NOAA Technical Memorandum NMFS-SEFC-21

ASSESSMENT OF THE FLORIDA STONE CRAB FISHERY

JAMES R. ZUBOY and J. ERNEST SNELL

JUNE 1980

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Center
75 Virginia Beach Drive
Miami, Florida

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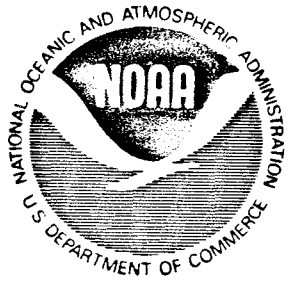

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U.S. DEPARTMENT OF COMMERCE
Philip M. Klutznick, Secretary
National Oceanic and Atmospheric Administration
Richard A. Frank, Administrator
National Marine Fisheries Service
Terry L. Leitzell, Assistant Administrator for Fisheries

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ABSTRACT

Under the auspices of the Fishery Conservation and Management Act of 1976, the National Marine Fisheries Service is responsible for providing scientific support for fisheries management to the Regional Fishery Management Councils. Accordingly, this is the first annual report on the status of the Florida stone crab fishery which is being managed under the Fishery Management Plan for Stone Crabs by the Gulf of Mexico Fishery Management Council. The report discusses the newly implemented fishery statistics collection program, reviews research needs and current developments, and provides a revised estimate of MSY based on new data. The effects of management regulations are also discussed briefly.

CONTENTS

I. Introduction

The fishery management plan for stone crabs (Menippe mercenaria), developed under the auspices of the Gulf of Mexico Fishery Management Council, was approved by the Secretary of Commerce in March 1979 and final regulations were implemented in September 1979. Thus, the plan has been in effect for almost one year and it is time for a review and update. The purpose of this report is to provide a current stock assessment and other information which may be useful for updating the plan. Included in the report are 1) a discussion of the fishery reporting system implemented by the plan, 2) an estimate of MSY based on the addition of two seasons of catch and effort statistics to the historical data, 3) a review of research needs and a summary of stone crab research being conducted, and 4) a brief discussion of the effects management regulations imposed by the plan have had on the fishery.

II. Fishery Statistics

The SEFC Division of Statistics began in May 1979 preparing for the required collection of data under the Stone Crab Fishery Management Plan. A trip was made to Everglades City and Chokoloskee to field test a draft dealer reporting form and fisherman logbook form. Based on the field test, the forms were revised and printed.

A letter was mailed to each stone crab permit holder on October 1, 1979. This letter, which was to be returned to NMFS, was to advise permit holders that the FMP would go into effect on October 15, 1979 and that certain reporting practices would be required. The letter also served to identify the commercial stone crab fishermen among the permit holders. Each permit holder who responded to this original letter by indicating he did intend to sell claws during the upcoming season was supplied a logbook by mail.

A second mailing was conducted on February 5, 1980 to the stone crab permit holders not responding to the original mailing. The respondents replying to the second mailing who stated that they did intend to sell claws were supplied logbooks by mail (Table 1).

Stone crab dealers were contacted in person by NMFS port agents during the week of October 8, 1979. The port agents explained the reporting procedures required under the FMP. A dealer reporting book was given to each dealer at this time and a supply of fishermen logbooks was also given to each dealer. Thus, fishermen were given two opportunities to obtain logbooks: by mail, or through the dealer to whom they sell.

Following are a series of tables which summarize data obtained from the logbooks and dealer reports, as well as some information obtained by NMFS port agents.

Table 2 summarizes stone crab operating units for 1977-78, 1978-79 and 1979-80. The reported number of traps decreased sharply from 1977-78 to 1978-79, while the total number of craft remained about the same. The reason for this is not clear but may be partly explained by the method of obtaining the data, i.e., port agents ask the dealers how many vessels and traps they have fishing for them. The large increase in reported traps from 1978-79 to 1979-80 can be accounted for at least partially by an increase of nearly 50 craft in the fishery.

Table 1. Record of response to notification of stone crab logbook reporting requirements.

	First Mailing-October 1, 1979 (to 2154 Permit Holders)		Second Mailing-February 5, 1980 (to 1117 Non-Respondents)		Grand Totals	
	Number	Percent	Number	Percent	Number	Percent
No Response	1,117	52	456	41	456	21
Undeliverable	63	3	18	2	81	4
Do intend to sell	308	14	124	11	432	20
Do not intend to sell	666	31	519	46	1,185	55
Total Permits	2,154	100	1,117	100	2,154	100

Table 2. Stone crab operating units for the Florida west coast.

	1977-78	1978-79	1979-80
Vessels	61	55	72
Boats	199	190	219
Crew	394	375	454
Traps	264,300	222,000	297,600

Note: The estimates given here are obtained by port agents from stone crab dealers and reflect the number of actual commercial fishermen as opposed to simply permit holders. Crew includes captain and helper.

Table 3 shows the total landings of stone crab claws by month as reported by dealers to NMFS port agents. To obtain an estimate of total value of the reported commercial harvest the monthly totals were proportioned into large and medium claw size categories, based on ratios of same from the mandatory dealer reports and multiplied by the average price. The total expressed value of the reported commercial catch thus derived is $5,135,422.

The landings by month as reported on the mandatory dealer reports are not included here because they were incomplete and did not represent a random sample of the dealers. The total reported for the season on the mandatory dealer report, however, was 1,619,704 pounds, which is 84% of the total reported directly to NMFS port agents.

Tables 4, 5, and 6 show relative catch, relative effort and catch per trap haul, by zone, as derived from fisherman logbooks. Catch and effort are shown only as percentages since the logbooks did not represent a random sample of fishermen and the data should not be expanded, which would be the tendency if the actual numbers were provided.

The vast majority of effort and hence catch is in Zones 1 and 2. Zone 3, which is seaward of the "stone crab line", accounts for only 7% of the logbook reported catch; however, catch per trap haul is on the same order as the other zones. This indicates that the fishery may possibly expand in Zone 3 at some point if such problems as gear conflicts (with shrimpers), water depth and cost effectiveness can be resolved.

The total catch reported on fisherman logbooks was 985,094 pounds, which is about 51% of the total reported by dealers to port agents. This is a remarkably high percentage considering that there was no follow-up or enforcement of the reporting system during the season due to limited resources.

Table 3. Landings and value of stone crab claws for October 1979 - May 1980.

Month	TOTAL[a] Landings (lbs)	Large Landings (lbs)	Large Average Price($)	Large Total Value($)	Medium[b] Landings (lbs)	Medium Average Price($)	Medium Total Value($)
October	207,279	159,605	2.84	453,278	47,674	1.99	94,872
November	315,919	236,939	2.87	680,016	78,980	2.07	163,489
December	232,973	167,741	2.85	478,061	65,232	2.04	133,073
January	257,882	185,675	2.86	531,031	72,207	1.93	139,360
February	199,891	127,930	2.93	374,836	71,961	1.74	125,212
March	329,622	197,773	3.00	593,320	131,849	2.16	284,794
April	242,710	143,199	3.29	471,124	99,511	2.09	207,978
May	144,558	91,072	3.19	290,518	53,486	2.14	114,460
TOTALS	1,930,834	1,309,934		$3,872,184	620,900		$1,263,238

GRAND TOTAL $5,135,422

a/ Total landings represent the amount reported to port agents by dealers. This was proportioned into large and medium using the ratio of same obtained on the mandatory dealer report forms. The average price is also from the mandatory dealer reports.

b/ The mandatory dealer report category "small" was integrated into the medium category here, since "small" and "medium" claws are marketed together.

Table 4. Percent of stone crab traps pulled in each zone (derived from logbooks), October 1979 - May 1980.

Month	Zone 1	Zone 2	Zone 3
October	66%	29%	5%
November	63	30	7
December	54	39	7
January	54	40	6
February	46	48	6
March	50	44	6
April	48	45	7
May	37	56	7

Note: See Appendix C for location of zones.

Table 5. Percent of stone crab catch taken in each zone (derived from logbooks), October 1979 - May 1980.

Month	Zone 1	Zone 2	Zone 3
October	64%	32%	4%
November	55	37	8
December	48	43	9
January	51	43	6
February	40	55	5
March	40	52	8
April	36	58	6
May	26	66	8

Note: See Appendix C for location of zones.

Table 6. Catch per trap haul by zone, October 1979 - May 1980

Month	Zone 1	Zone 2	Zone 3	Average All Zones
October	.70	.78	.60	.72
November	.55	.77	.74	.63
December	.49	.62	.66	.55
January	.49	.56	.68	.53
February	.45	.60	.48	.52
March	.58	.84	.81	.71
April	.46	.78	.55	.61
May	.50	.83	.70	.70
Grand Averages	.53	.72	.65	.62

Note: See Appendix C for location of zones.

Figure 1 shows the average catch per trap haul data from Table 6 in graphic form. The catch per trap haul is high at the beginning of the season, steadily decreases over the winter months, increases to a high level in March, and stays relatively high until the season closes. This suggests that catch may at times be influenced by availability or vunerability to trapping as well as by abundance.

III. Stock Assessment

Assessment of the west coast of Florida stone crab fishery treats the stone crab resource which is exploited in NMFS statistical zones 1-7 (Figure 2) as a unit stock. (These zones should not be confused with the three inshore-offshore stone crab line zones.) The small amount of crabs caught on the east coast of Florida is not included in the analysis. The recreational harvest is unknown but thought to be relatively low and is not included either.

The generalized stock production model was used to analyze the fishery. The method requires a time series of catch and effort data (Table 7). A regression line is statistically fit to the relationship of catch per unit of effort and effort to estimate the parameters necessary to fit the curve to the relationship of yield and effort.

Figure 3 shows the effort trend in the stone crab fishery. For the first ten years effort increased rather slowly, then, from 1972 to 1977, it increased steadily and dramatically. The first sign that effort might be leveling off came in 1978 with a substantial decrease in the number of traps. However, in 1979, there was a great increase in the number of traps to an all time high of nearly 300,000. (It would be desirable to use number of trap hauls rather than simply number of traps to represent effort, however, only number of traps is known.)

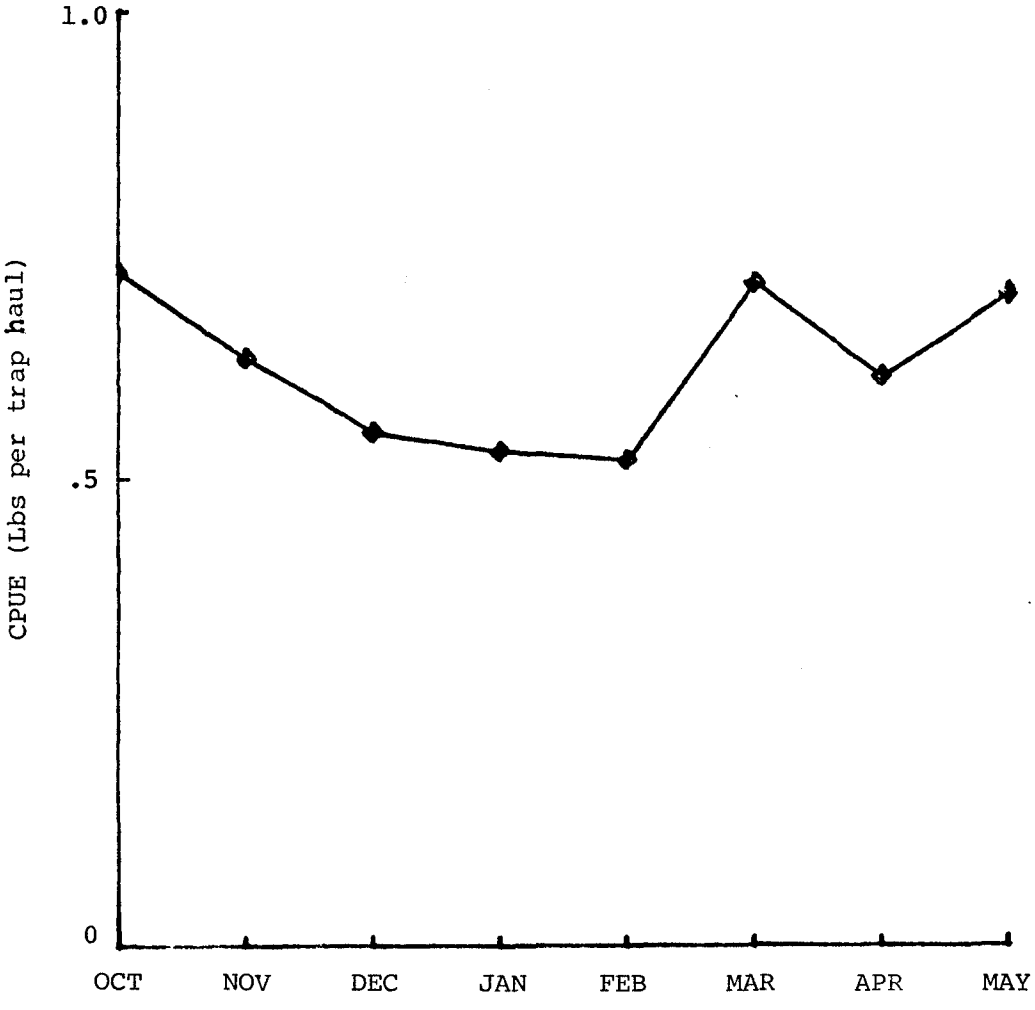

Figure 1. Intraseasonal CPUE in the west coast of Florida stone crab fishery.

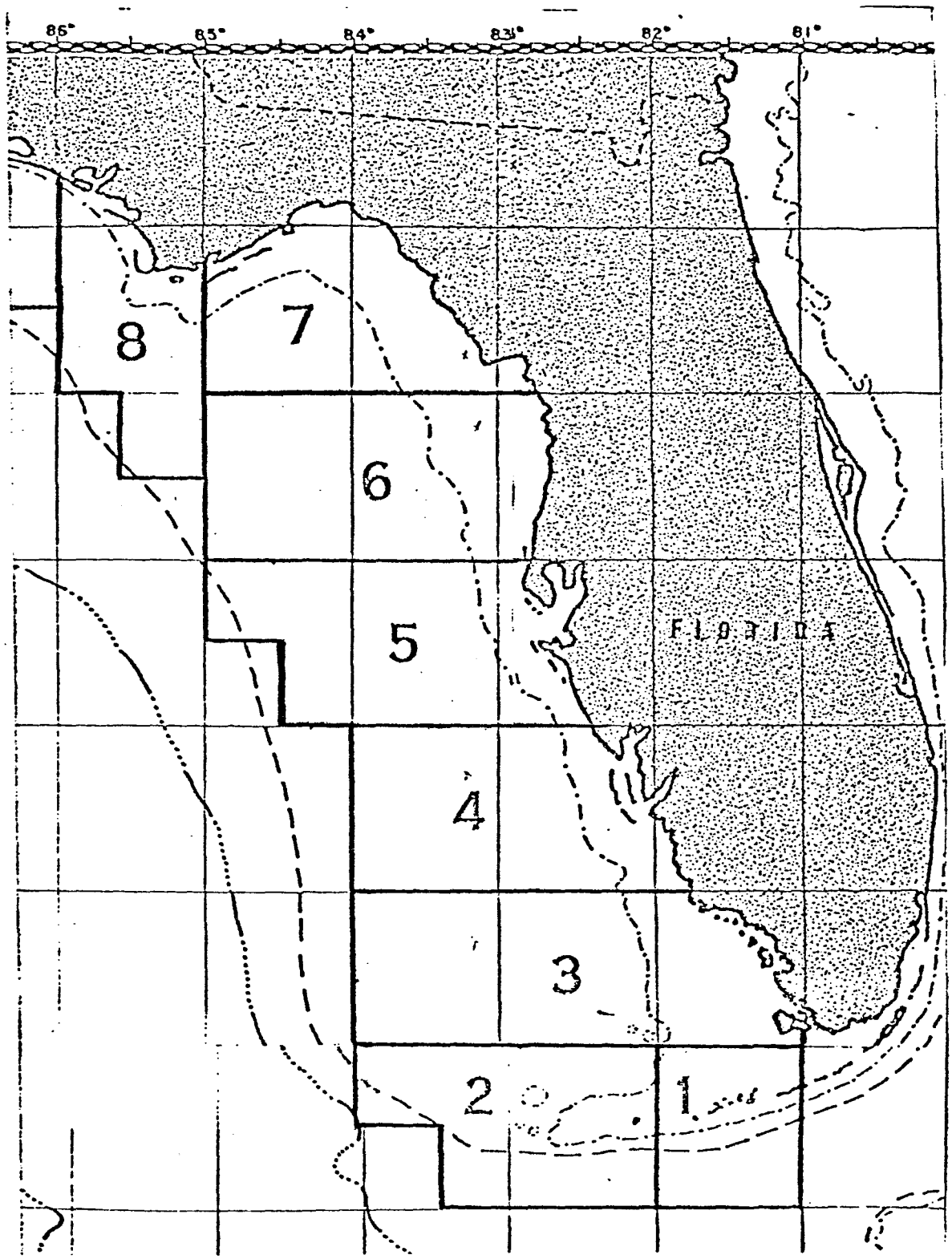

Figure 2. Stock area of the west coast of Florida stone crab fishery. The assessment covers zones 1 - 7.

Table 7. Catch and effort statistics for the west coast of Florida stone crab fishery.

Season	Catch* millions of pounds	Traps thousands	Catch Per Trap (lbs)
1962-63	.30	14.6	20.6
1963-64	.35	15.0	23.3
1964-65	.35	21.0	16.7
1965-66	.45	19.7	22.8
1966-67	.40	43.2	9.3
1967-68	.55	39.3	14.0
1968-69	.60	55.9	10.7
1969-70	.70	36.0	19.4
1970-71	.85	60.8	14.0
1971-72	.95	73.7	12.9
1972-73	.90	113.3	7.9
1973-74	1.25	143.0	8.7
1974-75	1.00	159.1	6.3
1975-76	1.15	193.2	6.0
1976-77	1.45	213.8	6.8
1977-78	2.10	264.3	8.0
1978-79	1.85	222.0	8.3
1979-80	1.93	297.6	6.5

*Catch is claw weight. Claw weight is 1/2 whole weight.

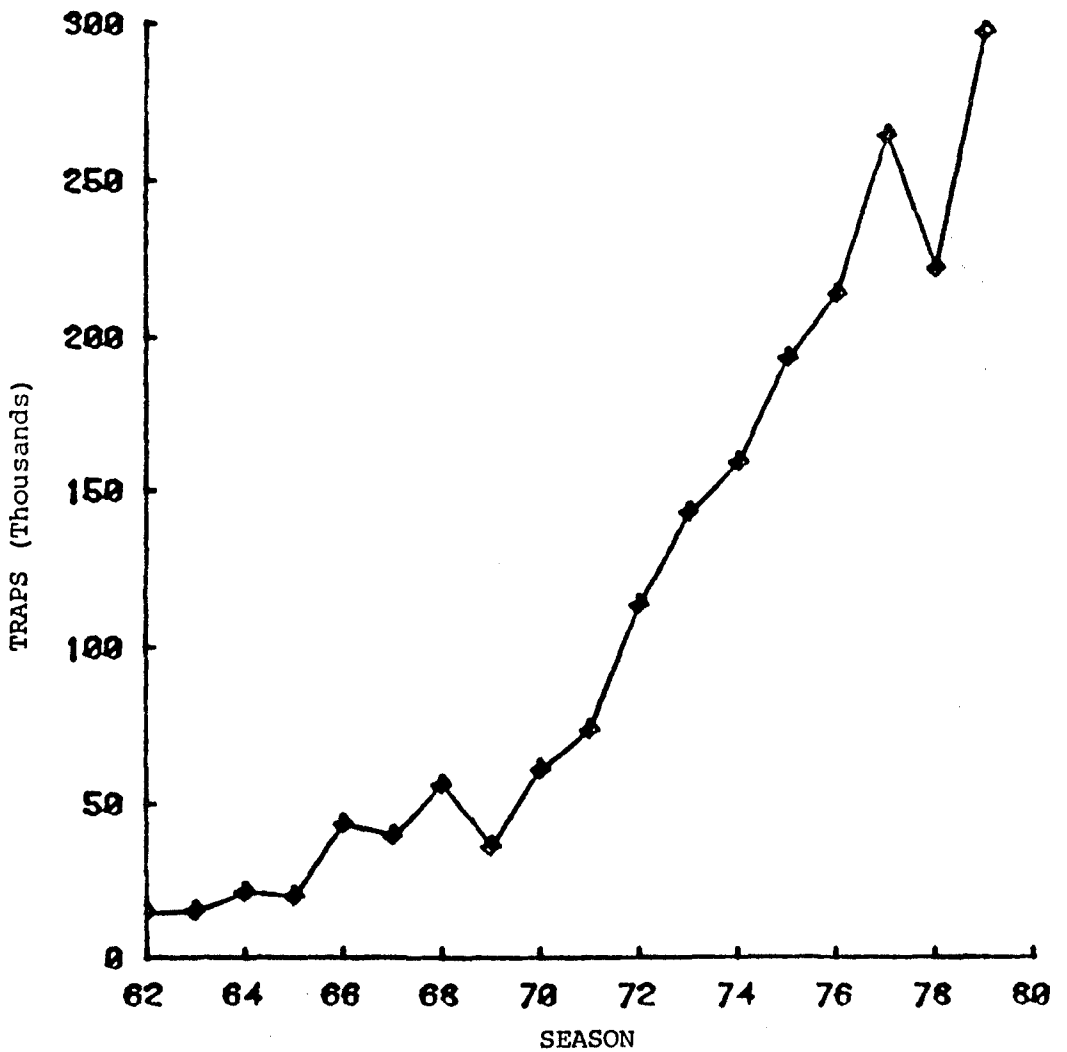

Figure 3. Effort in the west coast of Florida stone crab fishery.

The catch trend (Figure 4) generally followed the effort trend, however, at a somewhat slower rate. The catch gave no indication of leveling off until 1978, and even then one might attribute this to decreased effort in that year. However, in 1979, when there was a record high number of traps in the fishery, the catch did not show a corresponding increase. It is not known if environmental factors played a role, however, during the 1979-80 season environmental conditions were not notably severe. Thus, it appears that the stone crab stock may now be fully exploited over the current fishing area, and a further increase in effort is not likely to result in a corresponding increase in yield.

Figure 5 shows the catch per unit of effort (CPUE) trend in the stone crab fishery. CPUE has decreased from a high of nearly 24 lbs/trap in the early years to a low of around 6 lbs/trap currently. Thus, CPUE has decreased by a factor of four and may be approaching the point where economics will discourage the entry of additional effort in the fishery.

The production model analysis is portrayed in Figure 6. Two data points (1978, 1979) have been added since the preliminary analysis done for the stone crab FMP. The picture has become a little clearer, but no more definitive. The 1978 and 1979 seasons both produced less than the 1977 season at efforts both below and above the 1977 effort. Thus, it appears the yield may have peaked out in the area of two million pounds of claws. There is a troublesome discontinuity in the data, however, which suggests that the production model should not be fit to the entire array of data at this time. Note that the data share a common focus through 1971, shift to the right and generally upward for 1972-76, and then jump rather steeply and to the right for 1977-79. It is likely that

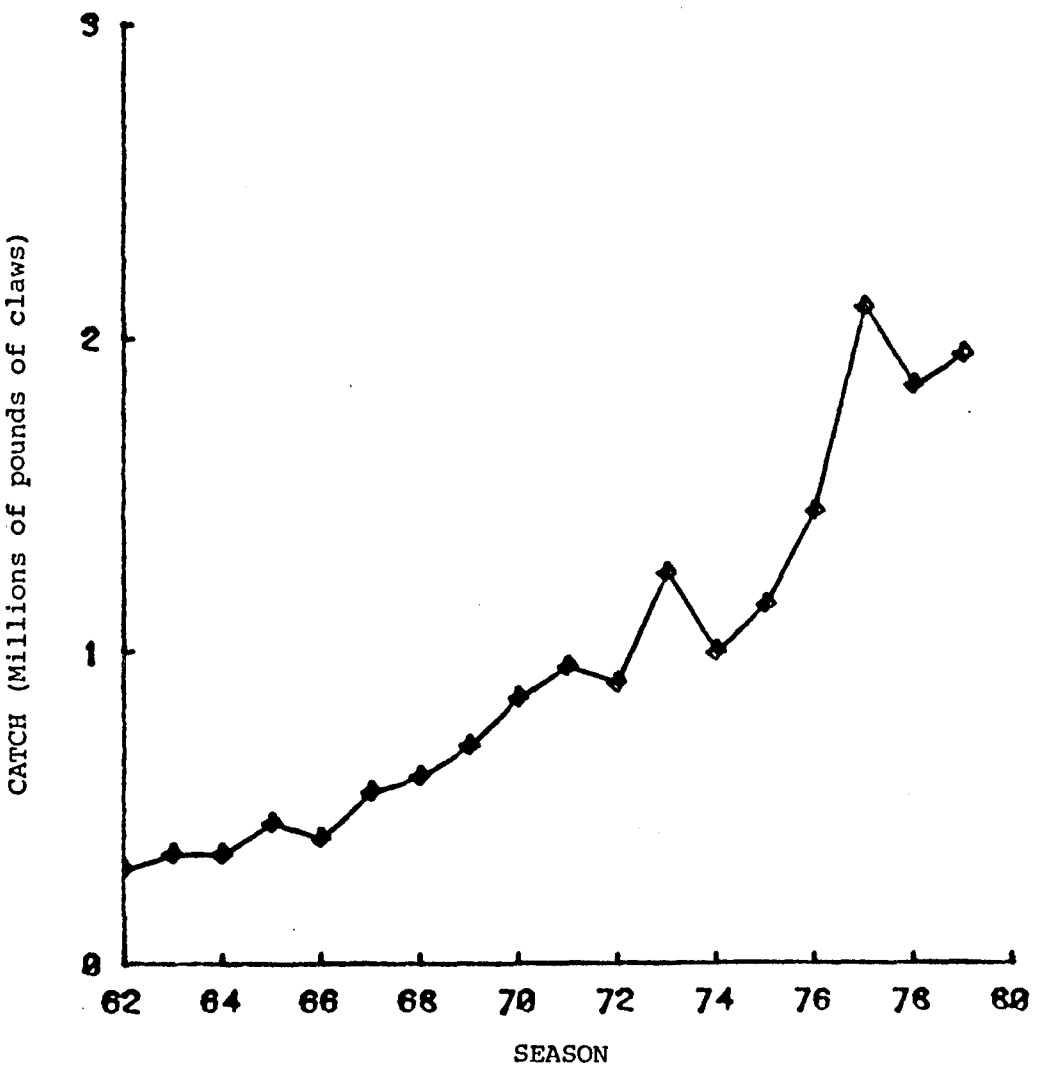

Figure 4. Catch in the west coast of Florida stone crab fishery.

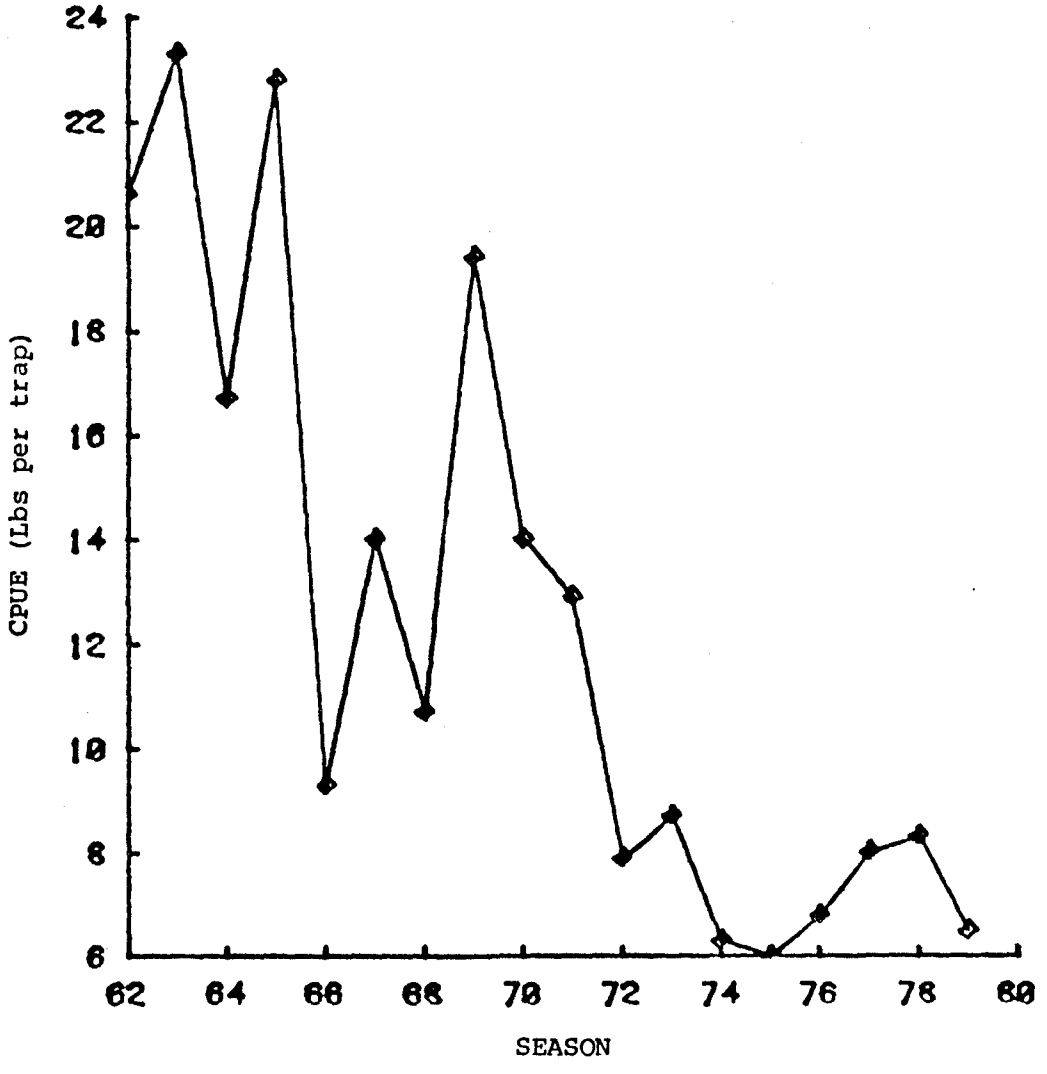

Figure 5. Catch per trap (CPUE) in the west coast of Florida stone crab fishery.

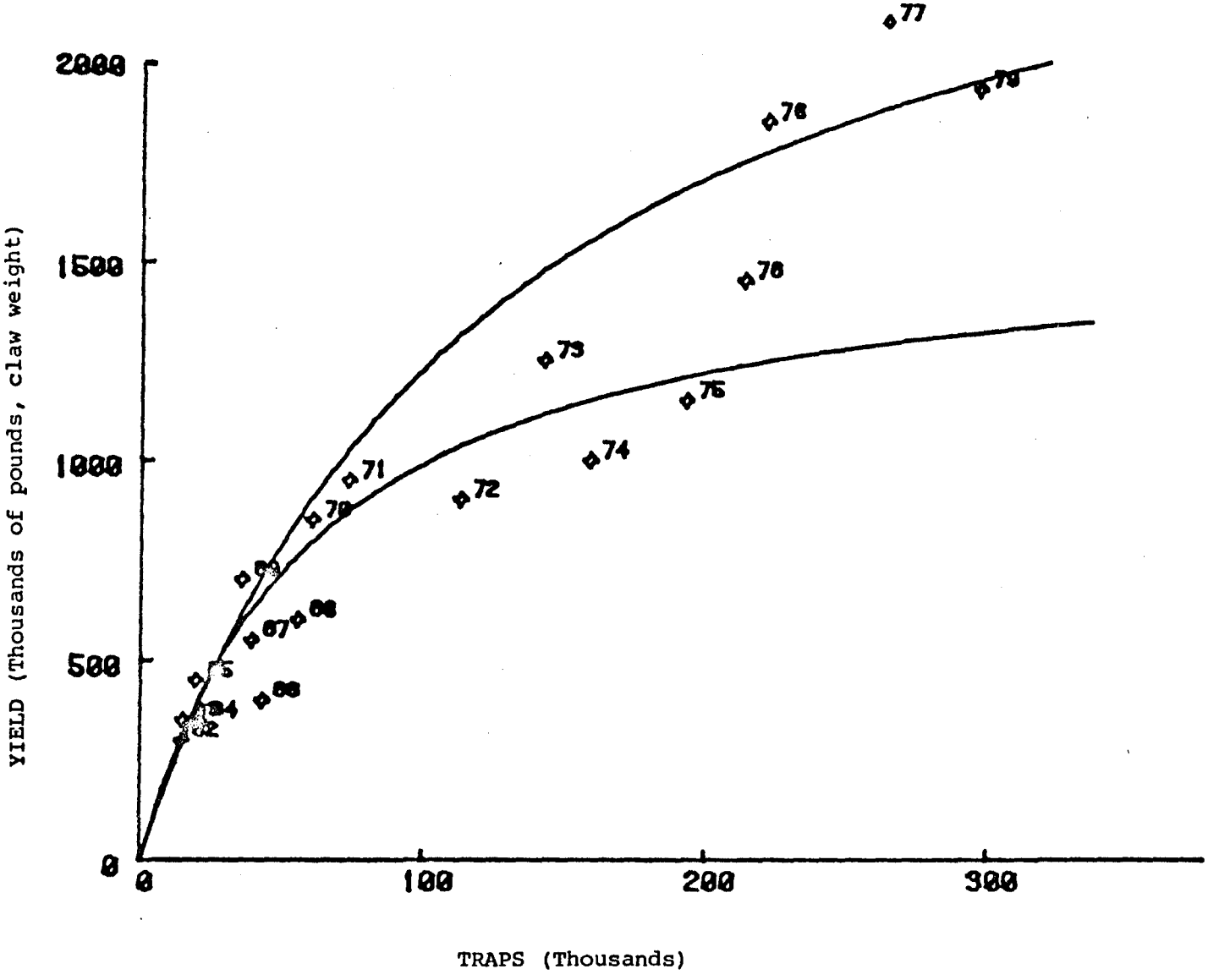

Figure 6. Production models of the west coast of Florida stone crab fishery. See text for explanation.

the data follow one curve or the other, but not both. What may be reflected here is a period of abnormally low recruitment for 1972-76, or a period of abnormally high recruitment for 1977-79, or a combination of the two. Whichever is the case, it would not be prudent to make a production model estimate of MSY based on the current data. The next few years of data should provide an indication of which curve (if either) the fishery is describing. In the mean time, the best estimate of MSY is the average of the three high years (1.96 million pounds for the commercial fishery). This is not significantly different from the 1.8 million pound estimate contained in the 1979 FMP.

To summarize, the stone crab fishery should produce approximately 2 million pounds of claws annually at an effort of 250,000 - 300,000 reported traps, given no detrimental environmental effects and the continuance of current size, sex, and season regulations.

IV. Stone Crab Research Developments

Research needs are stated in general terms in the FMP. The Gulf Council Scientific and Statistical Committee has identified some specific research needs and prioritized these (in relation to research needs of other FMP's) as follows:

1. Distribution and abundance - stock assessment (high priority research (deferred implementation) - long-term duration)

2. Declawing and desiccation effects - survival rates and reproductive potential (medium and lesser priority research)

3. Life history parameters and population dynamics (medium and lesser priority research)

4. Economic information on processing and marketing sector (medium and lesser priority research)

5. Study of economic interrelationship of stone crab fishery with other fisheries (medium and lesser priority research)

Research in progress addresses these needs to some degree and is summarized below by agency. Given the amount of manpower and dollars available and considering 1) the number of other FMP's requiring research and, 2) the relatively good condition of the stone crab fishery (from a biological viewpoint at least) as compared to some others, the amount of research being conducted and its general thrust seems adequate.

Southeast Fisheries Center

The Southeast Fisheries Center implemented a fisherman logbook and mandatory dealer report (as noted earlier) to obtain fishery statistics required for management. The Center also continued monitoring under the port agent system. The data thus obtained were used to provide the current stock assessment.

National Park Service

The National Park Service has concluded a four-year study on the distribution and biology of post-larvae and adult stone crabs in Everglades National Park and Biscayne National Monument. Field sampling ended in May and a first draft of the final report should be completed by September. Publication of the final report is expected in December 1980.

The NPS studies were all conducted within 15 kilometers of shore and within inland bays. Mark and recapture methods were used to study distribution, estimate population size in four areas of Florida Bay, and estimate growth and mortality parameters. Reproductive biology was studied including size of mature crabs, seasonality and fecundity. Some work was done on determining the effects of trap soak time on catch rates. A laboratory study was conducted to study the effects of declawing.

One aspect of the NPS research which has implications for management involves trap bias studies. According to Gary Davis (pers. com.) preliminary results indicate that stone crabs "apparently get up and move at certain times." The reason for such a movement is unknown at this time. This phenomenon could affect the use of catch per unit of effort data as an index of abundance.

Florida Department of Natural Resources

DNR has studied the claw reversal process and methods for identifying regenerated claws in dockside landings (Bill Lyons, pers. com.). The results of these studies are being prepared for journal publication, however, a first draft manuscript should be available by September 1980.

A recent (December 1979) publication entitled "The Stone Crab, Menippe mercenaria, in the Southwest Florida Fishery" by James R. Sullivan is available from the Florida Department of Natural Resources, Marine Research Laboratory, 100 Eighth Avenue, S.E., St. Petersburg, Florida 33701. An abstract of this publication is included in Appendix F. One of the most important findings in this study is that regenerated claws can attain harvestable size within one year. The study also determined that 20-25% of the legal size crabs are undergoing some form of claw regeneration. Thus, the management regulation requiring declawed crabs to be returned to the water otherwise uninjured may contribute substantially to the total harvest.

If the DNR studies do determine an easy and reliable method of identifying regenerated claws in dockside landings, the proportion of regenerated claws in the total harvest can be used as an index of survival of declawed crabs. A significant decrease in survival might signal problems in the fishery and prompt management action.

V. Effects of Management Regulations

The stone crab FMP basically recommended management regulations which were consistent with those already in effect under Florida law or the National Park Service. These regulations were developed and implemented over the years as biological knowledge of the stone crab accrued. The regulations, which include size, season and sex restrictions, are biologically sound and have contributed to the perpetuation of an apparently healthy stone crab stock.

One new regulation is the so-called "stone crab line" which was established to reduce conflict between stone crab and shrimp fishermen in the area of the Florida shrimp sanctuary. (The Southeast Regional Office of NMFS will report on law enforcement aspects of the line.) See Appendix C for a description of the line as given in the stone crab fishermen's logbook. Both "sides" can apparently live with the line in its present location, and there are insufficient data to do a proper cost/benefit analysis. SEFC plans no further measures at this time unless the Council identifies a problem or provides resources to map bottom types in the area of the line.

Although the stone crab stock is apparently healthy and the current management regime seems sufficient, basic research on the biology of the animal should be pursued to increase our knowledge and enable refinements to management. Research on the social and economic aspects of the fishery, although a lower priority, should be conducted should funds become available.

VI. Appendices

Appendices A - F follow this page.

FISHING VESSEL RECORD — STONE CRAB FISHERY

VESSEL NAME _____ PERMIT NUMBER _____ MONTH _____ 19____

DATE	ZONE 1			ZONE 2			ZONE 3			TOTAL	DEALER
	TRAPS FISHING	TRAPS PULLED	POUNDS CAUGHT	TRAPS FISHING	TRAPS PULLED	POUNDS CAUGHT	TRAPS FISHING	TRAPS PULLED	POUNDS CAUGHT	POUNDS CAUGHT	BUYING CATCH

NMFS COPY: FOLD AND MAIL

DEALER RECORD - STONE CRAB FISHERY
(PURCHASES OF STONE CRAB CLAWS FROM FISHERMEN)

FIRM NAME _____ MONTH _____ _____, 19_____

DATE	NAME OF VESSEL	LARGE		MEDIUM		SMALL	
		LBS.	$/LB.	LBS.	$/LB.	LBS.	$/LB.

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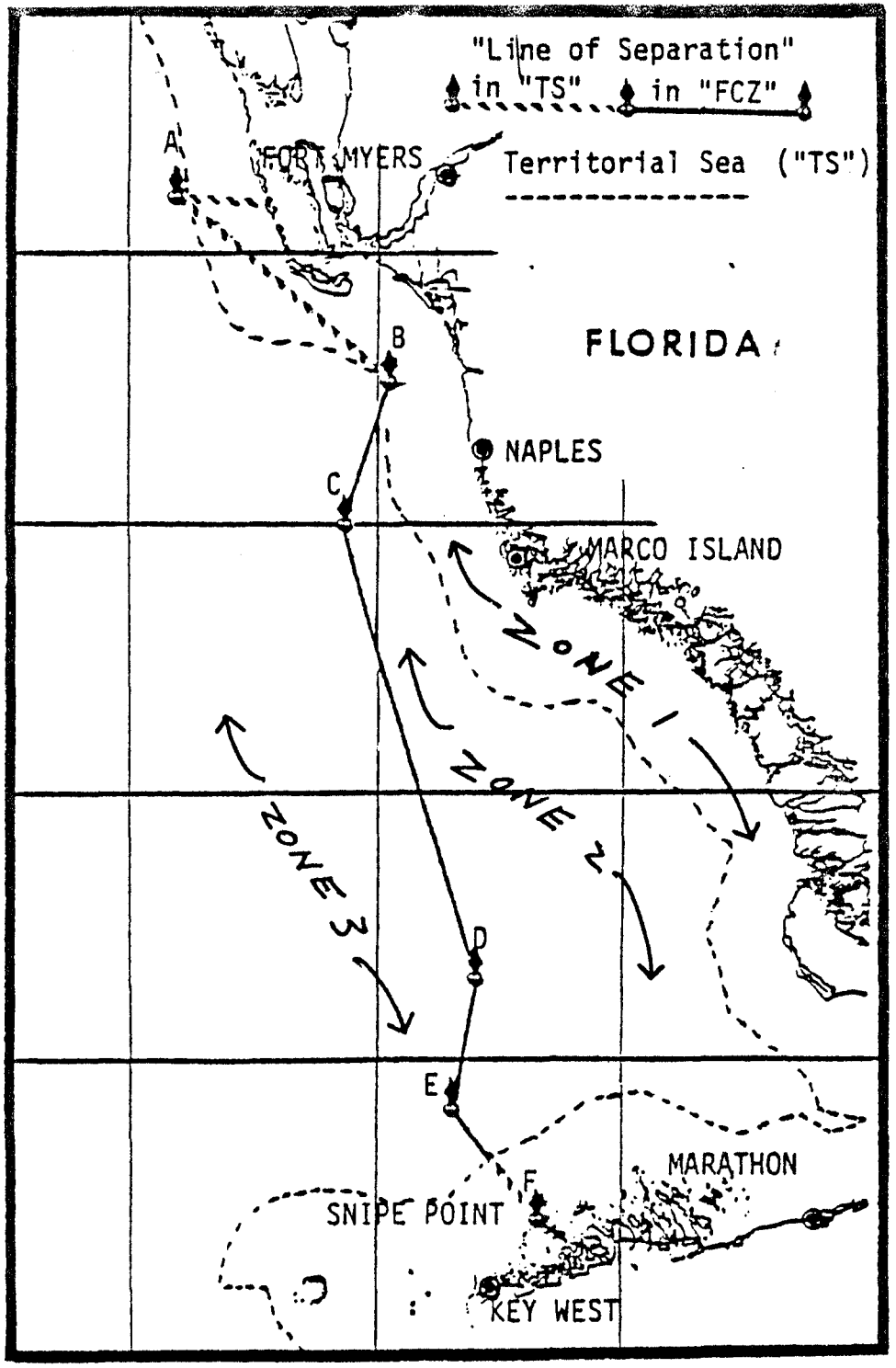

Use above zones for the area of Key West to Fort Myers

For fishing North of Fort Myers, use the zone explanati below.

ZONE 1 — TERRITORIAL SEA
(Inside 9 nautical miles)

ZONE 2 — FCZ SHOREWARD OF 8 FATHOMS
(outside 9 nautical miles and less than 8 fathoms)

ZONE 3 — FCZ SEAWARD OF 8 FATHOMS
(outside 9 nautical miles and more than 8 fathoms)

Stone Crab Line (from logbook)

APPENDIX D

Cost Estimates for Logbooks and Dealer Reports

STONE CRAB DATA COLLECTION COSTS
FOR DEALER FORMS AND FISHERMEN LOGBOOKS
(Compiled by Ernest Snell and Larry L. Massey)

1st PRINTING		
• design, testing, coordination, procurement, etc.		6 days
• printing (400 logbooks, 100 dealer books)	$2,300	
• distribution (Key West to Steinhatchee)		8 days
MAIL CONTACT		
• contract for mailing and information letter and form to 2154 permit holders (to be completed and returned)	$ 275	
• postage fees for above (about 1000 responded with about 400 saying they would sell claws)	$ 473	
REDESIGN OF FORM		
• redesign, coordination, procurement, etc.		3 days
• printing by GPO, Atlanta (400 logbooks and 400 dealer books)	$4,200	
• distribution (continuing)		2 days
SECOND MAILING		
• mailout to 1100 nonrespondents to first mailout		2 days
• postage fees	$ 240	
• distribution follow-up		1 day
EDITING		
• editing before delivery to data management for input		20 days
SUBTOTALS	$7,488	2.1 man-months @ $2,940
TOTAL (@ GS-9 level of pay)	$10.4K	

APPENDIX E

Florida DNR Application for Stone Crab Permit

FLORIDA DEPARTMENT OF NATURAL RESOURCES
202 BLOUNT STREET
CROWN BUILDING
TALLAHASSEE, FLORIDA 32304

APPLICATION FOR PERMIT TO TRAP STONE CRABS

I hereby make application for permit as indicated herein and do declare the following to be true and correct:

Name and Address

LIST ANY CHANGES FROM LAST YEAR

ADDRESS _____

PHONE _____

Maximum No. of traps fished:

BOAT REGISTRATION OR DOCUMENTATION NO.

FL _____ DO _____

Do you fish full-time for stone crabs during the open season(15 Oct-15 May).

YES ☐ NO ☐

Counties where products are landed _____

IN WHOSE NAME IS BOAT REGISTERED?

ADDRESS _____

Colors on buoys and boat:

IN ADDITION TO A STONE CRAB TRAPPING PERMIT, THE BOAT MUST BE REGISTERED FOR THE CURRENT YEAR, AND A COMMERCIAL FISHING LICENSE AND A COMMERCIAL BOAT TAX MAY BE REQUIRED DEPENDING UPON YOUR RESIDENCY STATUS.

RESIDENT? Yes ☐ No ☐

NON-RESIDENT? Yes ☐ No ☐

ALIEN? Yes ☐ No ☐

The following fees are listed.

FEE	RESIDENT	NON-RESIDENT	ALIEN
Commercial Fishing License	-0-	$25.00	$25.00
Commercial Boat Tax	-0-	$50.00	$50.00

A resident is a person who has maintained a continuous residence in Florida for a period of one year, and has actually resided in the state for a period of six months preceding date of this application.

A non-resident is a person who has not maintained a continuous residence in Florida for a period of one year and has not actually resided in the state for a period of six months preceding application for a license.

An alien shall be deemed a person who is not a citizen of the United States, although such person may be a resident.

I have read the appropriate laws accompanying this form, and understand that a violation of any regulations concerning stone crab trapping may be cause for revocation of the stone crab trapping permit, and that I am to have my permit whenever I am engaged in stone crab trapping.

DNR 33-108
(Rev. 7/14/78)

_____
Signature of Applicant

_____
Date

The Stone Crab, *Menippe mercenaria*, in the Southwest Florida Fishery

JAMES R. SULLIVAN

ABSTRACT

Sullivan, J. R. 1979. The Stone Crab, *Menippe mercenaria*, in the Southwest Florida Fishery. Fla. Mar. Res. Publ. No. 36. 37 pp. A total of 14,343 stone crabs were tagged during the 1975-76 commercial trapping season in southwest Florida, and 4,563 crabs were tagged during the summer closed season; return rate of tagged crabs was 4.4%. Inshore movement in fall and offshore movement in spring is indicated. Summer returns suggest little movement by spawning females.

Spawning females occur during every month but most frequently between March and September. Size frequencies of ovigerous females correspond to that of nonovigerous females. Monthly modal sizes of all crabs were most frequently 96-99 mm and 100-103 mm CW, well above legal size. Year II crabs comprise a large recruitment base of sub-legal sizes; legal portions of this population consist primarily of Year III and Year IV crabs.

Females have longer carapace lengths than do males for all carapace width sizes. Males are heavier and gain weight faster than nonovigerous females; gravid females weigh more than similarly-sized nonovigerous females and maintain an equivalent percent weight difference with increasing size-related fecundity. Males have larger claws and grow by greater increments than females for all CW sizes.

Crushers constitute 60% of legal claws available to the fishery, and 80% of crushers are from right-handed crabs. Carapace width, claw growth and regeneration rates from this study are higher than previously reported. Claw regeneration to harvestable size within one year is demonstrated. Clawless crabs had the second highest return rate of all tagged crabs. From 20-25% of legal sized crabs were undergoing some form of claw regeneration, implying intense fishery pressure but indicating survival of declawed crabs. Estimates of population size ranged from 9,057 to 32,036 legal sized crabs available to a trap line during one week; highest numbers occurred at the beginning of the commercial season. Fishermen caught 3-8% (average 5%) of the available population each time traps were pulled, indicating that most legal sized crabs were captured during each commercial season. A southwest Florida stone crab population successfully withstanding present fishery pressure is indicated.