - $50.00/100

(2) Crab boat (other than trawl)

18 ft. and under - $2.50
Over 18 ft. - $10.00

(3) Crab trap net (pound, etc.) - $3.00 ea.

(4) Soft shell crab operator - $75.00 (must also be licensed dealer or processor).

(5) Taxes - $.10 per 100 lbs. (hard or soft).

B. Laws and Regulations

1. General:

(a) "Peeler crab" is defined as a blue crab (Callinectes sapidus) having a new soft shell fully developed under the hard shell and having a definite white, pink or red line or rim on the outer edge of the back fin or flipper.

(b) "Soft shell crab" is defined as a peeler crab which has recently shed its hard shell.

(c) Any person engaged in the catching, taking or transporting of peeler crabs or in shedding peeler crabs for the purpose of producing soft shell crabs is required to have a valid permit or identification card issued by the Division of Marine Resources.

Permits under this section shall be issued only to bona fide dealers engaged in shedding peeler crabs and in possession of a valid crab dealer license. Identification cards may be issued to a permit holder under this section to be used by persons employed by him to catch and transport peeler crabs to his shedding operation.

(d) The Marine Resources Division and department law enforcement officers have authority to inspect the business premises of any person engaged in shedding peeler crabs.

(e) On each permit issued under this section, the Division shall have the authority to specify:

(1) The area from which peeler crabs may be caught or taken by gear other than crab pots;

(2) The types of gear or fishing equipment which may be used to take peeler crabs;

(3) Catch reporting requirements;

(4) Boat identification requirements;

(5) Any other provisions the Division deems necessary.

2. Size and Catch Limits

Minimum size of blue crabs - Unlawful to catch, destroy, hold or possess any blue crab of a smaller size than 5 inches across the shell from tip to tip. Does not apply to peeler crabs.

3. Restrictions on Fishing Methods, Gear and Areas

(a) Crab pots - Unlawful in Chechessee Creek, except for personal use, May 1 - October 1.

Unlawful in Pawleys Island and Midway Creeks, Georgetown County except for personal use.

Identification cards required of crab pot helpers or assistants.

(b) Scrapes, dredges and peeler pounds lawful under special permit from Division of Marine Resources.

IV. GEORGIA

A. Licenses and Taxes

(1) Crab pot

Resident - $2.00
Nonresident - $5.00

(2) Soft shell crab dealer - $10.00

(3) Commercial boat - $4.00 + $.50 per ft. in excess of 18 ft.

B. Laws and Regulations

1. General: Peelers may only be sold to soft-shell crab dealers (who apply to and are licensed by the DNR). No one other than a licensed commercial fisherman or a soft shell crab dealer may possess peelers in commercial quantities. Also, it is unlawful for anyone other than a soft-shell crab dealer to operate a shedding facility for commercial purposes. Soft-shell crab dealers may not purchase peelers from any one other than

a licensed commercial fisherman, or another soft-shell crab dealer or from outside the state.

2. Size and Catch Limits

It is unlawful to take or possess any crab (other than a peeler or a mature adult female crab) less than five inches (5") from spike to spike across the back. Peelers must measure at least three inches (3") from spike to spike across the back.

3. Restrictions on Fishing Methods, Gear and Areas

No power drawn nets, etc. may be used in tidal rivers or creeks to take crabs.

Georgia law contains no provisions for peeler pounds, crab scrapes, etc. and it is assumed the use of such gear would be illegal.

V. FLORIDA

A. Licenses and Taxes

(1) Commercial fishermen

Alien or nonresident - $25.00

(2) Processor or dealer

Resident wholesale - $100.00
Nonresident wholesale - $150.00
Resident retail - $10.00
Nonresident retail - $25.00

(3) Crab pot - Permit required.

B. Laws and Regulations

1. General: Special permit required for soft shell crab dealers.

2. Size and Catch Limits

Unlawful to possess for sale, blue crabs measuring less than 5 inches carapace width in an amount greater than 10% of the total number of blue crabs in possession. Does not apply to peeler or soft shell crabs when authorized by permit from the DNR.

3. Restrictions on Fishing Methods, Gear and Areas

(a) Crab pots - No person, firm or corporation shall transport on the waters, fish with, or cause to be fished with, set or place any trap designed for taking blue crabs, unless such trap has current state permit number permanently

attached to the buoy. The permit number shall be affixed in legible figures at least one inch high on each buoy used. The blue crab permit shall be on board the boat at all times. Only one permit shall be issued for each boat by the Department upon receipt of an application on forms prescribed by it. This subsection shall not apply to an individual fishing with no more than five traps.

(b) Crab scrapes or dredges, trawls, are not legal gear for taking peelers. No provisions for peeler pounds.

Table 1. Summary of Peeler-Soft Crab Regulations, Coastal Plains States, Atlantic Coast. (These laws and regulations are current as of November 1980. They are subject to change, however, and persons should check with local authorities to determine their current status.)

Regulatory Measure	Virginia	N. Carolina	S. Carolina	Georgia	Florida
Minimum size (Hard crabs)	5 in.	5 in.	5 in.	5 in.	5 in.
Tolerance limit	10%	10%	None	None	10%
Peeler crabs (Min. size)	None	None	None	3 in.	None
Special permit required	No	No	Yes	Yes	Yes
Catch limits	Optional	None	None	Personal use only	None
Limited entry	Residents only	No	Reciprocal	No	No
Closed seasons	Yes (scrapes)	Yes (scrapes)	Yes (trawl)	No	No
Closed hours	No	Sun (trawl)	No	No	Night (pots)
Restricted areas	Nav. Chnls.	Nav. Chnls.	100 yds of boat ramp	Nav. Chnls. priv. prop. (100 ft.)	No
Gear restrictions					
(1) dredge, scrape	Yes	Yes	N/a	Illegal	Illegal
(2) trawl (min. mesh)	N/a	2 in.	4 in. (hard crabs)	4½ in. (hard crabs)	N/a
(3) traps, pounds	Yes	N/a	Yes	N/a	N/a
(4) handline, dipnet	None	None	None	None	None

PANEL SESSIONS

Panel Chairman: Mr. W. A. Van Engel - Virginia Institute of Marine Science

Panel Members: Mr. George Spence - Quinby, Virginia

Mr. Murray Bridges - Kitty Hawk, North Carolina

Mr. Jerald Horst - Gretna, Louisiana

1. Harvesting Techniques for Peeler Crabs

Mr. Van Engel: There are some very interesting things that we'd like to talk about relative to harvesting techniques for peeler crabs; and I'd like to introduce to you the people on the panel in order of their geographical location. George Spence is from Quinby, Virginia on the eastern shore. He's operating a plant in an area where the salinity is somewhere around fifteen parts per thousand and catching his crabs in about seventeen parts per thousand in Machipongo River. Our next panel member is Murray Bridges from Kitty Hawk, North Carolina who is involved in shedding operations primarily. Our third panel member is Jerald Horst from Louisiana who is a marine advisory extension agent and is very knowledgeable about the practices and operations in Louisiana.

I'd like to advise you that you're going to hear some things about different gears and operations, and different methods of handling when we get into the handling practices session. This can be labor intensive but it can also be a single man, small operation. Don't get scared away by thinking that this has to be a very complicated, difficult, time-consuming task, with lots of effort put into it. Certainly I know that George Spence and Murray Bridges are busy men in their operation. Jerald Horst will tell us about some operations that are very simple, very small and I think you ought to pay attention to that.

I thought I'd feed questions to the panel members as to the types of operations they have and on the diversity of the gear. Now, I'll start with Murray Bridges because I just got through talking to him about some of his plans; and what I'd like him to tell us about is his fishing practices and what gear he uses and when he uses it.

Mr. Bridges: Well, I use two types of gear. I use a 30-foot, 2 seam trawl net similar to a shrimp net, and I also use crab pots and peeler pots. I make my own peeler pots and crab pots and they are made practically the same; the only difference is in

the mesh. Crab pots have inch and one-half mesh and peeler pots have one inch mesh.

When we start out we catch a green peeler crab with a white color line. At that stage a peeler won't pot and we use the trawl net. It takes roughly about ten days before they become rank enough that they shed.

Then after the peelers get rank and they will pot, I use jimmy crabs as bait in each one of the pots. The big, rusty, prime jimmies are the best bait. A peeler won't go into a pot baited with white belly jimmies, those that have just shed.

Mr. Van Engel: Is it true that on any day you go out and trawl first?

Mr. Bridges: Yes. I trawl in the mornings, usually making the first two tows around daylight; that's when you'll catch the peelers in a trawl net. After that, I don't know if the peelers go on the shoals or somewhere else but you can't catch them with the trawl. Then I use my pots.

Mr. Van Engel: Either your peeler pots or crab pots?

Mr. Bridges: Peeler pots or crab pots. Then at the stage where they're really mating, I put the trawl net up and use just the pots. I don't even mess with the trawl net at that time.

Mr. Van Engel: Are your peeler pots and crab pots baited with fish or with jimmie crabs?

Mr. Bridges: They're baited with jimmy crabs and I use roughly three to four jimmies to a pot.

Mr. Van Engel: When you use your peeler pots, are you catching equal numbers of males and female peelers or are you getting more females or more males?

Mr. Bridges: I get ninety percent female.

Mr. Van Engel: What about some of the other gears that are used in other places such as crab pound nets?

Mr. Bridges: We tried that in my area this year and it didn't work out. They caught a few peelers but it was not worth the investment and time to fish. You will do better with pots.

Mr. Van Engel: And you're catching crabs over what kind of bottom and what salinity?

Mr. Bridges: Well, the bottom is mostly mud bottom. We tow in muddy sloughs and we try to set our pots in muddy and silty sloughs. I've got a fathometer on my boat and found the best place to put your pots or tow a net is on the edge of these muddy sloughs, not right in the mud.

Mr. Van Engel: Do you have marsh land near there?

Mr. Bridges: Oh yes. I'm towing in a big body of water surrounded with marsh land.

Mr. Van Engel: And the salinity, tell them how you determine that.

Mr. Bridges: Well, I haven't got a salinity meter, so I taste the water. I've drank barrels of it, but it works out, I can tell you that. You can get the wrong taste and you won't catch any crabs.

Speaker from the audience: What is your tidal range up there Mr. Bridges?

Mr. Bridges: We don't have any tide, except when there is a wind. We don't have an ebb and flow at all. If we have a southwest wind, we have tides coming in which raises the water level a foot. And if we have a northeast wind, the tide goes out and it probably drops down a foot. But as far as normal tides, we don't have them.

Mr. Paparella: Do you use any bait when you have four or five jimmies so they don't attack each other?

Mr. Bridges: No, I don't use any bait at all.

Mr. Paparella: I mean just to keep them from eating each other?

Mr. Bridges: No.

Mr. Van Engel: We heard someone say that they take the claws off of jimmies. Do you find that necessary?

Mr. Bridges: No, I don't find it necessary.

Mr. Amason: Will the peeler pots catch primarily in the spring or will they catch right on during the summer months?

Mr. Bridges: No, they won't. In fact, we found out that the spring is the best time to use them. In June we shed off what we caught in May. After that we use hard crab pots. There are so many jimmies in the area that we don't and can't catch female peelers in pots. We catch a few but it doesn't justify using the peeler pots.

Mr. Amason: When do your crabs start shedding, what month?

Mr. Bridges: Well, we usually start in May. That's our biggest month, when we get our big run of crabs. I go by the full moon. I call it the full moon week and by that I mean about three days before the full moon and three to four days after the full moon.

That's our biggest shed and I try to get my shedders filled up. I start about ten days before that.

Mr. Amason: Then about July, are you running out of peelers?

Mr. Bridges: Well, no, I shed right on. In fact, I cut my shedders off last Sunday (September 22). I shed all through the summer but each month the number keeps dropping down. In the month of August, I'll shed about seventy-five to a hundred dozen a week.

Mr. Amason: All the way through August, you're still using the peeler pots?

Mr. Bridges: No, the only way I can catch them then is with the trawl net. I'm hard crabbing then and I also catch a few in my pots.

Mr. Llewellyn: Does your production pick back up in the fall?

Mr. Bridges: Well, sometimes in September. It's according to the water conditions and all. We have a fair run but it doesn't pick up like in May and June. There's no comparison.

Mr. Llewellyn: In May and June, when you're in a good run, how many peelers do you average in a pot?

Mr. Bridges: Well, one day in May I fished ten pots and I had a fish box full, which would run about four hundred and fifty peelers for ten pots. In May, if you're trawling or even if you're using crab pots with bait, you catch very few jimmies since the peelers are at the mating stage.

In June, the number of female peelers you can catch is down because there are so many jimmies in the area. In June, you'll catch three times as many jimmies in baited pots.

Mr. Van Engel: What is the difference in size of the crabs during the spring and summer? Do you catch different sizes at different seasons of the year?

Mr. Bridges: When we shed out in May, the crabs are running about the same size, between five and five and one-half inches after they shed and that's when they're at their last shed. We call the females double crabs, virgin peelers; and they'll shed their last time to what we call a sook crab, a regular (adult) female. They'll all run almost the same size. In June, they'll do practically the same thing. Ninety percent of our particular operation in North Carolina involves female crabs.

Mr. Llewellyn: How many tanks do you have and what's your peak production?

Mr. Bridges: I have sixteen tanks running, four by eight feet tanks, and during the big peeler run I use float shedders also. I had twenty-six shedders full in May.

Mr. Llewellyn: What's the most you've shed in a day?

Mr. Bridges: I think it was about two hundred and twenty-five to thirty dozen.

Mr. Llewellyn: A day?

Mr. Bridges: Yes.

Mr. Whitaker: In your trawling, I believe you probably use two inch mesh, correct?

Mr. Bridges: I use three inch mesh with a two and a quarter inch tail bag.

Mr. Whitaker: And are your drags pretty clean? That is, do you catch many fish or any large shrimp while using your nets?

Mr. Bridges: We don't catch any shrimp at that time of the year and usually, if the water is cold enough, we don't catch too many fish mostly crabs. If you're experienced with a trawl, you know that about that time of the year you get mostly crabs. Now, they're not all peelers; we get a lot of small hard crabs and stuff like that.

Mr. Whitaker: Is there any particular reason you chose the three inch mesh?

Mr. Bridges: Yes, to get rid of the small crabs. I've tried a two inch mesh and it seems like you get a lot of small crabs and there's no sense in damaging them.

Mr. Van Engel: I'd like to move on and talk with George Spence of Quinby. His is a different type of operation entirely and following a long conversation I had with George, I drew up a calendar of some of his activities which I think are very interesting. I think you'll find it interesting in his discussion of what he does in Machipongo Creek.

Now, what George is doing is fishing in a river, or creek he calls it, Machipongo, which is on the seaside of the eastern shore of Virginia. He has been working in that river for a long time and he has told me of some changes that have occurred in that river during his lifetime. George, would you tell us about the changes that have occurred in your fishing methods and quantities of crabs and then explain what you're doing now. This is a typical operation in this river. About how big is that river in width and length?

Mr. Spence: It's about five miles long and it's about a quarter of a mile wide at the widest point but it goes down to a few feet at the head. In the spring of the year we have about six to eight weeks to catch the male crabs, the hard crabs and the females too. We try to catch these crabs out by the time the peeler crab season starts. We save some of the males and put

them in our tanks. They will be used later to bait our peeler pots. After you catch all the hard crabs, then you catch a lot of peelers. So, the peeler run in that creek, the May run, lasts thirteen days and maybe fourteen if you have a cold spell or something like that, but we try to catch these crabs up so that we can just catch peelers.

Mr. Van Engel: Let me interrupt here for clarification. The females are going to molt for the last time in May. So, what you're doing is you are eliminating from the river as many jimmies as possible before you're intensively setting out peeler traps with jimmies as bait to catch the females. So your eye is on this thirteen day intensive fishing period?

Mr. Spence: Right.

Mr. Van Engel: All right, you told me how many you caught in thirteen days.

Mr. Spence: We caught twenty-five thousand in thirteen days using three hundred pots. We baited them with six males and we had the only pots of that type in our area. This year my cousin used the same type pot and he caught twenty-eight thousand with seventy pots. The only difference in that pot and the regular hard crab pot is it's an inch mesh but it has two upstairs to it, with three jimmies on each side where the females can't get to them. The jimmies constantly keep calling the females and we catch from twenty to a hundred and twenty peelers a day, depending on the run. When we first start, it's not many. After you're going awhile, it reaches a peak and then it goes downhill.

Mr. Van Engel: Twenty to a hundred and twenty peelers per pot per day. Now, are these what you call first run females? These are large females?

Mr. Spence: These are the large females and after that you take your peeler pots up because there's no more to catch and the only thing on the bottom then is crabs that you didn't get and the male crabs. The state law wouldn't allow us to use fish bait in peeler pots this year. So, then the hard crabs overtake the peelers to the point that you can't catch peelers any more. There are too many hard crabs. And the only way you could get back catching peelers again would be to set a thousand pots and get those hard crabs off the bottom again.

Mr. Van Engel: The law in Virginia specifies that peeler pots cannot be baited with fish. They have to be baited with jimmies only. On the eastern shore of Virginia, George says that it is just impossible to catch male peelers or small female peelers without using bait in the pot. So, he's at a standstill in his operation as far as the regulation is concerned. And you are saying, George, that from about July on, you're primarily doing two things - you're hard crab fishing with fish bait and most of the shedding involves crabs that you purchase.

Mr. Spence: We purchase the rest of the year.

Mr. Van Engel: What is remarkable about this is the intimate knowledge of that particular river. You've got an isolated individual river that George knows very, very well. He knows where the jimmies are and when the female peelers are coming into the fishery, but he's got to exclude all those jimmies before he can start catching the female peelers.

Mr. Spence: These female peelers are there all the time, but you can't catch them with fish. They just won't go in the pot for fish; but when you put your jimmies in there and begin to fill your pots that way, you begin to see that the females were there all the time, thousands of them. That's what I think occurs down here (in South Carolina) from what I have seen of it. The people down here have a good potential but they have to get some of these hard crabs out of the way or they'll never catch enough peelers to make it a big fishery.

Mr. Van Engel: I think that this should suggest that some of you who are in areas where you have a confined section of a river and where there is the potential for taking out your jimmies first, could utilize a similar approach so that you can then catch females in peeler pot type situations.

Dr. Otwell: This question is for anybody on the panel, George or yourself, primarily. Why do you think that jimmy pot is working? Do you think the females can see the jimmies or do you think the jimmies release any sort of secretion or anything?

Mr. Van Engel: Pheromones. There is a substance called pheromone which is a secretion of the crab that attracts one of the opposite sex. You've heard about this in other animals, that moths have pheromones, that moths are attracted to each other by this substance which is exuded into the air and drifts on the air. This happens to be something which is produced by the male or the female and it is carried by water. So, the females are attracted to the crab pots by pheromones released by the males.

Mr. Paparella: We had a visiting scientist from the University of Pennsylvania down at our lab this summer working on this very thing. He is with the Monel Chemical Census Center and he's trying to get characterizations of these pheromones. He's done a pretty good job and may eventually publish this work.

Mr. Van Engel: Dr. Rick Gleason?

Mr. Paparella: Yes, Dr. Gleason.

Mr. Van Engel: There is a fellow by the name of Rick Gleason who got his PhD at VIMS in the study of pheromones and mating behavior in blue crabs.

Mr. Amason: George, during the time that you are primarily fishing for hard crabs, do you have any peelers go into the pots?

Mr. Spence: Very few. We have what we call "crawl-in pots," the same thing as the natural habitat pot they have here (in South Carolina). They will catch because there's no males in there. Peelers won't go in pots you've baited with fish. Particularly the female peelers. They'll go in a pot with no bait but they won't go in a pot that has bait.

Mr. Amason: Do you catch many male peelers up there?

Mr. Spence: Yes.

Mr. Amason: How do you catch them?

Mr. Spence: We catch them in the first part of the season, if the state will allow us. There are plenty of them there.

Mr. Amason: You don't catch them in the peeler pot, though, because a male isn't going to be attracted to another male.

Mr. Spence: You could catch them with an inch-mesh pot with fish, but this is currently illegal.

Mr. Van Engel: So, he doesn't use it. He's very law abiding.

Speaker from the audience: What salinities and water temperatures are you talking about on your first run?

Mr. Spence: Anywhere from seventeen to twenty-five parts per thousand salinity. The water temperature is about sixty to seventy degrees Fahrenheit.

Speaker from the audeince: Do you stop catching peelers when the water temperature gets up higher or is it just a function of time?

Mr. Spence: No, it's a function of time.

Mr. Paparella: Why can't you bait the pots with females to attract the males?

Mr. Spence: We tried it, it doesn't work.

Mr. Paparella: The work that Rick Gleason did this summer showed just the opposite. He put females in tanks and their urine exuded this pheromone to attract the males.

Dr. Otwell: All those male crabs have limited capacity. I'm wondering, how often do you have to change those jimmies to attract those females?

Mr. Spence: In a thirteen day period, we don't have to change them.

Dr. Otwell: You don't have to change them? How about you, Murray?

Mr. Bridges: No, we don't have to change them.

Mr. Van Engel: He said he uses the pot as long as a month.

Mr. Amason: George, you said you use a type pot that precludes the female from getting to the male. Do you, Murray?

Mr. Bridges: No. I make my own peeler pots just like a crab pot with an upstairs and what I do is just put three to four jimmies right upstairs.

Mr. Amason: Do you leave the baitwell out?

Mr. Bridges: Well, in the peeler pots I do. Yes, I don't put a baitwell in.

Mr. Van Engel: This innovation of a peeler pot was made by one of George's friends. It's a standard size pot with a one inch mesh wire and a funnel in the usual place, under the arch of the upstairs partition. A second partition is placed above the top of the first partition, with a shorter arch and with wings 4 to 6 inches above the first partition, each wing attached to the side of the pot. The second partition has holes in the middle of the arch to match the holes in the first partition. There is no bait box. The females can rise up into this upper trap chamber in the usual manner. The second partition closes off two chambers for the jimmies, one on each side of the upstairs. The front end of each chamber, on the funnel side, is cut away, and the pieces held in place with rubber straps and hooks. When you want to empty the female peelers from the pot, you open the top the same way you open the hard crab pot.

There are other variations of peeler pots. One has a Quonset hut type chamber in the bottom for the jimmies. Some crabbers have taken regular crab pots and jammed the jimmy in the bait box. George says he's tried them all and he thinks his innovation has proven superior to anything else he's used.

I'd like to go on and talk with Jerald Horst about the many things he's seen in Louisiana and in the Gulf area.

Mr. Horst: We've got four gear types used in harvesting what we call a green crab in Louisiana. Now, before I go any further, I want to point out a difference in the terminology used there. We don't use the term peeler and if you say the word peeler in front of someone down there, they know what you mean, but it's not used extensively. "Green crabs" are crabs that exhibit white sign. That's a crab that's going to shed within two weeks, white or pink, light pink. Now, "buster" is a term we use for pink and red signs. These crabs or busters shed within three days. The "cracked busters" are twelve hour crabs. They have the cracks under the points on the wings.

The number one piece of gear in importance is the standard hard crab pot that we use in Louisiana. That's the number one method of obtaining crabs for soft shell crab shedding operations. One of the reasons, of course, is that most people in the state feel that it's not worth it to just go after green crabs and busters alone. They want to combine their shedding operation along with their hard crab operations. Now, there are a few basic rules on how they're used or a few basic ideas on what's best. Most people that shed soft crabs in addition to their hard crab operation, will fish near shorelines. We've got quite a few lakes, large lakes, large bay systems in Louisiana. It's somewhat different than what you have over here (on the east coast). They'll fish near vegetational beds. We don't have as much vegetation as we used to because of salt water intrusion problems.

In Louisiana, we have what we call a dirty trap. These are traps covered with marine growth. In fact, they'll get so fouled with marine growth, that the trap will actually become one big round ball of fuzz, if you let it. Most hard crab fishermen have to remove their traps from the water every few weeks or months and either steam clean them or let them dry. The people that are working with a soft crab shedding operation generally fish their traps dirty longer. These dirty traps are used near shorelines and near grass beds and, I presume, would work very similar to the artificial habitat pot in that it creates a dark little haven for these crabs to go up in to shed. One final point is that people who are seeking what we call green and buster crabs do not use the same bait as people who are seeking the hard crab alone. The fresher and bloodier the bait, the better it is for hard crabs. We actually find that a day-old or two-day-old bait, a bait that's been in the water and been used for hard crab fishing, is a much better bait to use for a soft crab operation. Some of the fishermen feel that the reason for this is that older bait doesn't attract as many hard crabs. When you get a lot of hard crabs in a pot, you don't get too many crabs that are close to shedding.

The second most important method of obtaining crabs is the bush line and this method is unique to only a very small portion of Louisiana. As far as I know, it's not done anywhere else successfully. In Louisiana, we don't stick a pole in the mud, we "joog" it in the mud. We joog two large poles in the mud in approximately three to six feet of water. We have very shallow water in large areas of the state. We really don't have many areas in any of our bays that's more than six feet deep except in the passes. We joog two large poles and string what's very similar to a catfish trotline, only the main line will be slightly above the average water level. From that we hang droppers, snoods, whatever you want to call them, instead of hooks like you use for catfish, and attach bundles of wax myrtle to the snoods. Many fishermen have tried several different types of brush but wax

myrtle is by far the best. An average fisherman will fish anywhere from a hundred to three hundred bushes. There's no set length on the lines. There can be from ten to a hundred bushes on any one line. The lines are run downwind at all times. The reason for that, of course, is that if we ran them upwind and pulled the boat along, we would be shaking the bushes that we haven't gotten to. In Louisiana, during the peak run in April, we will get four to five good crabs from each bush and that includes not only green crabs but busters, cracked busters and soft shell crabs. We get a significant number of soft shell crabs from the bushes themselves.

Those are the two main methods used. A third method that was used extensively years past (scooping with a hand dip net) is losing favor because of the loss of our grass beds. Most of our soft crab shedding work is done in salinities under twenty parts per thousand. As you know, in the Gulf, full strength seawater is about thirty parts per thousand, but where our shedding is done its under twenty and a lot of times under fifteen. The grass that we have is water celery, if you want to call it that or we call it eel grass or ribbon grass. A method of fishing that was prevalent in the old times was to wade and scoop with a hand held dip net in waters two to three feet deep, usually on a sand bottom. This was done extensively in Lake Pontchartrain. It's one of the few places where we have a hard, firm, sand bottom. Most other places we've got gumbo mud and you'll sink up to your eyeballs in it. The crabbers wade and push this scoop net in front of them through the grass. The crabs that are in this grass are usually crabs that are going there for protection during the shedding period. They will shoot out, come to the surface and take off. The crabbers immediately scoop them up. They generally drag what we call a pirogue or a bateau behind them. These are small boats with baskets filled with buck brush; as they dip the crabs, they drop them in the baskets with the buck brush and the crabs will work their way through the brush.

The last method of obtaining crabs is shedding crabs on board shrimp trawling boats. And this, I think, has a lot of potential. It's just been in the last couple of months that we've even gotten people to work at this and we've been preaching it for three years. It's been very, very successful. We have a very large shrimp fishery in Louisiana. There are three general types of vessels in the fishery. We have the small inshore fleet which is called a mosquito fleet and consists of skiffs that range anywhere from twenty to forty feet in length. However, their space is very limited. We've got nineteen thousand of these, by the way, in the state of Louisiana. Their space is limited and most people on these boats do not shed crabs except for cracked busters which they simply throw in a pail of water. In a day they shed a dozen or two dozen. So, we didn't see much potential there because

of lack of space. Our offshore fleet has two different size vessels. The nearshore vessels, which are very similar to South Carolina's and Georgia's, are boats in the forty-five to sixty-five foot range and they fish from the beaches to two or three miles out. This is the group on which we are concentrating. The large fleet has what we call slabs or boats that are seventy to a hundred and five feet long and they fish twenty or thirty miles offshore and there aren't a whole lot of crabs out there. During some times of the year, the amount of crabs which these nearshore vessels catch is unbelievable. They'll catch as much as five or six hundred pounds of hard crabs, cracked crabs and busters in one drag on these nearshore vessels. To date, they've been discarding all the crabs. Just recently we've encouraged these people to put flow through systems on board their vessels and it has been rather effective.

Mr. Van Engel: It's a very interesting variation, to use an operation, ongoing for one type of species, shrimp, and make use of a product, a byproduct very profitably. What size tanks, and how many are used?

Mr. Horst: One subdivided tank, usually, measuring four by six feet or four by eight feet.

Mr. Van Engel: You run water right straight through and you have the same quality of water with the same temperature and salinity as where the crabs are caught?

Mr. Horst: Exactly. You're in the same water where the crabs are.

Mr. Van Engel: Do you use the bilge pump?

Mr. Horst: That's right. We use a bilge pump to circulate the water through.

Mr. Van Engel: Now, what is the production per day, per week?

Mr. Horst: These vessels we're referring to are week trippers, they're out five to seven or eight days. We've seen, in the very short period of time this method has been used, from fifteen to twenty-five dozen large crabs per trip. When I say large crabs, I'm talking about product that's worth eighteen to twenty dollars a dozen, minimum, being shipped in five to seven or eight days.

Mr. Van Engel: One of the things that I think perhaps we'd like to do when we get into the handling practices is to pick this discussion up and see what they do with those crabs after they shed. I want to remind myself for Jerald to get into this because there is something different about the handling practices there. You asked me about covering another subject?

Mr. Horst: Our seasonal variations.

Mr. Van Engel: Seasonal variations I think would be very important to cover.

Mr. Horst: Now, we're not as specialized as people on the east coast are. We have a very broad and diverse fishery. So, I guess we probably haven't gotten as refined as soft crab shedders have on the east coast. We use the same types of gear on a year round basis. We have a good strong crab shedding period from sometimes in March through October and we get incidental shedding, enough to make a little money, all the way into December. Generally, the only time that weather affects us adversely is in the fall months when we get an early norther that blows through and knocks the water temperature down. You will immediately get a tremendous spurt of shedding in your holding tanks or cars, but the production in crab pots drops dramatically for two or three days. Also, in the dog days of July, it gets so hot that the crabs take longer to shed in the tanks and they're also harder to catch, the green crabs. Generally what we see in the spring (March, April and May) is a general mixture of crabs, males and females, about a fifty-fifty mixture. They're somewhat on the small side. When I say small for the Gulf I'm sure it's not small for what you may be accustomed to on the east coast. They're rather large crabs but we consider them small. In June, we get a good run of females and this is followed by the dog days of July. When the season picks back up in August, we get a run of almost entirely males. Some of these are very large crabs. During September and October, we run heavy to females. Two weeks ago, I was at a crab shedding operation in Lake Pontchartrain where they had almost entirely females of a medium size. In October, the end of what's our really good season, you get a heavy, heavy run of large premium females. These large crabs are worth quite a bit so they're worth the trouble to shed. It must be due to changes in water temperature, but in any case, we find that a crab that would ordinarily take two weeks to shed will take as long as six weeks to shed in October. But most people do it because they command a premium price, quite a high price as a matter of fact.

2. Shedding Operations and Handling Techniques

Mr. Van Engel: I'd like to show some slides of George Spence's plant, at Quinby, Virginia. This will give us an opportunity to draw parallels between his operation, what you are doing, what Murray Bridges is doing, and what Jerald Horst sees in Louisiana. (Slides of exterior of plant on Machipongo Creek.)

George uses fifty-two tanks, supplied with six, one-horse power pumps (slides of interior of plant are shown). George uses an overhead supply of water and a valve over the tank to control flow. Attached to the overhead pipe is an L-shaped piece of pipe, to inject air by Bernoulli suction, where air is sucked into the water supply. The water splashes down into the tank and I'm sure he gets plenty of aeration that way. The water level is fairly low. He uses plastic baskets around and near the stand pipes.

Speaker from the audience: What does he use those for?

Mr. Spence: That's to keep the crabs from getting in the overflow, stopping it up and then the water would overflow. Busters and soft crabs that are not ready to take out can be put in those baskets too until you fish up again.

Mr. Van Engel: I think you can see the simple type of aeration system that he uses to bring air into the water supply. This is a splash system and it provides an adequate amount of oxygen. I think in some of these operations, not here at George's place, but at others, if there are too many crabs in a tank and the water flow is not large enough, the operator automatically recognizes the situation and puts in fewer tanks or tries to correct the flow. The obvious signs of too many crabs and not enough flow are crowding of crabs to the sides of the tanks or right underneath the water fall. You probably see that George's tanks are painted dark. He asked me earlier about painting them white and I conveyed the same idea that I did earlier today that I just thought it was not a particularly good idea; but if he wanted to try it, I'd be interested in knowing his results.

(Slide) These are some of the floats that are commonly seen on the eastern shore. I'll let George tell you a little bit about when he uses them in the shedding operation.

Mr. Spence: After we fill our tanks in the shedding house, then we have fifty-five of these floats that we use overboard and we only use those in May and August because you don't have enough crabs to use them other times of the year.

Mr. Van Engel: Are these floats left in the water for very long or do you take them out to clean or to dry?

Mr. Spence: Well, we use them for that run, that May run, then you pull

them up and they'll be all dry for August.

Mr. Van Engel: So, they're not in the water longer than what, two or three weeks?

Mr. Spence: Right, three weeks.

Mr. Van Engel: Have you had experience with floats left in water a much longer period of time?

Mr. Spence: Well, out in the sunlight they would grass up. You'd have a lot of marine growth that you don't have in a shedding house. So, if you wanted to keep them overboard, you'd have to clean them more often.

Mr. Van Engel: What sort of materials do you use? What kind of wood is this?

Mr. Spence: The wings and the stays are made out of cedar and the bottom is generally yellow pine.

Mr. Van Engel: Are the bottoms solid or slatted?

Mr. Spence: Solid.

Mr. Van Engel: Solid for all stages of peelers?

Mr. Spence: For all stages, yes.

Mr. Van Engel: In earlier years in other places I saw slatted bottoms used for the white sign and pink sign peelers and solid bottoms in floats used for red signs and busters. Did you ever see that kind of a system or use that?

Mr. Spence: We tried to use that but the eels can suck crabs right through the slats and generally they tear the aprons off the female crabs. So, for that reason, we make a solid bottom.

Mr. Van Engel: (Slide) This is your culling of the catch. These are the soft crabs that you've gotten out of the tank. Again, you can see that dark green tank bottom. (Slide) Would you comment on what's going on here?

Mr. Spence: One of the men is cleaning the crabs prior to wrapping it.

Mr. Van Engel: And he's got scissors?

Mr. Spence: He's got a pair of scissors and he's cleaning the crabs and his wife will wrap them.

Speaker from the audience: He's taking the feelers and the gills, is that what he's cutting out?

Mr. Spence: He's taking the apron off, the eyes and the dead man or the gills.

Mr. Van Engel: Ok, that's George Spence's operation (Slide). This is Mike Paparella's cooling tower over at Crisfield. It's not mounted on legs here but set up on a platform. So, you've an idea of what a homemade cooling tower looks like. (Slide) This is a small part of the protein skimmer that we saw near Crisfield. It's a big PVC tube about ten feet tall and the lines that are coming off the top of the picture are those that are bringing water from the top of the tube into the shedding tanks. (Slide) This is part of the same operation that Steve Otwell showed, the tiered system where the water flows from one tank to ten inches lower, to the next tank, ten inches lower, to the next tank and so on in a continous circle, in a spiral. (Slide) This was part of the operation, a protein skimmer to get rid of some of the organic material.

We talked about and heard about the practice of nicking crabs and it certainly has not been demonstrated that it is an altogether bad practice. The question is, what good does it do? So, I'd like to ask you, for example, in your own fishing, in your own handling of your catch, do you usually nick the claws?

Mr. Spence: We generally do break the claws. There are methods of breaking the claws that are better than others; if you take a crab and you go to crack the biters, the first time it cracks, stop. If you go on further, you'll make that crab bleed unless it's a rank crab and it won't bleed. So, really, you can't hurt a rank crab. It's the green crabs that you have to keep for a couple of weeks that you want to break real easy.

Mr. Van Engel: I think some of you working with peelers will certainly have to do some thumb exercises to get to where you can take your hand and press down on those movable fingers and break them without mashing your hand or tearing it up or breaking the crab up because it takes some strength which these people have that I don't have. I can't do it with one hand. I've got to take two but it is a very delicate operation as George says. The important thing is to dislocate the movable finger without tearing the crab. If you go beyond the first click, you've gone too far. The first click is the important one.

Mr. Spence: When you pick the crab up, naturally he's going to open his biter and try to bite you, so the trick is that when you pick him up and he opens his biter, then break it before he can shut it up.

Mr. Van Engel: When you get the crabs, either your own catch or from the watermen that you buy crabs from, you sort them right away, you cull them into different stages as to peelers. What are the different groups that you put them in?

Mr. Spence: We use two baskets when we're buying the crabs from the crabbers. We put the white sign crabs in one basket and the red and pink sign in the other basket. All the red and pink sign

crabs go in tanks that never have to be culled. You have to cull over all the white sign crabs in four days and take out the ones that have turned red and pink. So, there's a lot of work to it.

Mr. Van Engel: You cull over the white signs every four days?

Mr. Spence: Every four days.

Mr. Van Engel: And is there a time when you then discard what's left?

Mr. Spence: After the second time, if there's any left then, they wouldn't be any good, you can discard them.

Mr. Van Engel: I have seen and have recognized some of the early stage peelers prior to the white sign which over on Tangier Island they call hair sign crabs. Do you see many of those or do you put them in with the white signs?

Mr. Spence: No, there are quite a few of them, but we don't buy them.

Mr. Van Engel: You don't buy the hair signs?

Mr. Spence: No.

Mr. Van Engel: It's very easy to recognize if you look carefully and you know what you're looking for. If we have time, I have some slides of peelers including those of hair sign, white and pink and so forth, I'd like to show.

Dr. Otwell: George, how long do you leave your crabs in the water before they're ready to take out after they've already busted out?

Mr. Spence: We generally do what we call fish up, taking the soft crabs out, every six hours. All those that are real soft, too soft to take out, we put back in the baskets you saw and then we go back and take those out in between the regular fishing up.

Dr. Otwell: So, you're not really taking them out all the time. You just take them out every six hours?

Mr. Spence: Every six hours except those in the baskets.

Speaker from the audience: How many people do you have working your fifty-two trays?

Mr. Spence: Three people.

Mr. Van Engel: That doesn't include the two who clean the crabs and wrap them.

Speaker from the audience: If you only fish the crabs out every six hours, do you have problems getting paper shells?

Mr. Spence: No. We have much harder water on the seaside where we live. On the bayside there is softer water and crabs would harden up much faster than ours do.

Speaker from the audience: What do you mean by hard and soft water?

Mr. Van Engel: This is in reference to salinity. He's running about fifteen to seventeen parts per thousand, whereas many of the shedding operations on the bayside, in the Chesapeake Bay proper, are at lower salinities.

Dr. Otwell: Do they harden more rapidly in lower salinity?

Mr. Van Engel: I was not aware of this. This is brand new information from George Spence.

Mr. Spence: Yes, they do harden faster.

Dr. Otwell: It's interesting. He's observant so it must be.

Mr. Llewellyn: Do you know how long they leave them on the bayside before they fish out?

Mr. Spence: No.

Dr. Bishop: Van, when we were in Virginia, the person we talked to looked at them every three hours.

Mr. Van Engel: That was on the western side of the bay in either the Rappahannock or the Piankatank River. Salinities there run around ten or twelve parts per thousand and you said they told you they look at them about every three hours. Not at night, though?

Dr. Bishop: I understand that to be the situation.

Speaker from the audience: I was in Crisfield a couple of weeks ago talking to some of the crabbers and they said they fish out every four or five hours.

Speaker from the audience: What problems, if any, do you have with disease or parasites in your shedding tanks?

Mr. Spence: I don't know of any but we lose a lot of crabs in June.

Mr. Van Engel: This, I think, is a very interesting question and very pertinent here. You may hear something about a problem called grey crab disease. This was discovered a number of years ago by some people in Maryland. One of the investigators was Dr. John Couch, who is going to talk on Paramoeba, the grey crab disease, at a two-day session which is going to be held

in Biloxi, Mississippi, October 18th and 19th. As far as I know, this is primarily a protozoan disease which is prevalent in high salinity water only. It may occur rarely in low salinities. It would not be a problem within the Chesapeake Bay but it might occur in high salinity waters. I can't tell you anything more about the range of salinities where you might see this protozoan.

Mr. Spence: We tried one time to raise blue crabs and we found that the crabs would turn grey after so many weeks in a tank in the process of growing up. We had the crabs analyzed and I think that's how they got the grey crab disease name. They never could come up with any real reason, only that in high salinity water it was bad. They tried feeding these crabs to each other to see if it was catching and it didn't bother them. So, we don't know what caused it. I would think, from my own observation, it was a lack of some food that they could normally get on the bottom that they couldn't get in tanks but I don't have any way of knowing that.

Mr. Van Engel: Earlier in talking with George, he commented on seasonality and mortality, when crabs are likely to die. Very often you will hear of a tremendous mortality in both Maryland and Virginia shedding operations. 1979 was a very bad year, not necessarily for George, but in the bay side proper there were months when they were getting forty to sixty percent mortality of shedding crabs. That is one of the reasons why we've been spending a couple of years trying to find the causes of these mortalities. We still haven't gotten the causes pinned down. It seems to be very elusive but in talking with George, I have the impression that there is a time of the year when he expects to get mortalities.

Mr. Spence: During the second run, which usually occurs in June, the crabs die in large numbers. We take a loss of say twenty-thousand crabs in the month of June every year. All the other crab shedders that I know and some of the people I've talked to here lose crabs. I don't know the reason why. I feel that crabs in early spring have six weeks of a gradual rise in water temperature and are in relatively good shape compared to the second run crabs which shed two weeks later.

Although the second run crabs have another sign and they shed again, they're not ready inside. If you tear the crab's back off you can see that the crab is not ready to shed. Other than that I don't know why they die.

Mr. Van Engel: When I talked to George about this and said as far as I know everybody else complains about high mortalities in June, he said he thought the crabs were very weak looking, very thin looking. Then I asked him if he'd ever fed crabs in June which is a subject I brought up earlier today about starvation, whether there is a problem with starvation or underfeeding or malnutrition of the crabs at certain times of the

year. Perhaps George might get into feeding some scraps to some of the crabs in June to see if he can find out if it is or is not a matter of starvation. Generally we think that peeler crabs do not feed. Certainly it's true of busters and red signs but you know how predacious whites and pinks can be.

I'd like to proceed if I may and talk to Murray. Is there some way that your handling practices are different from George Spence's?

Mr. Bridges: No, I can't see any way. You were talking about feeding crabs and I've tried that in June. We also have a larger mortality rate in June than we do in May. But it seems that the green peeler, the white line peelers, won't feed.

Mr. Van Engel: Ok, so it's been tried.

Mr. Bridges: The only thing the crabs would eat is the crabs that died. They would eat crabs but I've tried fish and first one food and then the other and they won't feed on them. I don't know if it's because they're corralled up in the shedder or what.

Mr. Van Engel: You're shedding crabs in salinities close to freshwater. Do you notice any difference in the speed with which they harden up going from soft crab to paper shell?

Mr. Bridges: The only difference that I see is related to the temperature of the water. As far as the salinity of the water, I can't see any difference. If we have warmer days and nights, they'll harden up quicker. The water will get warmer but you can have a variation of three to four degrees and it'll change it. We usually fish ours about every three to four hours.

Mr. Van Engel: Three or four hours. So that you do cull more frequently than George does? You are in lower salinity water?

Mr. Bridges: Yes.

Mr. Van Engel: Do you nick the crabs?

Mr. Bridges: Yes, we nick them in May but from June on we don't nick them.

Mr. Van Engel: Any reason why?

Mr. Bridges: In May we have northeasters and the water temperature fluctuates greatly. When we have these northeasters, crabs have a tendency to cling together and to eat the legs off of each other. We found out that if we nick their biters they can't hold onto each other and eat their legs. I've lost thirty-five hundred crabs overnight like that. So, we nick all of them in May and after the May run, from June on, we don't nick any of them.

Mr. Van Engel: You spoke about a northeaster. Now, does it seem to you that

every time you get a northeaster, you lose crabs in your tanks?

Mr. Bridges: No, we won't get a loss of crabs unless we have not nicked them and they'll get cold and cling together.

Mr. Van Engel: Are there any things that happen just before you lose a lot of crabs? In other words, do you notice anything regarding the direction of the wind, a storm, or rainfall that occurs at the time you're losing crabs?

Mr. Bridges: No. Seems like in June we'll lose crabs regardless of whatever conditions are. We just lose them.

Mr. Van Engel: I think I'll go back to George Spence because this is something we overlooked. Aren't there times when you feel that you get a loss of crabs due to something happening in the weather?

Mr. Spence: A southwest wind will stir up the bottom, making the water more turbulent. When the pumps bring the turbid water into the system, that will help kill crabs.

Mr. Van Engel: You get more sediment?

Mr. Spence: More sediment in the water.

Mr. Van Engel: What about rainfall?

Mr. Spence: Well, rainfall is something I failed to mention awhile ago. Rainfall will harden crabs. If you have a heavy rain, you have to take your soft crabs out much faster than six hours. That fresh water will make them harden up fast.

Mr. Van Engel: Obviously since George is working on a small creek on the eastern shore, there's a very small watershed. So, that anything that falls there is quickly brought down into his system. His salinity can drop very rapidly in a very short period of time.

I'd like to bring in a point here that on the western shore, the crabbers are a hundred percent unanimous in believing that heavy mortalities occur in the crabs in their shedding systems whenever they get great turbidity of the water, whenever they get rainfall. That rainfall and turbidity are almost synonymous terms and that means also mortality. So that the more rainfall and the more turbidity, the more mortality they get. This is interesting and provokes a lot of things in your mind as to what might be causing this mortality. We're not sure but it is some lead.

We've had our share of mortality on the western shore of Virginia this year. Jerald Horst, how about you describing practices in Louisiana?

Mr. Horst: We do things a little different. I guess that's the nature of Louisiana, the state that brought us all crab cholera. I want to draw what our floats look like. We use all three methods incidentally in shedding crabs in Louisiana. We use floats, we use closed systems and we use open systems.

Floats in Louisiana are only used in areas of major bayous or lakes. The reason for that, of course, is that we've got a real peat marsh and there's not a lot of oxygen in it and that's the area of our best water flow. We have a good bit of flow in a major bayou or a lake where wind turbulance kicks up. Our boxes or floats in lakes look quite a bit different than what you're probably used to seeing. They have a trapezoid shape. Looking at them from the side, they're perfectly flat. They're anchored, they'll usually run a cable with a good anchor on each end and each box will be tied to the cable facing into the wind. This allows the box to ride a lot rougher weather. Virtually all of our boxes are made out of cypress. There is a difference between hard cypress and the modern sapwood cypress. We prefer to use old hard cypress; it's really impregnated with resins, it never rots and it floats a lot longer. As a matter of fact, a cypress box can be floated for four months easily with no problem. The boxes are about twelve to fourteen inches deep. The largest boxes are about five and a half feet long and at their greatest width, they're about three and a half feet. Some of the oldtimers who have a tough time handling these boxes are using a size box that is about three feet long and two feet wide. The box is solid on the ends and there are no openings. On the sides, they're solid with holes drilled in them; and I've seen all different size holes. Interestingly enough, they don't seem to have too much problem in the lakes with eels, which suck crabs right out of the box. We don't have an eel fishery to knock them back, not a significant eel fishery like they do on the east coast. I've seen holes in the sides that must be almost a half inch in diameter. The bottoms, in contrast to the floats that are used on the east coast, are slatted. We have anywhere from a quarter inch to half inch slots between the boards in the bottom; and the whole entire bottom is covered with quarter-inch hardware cloth. Now, let me explain the reason the boxes are slotted in the bottom. In the Lake Pontchartrain area where most of these trapezoid-shaped floats are used, we get some pretty rough winds at times and it kicks up one heck of a lot of sand, especially when you are on the windward shore. Sand gets in the holes in the side that are obviously for circulation, but the sand that does get in will drop through the bottom cracks and get out. We don't really have a serious problem with eel predation here. Now, in our major bayous where we shed, we generally use square boxes, some covered, some uncovered. It varies from person to person. They are usually made with cypress. I have also seen just regular pine frames with styroform floats on quarter inch hardware cloth.

Our flow-through systems come in all shapes and sizes but most Louisiana flow-through systems measure from twelve feet to twenty feet in length. We don't use an aeration system similar to what you do on the east coast. We'll run a piece of PVC piping from the pump along one edge of the box. This PVC tubing is going to have a whole series of holes drilled in it, very small holes, but it varies among individuals depending on the size of their pumps and the number of tanks they've got to aerate. These will spray at a tremendous rate. Earlier it was said that perhaps this spraying seems to agitate and aggravate the crabs. We have found that this is the best way to go. You have less mortality this way. We may get some aggravation but that's the best system that we have. Most of the boxes drain in the corners. What is becoming more common, is a self-cleaning drain that cleans the box and keeps all the waste products from the crabs; and crabs will dirty a box in a real hurry. This drain is constructed by mounting a piece of PVC tubing about four inches high in the bottom of the tank and about an inch up from its base, a very small hole is drilled. If left like this, the water would leave from the surface. The way the drain is made into a self-cleaning drain is by taking another piece of PVC tubing about six inches tall and a little bigger than the diameter of the first tube and you put some crenulations (notches) on the bottom edge. This tube sits down over the inner tube. Water and dirt will be sucked out through the crenulations in the outer tube and go between the two pipes and over the top of the inner tube and out. Now, the very small hole is really insignificant as long as you're pumping water into the tanks. It does very little draining but in Louisiana we get a lot of power outages. If the crab fisherman or the operator is not at the shedding tanks at the time, he can lose about six to ten dozen crabs in a four by four box. Our waters get pretty hot, even though virtually all of the tanks are covered. So, you can lose all your crabs if your power cuts out and you don't get a flow of water. With a small hole in the inner tube the water level will drain down to the one-inch line. That leaves enough water in the bottom of the tank to keep the crabs' gills moist and yet not enough to drown them because the gills are partly exposed to the atmosphere and so the crabs keep breathing.

Mr. Van Engel: May I interject one thing here. There are variations on this that I've seen. To create greater circulation, I've seen a system with a double line of pipes with one line across each end. One stream is jetted from each end along the side and this creates a circulation of water around the tank. The drain is in the middle of the tank. It gives you good aeration and good circulation. It keeps dead water out of the corners. When you're working with a single jet from only one end, it's obvious that you've got to have the drain somewhere on the other side, either as Jerald has or as you've seen at George Spence's. Perhaps Murray's is the same. Do you come in from the top or the sides...

Mr. Bridges: I come in from the sides.

Mr. Van Engel: In the middle?

Mr. Bridges: Right, I put it in the middle. I put a garden hose on the inlet and run the hose underneath the water, with holes in the hose for aeration.

Mr. Van Engel: There is individual variation depending upon where you are located and what your ingenuity dictates, but by all means you want to have good circulation within the system to bring water in and a good drainage system.

Mr. Horst: One thing I forgot to mention, almost all of our boxes are constructed of plywood, whether they're closed circulating systems or are open. They're set on two by four frames. The plywood is in almost all cases unpainted. About half the time you're going to find the boxes fiberglassed completely on the inside, the other half of the time you're going to find that they're fiberglassed only in the corners and along the seams. Unpainted boxes or unfiberglassed boxes need to dry out or you start noticing mortality. So, usually crabbers that use a closed system will have extra boxes at hand at all times. They'll dry some boxes out and use others. I personally think that the fiberglass box is better. One thing we have noticed on all forms of plywood boxes, whether they have fiberglass or not, is that we get a certain percentage of what we call box burned crabs. I guess you all may see this too. The crabs develop lesions or sores on the bottom of their shell. This usually occurs in the green crab stage. Once the crabs get box burn, you can pitch them overboard, because they're not going to shed. We all seem to produce box burned crabs, it seems to be characteristic of the whole area. Now, in float cars, they don't burn.

Our closed systems are very simple. Most people that use a closed system do so out of necessity and the reason is that being in the proximity of New Orleans, a large part of the city and surrounding area is below sea level. In fact, the major part of New Orleans is six feet below sea level. So, we've got a very extensive levee system and quite a few of our fishermen live on the other side of the levee system from the water. If they want to produce soft shell crabs, they almost have to do it in the yard because of the theft problem and it's a lot of trouble to walk over a levee. There are one or two people that use tap water. Most people, every other day, every second day, maybe every third day if it's kind of cool, haul thirty gallon garbage cans and fifty-five gallon drums full of salt water over the levee and put the water in their system. A couple of people I'm referring to use just common sea water, and like you, Murray, they taste the water. They taste the water where they are fishing, they taste the water in their tanks and that's how they determine the salinity. There's nothing complex or complicated about it. It's

a very basic system. A lot of our people operate with one, two, three, four, five of these boxes in their yards and they produce a significant number of soft shell crabs. Enough to augment their income.

Now, on factors affecting the shedding success, we've definitely found that as you have mentioned Van, you can't move crabs from salt to fresh or fresh to salt. Crabs get shocked and they just aren't going to shed. As far as what type of gear produces the most sheddable crab, there's no question that a bush line produces the best crabs. The crabs are not shocked or scared by being confined in a crab pot with other crabs. They're not being trawled up with a trawl and drug through the sand and the mud. They're not being chased with a scoop net. One minute the crab is hiding in the bushes and the next minute it's in a box. Crabs produced from this bush line method will shed to a higher percentage. Crabs produced in hard crab pots are next best. The trawler crabs seem to be doing surprisingly well so far or they seem to shed pretty good.

The depth of the water in our tanks, as has been mentioned, is almost universally four inches. I think just about everybody works with four inches of water in their tanks. Our floats, like I mentioned earlier, are usually in major bayous or lakes. Now, in the lake situation it's kind of unusual, we don't work our floats out of boats. We wade the lake in about three feet of water. When it's cold, we use waders and we work the floats while we're in the water. In bayous, we do use boats because the bottoms are soft.

As far as season, crabs generally shed the fastest and we get our quickest turnover in May. This, again, is a really good time. They shed slow in April and September and they get really slow in the months of August and, of course, July, the dog days, and October. As I mentioned earlier, when we get a norther that moves through the area, an interesting thing is that the crabs all of a sudden put on a real spurt of shedding if they're in a float car and exposed to the water changes. In our closed circulation systems, this is particularly noticeable to the people that use New Orleans tap water which does come from the Mississippi River, when we get a sudden spurt of shedding the crab people expect a real problem. It seems that when the crabs are stressed, the ones that are near shedding will almost rush to shed and the ones that aren't near shedding are going to die. Since we use New Orleans city water, we don't dechlorinate it, but rather just put it right in the tank and use it. It seems like this little shock shows that we put some bad water in the tanks. This can also happen when you haul water over the levee. You just get a little sudden shock when you get a little pollution. If you've ever been to New Orleans or that area around Louisiana, you will find there's more petrochemical industries located between St. Francisville and New Orleans than any

other place in the United States. So, we do have water pollution and water quality problems. Interestingly enough, you were talking about silt. I don't really think we get the silt problem and part of the reason is our marsh lands are so big that we don't get drainage from fast ground, from hard land, from dry land. We don't get this clay and silt washed into our marsh areas. Actually, if anything, when we get a good heavy rainfall, the water clarifies, it becomes clearer. So, we're very fortunate in that respect. When I was preparing for the program and Van sent me a few things to check for, he had silt on the list. I bet I called twenty people, and not one person felt that silt was a cause of mortality in our area. However, a heavy rainfall can cause mortalities. More typically it shocks crabs. When you get a real heavy rainfall, and living in the subtropical area that we are, a heavy, heavy rainfall of five and six inches will sweeten the water to such degree that the salinities are changed from salt to fresh and the crabs just won't shed. Are there any questions?

Dr. Burrell: I just wanted to make an observation about silt in our area. Apparently where we have a heavy silt load in our shedding tanks, we have a larger percentage of what we call cigarette burn disease. I guess it's what you call box disease, Jerald. It has been reported in the literature that cigarette burn disease is associated with heavy silt. One thing I haven't heard any of you touch on, I don't think, and Mr. Spence and I were talking about this, does anybody in Louisiana do any transporting of the peeler from the producer or the fisherman into their tanks? If so, what problems were they having and what did they do about it?

Mr. Horst: Well, everybody transports.

Dr. Burrell: Now, are they transporting any distance? When I say distance, I mean thirty, forty, maybe fifty miles.

Mr. Horst: Yes.

Dr. Burrell: And how are they handling the crabs during that time?

Mr. Horst: Almost in every case, when we first harvest the crabs, we put them right into bushel baskets. Before the fisherman ever goes out he cuts some buck brush or mangroves or wax myrtle, which goes by the name serea, and he stuffs large clusters of these bushes in bushel baskets and the crabs are taken and laid, not tossed, in these bushel baskets. Of course it's nice and springy and the crab will scoot down and settle down in the bottom. You don't have any injured crabs, any damaged crabs; the crabs won't pinch each other, and they won't stick each other with the spines on the end as they would if you dropped them in. We find they last very well.

Dr. Burrell: Is there any type of refrigeration that they use in this transport?

Mr. Horst: None.

Dr. Burrell: Is this a closed truck or what?

Mr. Horst: No, they carry them by truck, or they'll go twenty or thirty miles by boat.

Dr. Burrell: As far as numbers are concerned, how many would you say they put on the average in a bushel basket or does it vary with the crab size?

Mr. Horst: I don't have an answer to that. It's very hard for me to estimate that. One thing I'd like to mention, since we were talking about mortalities associated with the seasons, is some years being very bad and some being very good. Our fluctuations in production of soft shell crabs are due more to the availability of green crabs and busters than they are with mortality. We generally don't see one year with a great many more mortalities than another year. Now, we will have periods when you can't shed a crab if your name was Mr. Crab. We don't know what causes it, but then things just seem to return to normal. Observations by just about all the fishermen are that the crabs today are much weaker than they were in years past. I don't know if you see this too. They seem to feel that they're losing more than they used to in years past and they feel it's a gradual process.

Dr. Burrell: From the time the crabs shed until you take them out of the tank, is that about the same as everybody else has been reporting?

Mr. Horst: Yes. We grade about every four hours on the average and we usually don't do it at night except in peak seasons. In peak seasons, when you have a lot of crabs, you go out there every four hours, night and day.

Mr. Van Engel: Jerald, what is the average size operation, number of tanks, et cetera that the people in your area are using?

Mr. Horst: Real small. We've got a lot of individual type producers. We don't have much buying of crabs from fishermen. Most people catch their own green crabs and busters. The few that do get crabs from fishermen shed them on halves. The fishermen don't want to go to the trouble of sorting the crabs. This is our problem in the state. They can make money by selling hard crabs, why should they bother with having to sort crabs. So, if they go to the trouble of sorting them, they want more than twenty-five cents a crab. They usually shed them on halves.

Mr. Van Engel: These are hard crab potters?

Mr. Horst: Yes, hard crab potters. The people in Lafitte, that use the bush line, are very unique. Most of our shedders utilize

one to five tanks. Many of the tanks are eight by four with two partitions.

Mr. Van Engel: You don't have to have a big operation. You can do this on a small scale. You can be hard crab potting or some other activity and do this in addition as a sideline.

Mr. Horst: This is very typical there, yes. We grade our green crabs, by the way, every three days on the average. I've seen people that grade them every day. Some grade them every two days; but more people do it every three days than not. We grade our busters every day, every twenty-four hours, and the cracked busters, of course, we go through, like I say every four hours.

Speaker from the audience: Do either of you gentlemen have a feeling for whether a re-circulating or a flow-through system would give you a higher survival? Overall I know different individuals have different problems but as these relate to the diseases?

Mr. Horst: Flow through in our area is much preferred. You only recir-culate if you're behind a levee and you can't get water. In my area you definitely want to go to a flow-through system.

Mr. Spence: We have tried both methods and we find that the flow-through is the best.

Mr. Van Engel: At the present time with the work we're doing at VIMS, since we have not found any causative agent for heavy mortalities at any time of the year, we're coming to believe very strongly that perhaps there is something wrong with the crabs before they get to the shedding plant operator, that there is nothing that the operator can do to eliminate the mortalities that will occur. He can minimize them to some extent with con-trolled conditions in his plant, adequate flow rate, adequate oxygen, adequate handling; but he's bound to lose a certain number of crabs depending upon the quality of the crabs that he catches. The quality varies with the method of fishing, as Jerald pointed out. There are certain superior methods of catching crabs, certain, superior areas, but we're beginning to believe that we've got to go back to the crab in the water to find out what it is that is happening to that crab before it gets to the shedder. At the moment, whereas it might be convenient or necessary for some people to operate recircu-lated water systems, we feel that we can't give them the as-surance that that's going to reduce or eliminate their mor-talities. To be honest, I don't know anything else to say. And although I will encourage people to build recirculated systems, under certain circumstances, it will not eliminate certain types of mortality which we think are going to go on anyway.

Speaker from the audience: In this type of mortality, not something that's caused by heavy siltation but the mortalities that you're now explaining, are those crabs that are dying up until that time, are they progressing normally or have they stopped in the molt cycle?

Mr. Van Engel: They seem to have been progressing very normally. Where they get problems in the tanks that are not due to flow rate, that are not due to insufficient oxygen or not due to nicking, bad nicking, mortalities are related primarily to large changes in the temperature, and to salinity in the tanks. When you get a heavy rainfall in an area your inflow water drastically changes salinity; then you're going to have mortality.

Mr. Horst: Can I make a point Van? Almost everyone with flow-through systems in our area draws water from approximately eight to twelve inches off the bottom. It avoids sucking up mud. If you get a heavy rainfall, the fresh sweet water floats on top of the salt water and the salinity at the intake is not significantly changed. So, we don't really have a problem with rainfall in circulating systems. We have a problem with rainfall in the float cars.

Mr. Amason: You don't have much tide, either, do you?

Mr. Horst: It varies. Normal fluctuation is measured in inches - ten, twelve inches. However, we're faced with the situation where a south wind and a north wind affect us directly, not obliquely like on the east coast. A north wind can blow two feet of water out of the marsh and a south wind can blow two or three feet in. Incidently, two things in our handling I didn't point out. Virtually everyone in our state feeds their crabs in the green crab stage. They feel it reduces predation and they cut up fish in small pieces to feed the crabs. Secondly, almost everybody nicks the movable part of the pincher with a pair of fish skinning pliers, catfish skinners, and they just take off the very end. The reason for this is, of course, for ease of handling. Green crabs are pretty frisky and they can cut your hands up pretty good.

Mr. Van Engel: I think there are a couple of little things to remember. One is the drain that Jerald speaks about. I know that Mr. Bridges and Mr. Spence both use a little drain in the bottom of the stand pipe in case they get electrical failure. You've got to get the water out of the tank down to about an inch so that you have a moist condition for the crabs in the bottom of your tank.

Secondly, to recognize those spots that you get on certain crabs when they are resistant to shedding. They stay in the tank day after day after day. They develop those round cigarette burns, what did you call them, tank burns?

Mr. Horst: Box burns.

Mr. Van Engel: Box burns, when you see it you might as well get that crab out of your system because he's resistant to shedding. Whatever it is, you're wasting your time and space handling them.

Dr. Otwell: Van, I just wanted to answer the gentleman's question about transporting crabs. I had the opportunity to work one whole summer with some people transporting crabs that were dying in warm weather. We'd set up a lot of very impractical, expensive things and we found out that the temperature that they stayed alive in the best, coming out of all salinities and all temperatures of water, was around fifty degrees Fahrenheit. We wanted to keep the humidity on them as high as possible. The best method we observed involved taking tubs and putting a very thin layer of ice in the bottom. A cloth bottom built around light wire was placed in next followed by the crabs and then moist burlap right on top of the crabs. It worked. It's very simple. Now, some individuals were actually putting the crabs in direct contact with the ice or putting the ice on top of the burlap and letting it melt through. Both of those systems were detrimental and killed the crabs. You do not want cold water to come in contact with the crabs, it kills them right away.

Mr. Van Engel: We transported some crabs from Florida to Virginia for experimental purposes. They were put in coolers with wire bottoms, ice was placed in the bottoms below the wire baskets and the crabs on top of that with burlap covers over them. They came through beautifully.

Speaker from the audience: This is the same thing we've been doing. I'm just trying to figure if there's any difference between what Mr. Spence talked to me about and what Louisiana or Florida or North Carolina are doing? I don't think they can improve on what's already been done, really.

Mr. Horst: I might point out one thing. We've found in Louisiana that the saltier the water the crabs come from, the sooner they die when they're left out, and that's almost universal. A fresh water crab is so frisky, he'll stay alive completely dry for hours and hours and hours. A salt water crab is dead in thirty minutes.

Speaker from the audience: You said that they feed some of the green crabs. Is there a difference in the feeding tanks compared to the population of your cracked buster and your buster tanks?

Mr. Horst: You've always got more crabs in the green crab tanks than you do in the buster, than you do in the cracked busters because you've got mortality, you're going to get rid of box burned crabs. That's just natural. Yes, sir.

Speaker from the audience: How much mortality do you have?

Mr. Horst: You know, I'd hate to say. I've seen times that it looked like we got a hundred percent shedding. Then, I've seen times when there was a high percentage of mortality. I really don't have an answer to that.

Mr. Van Engel: George has got probably the best system of all. What's your mortality rate?

Mr. Spence: Twenty-five percent average.

Mr. Van Engel: Except in June?

Mr. Spence: No, I was averaging that out.

Mr. Van Engel: If you don't average June.

Mr. Spence: Fifteen percent in May and sixty percent in June.

Mr. Van Engel: And in the fall?

Mr. Spence: In the fall, seventy-five.

Mr. Van Engel: You mean mortality?

Mr. Spence: No. Twenty-five percent mortality.

Mr. Van Engel: How about you Murray?

Mr. Bridges: Well, in May about ten or fifteen percent and in June it'll run about thirty percent.

Mr. Van Engel: On the western shore of Virginia, it varies every year. We never know what it's going to be. One year it can be fifteen, twenty percent mortality all year. Another year we'll have fifteen or twenty percent in the spring, in May, and after mid-August, and in between anywhere from forty to sixty percent. One year, 1971, there was as much as eighty percent mortality all year that I know of throughout the bay. And nobody had any idea what to do about it.

Mr. Bridges: On this mortality issue, I have cut mine down quite a bit in the last two years. I used to save a lot greener peeler than what I did in the last two years. Mr. Van Engel was talking about the hairline peeler. I used to save some of them and I found out that I lost more by keeping them longer in my tanks than I would if I kept what I call a green peeler which was between a white line and a pink line from June on. Now, in May, you can keep a white line peeler and you won't have very many to die. But in June on up through the summer, I found out you'd be better off to keep a better peeler and in the long run you'll shed more.

Mr. Horst: That's more or less true of Louisiana, too, Van. In the dog days of July, it's pretty rough; but, you know, in the early time in the spring, in May, we have a high rate of shedding success.

3. Marketing Soft Shell Crabs and Preparing Crabs for Market

Mr. Van Engel: The man who is shedding crabs ought to have an idea of what he's going to do with them after they shed. George, can you tell us what your particular procedure is for handling the crabs after they're shed and how you prepare them for market and where you market them?

Mr. Spence: From May until the 4th of July, we try to sell most of our crabs live. They're packed in boxes mainly for New York or any market that we can get; but that's the highest market at that time of year. We pack nine dozen jumbos in a box, twelve dozen primes, and eighteen dozen mediums. Since the market will only hold so many crabs without dropping, we freeze some crabs to keep the market stable. Buyers generally call us every morning and give us a price and we know what we're getting and we freeze the balance that day. For the northern markets, the buyers start purchasing down south and they move north and as they get up north, further up north, our crabs become less desirable. We freeze everything from July on that we don't sell every day.

Mr. Van Engel: These crabs are prepared before they're frozen?

Mr. Spence: They're cleaned and dressed and wrapped in cellophane and frozen.

Speaker from the audience: What about your live ones?

Mr. Spence: Live ones are just packed live in eel grass.

Speaker from the audience: How do you ship those, say to New York?

Mr. Spence: We have Tidewater Express trucking line that takes them to New York.

Speaker from the audience: Do you use brokers for this?

Mr. Spence: No, you mean...

Mr. Van Engel: Commission man or broker in New York?

Mr. Spence: Yes, they are commission men but they buy direct. They don't take out a commission in New York but they do in Baltimore. In New York, when they buy, they'll tell you what they're going to give you that day.

Mr. Van Engel: They give you that price less freight, unless you pay the freight.

Mr. Spence: Less freight. If they want them real bad, they'll pay the freight, too.

Speaker from the audience: Do you call them or do they call you every day?

Mr. Spence: They call us every morning.

Mr. Van Engel: Do you use the railroad? There's a railroad line that used to run?

Mr. Spence: No.

Mr. Van Engel: There are people in Virginia who sell their crabs through a commission man. On the western shore, Baltimore is a big market and they sell crabs there to merchants, commission merchants, who charge about an average of ten percent commission less freight. I think that the biggest complaint that I hear is that the soft crab shedder, shipper, looking at the green sheet that comes off of the market news service of the National Marine Fisheries Service, feels that he does not get the price that's quoted there. Now, I'm sure that the Baltimore market news reporter jots down the figures that he gets from the commission people as to their estimate of the price; but there's something lost in the conversation between the commission man and the processor. I think it is up to the individual man to look out for himself and to querry and get an agreed upon price with the commission man if you're trading with him, as to what he's charging you for commission and what he's charging you for freight. One of the things you can do if dissatisfied is either deal with a different commission agent or process, clean the crabs yourself, freeze them and do your own marketing. You've got to be aware of the pitfalls and the losses that occur economically.

Speaker from the audience: I'd like to direct this to Jerald. Of course, you couldn't send yours to New York from Louisiana or can you and how?

Mr. Horst: We don't want to. We can't supply our own market.

Speaker from the audience: Do you have brokers there in...

Mr. Horst: There's no such thing as a broker. Perhaps it would be best to defer this for my section or should I go ahead and do it now?

Mr. Van Engel: Go ahead now.

Mr. Horst: We have a very unusual situation in New Orleans. We can't supply our own market. We import crabs from Maryland and from Virginia and we import a substantial number. That's one reason we get twice to two and a half times the price per pound for Louisiana crabs than what's gotten in the Chesapeake Bay area. We get as high as an average of $2.50 a pound, as compared to a $1.00 to a $1.10 in Maryland.

Speaker from the audience: Who is your distributor? Naturally, all these little people cannot just go in and call...

Mr. Horst: That's the way it works. The seafood marketing situation is chaotic at the present time in New Orleans and not just the crab market. For example, our catfishermen are packing their own catfish and bootlegging them. They have a regular route through the restaurants in the city. New Orleans is synonymous with food and if you've been to New Orleans you know it. We've got restaurants on every corner. The hard crab fishermen peddle their own hard crabs. The only thing that isn't handled like that, to a large degree, is oysters and shrimp. But so much of our seafood is, it's unbelievable. In other words, the fisherman who sheds his own crab, makes the money that the middle man would have made because he does as you suggested, he hustles his own markets. Now, of course, they're not really big time operators like the other two producers on this panel. They don't produce that much. But, the way it stands now, we're in a tremendous short supply of soft shell crabs.

Speaker from the audience: Mr. Llewellyn, how do you get rid of yours?

Mr. Llewellyn: I wish I had ten times as many. A few restaurants take everything I've got. If I have extra, they'll take them and freeze them. They have doubled their business because they have live soft shell crabs.

Mr. Horst: That's another point, ninety percent of all our crabs are marketed frozen and uncut and uncleaned. The reason we don't cut them is because if you cut them and freeze them, they bleed, the juice runs out of them, they flatten and they become less attractive. We market them completely untouched. The ten percent that is marketed live goes directly to the local individual, retail trade, people who drive out where the fishermen are.

Mr. Van Engel: Who buys these uncleaned crabs?

Mr. Horst: The restaurant and hotels and a few wholesalers, now. There are a few wholesalers but they handle soft shells as a sideline with their main business being shrimp.

Mr. Van Engel: And the wholesalers do the cleaning?

Mr. Horst: No.

Mr. Van Engel: What about the restaurants?

Mr. Horst: The restaurants, yes, in all cases.

Mr. Spence: We had one Louisiana firm that wanted five thousand dozen this spring.

Mr. Horst — Were they cleaned? Did they want clean or uncleaned?

Mr. Spence: — I didn't have them.

Mr. Horst: — The ones we get from Maryland and Virginia are usually cleaned. We have a little unique situation, too, as I mentioned to Van this morning. I think all of you that have fooled with crabs have had what's called a still. Is that the correct term, Van, for the crabs that don't make it?

Mr. Van Engel: — What we call a still is a crab that dies during the shed.

Mr. Horst: — They back part ways out and they die. They just don't make it and from what I've been hearing, a lot of people consider that a loss or a detriment. There are a handful of the very finest restaurants in the city that sell buster crabs. This is a third use of the term buster. A buster crab in our area is one that died coming out of the shell and this crab has had the legs and pinchers cut off and it's just a body. The crab is extremely soft and since it died before it had a chance to inflate it's body with water to expand, it's a succulent, juicy product and they command fifty to seventy-five percent more than a regular soft shell crab.

Mr. Van Engel: — Anything in New Orleans. I think those of you who have shed crabs recognize the possible loss of crabs that don't make it through the molt. Some come through the molt without legs and they call them buffaloes, some die in the molt and often times they're just tossed in the water for the eels or the bull minnows to eat. Now, I know and you know that if you get a crab that has just died in the molt, there's nothing wrong with it if you pull it out of the shell and arrange it neatly and so forth and handle it carefully. It is edible and is not contaminated in any way. It is a perfectly good edible crab and I would like to emphasize that in light of what Jerald is saying. However, it has been commonly considered loss and I know at least one place where they took all the stills, as they call them, and cleaned them up and froze them and they paid for their freezer in one year from the stills and they sold them to market.

Speaker from the audience: — A question on that one thing, Van. If you were fishing say, every four hours, how long would it take one in eighty degrees water to start breaking down? Would they start breaking down in less than four hours?

Mr. Van Engel: — That's a hard question. I don't know. You're cutting it kind of thin, you know, two hours, three hours, four hours, six, I can't answer.

Mr. Llewellyn: — I've sold some of the dead busters still in their shells as fish bait and gotten my money back on the crabs. The ones that die as stills that I haven't revived, don't go to waste

either because I eat them all.

Mr. Van Engel: A word was mentioned here about the sale of peelers. We haven't mentioned that at all today and I think this is possibly something that ought to be brought up. You do sell peelers for fish bait. Would you say a substantial amount, small?

Mr. Spence: On weekends we sell from ten to a hundred dozen peelers and we try to pick the best we have but it's one thing I hate to sell because the guy is standing over you and you put one in and he says that's a little one. You want big jumbo soft crabs and yet your giving him all the big ones and he says they're little; but we do sell a lot of them and I've never put a sign out Peelers for Sale.

Mr. Van Engel: This is a big market, though.

Mr. Bridges: I also sell peelers for fish bait but like Mr. Spence, I don't like to sell them.

Mr. Horst: Crabs are unused for fish bait in our area. Nobody uses them and nobody wants them for bait in our state.

Speaker from the audience: Is the price the same when you sell them for fish bait as it is when they are sold in the market?

Mr. Spence: I've been charging nine dollars a dozen this year.

Mr. Bridges: The price I sell the peelers for fish bait is the same as the price I get for my soft crabs.

Dr. Otwell: When you're buying peelers from the crabbers to put into your shedding operation, how much do you have to pay for crabs? How do you handle that to make the crabbers keep coming back with the peelers?

Mr. Spence: I pay twenty cents apiece, right now.

Dr. Otwell: If it's a prime peeler?

Mr. Spence: If it's a white sign peeler or a red. It doesn't make any difference.

Mr. Bridges: I don't buy peelers from other crabbers.

Mr. Van Engel: He doesn't buy any at all. Perhaps you'd like to know about how many crabs the producers on the panel handle in a year. What's your production this year?

Mr. Spence: This year our production will be two hundred and eighty or ninety thousand.

Mr. Van Engel: Two hundred and eighty or ninety thousand crabs.

Mr. Bridges: I shedded roughly about thirty-five hundred dozen. That's from May until, I cut my pumps off last week.

Mr. Van Engel: How many crabs is that? About forty-two thousand crabs. I started to ask the question myself before, why is there such a high price paid for big crabs - whales and jumbos? I wouldn't pay that for that kind of crab.

Mr. Bridges: They're not as good to eat.

Mr. Van Engel: I wouldn't eat one. I say that kind of off the record, but I'll ask some of the others how they feel about it. I would rather have a prime or a medium size crab. You get two or three of them and that's satisfying. They're very tasty, they're very good and I'd rather have them than anything else. I think it is ridiculous to go for and brag about these great big whales and jumbos because personally I would pass them by as unrealistically priced and not worth what you're paying for them. This is my personal feeling. I don't know whether any of you want to volunteer how you feel about it but Vic Burrell wants to make a comment.

Dr. Burrell: My only comment is that the same sort of thing holds true generally in our area in regards to shrimp. The big price is on the big shrimp. The people around here want big shrimp but the small shrimp is a much better shrimp.

Speaker from the audience: What is the maximum amount you've paid for a peeler?

Mr. Spence: We have paid forty cents, that's the maximum. It depends on the number of good rank crabs, you know, like in May they're all she crabs. At that time, you can pay more money than you can this time of the year.

Mr. Llewellyn: Are you still in operation right now?

Mr. Spence: Yes.

Mr. Llewellyn: When do you expect to shut down?

Mr. Spence: The end of next week. We'll stop buying the end of next week and then it'll take two more weeks to shed off.

Dr. Otwell: I think you have to be kind of careful when you get ready to market your crabs. Success depends on what area you want to sell them to. In Florida, I can go to a certain area where there are a lot of retired people that have moved down from the Chesapeake and they know what soft crabs are about; but I can go to another city in Florida that doesn't have this many retired people, they don't even know what a soft crab is, have never seen one and don't even want it. So you have

to be careful. Like George said, he's dependent on the northern market because that's where it is and wouldn't it be nice if he could sell some of his crabs in that population over there in Virginia?

Mr. Van Engel: He does.

Dr. Otwell: He does but probably not as many as go up north. When you try to sell your soft crabs, you have to have a little education to go along with it because a lot of people don't know what soft crabs are.

Mr. Van Engel: I have a friend who sheds, perhaps handles more crab pound nets than anybody else in Virginia, in the Rappahannock River and he and another fellow nearby sell everything to Louisiana, frozen, everything. They feel the market is pretty well satisfied by other processors in Maryland and Virginia, so they send everything south and Louisiana send all of their big hard crabs north.

Speaker from the audience: How many people do you employ in your operations?

Mr. Spence: Are you talking about all operations or just the crabs?

Speaker from the audience: The entire operation.

Mr. Spence: Crab pickers and all, we have at least thirty.

Mr. Van Engel: He picks crab meat, too.

Mr. Spence: In the crab shedding operation, we only have four or five people.

Mr. Bridges: My operation consists of myself and my wife.

Mr. Van Engel: That's fishing, shedding and everything?

Mr. Bridges: Yes, the entire operation.

Speaker from the audience: You were discussing marketing in the last few minutes and there seems to be a lot of different ways of handling the soft shell crabs before they're sent out. Some are clipped, cleaned and dressed and other aren't. I'd like to get some specifics on this?

Mr. Van Engel: When you prepare crabs for shipping alive, is that what you mean?

Speaker from the audience: Both ways.

Mr. Van Engel: Crabs that are shipped alive, after you take them out of the shedding tanks, what do you do with them? How do you put them in trays and so forth?

Mr. Spence: Well, are you familiar with the crab box? There are three trays in it. We pack the crabs in eel grass, put a sheet of parchment paper over the top, more grass and ice in it; three trays like that in a box.

Mr. Van Engel: Grass, crabs?

Mr. Spence: Grass, crabs, paper, grass and ice. That's one tray. You do that three times in the box.

Speaker from the audience: How many crabs in a box?

Mr. Spence: The boxes will handle nine dozen jumbos, twelve dozen primes or eighteen dozen mediums shipped alive.

Mr. Van Engel: And there's a cover placed on the box. It's a slatted box. The cover's placed on the box and it's shipped.

Mr. Spence: Anywhere you have an order.

Mr. Van Engel: Any distance.

Speaker from the audience: When they're shipped alive like that, how long a distance can they go? How long will they stay alive?

Mr. Spence: Well, you can pack them that way and put them in a cooler and keep them a week.

Mr. Van Engel: By the way, there's a technique.

Mr. Spence: You place the eyes on the back of the other crab so that the eyes are setting up, not straight up, but, you know, just at an angle.

Mr. Van Engel: The idea being that you don't want the crab to lose water out of the gill chamber and if you stack them with the eyes up and the crabs leaning against each other, the gill chambers openings are at the highest part of the crab so that there's no drainage down or out.

Mr. Spence: But don't take the crabs right out of the tank while they're soft and pack them that way, they won't carry. The heart is right under the carapace and the weight of the ice and the water and the grass would stop him from beating in a little while.

Speaker from the audience: How long do you have to wait to pack them?

Mr. Spence: Well, we take them out every six hours. That's a good time for shipping a crab. Now, if you're freezing, you take them out a little more often.

Mr. Van Engel: I think a good general rule is that they have to have at least two hours before they firm, at least two. Otherwise, they're too jelly-like and they collapse from their own weight; but I don't know any maximum.

Mr. Amason: For your own personal eating George, hadn't you rather take them out quicker than that?

Mr. Spence: Yes, but in a big operation, you just can't keep going over and over the crabs, the cost of labor would be so great that you wouldn't make anything. You also have to have time to pack them or clean them or whatever you have to do.

Mr. Van Engel: You want to know about the freezing part?

Speaker from the audience: What do you remove when you dress them out?

Mr. Spence: You cut the eyes off and you try to get the stomach out because it's full of water and when they go to cook the crab, the stomach will pop. Then you take the gills off, or the dead man as we call them, and the apron and that's all.

Mr. Van Engel: Than you lay them out in a nice order and wrap them in cellophane and freeze them.

Speaker from the audience: Each crab individually?

Mr. Van Engel: Individually.

Speaker from the audience: You can box those in those boxes you have, and that's approximately how many dozen?

Mr. Spence: Two dozen jumbos, three dozen primes and five dozen mediums are boxed frozen.

Speaker from the audience: I'd like to direct this to Mr. Bridges. Some of the fishermen are interested in how much money they're going to have to spend to set up an operation. Say one on your level, considering current prices and labor and such, how much money would a man have to spend to set up one?

Mr. Bridges: Well, I've got cement shedders plus I've got wooden boxes. I make four- by eight-foot wooden boxes with three-quarter inch plywood bottoms and I use twelve-inch shelving boards for the sides. They cost about thirty dollars apiece. I use a three quarter horse pump. Well, they call it a sprinkler

pump. You want a high volume water pump with very little pressure. I use plastic hose and valves and everything. Well, the pump usually runs about a hundred and sixty dollars. Then your valves and hoses to outfit six shedders, I'd say cost around a hundred dollars. I'd say about five hundred dollars would set you up for six tanks. That's with your drains and all. That's if you do it yourself and just counting the actual cost of materials.

Mr. Horst: Something that you should keep in mind if you're going to recommend that people get into this thing and it hasn't been mentioned today. I have seen more problems due to one little valve that's copper, something lead or something zinc in the line. In no place should they have any of these type of metals because they'll poison the crabs and shut you down. I think this is true. We find it's very true in our area.

Mr. Bridges: When I first started out I used copper tubing. I made air jets out of copper tubing and I didn't have any problems.

Mr. Horst: Well, one operation that I looked at had one valve that was copper and he was really having problems. He thought the valve didn't have any toxic metal in it. Those of you that fool with aquariums know, a little bit of copper in your water will really wipe you out.

Mr. Bridges: I use brass valves, brass guages.

Mr. Van Engel: I think what is important to realize is that there are lots of problems with natural mortality and what you need to do is set up as clean and nice a system as you can and avoid problems. Now, the actual mortality caused by copper paint of tanks or copper tubing or copper valves or brass, or zinc in the system are in detail not known; but if you can avoid using them, why not do so. It's not going to cost you very much to buy better things. It isn't quite as easy to work with and available in quantity. Use things that are going to give you assuredly the least trouble and don't try to invite problems by using something that somebody says might give you a problem. Just take his word and say, well, you think it might give me a problem and I'll avoid it.

Mr. Horst: The toxicity of these metals, by the way, has a lot to do with your water hardness, not salinity, but hardness. So, in some areas you may not have any problem, in other areas, it can be bad. I've seen it in twenty-four hours just destroy everything.

Mr. Bridges: When I started out it was just a trial. I was the first one that started this system in the area where I live and everybody said it wouldn't work, so I didn't want to put any money in it. So, I went to trash piles and picked up junk and fixed it up that way; but now, I've got a good system. I have found out through the past six years that I've been involved with

shedding crabs that you're better off to go all plastic. PVC plastic. I've used black pipe, ABS plastic they call it, and it seemed like the PVC is the best. It costs just a fraction more but it appeared in time that it would pay off. As far as my using galvanized nipples, one hard thing about it is in this plastic, you can't buy the plastic nipple, you know, like a white with red and pink skin; but with PVC, you can thread that, so that's what I've made mine out of. I used all half inch fittings that runs so if I use an inch and half over top in the main run, then I branch off a T to each one of my boxes of half inch; and I've made all these fittings up out of this PVC pipe and I take pipe dye and dye it so it's red just like galvanized or anything else.

Mr. Van Engel: What do you use for valves in your PVC pipe?

Mr. Bridges: Well, I still use the brass valves.

Mr. Van Engel: One of the shedders told me the other day and showed me some plastic valves that were working nicely. He'd been able to buy them from Sears, Roebuck. It's a plastic valve which is oval shaped and he says it's working beautifully. You might look into it. It's a Sears product that's apparently a very effective good plastic valve which is something brand new.

Mr. Paparella: Willard, Mike told me recently that it's best to avoid water with a high iron content. Because of the high aeration involved in this set up, you're going to precipitate iron oxide which gets into the gills and knocks them out. So, it's good to remember that.

Dr. Otwell: Where's the best place to get pumps? I don't want you to give a plug for anybody but are Sears pumps any better than anybody elses?

Mr. Spence: That's what I use, Sears.

Mr. Bridges: Well, Sears is just as good. I use a Gould.

Dr. Otwell: What's that?

Mr. Bridges: Gould pump but the Sears pump is made on the order of the Gould pump. Now, I've used the Wayne and the Teal pump. The only problems I've had with them is with the impellers: the Teal pump has got aluminum impellers and you can't get the thing apart if you want to put a seal in it or something.

Dr. Otwell: You've used so many pumps. How long does a pump last you?

Mr. Bridges: Well, the Gould has lasted me the best. I'm going on the third year on one of them.

Mr. Van Engel: Would you describe that particular characteristic of these pumps that you said that they needed?

Mr. Bridges: Well, once in a while what happens is you'll get some silt in the back of your impeller.

Mr. Van Engel: No, I meant as far as the pressure? Earlier you were talking about getting pumps with a certain low pressure?

Mr. Bridges: Well, what's happened, some of the fellers at home had thought they could get away with a domestic pump, the jet type pumps that you use to your house. It would be alright for maybe two shedders but they tried to put five or six on there and they had a high pressure but they didn't have the necessary volume of water. I always emphasize to make sure it's a high volume water pump. They only put out about thirty pounds of pressure but they'll put out a high volume of water.

Speaker from the audience: Do you know what the gallons per minute is?

Mr. Bridges: Seems like to me, mine's about thirty-five gallons a minute.

Mr. Van Engel: Did you say you measured the volume?

Mr. Bridges: Yes, I measured the volume in my tanks. I've got four by four foot tanks with four inches of water which gives me about forty gallons of water. I have a turn over of between four to five times an hour.

Mr. Van Engel: Are we ready to go back to the question that was raised earlier that I tried to defer. What would you do now in South Carolina? Do you want to restate your question?

Mr. Llewellyn: Right, if you were planning to open an operation here in South Carolina, whether this very minute or starting in the spring, how would you go about it, like especially you Mr. Bridges, you catch your own crabs.

Mr. Bridges: Yes.

Mr. Llewellyn: What type of apparatus would you use in South Carolina, taking into consideration an average of six foot tides, to capture enough crabs to run your operation?

Mr. Bridges: What type gear would I use to catch the peelers?

Mr. Llewellyn: Correct.

Mr. Bridges: Well, like I say, I would more or less go by what I do in North Carolina. I'd have to feel it out. If you could pull a trawl net inside these rivers, I would start out with a trawl net.

Mr. Llewellyn: On your net, do you use heavy cables?

Mr. Bridges: No, I don't use any cables.

Mr. Llewellyn: So, it's basically like a shrimp net?

Mr. Bridges: It is identical. It's made just like a shrimp net. The only thing is it's a three inch mesh body and a two and a quarter inch tailbag.

Mr. Llewellyn: Ok, let me ask Mr. Spence since he buys. How would you recommend educating the crabbers to the fact that they can make money on peeler crabs and have them setting for you?

Mr. Spence: Well, now that's a problem. It's very hard to take a crabber that's hard crabbed all his life and tell him he can make money catching peelers. They can but there's times when the hard crabs, the hard crab catch goes down and the peeler catch comes up and unless they realize that and know when to set their pots, the peelers could be all around them and they'd just say, oh, I can't catch them. First, I would determine where the small crabs are and any crabber can tell you that. Then I would determine whether they were ripe to catch now or whether you had to wait a week or what; but as soon as they got ready, I'd have peeler pots ready for them. I'd have the male crabs to put in them and then when the females are right, you'll catch them.

Mr. Llewellyn: How do you manage to stay in operation after the early runs? In the springtime, I can catch peelers and catch enough right from the commercial pot. After that first and second run is over, however, I have to shut down the whole shed. You managed to stay open, you're doing something I'm not.

Mr. Spence: Well, we buy. We buy crabs and then after the May run, we have scrapers start and they scrape crabs. Now, they can only scrape on the Chesapeake Bay. They're not allowed to scrape where I am, so I can't buy them there. I have to buy from Chesapeake Bay.

Mr. Van Engel: There are other ways of catching crabs than what George does or what Murray does or what they do in South Carolina. In the Chesapeake Bay one of the oldest systems was trotlining, but they don't do that anymore. It was a high quality crab which was caught. A female was caught as a doubler crab but they don't do much trotlining any more. Another system was, of course, dip net or a very good system was scraping with a toothless bar dredge, lightweight with a long net trailing behind it pulled starboard and port side of a Chesapeake Bay canoe type thing with an inboard or outboard motor. They could not be lifted into the boat by winch, they had to be pulled by hand. They were pulled through eel grass beds and they produced very high quality and very large catches. So, scraping is a good source of peeler crabs. There's another type of gear which is the crab pound net, trap type, which is an all summer long operation in Virginia. There is another method of catching peelers called mudlarking. This involves walking through the marsh and picking up peelers that way.

Mudlarking is a good source in small quantities. So, George buys peeler crabs from scrapers, from mudlarking people, hard crab potters and from crab pound net operators on the bay side of Virginia.

Mr. Llewellyn: Ok, the peeler pounds we cannot use down here. As Jim Bishop said, he has taken them up and abandoned them because of the tidal currents and the trash in the water. I had scrapes built and went out with one of the men from the Wildlife Department to try them out. We don't have any eel grass and were looking for another type of seaweed, the one that is causing all the problems up here, but it wasn't settled on the bottom and if you can't catch any grass or seaweed in this scrape you're not going to catch the crabs either. So, that leaves scrapes out.

Mr. Van Engel: Not necessarily. There are other places you can scrape. Don't go out in hard sand. If you don't have any grass, go on a softer bottom. You don't have to have grass.

Mr. Llewellyn: I only caught one crab in about three hours.

Mr. Van Engel: Mr. Spence can't use the scrape on the eastern shore because it's outlawed there, protecting the oyster sources; but within the bay, you can scrape and they scrape on muddy bottoms.

Mr. Llewellyn: Maybe there needs to be a little bit more research done with the scraper.

Mr. Bridges: You're in the same situation I am. See, when I first start in the spring of the year, I don't use peeler pots because the crabs I catch are too green, they won't mate. In other words, the peelers won't go to the jimmies. I'll start out with a trawl net and I catch white line peelers quite good. I wouldn't say all of them are white line peelers, but the majority are. After the crabs start mating, that's when I put my peeler pots out and I'll quit dragging. Then in June, when I get the June run, about 50 percent of the crabs in my pots are mated and the reason why is because there's so many jimmies in the area that the jimmies I got in my pots are not calling. There's so many others calling the females; and then that's when I go back to using the net and that's the same problem that you're having.

Mr. Llewellyn: Ok, when the crabs are coupling or working in the peeler pots, are you getting enough in the peeler pots that you don't have to use a net?

Mr. Bridges: Yes, I just put the net up. I can catch as many in twenty-five peeler pots as I can in a net, making three or four tows.

Mr. Llewellyn: How long can you use the peeler pots?

Mr. Bridges: Well, you can use them, like I say, in June. Although the

catches decrease quite a bit, they still justify using the peeler pot. After June, in July and August, they won't pot (peeler pot), because there's too many jimmies in the area. So that's when I use the net, in July and August.

Mr. Spence: What's the population of jimmies at the time you're catching your peelers with jimmies. Have they been caught down?

Mr. Bridges: Yes, well, there just aren't any there. You can't even catch jimmies in the crab pot.

Mr. Spence: That's the point I'm making, down here you've got to get the jimmies off the bottom.

Mr. Llewellyn: We have so many crabbers that that's no problem in the spring. There's no crabs left, just crabbers.

Mr. Spence: Generally you have time in the spring to catch them, so you should catch more double crabs down here, the she crabs.

Mr. Llewellyn: The spring I'm not worried about. In the spring I can get plenty of peelers and fill my sheds in a couple of days. But you can't run a business and only operate it one month out of the year and what do you do the other eleven months? That's the whole problem.

Mr. Bridges: We only run from, say, April to September.

Speaker from the audience: I'd like to ask something on marketing. You say you freeze them this time of the year, you freeze them until October and then you don't start catching again until May. What is the shelf life of a frozen soft shell crab?

Mr. Spence: Well, I've never had to keep them over a year.

Speaker from the audience: Will they keep that long?

Mr. Spence: They will keep that long. Some of the bigger people in Crisfield have a few left over longer than that, but they keep them at the right temperature.

Dr. Bishop: I have a question I'd like to ask Murray. How long do you drag when you're using your trawl net?

Mr. Bridges: I usually make an hour's tow.

Speaker from the audience: You don't drown the crabs?

Mr. Bridges: No sir. When we get this higher mortality rate in June, I would make my tows fifteen and twenty minutes and it didn't make any difference.

Mr. Horst: You know that crabs are caught as a bycatch in the shrimp fishery. We make three hour tows and we still get a rather good shedding success.

Speaker from the audience: I'd like to address this to Mr. Bridges. How do you handle your crabs from the place they are caught to your shedders?

Mr. Bridges: I put them in bushel baskets. I fill my basket about three quarters full and I put a wet tote bag over the top. I found out you need to make sure that the backs of your crabs don't dry. When they start to molt and shed, they'll bust open and if the shell is dry or has been dried and formed a film, they won't come out. And I always turn the back up and belly down. I just don't throw them in the baskets.

Dr. Bishop: I have a question I'd like to ask you, Van. Is there any other crab in the world that is marketed as a soft shell?

Mr. Van Engel: George Spence has shed Cancer irroratus, the rock crab. It sheds in the winter. It's about the only crab we know of that can be shed and purchased as a fresh soft crab in winter time. George, tell them about it.

Mr. Spence: Well, it only sheds in the month of January and it starts shedding when the water temperature reaches fifty-five degrees. When the water temperature gets down to thirty-six degrees, it'll stop shedding. The blue crab will stop shedding when it gets down to sixty degrees. Generally, you start catching rock crabs right after Christmas Day, and shed them the month of January and by February the lst, you can't find one, a peeler, I mean a peeler rock crab. There are plenty of rock crabs.

Mr. Van Engel: Color sign?

Mr. Spence: They don't have any back fin at all, so you can't tell by that; but on the under side of the crab, his stomach will get pink.

Mr. Van Engel: What sex of crabs do you shed?

Mr. Spence: Well, ninety-seven percent of those that come in our waters are males. You see three females in about a hundred and they're very little so you throw them back.

Mr. Van Engel: The size of the crabs that you shed?

Mr. Spence: Anything over three and a half inch would be a mature male, so you don't save it. You save all the others from two inches on up to three and a half inches.

Mr. Van Engel: These crabs come into the Chesapeake Bay from deep waters on the shelf somewhere around November. You can catch them but

there's no point in bringing them into the shedding tanks. Leave them alone until mid-December. From about mid-December on, you can bring them in. George says he has success in January. Mid-December you can bring them in and they'll shed until the end of January. You don't take any very large crabs and don't take any females. The females are too small. The males apparently are refractive to shedding or they're not going to molt after they are three and a half or four inches. So, you discard all of the big ones. They get a lot of them. They get some of them in crab pots on the eastern shore in winter, but the biggest supply seems to be coming from the winter dredge fishery for hard blue crabs except they don't always save them and they don't always catch them.

Speaker from the audience: What about the market for them?

Mr. Spence: Well, so far, we've been able to sell all we can get, but there is a limited market. I would say overseas would be a good market, but not locally because there's too many blue crabs.

Mr. Van Engel: They're heavier weight for the same size. They're longer from head to tail than a blue crab, have a little stronger flavor and are a darker color.

Mr. Amason: Murray, what percent of the crabs that you shed would you say are females?

Mr. Bridges: Female, I would say ninety percent.

Mr. Amason: How about you George?

Mr. Spence: Sixty percent.

Mr. Amason: I'd like a little bit of discussion on the colors and signs you look for. Now, the apron on the female is as easy to pick as it is to see from me to you, but I can't see color on the back fin. Even when I get close, I can't tell.

Mr. Van Engel: I have some slides that might be able to show you some of these things about the color signs on the back fin. I don't know how long it would take to go through them.

Speaker from the audience: For Jerald, on the shrimpers, how do they handle the soft shell crabs they shed during their shrimping operations? Are they cleaning and freezing them or keeping them alive?

Mr. Horst: These are mainly week trippers, five to seven days. They'll generally put a dozen or so soft shell crabs in a large zip lock bag and then they'll put them in the ice hole. They'll pat them down nice and flat and put a good layer of ice on top of them, except for those caught during the last few days.

They'll put these in a beer flat and put wet newspaper on top of them. These crabs, caught during the last few days, will then be sold live.

Mr. Van Engel: Those in the zip lock bags are dead?

Mr. Horst: Yes, the ones in the zip lock bags are dead. The other ones are placed sitting up at an angle, with eyes up.

Mr. Van Engel: I certainly would discourage the use of newspaper as a cover. Wet newspaper is miserable to get off of crabs.

Speaker from the audience: Do you get the same price for dead crabs as live, or is it easier to sell the live ones? What's the reason for keeping them alive?

Mr. Van Engel: Oh, I think it's a precaution not to buy crustaceans dead because they do deteriorate very rapidly. There is a rapid digestion of the insides of the crabs from its own enzymes and it goes on very rapidly if you don't refrigerate them or if you keep them too long. So, generally, crustaceans are refrigerated and consumed in a relatively short time.

Speaker from the audience: But as far as the price goes, there's no higher price for live ones as opposed to dead ones?

Mr. Van Engel: I would think that since more of the frozen ones are sold in winter, that there's a higher price for them in winter, frozen. Vic?

Dr. Burrell: I've had my hand up a pretty good while and so the question I'm going to address is way out of context. Speaking to Mr. Llewellyn regarding the methods that we have been looking at to capture peeler crabs in South Carolina, we are probably going to, next year, try all these methods which you have suggested or which people have suggested. But the point I want to make is the fact that Mr. Spence and Mr. Van Engel have, over the past two years, given unstintingly of their time at no recompense to the crab industry of South Carolina. They have done much for this group and we would like to express our gratitude here at the Marine Resources Division for the help and assistance which they have given us towards establishing a soft shell crab industry in South Carolina.

Mr. Van Engel: Thank you Vic. Now, I would like to show some slides which depict the color signs which Mr. Amason asked about earlier. The color in the back fin is due to the color of the hairs, or setae as we call them, which ring the last two segments of the leg. So that what you're seeing is the development of these setae or hairs on the last two segments of the back fin, the paddle. In the mature crab, these setae are reddish in color. In the development of these setae, they first grow

inside out; imagine that you were taking off a pair of rubber gloves and you had pulled the fingers back inside. Now, I have a slide that will show that pulling the back fin away a little, some setae have popped out from their inverted position. What you're looking at is the gradual development from a white color, with early developing setae, to a pinker one to a redder one. Now, one of the things that I wonder about in the crabs in the St. Johns River that Steve Otwell says do not seem to show signs is what color are the back fin setae. Since it doesn't show it's peculiar why it doesn't show. Since the color is not just blood, but the color of the setae, you would expect it to show through.

Now, the crab itself needs a couple of trap doors in which to help expand beyond the capacity of the shell. So you find one of them in the section of the leg called the merus, which is an oblong shaped segment that you might look for and secondly or more importantly, there is the line which we call the suture line or the epimeral line which runs from the face of the crab down around to the back side.

Alright, I think the first slide is one in which you see a very broad outside red band, which are the setae, then there's the edge of the shell and inside that is the red sign. There is a big broad band in this red sign. In the next slide the red band is less intense. That's still a red sign. Now, here we have a crab which is hair sign; what you see is a thin pigmented area running close along the border; this is the edge of the new skin underneath the old shell. Just inside of the old shell there is a light space. The name hair sign is given to this sign because the only thing that there is to see is this very light border.

Speaker from the audience: Van, how much time lapse between a hair sign and a good white sign?

Mr. Van Engel: I can't answer that. I would think it would be a couple of days. I really don't know.

Alright, here we're beginning to get a development of a white sign. We see a very clear space at the edge of the crab inside the border, a more opaque band which is the beginning of the development of those setae. But, again, I think you should see a very clear space just inside the edge of the shell in any peeler.

I think these are green crabs. We show no border at all, no white line border at all. There's no separation, no clear space. In the next slide we see a portion of the back fin that has the red sign border and the setae are inverted or inside out. In another portion of the back fin the new setae were pulled out by tugging on the back fin. In the next slide, you see an area of soft tissue near the wrist of the

crab, next to the merus. In this area, there are streaks running across the soft tissue. The more wrinkled this gets, the closer the crab is to becoming a red sign crab. This is not an area which is frequently examined by crabbers but you might start looking at this area, this soft joint. It's comparable to the inside of your elbow on the crab.

Speaker from the audience: Is that next to the body itself or is it in a joint comparable to the elbow joint?

Mr. Van Engel: This is a joint between the merus and the carpus. It is not next to the body.

Ok, here we have the trap door in the merus. You might press on its boarders to see if it is softened through the re-absorption of calcium by the crab.

Limb buds are very good clues to the fact that you have a peeler. Often times this is overlooked as a good indicator. If you have a limb bud replacing a lost leg, this is a good sign that this is a peeler crab and it will shed soon. A crab that's in a hard crab stage will not have a developing limb bud.

In the next slide you see the ventral side of a female crab in a very early stage, either green stage or hair sign or white. I want you to pay particular attention to the changes in color that occur. First a darkening, a blueing, this is the color of the new abdomen underneath the old shell. This shell has a little rusty color on the outer shell. In subsequent slides you will see the border becoming pinker. These are closer and closer to shedding. If you see any darkening or red you know you have a peeler. This only occurs on a female crab that is going to be shedding for the last time before becoming an adult.

Now, I might point out that some of you are not aware that this abdomen of the female is sealed to the bottom of the crab. The abdomen is sealed to the sternum. The only place that is open is the telson, that little flap where the fecal material is eliminated. When the crab molts for the last time, to become an adult, the seal is broken between the abdomen (apron) and the sternum. The seal simply maintains the abdomen close to the body in the juvenile crab. Comparably, on the abdomen of the male you'll see that there is no color change, no change that I would say is indicative of an advancement of a white sign to a red sign. If you want to look for a male peeler, either look for a limb bud on a leg that's been removed, look for this breakage of the epimeral line or look for color sign in the back fin which is what ninety-nine percent of the Chesapeake Bay watermen use, the back fin color.

Also, on the juvenile crab the male abdomen is sealed to the sternum. It is not free from the sternum of the crab until the crab becomes sexually mature. If the abdomen is sealed to the sternum, you have an immature male crab. This generally is occurring in crabs that are under three inches in width in the Chesapeake Bay.

Speaker from the audience: Van, isn't the next to the last segment of the hind leg the best one for color sign?

Mr. Van Engel: Yes.

Speaker from the audience: Don't most of the crabbers in the Chesapeake use that segment?

Mr. Van Engel: Yes, this is the last one, the broadest, the final segment of the leg, but the next to the last one is the one they typically use.

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