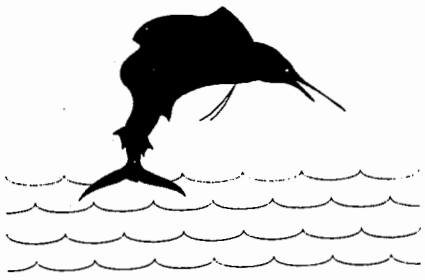
Marine Fisheries Initative

(MARFIN)

Gulf of Mexico Phase

Proceedings:

Second Annual MARFIN Conference



September 20–21, 1989
New Orleans, Louisiana

PREFACE

The Marine Fisheries Initiative (MARFIN) Program has been funded since 1986 by Congress to develop, rejuvenate, and maintain Gulf of Mexico fisheries. Any citizen of the United States can apply for financial assistance to assist the Federal Government (NOAA Fisheries) in meeting the goals and objectives of the MARFIN Program. Each year, MARFIN priorities and directions for submitting proposals are published in the Federal Register.

MARFIN is managed by the Southeast Region of the National Oceanic and Atmospheric Administration (NOAA) Fisheries, with assistance from members of the MARFIN Board. The Board is composed of eight members and alternates (plus an ex-officio member) from the following organizations.

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The Board members assist the Regional Director of the Southeast Region NOAA Fisheries in developing Gulf fishery priorities, evaluating proposals for financial assistance, and monitoring existing projects. The NOAA Fisheries (National Marine Fisheries Service - NMFS) provides a program manager to coordinate all of the MARFIN activities, and individual program officers for each of the projects. A Grants Officer in the NOAA Central Administrative Support Center (CASC) in Kansas City, Missouri, administers the awarded projects with the assistance of the designated program officer.

The MARFIN conference is held annually and is designed to allow a free interchange of ideas among all the MARFIN cooperators, to disseminate information to fishery managers, researchers, and other interested Gulf fishery parties, and to assist the MARFIN Board and the NOAA Fisheries in identifying priorities for future MARFIN projects.

The MARFIN research units include:

- Shrimp
- Menhaden
- Coastal Pelagics
- Reef Fish
- Coastal Herrings
- Ocean Pelagics
- Marine Mollusks
- Crabs and Lobsters
- Bottomfish
- Estuarine Fish
- Anadromous & Catadromous Fish
- Mariculture
- Marine Mammals & Endangered Species
- Corals and Sponges

The conference sessions are organized to address most of the research units with MARFIN Board members acting as chairpersons for each of the sessions.

The MARFIN Program was developed around the concept that fishery data concerning the Gulf of Mexico required coordination. Many state, university, federal, and private groups were not working in concert. Enhancing cooperation among these groups was a key aspect in the initiation of MARFIN. If those of you who read this document are considering submitting a proposal to MARFIN, think in terms of cooperation. We would like to see proposals that bring together talent from a number of areas. We would also like to receive proposals that could help develop a fishery resource, maintain an existing resource, or aid in the recovery of a resource that had been diminished. The economic aspects of fishery development, maintenance, and recovery are also key areas of interest.

For further information call or write the MARFIN Program Office:

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WELCOMING REMARKS
STRUCTURE AND OBJECTIVES OF CONFERENCE
INSTRUCTION TO PARTICIPANTS

Dr. Donald Ekberg, MARFIN Program Manager, Southeast Regional Office, National Marine Fisheries Service, opened the conference and introduced Dr. Joseph Angelovich, who gave the welcoming remarks.

Dr. Angelovich, Acting Regional Director, Southeast Regional Office, National Marine Fisheries Service, greeted the participants and commented that he would not take up very much time since the agenda was a very ambitious one. He welcomed everyone to the 2nd Annual MARFIN Conference. He related he was pleased to see everyone in attendance and that this was the second annual conference of many more to come.

Dr. Angelovich stated that last year's conference goal was to look at the results of the program and to make any adjustments that were needed. This goal was met and the MARFIN program continues to be a success. The main purpose of this conference is to see what the program is accomplishing and to share information. The agenda contains a variety of subjects that should provide useful information for the current fishery management. Perhaps, through the discussions, it can be determined if any areas of research have been overlooked, or if there are any areas that need improvement. The MARFIN program has funded something on about every resource in the Gulf and the money has been distributed equitably among the states, universities, industry, and in-house fisheries.

In his final remarks, Dr. Angelovich reminded the participants that what they are presenting at this conference is very important to the MARFIN Board in order for them to be aware of where the program ought to go, what the priorities ought to be,

and that the Board will be using this information to make recommendations to the fisheries service on how the funding should be allocated.

SESSION I

REEF FISH

THE STRUCTURE AND ECONOMICS OF THE CHARTER AND PARTY BOAT FISHING FLEET OF THE GULF COAST OF FLORIDA (MARFIN # NA87WC-H-06141)

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Introduction: The purpose of this project was to provide federal and state fisheries managers with information on the social, business and economic aspects of the charter and party boat fleet on the Gulf Coast of Florida. Charter and party boat operators along the west coast of Florida were interviewed at their home port by field personnel between February and July of 1988. One hundred and forty five charter boat captains and twenty-one party boat captains in 15 different ports were interviewed. This is approximately one out of five of all the charter or party captains on the Gulf coast. Below is a summary of major findings for each group of operators by specific study objective.

Results:

Objective 1: To update and describe the distribution of charter/party boats by location:

- A total of 808 boats were identified as operating as charter/party boats from the west coast of Florida. This is 77% of all the charter or party boats in Florida (including Atlantic coast) and 75% of all the for-hire boats operating from the United States in the Gulf of Mexico based on a 1987 boat census.
- There are about 70 party boats and 738 charter boats operating from the west coast of Florida and the Keys.
- A total of 223 boats (28%) were identified as operating around the Florida Keys, 364 boats (45%) operating off of the western peninsula coast and 221 boats (27%) from panhandle ports.

Objective 2: Describe which species the charter and party boat fleet are utilizing by season and location:

Charter Boats

- The species which are targeted by more than 60% of the boats in the Florida Gulf are: Grouper (81%); Snapper (76%); King Mackerel (74%); Amberjack (73%); Dolphin (68%); Bonito (65%); Shark (65%); and, Cobia (62%).

- The species receiving the greatest degree of targeting effort from the aggregated Florida Gulf boats are: Grouper (15%); Snapper (12%); Dolphin (10%); King Mackerel (9%); Amberjack (8%); Sailfish (7%); and Shark (5%).

- The species receiving the greatest degree of targeting effort from the Panhandle boats are: Snapper (17%); Grouper (15%); Amberjack (10%); King Mackerel (10%); Spanish Mackerel (6.1) and Shark (6%).

- The species receiving the greatest degree of targeting effort from the Peninsula boats are: Grouper (30%); Snapper (14%); Amberjack (8%); Speckled Trout (7%); Tarpon (6%) and King Mackerel (6%).

- The species receiving the greatest degree of targeting effort from the Keys boats are: Dolphin (25%); Sailfish (17%); King Mackerel (12%); Barracuda (6%); Wahoo (5%); Snapper (5%); and Bonito (5%).

Party Boats

- The species which are targeted by more than 40% of the boats in the Florida Gulf are: Grouper (93%); Snapper (93%); Amberjack (60%); Dolphin (47%); and, Bonito (47%).

- The species receiving the greatest degree of targeting effort from the aggregated Florida Gulf boats are: Snapper (40%); Grouper (30%); Amberjack (8%); Flounder (4%); Spanish Mackerel (3%); and, Cobia (2%).

- The species sought by the greatest percentage of Panhandle boats are: Snapper (100%); Grouper (100%); Amberjack (100%); Bonito (100%); Dolphin (100%); Cobia (67%); Shark (67%) and, Blackfin Tuna (67%).

- The species sought by the greatest percentage of Peninsula boats are: Grouper (100%); Snapper (88%); Cobia (75%); and Amberjack (63%).

- The species sought by the greatest percentage of Keys boats are: Snapper (100%); Grouper (75%); and, Dolphin (50%).

Objective 3: Provide descriptive information on the operating policies of charter and party boat operations and develop a financial profile of these operations.

Charter Boats

- The majority of trips (85%) were offshore in non-bay areas and 46% of the trips were in waters less than 9 miles offshore.

- Charter boats charged an average of $448 for a full day trip which included an average 5.8 persons. The average half-day fee was slightly more than half of the full day rate.

- Gross revenues for an average boat operation were estimated to be $62,135. Total expenses including all wages and salaries were estimated to be $56,218. Based on an estimated investment of $106,684 in the average charter boat, the average net return (before taxes) was $5,917, which represented an average return on investment of 5.5%. These estimates are based on certain assumptions and should be interpreted as general indicators of financial performance and not as precise measures for an individual business.

- The majority of businesses were organized as sole-proprietorships although both partnerships and corporate structure were used.

- The majority of business operators felt that their business had improved or remained the same over the prior three years.

- About 58% of the charter captains chartered tournaments in 1987.

- About 26% of the charter boat captains said that they fished commercially in 1987.

Party Boats

- Party boat carrying capacities averaged 80 people on the boat.

- The majority of trips (88%) were offshore in non-bay areas and 45% of the trips were in waters less than 9 miles offshore.

- Party boats charged an average of $36 for a full day trip which included one person.

- Party boat operations had higher revenues and expenses than charter boats but a lower rate of return due to a higher level of investment. Gross revenues for an average boat operation were estimated to be $111,500. Total expenses including all wages and salaries were estimated to be $107,873. The average net returns of $3,627 provided an average return rate of 1.75%. These estimates are based on certain assumptions and should be interpreted as general indicators of financial performance and not as precise measures for an individual business.

- The majority of business operators felt that their business had improved or remained the same over the prior three years.

- About 10% of the party boat captains chartered tournaments in 1987.

- About 10% of the party boat captains said that they fished commercially in 1987.

Objective 4: Report captain's perceptions of problems in their business and relevant agencies.

Charter Boats

- Using number of fish caught as the indicator, captains rated the fishing around their home port in 1987 compared to the previous two years as: Excellent (8%); Good (30%); Average (28%); Poor (30%), and, Very Poor (4%).

- Using size of fish caught as the indicator, captains rated the fishing around their home port in 1987 compared to the previous two years as: Excellent (6%); Good (23%); Average (46%); Poor (23%), and, Very Poor (2%).

- Regarding fishing trends; 87% of the captains from the Keys, 77% of the captains in the peninsula, and 58% of the captains in the panhandle said that the quality of fishing had decreased in recent years. When asked why they thought the decline had occurred, a variety of reasons was offered with the most frequent being "over-fishing" (33% gave this response).

- Other problems that were rated as major by a majority of captains include: high cost of insurance (83% of the captains); high cost of business overhead (65%); and, fishing regulations (52%).

- Opinions on existing recreational catch restrictions ranged from a relatively higher approval of restrictions on Cobia (all regions) and Red Snapper (all regions but especially panhandle) and a lower approval among Keys captains of King and Spanish Mackerel restrictions. Captains were about evenly split in their approval or opposition toward Red Drum or Bluefin Tuna restrictions.

- About 82% of the captains said they expect to be in business in three years. Those who were quitting mentioned lack of money, fishing regulations, and retirement as the main reasons.

Party Boats

- Using number of fish caught as the indicator, captains rated the fishing around their home port in 1987 compared to the previous two years as: Excellent (0%); Good (14%); Average (48%); Poor (33%), and, Very Poor (5%).

- Using size of fish caught as the indicator, captains rated the fishing around their home port in 1987 compared to the previous two years as: Excellent (0%); Good (5%); Average (38%); Poor (48%), and, Very Poor (10%).

- Captains were generally satisfied with the quality of services where they docked: 38% rated their dock as Excellent, 43% as Good; 14% as Average; 5% as Poor and 0% as Very Poor.

- About 71% of the captains said they expect to be in business in three years.

- Regarding fishing trends; 80% of the captains from the Keys, 91% of the captains in the peninsula, and 75% of the captains in the panhandle said that the quality of fishing had decreased in recent years. When asked why they thought the decline had occurred, a variety of reasons was offered with the most frequent being "over-fishing" (57% gave this response).

Objective 5: Compare 1988 results with 1978 study and with western Gulf.

- There is a move away from wooden hulls to fiberglass hulls in the last 10 years. The average age of hulls has remained about the same at 11 years.

- Average charter boat length has increased about 3 feet over the last ten years to 38 feet.

- The state average age of captains is 5 years younger than in 1978.

- Stability of captains living near their home port has remained high as in 1978 with the average number of years that they have operated from their home port being about 20 years.

- The targeted species remained about the same as ten years ago with some shift away from King Mackerel and some increase in targeting Amberjack.

- Western Gulf captains spent more time targeting Red Drum, Speckled Trout, King Mackerel, and about 50% more time on Snapper compared to Florida captains.

- The majority of captains in Alabama, Louisiana and Texas targeted less than six species while only 20% of the captains in Florida (or Mississippi) sought five or less species.

AN EVALUATION OF THE USE OF LARGE FABRICATED ARTIFICIAL REEFS TO ENHANCE REEF FISH POPULATIONS AT DIFFERENT DEPTHS IN THE FLORIDA KEYS (MARFIN #NA89WC-H-MF020)

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INTRODUCTION

The Florida Keys Artificial Reef Association was formed in 1980 to facilitate the proper design and construction of artificial reefs in waters of the Keys. From 1981 to 1987 the FKARA was involved in the placement of over 37,000 tons of concrete bridge rubble at seven permitted sites and the sinking of 12 large vessels and barges at 8 sites along the Keys. Goals of the FKARA include constructing artificial habitats to enhance and improve fishery resources and to provide alternative fishing and diving sites thereby relieving some stress from natural habitats. The Association is committed to documenting the effects of this construction with data that can be used in future management decisions.

In June, 1988, 7 fabricated concrete units (up to 8 tons and 16' high) were placed by the FKARA in sandy areas of the Florida Reef Tract off Big Pine Key. Two large units were placed 50 m apart and 50 m from adjacent natural reef lines at depths of 14 m and 25 m. Three smaller, low profile units were placed 50 m apart at a depth of 8 m approximately 50 m from a shallow reef area. The proposal for work included bimomthly total counts of the fish and macroinvertebrate populations associated with the units and an intensive assessment of the adjacent natural reefs using the stationary visual census technique developed by NOAA Fisheries in Miami. Specific objectives include:

- quantifying the species composition, biomass and seasonality of fishes attracted to and produced by the artificial reefs over a 24 month period.
- comparing the colonization and community structure of reef fishes on the fabricated habitats to nearby natural reefs.
- evaluating the effects of reef siting at different depths on species composition, recruitment and biomass.

- using photographic techniques. document plant and invertebrate fouling communities as a function of substrate and water depth.

- seperating fish communities into trophic levels to assess the location of the food source being used.

- determining if large fabricated habitats of this type can provide significant fishing opportunities.

- evaluating the economics of constructing, transporting and placement of artificial habitats.

- censusing the fish populations of nearby older bridge rubble artificial reefs for comparison to the fabricated units and natural reefs.

SUMMARY

As of early September. 1989. 15 months of the proposed 24 months of census work had been accomplished with MARFIN funding available for 11 months of that period. The proposed work schedule has been met with few exceptions and the following summarizes the census work accomplished:

LOCATION	# CENSUSES
Shallow artificial habitats	30
Shallow natural reef	76
Mid artificial habitats	22
Mid natural reef	46
Deep artificial habitats	18
Deep natural reef	46
Bahia Honda artificial reef (9m)	26
American Shoal artificial reef (12m)	24

The creation of computer data bases utilizing software provided by NOAA Fisheries in Miami is proceeding and analyses of data will be accomplished after the completion of field work using methods consistent with those of recent NOAA research.

INVESTIGATION OF REEF FISH RECRUITMENT FISHING EFFORT AND MANAGEMENT IN THE NORTHERN GULF OF MEXICO

(Grant No. NA89WC-H-MF027)

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INTRODUCTION

Recently the Gulf of Mexico Fisheries Council has released data which indicate many populations of reef fishes (including red snapper, vermilion snapper, several grouper species, and amberjack) are being severely over-fished. As well, several species of secondarily targeted fished (e.g. grey triggerfish, lane snapper, grey snapper) are heavily exploited. Many of the species are taken in significant numbers before the age of first spawning which seriously affects the maintenance of harvestable stocks. Consequently, very restrictive bag size limits for recreational fishermen, and landing quotas for commercial fishermen, have been proposed and some are being currently implemented.

Basic fishery data are urgently needed to assess the current extent of the over-fishing; these data include age-at-lengths, length-frequencies of the catch, and age of first spawn for each of the populations. Our project is focusing on determining the age of length of several species of reef fishes commonly caught in the northern Gulf of Mexico using contemporary aging techniques. We are currently collecting length and sex data, as well as otoliths and other calcified parts, from reef fishes landed between Dauphin Island, Alabama and Panama City, Florida.

METHODS

Fish carcasses (filets removed) are collected from a variety of sources, including sport fishing boats, commercial boats, fish markets, and sportfishing rodeos. Of primary interest are red snapper, vermilion snapper, amberjack, triggerfish, read grouper, and gag grouper, but we collect any reef species regularly landed (including white porgy, grey snapper, lane snapper, yellow-edged grouper, snowy grouper, and Warsaw grouper) for future analysis. Fish of all sized are collected; date, length and sex are recorded, and state of gonadal development is noted. The otoliths are removed from the fish at the lab and stored dry in vials.

We are currently utilizing a variety of techniques to determine which most clearly reveals rings in otoliths for each species. While rings are visible in whole otoliths of all species (except grey triggerfish, where the first dorsal spine better shows incremental growth), use of an Isomet Low Speed Saw to section otoliths appears to provide clearest definition of growth increments.

RESULTS

The project was funded in March, and collection of material begun shortly thereafter. To date more than 1000 specimens have been collected, and removal of otoliths is proceeding. Collection of material from rodeos and tournaments continues as the priority activity through September, at which time focus will shift to analysis of otolith material.

Program officer, Dr. Phil Goodyear, visited our laboratory in August, and requested we continue to collect data on read and vermilion snapper. He stressed that although these were not included in our project as "secondary target species," the need for age/growth data on them is so critical that we could greatly benefit his program with additional material. We are responding positively to his request.

Total species collected to date are presented in Table 1.

Table 1. Otolith Collection to Date
29 August 1989

SPECIES	NO. IN COLLECTION	TL RANGE (MM)
Groupers:		
Rock hind (Epinephelus adscensionis)	5	275 - 397
Yellow edge grouper (E. flavolimbatus)	25	514 - 955
Red grouper (E. morio)	30	488 - 759
Gag grouper (Mycteroperca microlepis)	84	297 - 1115
Snappers:		
Red snapper (Lutjanus campechanus)	301	41 - 827
Grey snapper (Lutjanus griseus)	31	46 - 401
Lane snapper (Lutjanus synagris)	155	220 - 738
Vermilion snapper (Rhomboplites aurorubens)	222	135 - 400
Others:		
Amberjack (Seriola dumerili)	38	493 - 909
Porgies (Calamus & Pagrus sp.)	35	189 - 357
Grey triggerfish (Balistes capriscus)	35	160 - 379

SUMMARY OF REEF FISH PANEL DISCUSSION

- Amberjack declines toward west in Gulf of Mexico.
- Almaco jack abundant off Louisiana.
- Lesser amberjack and almaco jack otoliths are quite similar.
- Samples from fishing rodeos or party boats should be traced to particular areas or reefs to ensure that data refers only to certain geographical ranges.

SESSION II

COASTAL HERRINGS

Fisheries-Independent Data on Coastal Herring, Carangids, and Red Drum from the Northern Gulf of Mexico (Grant No. NA87WC-H-06135)

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ABSTRACT

The main objectives of this research were 1) to document larval distributions, temporal and spatial variability in abundance, and spawning ecology of coastal herring and carangid larvae from SEAMAP collected samples; and 2) to analyze red drum egg and larval data from fine- and broad scale collections in northcentral Gulf shelf and coastal waters and estimate their spawning biomass from egg and larval production. The red drum spawning seasonality and spawner biomass estimate final report has been submitted and therefore only the coastal pelagic research will be discussed.

SEAMAP bongo net samples collected during 1984 and 1985 were examined for the presence of blue runner and Atlantic bumper larvae. C. chrysurus were most abundant over the shelf within the 40 m depth contour, whereas, C. crysos were most abundant considerably beyond this depth. C. crysos were collected between March-November, and C. chrysurus from April-October; both species were most abundant during June-August. Most C. crysos were collected at salinities > 30 ppt ($\bar{X}$ = 32 ppt), whereas, C. chrysurus were most abundant at < 30 ppt ($\bar{X}$ = 28 ppt). For summer 1984 and 1985 combined about 70% of total stations < 40 m depth were positive for C. chrysurus; only about 26% of total stations > 40 m depth had a positive catch for C. crysos. Both species were relatively more abundant during 1985 than 1984 and off Louisiana and Texas than off Florida.

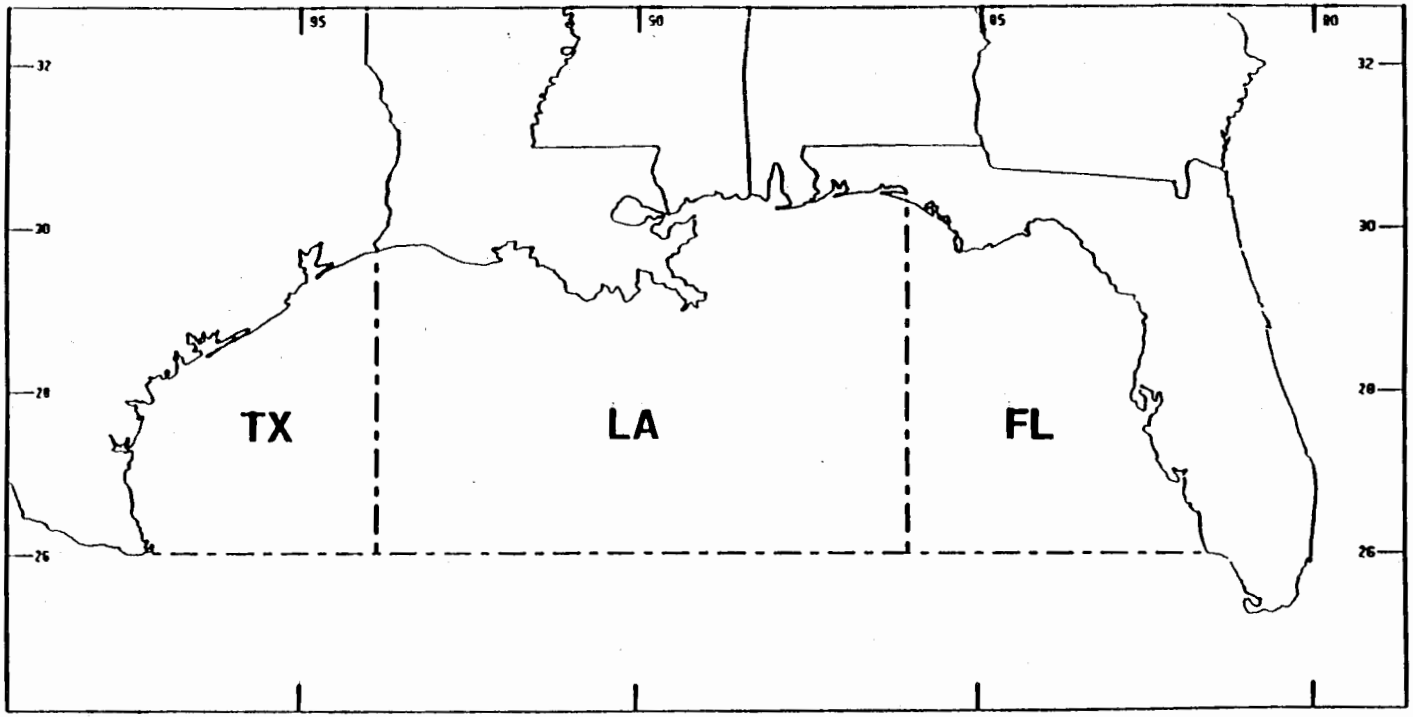

FIG. 1. SUB-REGIONS OF THE GULF OF MEXICO.

Table 1. Environmental parameters (mean over range) by region and year (summer only, June through August combined) for Chloroscombrus chrysurus; positive catch stations only.

	1984			1985		
	FL	LA	TX	FL	LA	TX
STA. DEPTH (m)	16.6 (12-28)	50.2 (12-515)	28.5 (9-80)	NC*	76.0 (4-134)	26.2 (11-42)
SALINITY (ppt)	33.9 (32.3-34.8)	27.2 (11.8-36.6)	30.0 (17.1-36.2)	NC	27.5 (14.9-33.5)	33.3 (30.9-36.1)
WATER TEMP. (°C)	28.8 (27.6-29.4)	28.3 (24.0-31.0)	28.8 (25.8-30.5)	NC	28.5 (27.0-30.2)	28.2 (27.7-29.2)
POS. CATCH (N)	8	65	34	NC	75	9

* NC - No catch

Table 2. Environmental parameters (mean over range) by region and year (summer only, June through August combined) for Caranx crysos; positive catch stations only.

	1984			1985		
	FL	LA	TX	FL	LA	TX
STA. DEPTH (m)	NC*	312 (13-1702)	220 (31-1336)	317 (205-481)	208 (21-637)	147 (26-459)
SALINITY (ppt)	NC	31.2 (23.4-35.9)	33.8 (29.9-36.1)	31.5 (30.8-32.6)	30.8 (25.4-35.4)	34.9 (32.4-36.2)
WATER TEMP. (°C)	NC	28.8 (27.3-30.5)	28.8 (28.1-30.0)	29.2 (28.8-29.6)	28.7 (27.0-30.9)	28.5 (27.7-29.7)
POS. CATCH (N)	NC	33	12	3	34	13

* NC - No catch

Table 3. Mean total abundance of Chloroscombrus chrysurus larvae (NO./10m^2) by region during the summers of 1984 and 1985. Data was combined for the months June through August.

	1984		1985	
Region	Abundance	Pos./Total	Abundance	Pos./Total
FLORIDA	36	8/22 (36)*	0	0/29 (0)
LOUISIANA	73	66/149 (44)	306	75/134 (56)
TEXAS	173	34/59 (58)	40	9/30 (30)

* Catch Ratio

Table 4. Mean total abundance of Caranx crysos larvae (NO./10m^2) by region during the summers of 1984 and 1985. Data was combined for the months June through August.

	1984		1985	
Region	Abundance	Pos./Total	Abundance	Pos./Total
FLORIDA	0	0/22 (0)*	<1	3/29 (10)
LOUISIANA	2	33/149 (22)	3	34/134 (25)
TEXAS	4	12/59 (20)	10	13/30 (43)

* Catch Ratio

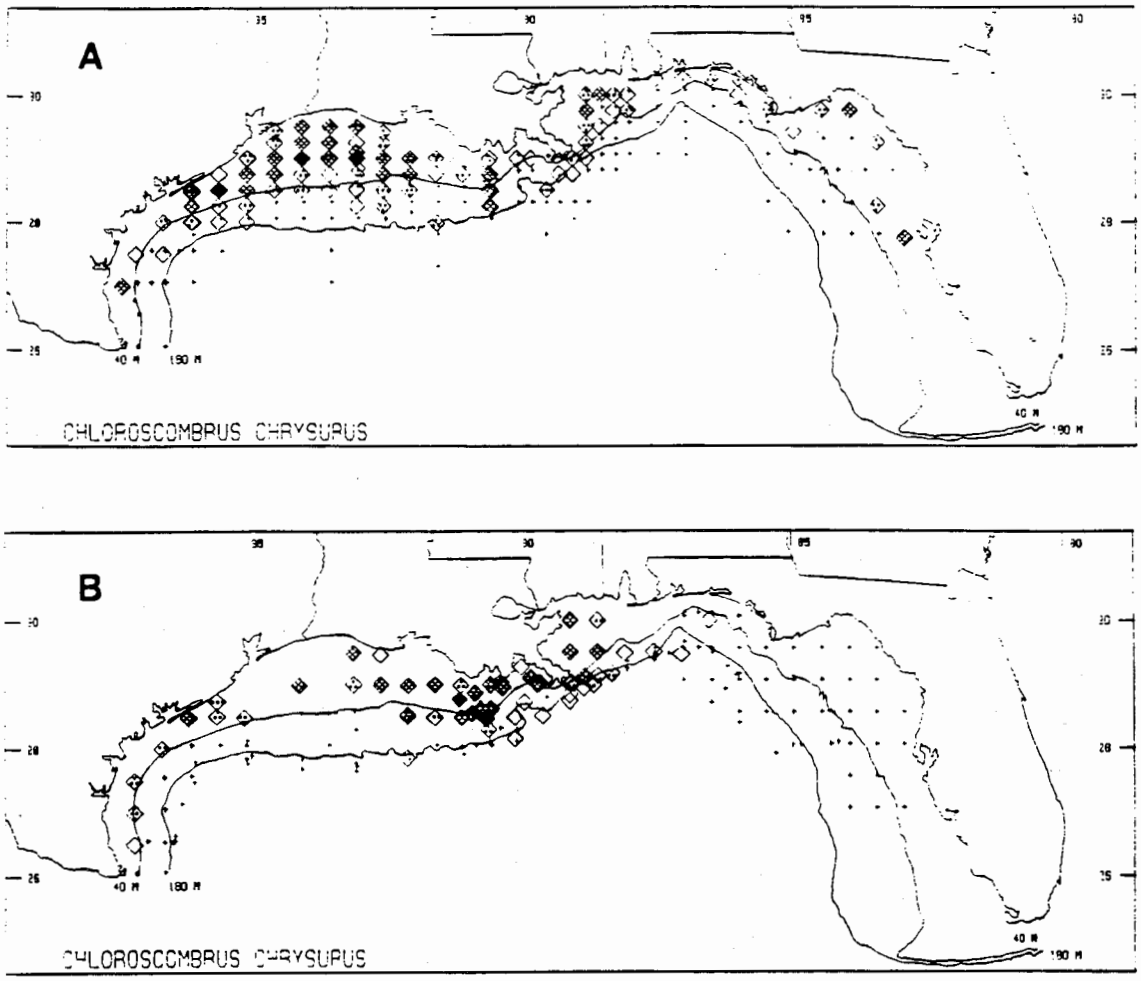

FIG. 2. GULFWIDE DISTRIBUTION AND ABUNDANCE OF Chloroscombrus chrysurus. A-1984; B-1985. MONTHS OF JUNE THRU AUGUST WERE COMBINED BY YEAR.

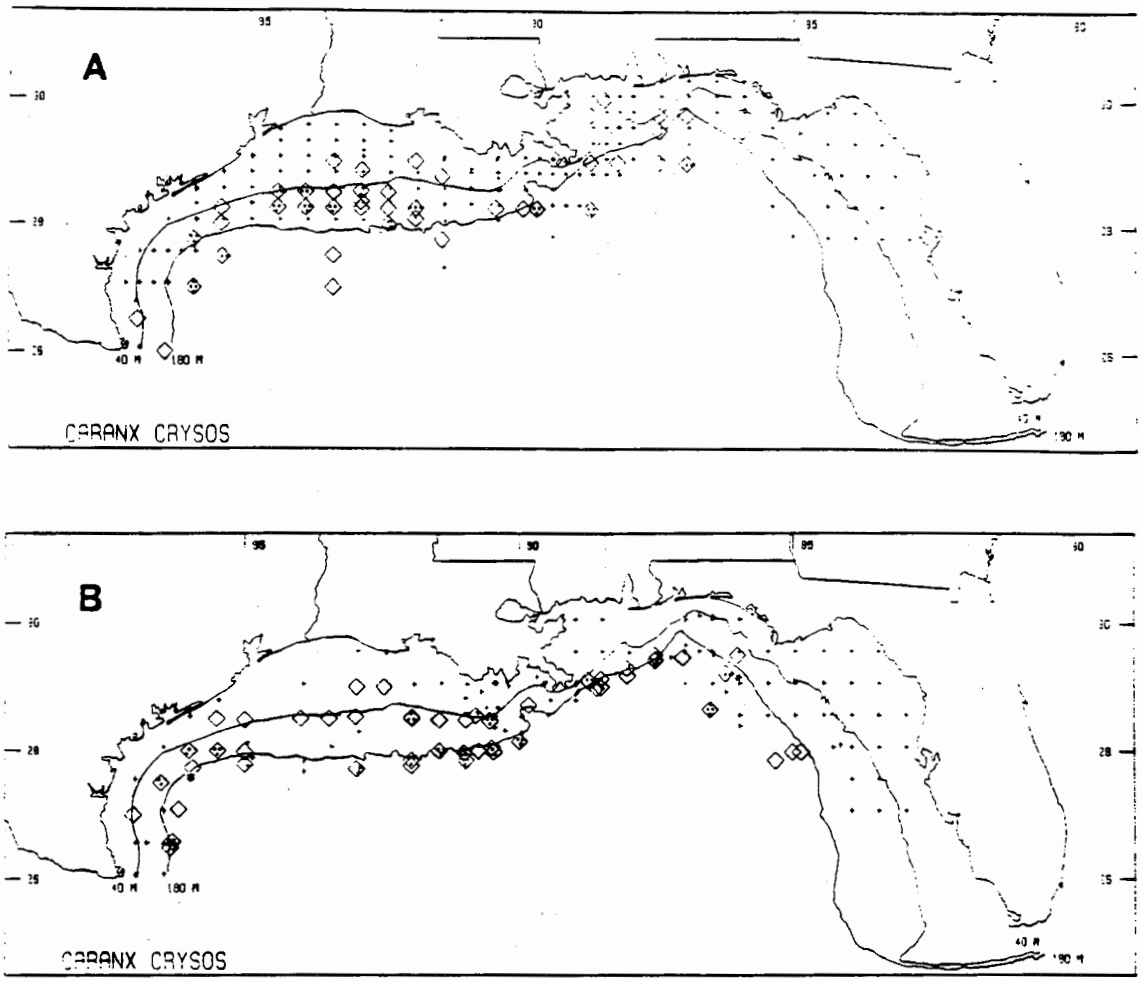

FIG. 3. GULFWIDE DISTRIBUTION AND ABUNDANCE OF Caranx crysos. A-1984; B-1985. MONTHS JUNE THRU AUGUST WERE COMBINED BY YEAR.

Species Composition and Population Genetics of Spanish Sardines in the Eastern Gulf of Mexico (NA89WC-H-MF028)

by

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INTRODUCTION

The Spanish sardine, Sardinella aurita, has traditionally been viewed as the primary species comprising the sardine fishery of the eastern Gulf. Whitehead's recent FAO publication indicated the presence of a second sardine species, Sardinella brasiliensis, in the Gulf of Mexico. Whitehead's morphological definition of this second species was based, however, upon specimens collected in the western South Atlantic, and was apparently only a tentative definition pending further investigation. This possibility of a two-species fishery for "Spanish sardine" in the eastern Gulf raises potential management concerns for this component of a burgeoning baitfish industry. A study of the species composition of this fishery was therefore undertaken to test the hypothesis of a two-species fishery.

The weak morphological basis for species identification prompted the use of protein electrophoresis to survey for evidence of genetically distinct, but morphologically cryptic, sympatric sardine species. The goal was to collect specimens primarily from the Cortez fishery throughout the primary fishing season and survey approximately 50 presumptive genetic loci for alternate alleles for which heterozygotes did not occur. As a control, specimens from Florida's east coast would be included since no S. brasilienis have been reported to occur in the northwestern Atlantic outside the Gulf or Caribbean.

It was decided that a survey of approximately 400 specimens would be sufficient to ascertain the presence of a second species at high enough levels of representation to have an impact on fishery management. A second emphasis of the project was to investigate the use of a second genetic technique, analysis of mtDNA restriction-site polymorphisms, as

a potential tool for future studies of species or stocks of sardines or other clupeids in the Gulf of Mexico. An outcome indicating the probable absence of a second important species in the Gulf would prompt the use of the collected data to evaluate possible genetic differences between sardine stocks around Florida.

SUMMARY OF RESULTS

A second consecutive poor year for the sardine fishery at Cortez hindered routine sampling throughout the fishing season. Thus, samples were collected as possible from various sites in the Gulf. The spacial and temporal distribution of the 400 surveyed specimens is given in Table 1.

Data were obtained on 49 presumptive genetic loci for most specimens (Table 2). From these data, no clear indication emerged of two common, sympatric species of Spanish sardine in the Gulf. However, our in-progress quantitative analysis of allelic frequencies at polymorphic loci (Table 2) is uncovering certain irregularities which hint that sardine populations may not be well-mixed genetically all around Florida. For example, a fast allele at G_3pdh-1 of liver is present at a very low frequency in specimens from Longboat Key but is very far from Hardy-Weinberg equilibrium, indicating an apparent lack of its recombination at expected frequencies. However, no statistically significant differences between allele frequencies between collection sites have been found to date. Some loci are still being evaluated.

The research on sardine mitochondrial DNA has been highly successful. We have obtained high yields of highly purified mtDNA from both sardine and thread herring ovarian tissue. Moreover, we have successfully cloned the entire mtDNA genome of thread herring from Hind-III fragments. This cloned material will allow the making of highly specific genetic probes for use in any number of potential genetic problems relating to clupeids. In addition, we are near completion of a comparative preliminary survey of variability at one restriction site, Eco-RI, of Spanish sardine from the Panhandle and Cortez. To date, no variability has been found, a finding which reinforces our conclusions from the protein electrophoresis data base.

Table 1. Summary of Sardinella sp. collections to date.

Month & Year	Site	No. Collected	No. Worked Up
June, 1988	Charlotte Harbor*	47	47
Sept./Oct., 1988	Panhandle	>200	87
Nov., 1988	Off-shore Tampa Bay*	21	21
Feb., 1989	Tampa Bay, Cortez	>200	151
May, 1989	West Palm Beach	>200	50
June, 1989	Inshore Tampa Bay*	20	20
August, 1989	Panhandle	40	24
			400

*Taken with cast nets.

Table 2. Summary of forty-nine presumptive genetic loci under evaluation in Sardinella sp.

Locus	Tissue	Polymorphisms
M-Aat-A	Muscle	None detected
S-Aat-A	Muscle	Triallelic
S-Aat-B	Liver	None detected
Acph-A	Brain, liver	Triallelic
Adh-A	Liver	Uncertain
Adh-B	Muscle	None detected
Ak-A	Muscle	None detected
Ald-C	Brain	None detected
Ck-A	Muscle	None detected
Ck-B	Brain	None detected
Ck-2	Brain	None detected
Est-1	Muscle	None detected
Est-2	Muscle	Triallelic
Est-3	Muscle	Triallelic
Ga_3pdh-A	Muscle	None detected
Ga_3pdh-B	Brain	None detected
Ga_3pdh-C	Liver	None detected
G_3pdh-A	Muscle	None detected
G_3pdh-1	Liver	Triallelic
G_3pdh-2	Liver	None detected
Gpi-A	Muscle	None detected
Gpi-B	Muscle	Diallelic
Fum-A	Muscle	None detected
M-Icdh-A	Muscle	None detected
S-Icdh-A	Liver	Diallelic
Iddh-1	Liver, brain	None detected
Iddh-2	Liver	None detected
Ldh-1	Muscle	None detected
Ldh-2	Muscle	None detected
Ldh-3	Muscle	None detected
Mdh-A	Muscle	Diallelic
Mdh-B	Muscle	Diallelic
M_6pi-A	Muscle	None detected
Pgm-A	Muscle	Diallelic
Pgm-B	Brain	None detected
Pgdh-A	Muscle	Diallelic
Pep-1	Muscle	Diallelic
Pep-2	Muscle	Uncertain
Proteins, 1-5	Muscle	None detected
Sod-A	Muscle, brain	Uncertain
Tpi, 1-4	Brain	None detected
Xdh-A	Liver	None detected

PRESENTER: Chris Gelhed

Grant No. 89NMFS04

TITLE: Latent Resources Research in the Gulf of Mexico

INVESTIGATORS: Andrew J. Kemmerer (Principal Investigator/Applicant), Wilber R. Seidel (Co-Principal Investigator), and Walter F. Gandy (Co-Principal Investigator)
Mississippi Laboratories - Southeast Fisheries Center
National Marine Fisheries Service
Post Office Drawer 1207
Pascagoula, MS 39568-1207

INTRODUCTION: Latent resources in the Gulf of Mexico represent a large and potentially valuable commercial resource. Because of their presumed large biomass and trophic importance for a number of marine species, however, the ecological consequences of a significant commercial fishery could be profound. Research under the Latent Resources Program thus seeks to provide information both for gaining a good understanding of the ecology of these resources for wise and effective management, and for aiding in the development of those resources which have potential for supporting commercial fisheries.

The Latent Resources Research Program was initiated modestly in 1983 through adjustments in Southeast Fisheries Center funds. Early successes and needs prompted the transfer of the NOAA Ship CHAPMAN to the Gulf in 1984 as a primary research vessel, and special Congressional appropriations in FY 85 and FY 87 helped support the program. Funding support from MARFIN in FY 86, FY 87, FY 88, and FY 89 has been essential for maintaining the program. The major initial success was identification of a large resource of unused butterfish, and accompanying information on safe yield potentials and fishery ecology. A commercial fishery for Gulf butterfish began in 1986, involving vessels both from New England and the Gulf. In response to this development, the Gulf of Mexico Fishery Management Council has begun preparation of a fishery management plan for butterfish based to a large extent on information provided by the program.

SUMMARY OF RESULTS: Research was accomplished under six categories: resource surveys, sampling gear development, observers and port samplers, survey technology, handling and processing technology, and technology transfer. Four survey cruises were conducted with the NOAA Ship CHAPMAN, with portions of each of the cruises used to complete an evaluation of midwater trawls for sampling coastal herrings. This evaluation resulted in a compromise design that allows the trawl to be operated midwater, near bottom, and on the bottom. This trawl, of a supermesh design and construction, was procured late in FY 89 and will be field tested in FY 90. Observers continued to collect information on butterfish, bycatch, and other latent resources from cooperating trawlers. Although commercial activities for butterfish were reduced during FY 89 because of market problems, observers provided fishery-dependent data that can only be obtained at sea and helped to ensure that landing data from all vessels operating in the fishery were collected.

Upgrading survey technology for fishery-independent surveys continued with emphasis on hydroacoustics and satellite remote sensing. Applications of satellite technology for tactical direction of survey efforts with benefit for commercial fishing was continued through a cooperative pilot study with the Mississippi Office of Technology Transfer at the Stennis Space Center and with Mississippi State University. The project provided hardware with which to communicate and display near real time satellite imagery on four cooperating fishing vessels to pinpoint high probablity fishing areas while at sea. An acoustic echo integrator system was acquired in FY 89 that uses two dual-beam transducers in a towed body to acquire and process in situ target strength measurements and provide extimates of biomass. This will become an important tool in fisheries survey activities once the system is operational and incorporated into survey strategy.

Herring samples were provided to a large number of potential buyers and processors. Some test marketing of several species in Japan was done through two marketing shows in Japan. As a result of not being able to respond to many questions related to handling and processing of coastal herrings and butterfish, the Charleston Laboratory in cooperation with the Mississippi Laboratories entered into a formal cooperative research agreement with Mississippi State University to establish an experimental seafood processing plant in Pascagoula to help solve handling and processing problems.

Technology transfer continued to be emphasized through workshops, demonstrations, and direct technical assistance with much of it done in cooperation with Sea Grant. Work was directed at encouraging fishermen to try the new butterfish fishery, and to develop information for recreational and commercial fishermen and organizations. This included the cooperative study to demonstrate the use of computers and communication systems on Gulf fishing vessels to evaluate satellite assisted fishing operations.

SUMMARY OF COASTAL HERRING PANEL DISCUSSION

- Major market for butterfish has been Japan. In comparison to Atlantic butterfish, Gulf butterfish have a lower fat content and parasites.
- Major problem with butterfish has been small size and tremendous quantities landed last year, i.e., saturation of the market. Market outlook remains fair, despite problems.
- Five years of data have been accumulated on several coastal herring species, which should allow an estimate to be made of stock sizes.
- Fish-environment relationships derived from remotely sensed data are useful mainly as an aid to survey and sampling.
- Satellite data presented to fishermen via television should create new approaches to fishing by recreational as well as commercial fishermen.

SESSION III

OCEAN PELAGICS

Frontal zones, thermal variability, and tuna catch and effort in the Gulf of Mexico (NA89WC-H-MF015)

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INTRODUCTION

A significant longline fishery for tuna has recently developed in the Gulf of Mexico. Tuna, as ocean pelagics, are believed to aggregate along regions of rapid sea surface temperature change (fronts). This behavior, if it occurs consistently in the Gulf of Mexico, has important implications for: 1) the relative success of the fisherman who might locate a productive frontal region; and 2) the assessment of the tuna stocks, i.e. tuna catch and effort statistics will be biased, and will give an inaccurate indication of the stock status, if effort is concentrated at (or away from) regions where the tuna might be aggregated. In this study we are developing and/or examining two data sets: the tuna catch and effort information compiled from the longline fishery's logbook records, and a collection of satellite images depicting the patterns of sea surface temperature in the Gulf of Mexico. Our objectives are to analyze the satellite thermal imagery to assess the seasonal distribution and persistence of frontal regions, and to evaluate the concurrent tuna catch and effort information with regard to these zones to determine whether such regions provide increased fishing success.

SUMMARY OF RESULTS

Logbook information for the Gulf of Mexico longline fishery spanning the period from mid-September, 1986 through all of 1987 was for the Gulf of Mexico was acquired from the National Marine Fisheries Service. This data set was examined for validity, and records with questionable data were eliminated. Additionally, a portion of the records where the geographic coordinates of the set were not recorded, or only recorded to the nearest whole degree of latitude and longitude, were eliminated. The resultant data set contained information for 4,141 longline sets. All subsequent results and discussion were derived using this data set. Yellowfin tuna catch per unit of effort was computed by summing the numbers of tuna kept and the numbers discarded, and computing the number of tuna caught per 1,000 hooks.

Figure 1 presents a plot of the number of sets taken each day. Generally there were ten to fifteen sets each day throughout the year, with little evidence of a seasonal pattern to the fishing effort. These sets were generally successful at capturing yellowing tuna. Figure 2 illustrates the percentage of a sets on a given day that caught at least one yellowfin tuna, and it is evident that the percentages of successful sets is high throughout the year, with the exception of a decline in the success rate that occurred between January and April of 1987. The overall mean number of yellowfin caught

per 1,000 hooks for all data was 13.9, and the median yellowfin CPUE was 10. Figures 3 and 4 indicate that there was little seasonal trend in yellowfin CPUE about this mean value, with the exception of a possible depressed CPUE between January and April of 1987 (coincident with a reduction in the percentage of successful sets) and a possibly elevated CPUE during the late summer and early fall of 1987.

Effort in this fishery is largely concentrated in a zonal band between 26° and 28° N latitude and west of 88° W longitude, and the region north of 26° N latitude and between 86° and 90° W longitude (offshore of the Mississippi River delta). Figure 5 is a plot of the yellowfin CPUE for May, 1987. The sizes of the circles are scaled relative to the CPUE, and the two circles on the Florida peninsula represent 5 and 25 yellowfin per 1,000 hooks. Crosses on the figures indicate longline sets where no yellowfin were reported as being caught, and it is apparent that virtually all longline sets during May of 1987 caught at least one yellowfin tuna.

The distribution of sea surface temperature is obtained from images acquired by the Advanced Very High Resolution Radiometer (AVHRR) aboard the NOAA 9, 10, and 11 satellites. A primary source of images data is an archive of cloud-free images compiled by the Fisheries Image Processing System of the National Marine Fisheries Service at the Stennis Space Center. We have supplemented these images with additional data obtained from the National Environmental Satellite Data Information Service. Presently we have available images for 84 dates, with 54 of these coincident with the logbook data presently available to us. Each vertical line on Figure 1 corresponds to an image of the Gulf that has been registered to geographic features and where the information in AVHRR channels 4 and 5 has been converted to sea surface temperature. We have processed slides of these images, and these will be presented at the oral presentation. Work to be completed on this project involves processing these images utilizing edge detection techniques to obtain a measure of the frontal gradient. For each geographic location we then plan to evaluate the strength of the statistical relationship between yellowfin tuna CPUE and the magnitude of this gradient.

Figure 1

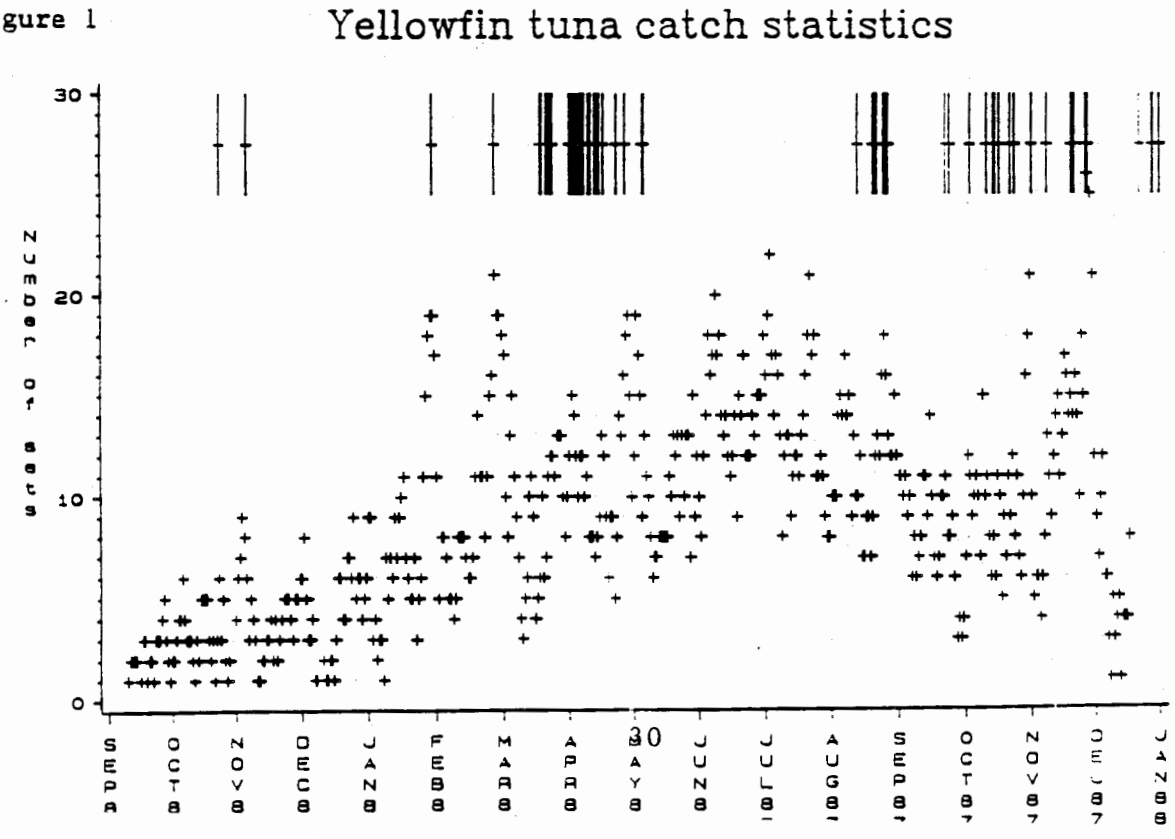
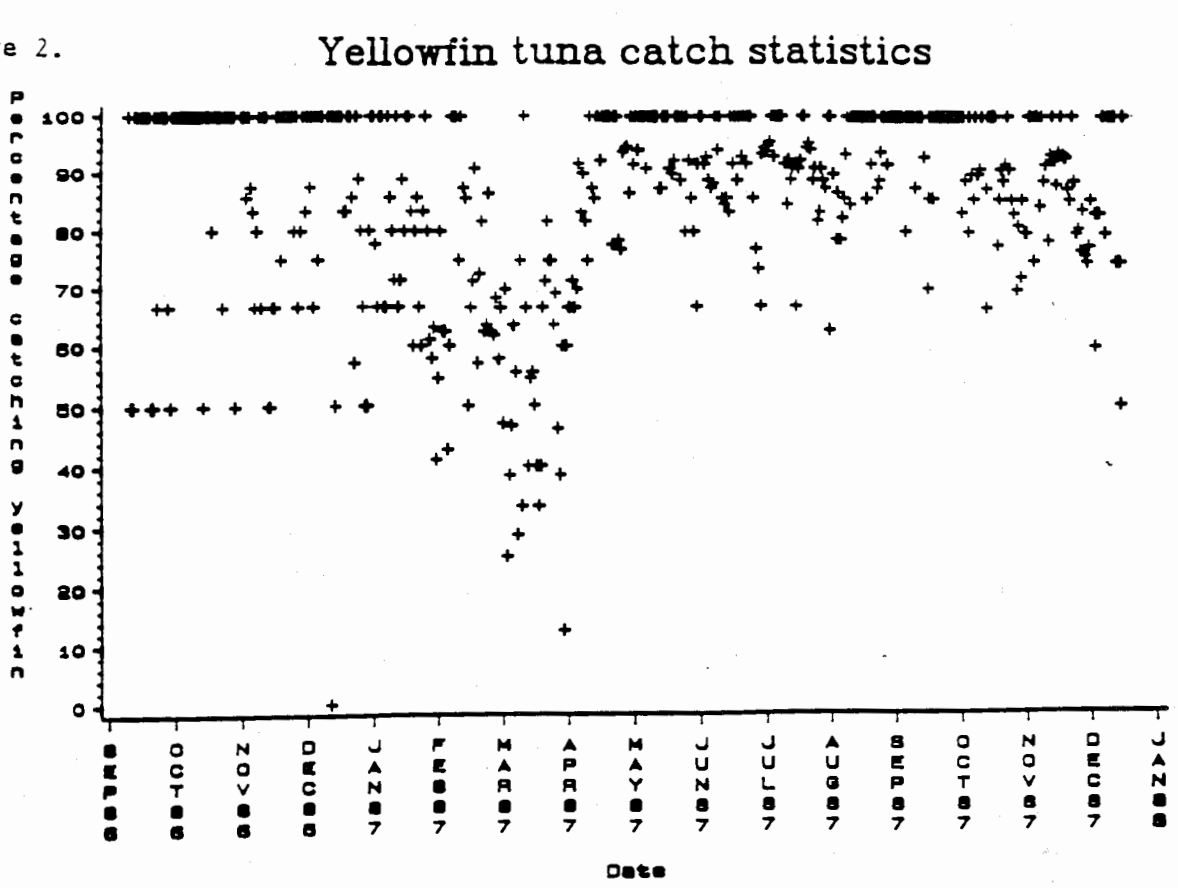


Figure 2.



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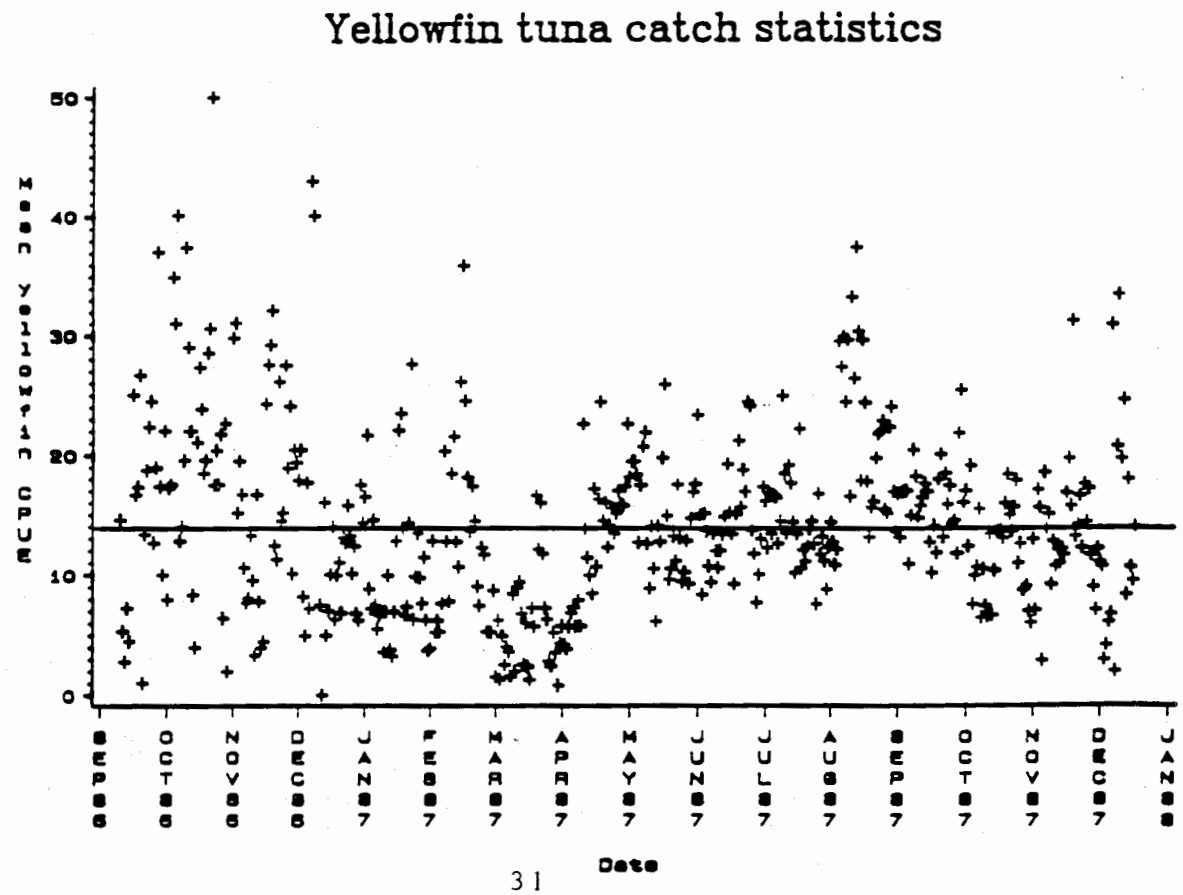

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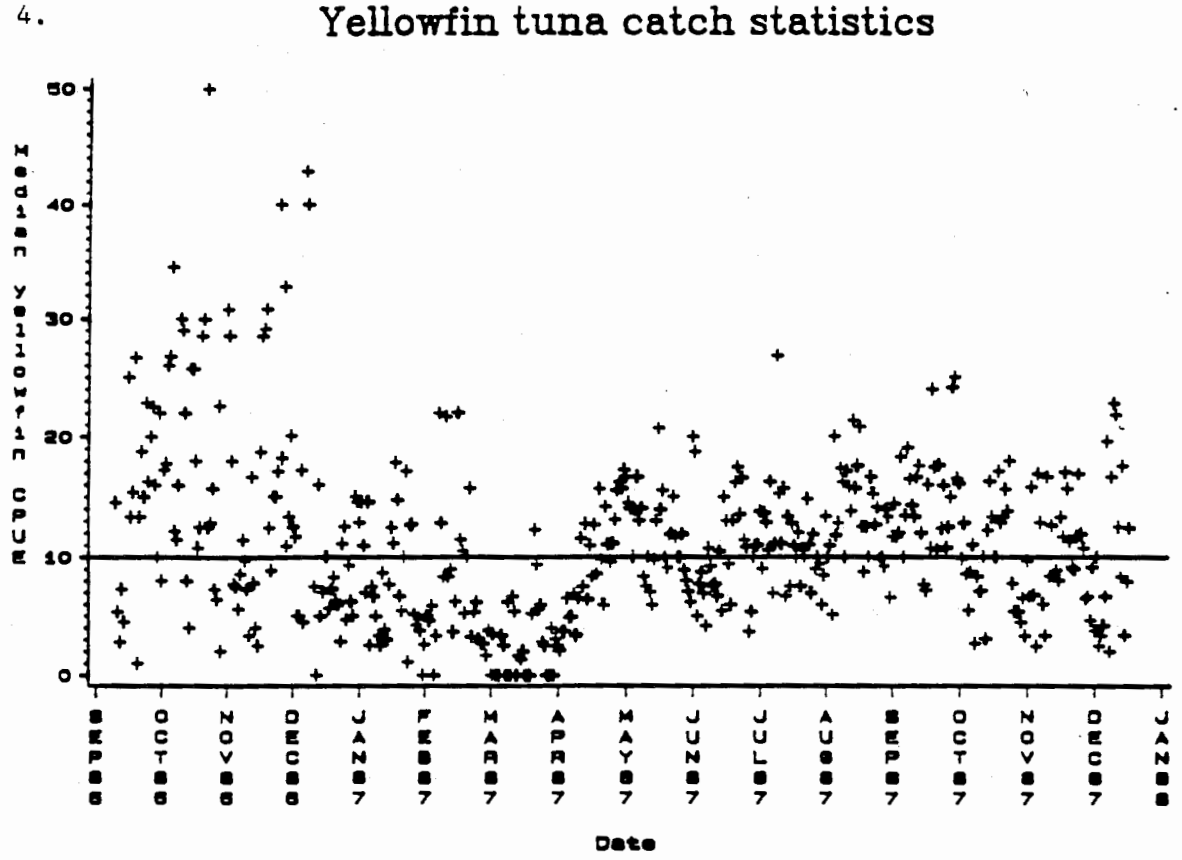
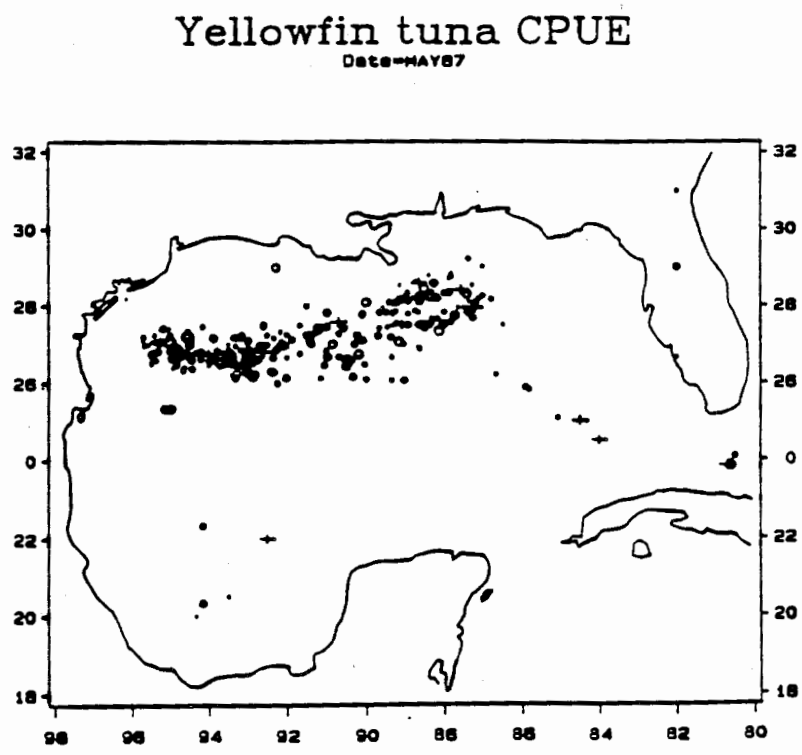


Figure 5.



BIOLOGICAL AND CATCH/EFFORT DATA COLLECTION FROM THE DOMESTIC TUNA LONGLINE FISHERY IN THE NORTHERN GULF OF MEXICO

MARFIN Project #NA89WC-H-MF014

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The goal of this project was to document catch/effort, by-catch, and biological data from the domestic tuna longline fishery in the northern Gulf of Mexico. This study was a one-year renewal of the 1987-88 MARFIN tuna project. Observers were hired to go to sea aboard tuna longline vessels to record detailed effort information, numbers and species of retained and discarded by-catch, lengths and weights from all fish broughtaboard, estimated lengths and weights of discarded fish, and dock weights. All data is being computerized at LSU and will be sent to NMFS-Miami Lab via tape when completed and verified.

LSU had better luck with hiring observers this year although one had to be fired for incompetence due to alcoholism. However, from October 1, 1988 through mid-August 1989, LSU observers took 18 trips aboard 9 different tuna vessels (4 of which were Vietnamese-American) for a total of 159 sea days. These 18 trips produced a retained catch of 408 yellowfin tuna, 27 blackfin tuna, and 225 fish of 14 other species. This retained by-catch was dominated by common dolphin (44.4%), swordfish (20.4%), blacktip sharks (15.1%), and wahoo (12.9%). The discarded by-catch included 321 fish of 34 species and was dominated by spinner sharks (17.1%), little tunny (14.3%), blue marlin (12.1%), yellowfin tuna (11.2%), and sandtiger sharks (11.2%).

Four bluefin tuna were also part of the discarded by-catch; two were alive when released. The bluefin remained in the Gulf an unusually long time this year and longliners were still catching them in late June. Shark by-catch was also unusually high this year, and there was persistent, widespread destruction of hooked fish by sharks. There were 14 sailfish (42.9% alive), 8 white marlin (75% alive), and 39 blue marlin (53.8% alive) recorded from the 52 tuna sets. Some were tagged by the boat captains before being released.

The use of live bait has become almost universal throughout the Gulf tuna fleet. Big-eye scad is the favorite bait species because it is easy to catch and very hardy, but chub mackerel, blue runner, and pinfish are used successfully as well.

THE APPLICATION OF PELAGIC LONGLINE DATA IN REDUCING BILLFISH BY-CATCH AND RESOURCES MONITORING

(Grant # NA89WC-H-MF013)

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Introduction

Pelagic longlining has had a long and erratic history in U.S waters. During the early 1960's the Japanese fleet entered U.S. waters and longlined for tuna until they abandoned the fishery in 1981. During this period two data collection and reporting programs were implemented: 1) the Japanese Quarterly Statistical Report (1963-1981), and 2) the Foreign Fisheries Observer Program (1978-1981).

The Foreign Fisheries Observer Program was developed by NMFS to address rising concern over billfish and shark by-catch by the Japanese. Data obtained during this program provided accurate records of Japanese activity and raised questions about the validity of the Japanese data available through the required reporting program. When the Japanese abandoned the fishery in 1981, U.S. concerns over targeted and non-targeted pelagic resources eased. During the past several years, however, domestic landings of tuna have increased significantly and new concerns have been raised regarding tuna and billfish resources.

The present project was designed to; 1) use existing NMFS longline data (foreign and domestic) to determine relationships between billfish by-catch and longline fishing techniques that could be applied by the domestic fishery to reduce billfish by-catch, and 2) use existing NMFS data to develop guidelines for a pelagic longline monitoring program.

Summary of Results

Tuna and billfish catches recorded during the foreign observer program are listed by year in Table 1. Although some trends in catch by species appear evident, it is difficult to interpret these data without applying additional information (i.e. target species, area fished, changes in fishing technique, effort in relation to time of year). Domestic tuna and billfish data will not become available through NMFS until September, 1989. The addition of these data along with specific effort information will help define species catch trends over time.

Frequency of co-occurance among species of tuna and billfish observed during the 1978 foreign observer program is presented in table 2. Blue marlin and white marlin co-occurred most

frequently with yellowfin tuna, however, co-occurance was also significant with bigeye tuna and albacore for both species. As with species catch trend data, the addition of specific effort information will aid in the interpretation of these relationships.

Exploratory data analyses on the foreign observer data indicate that there may be some methods available for reducing billfish by-catch by modifying fishing techniques. Factors which may influence billfish catch include bait type, water temperature, barometric pressure, hook depth (gangion length) and various other environmental and positional parameters. It is not clear at this stage of analysis whether these factors are significantly independent from factors influencing tuna catch to be useful. Preliminary analysis of the relationship between catch per unit effort (CPUE) of yellowfin tuna and blue marlin shows that catch of blue marlin is highly correlated with catch of yellowfin tuna (Figure 1). Since CPUE estimates account for differences in effort to explain catch, a possible inference is that abundances of these two species are correlated due to similar environmental or ecological attractions among areas.

Preliminary analyses were conducted in 1987 to determine the feasibility of developing guidelines for a tuna monitoring program from existing NMFS data (Wilson and Render - in press). Based on favorable preliminary findings, guidelines are presently being developed using refined statistical forecasting techniques (Figure 2) and multivariate analyses of the relationship between CPUE, length frequency and the level of sampling effort needed to adequately estimate them.

Table 1. Tuna and billfish catch (number) recorded by U.S. observers aboard Japanese longline vessels from 1978-1981.

Species	Year 1978	1979	1980	1981
Bluefin	822	1,043	1,942	2,488
Bigeye	4,010	2,578	6,575	11,026
Yellowfin	11,109	9,987	5,399	4,802
Skipjack	25	65	23	27
Albacore	1,444	4,357	3,728	6,033
Blackfin	243	1	53	70
Little Tunny	18	---	16	4
Atlantic Bonito	---	---	8	2
Unident. Tuna	23	5	10	107
Blue Marlin	275	197	135	117
White Marlin	1,139	939	432	847
Sailfish	146	106	82	15
Spearfish	104	206	113	29
Swordfish	978	888	1,433	1,843
Unident. Billfish	34	8	10	21

Table 2. Frequency of co-occurance of tuna and billfish species observed during the 1978 foriegn observer program.

Total # of sets = 1,567

	BF	BE	YF	SJ	AL	BL	LT	AB	BM	WM	SF	SP	SW
BE	13												
YF	65	162											
SJ	1	9	16										
AL	8	151	116	7									
BL	2	8	64	10	14								
LT	0	1	6	0	1	3							
AB	0	0	0	0	0	0	0						
BM	18	44	84	3	35	24	1	0					
WM	34	64	160	12	47	61	6	0	70				
SF	15	18	62	7	15	32	1	0	30	47			
SP	7	12	43	6	12	21	3	0	19	39	18		
SW	58	170	205	15	120	58	4	0	50	108	51	29	

BF=bluefin BE=bigeye YF=yellowfin SJ=skipjack AL=albacore
BL=blackfin LT=little tunny AB=Atlantic bonito BM=blue marlin
WM=white marlin SF=sailfish SP=spearfish SW=swordfish

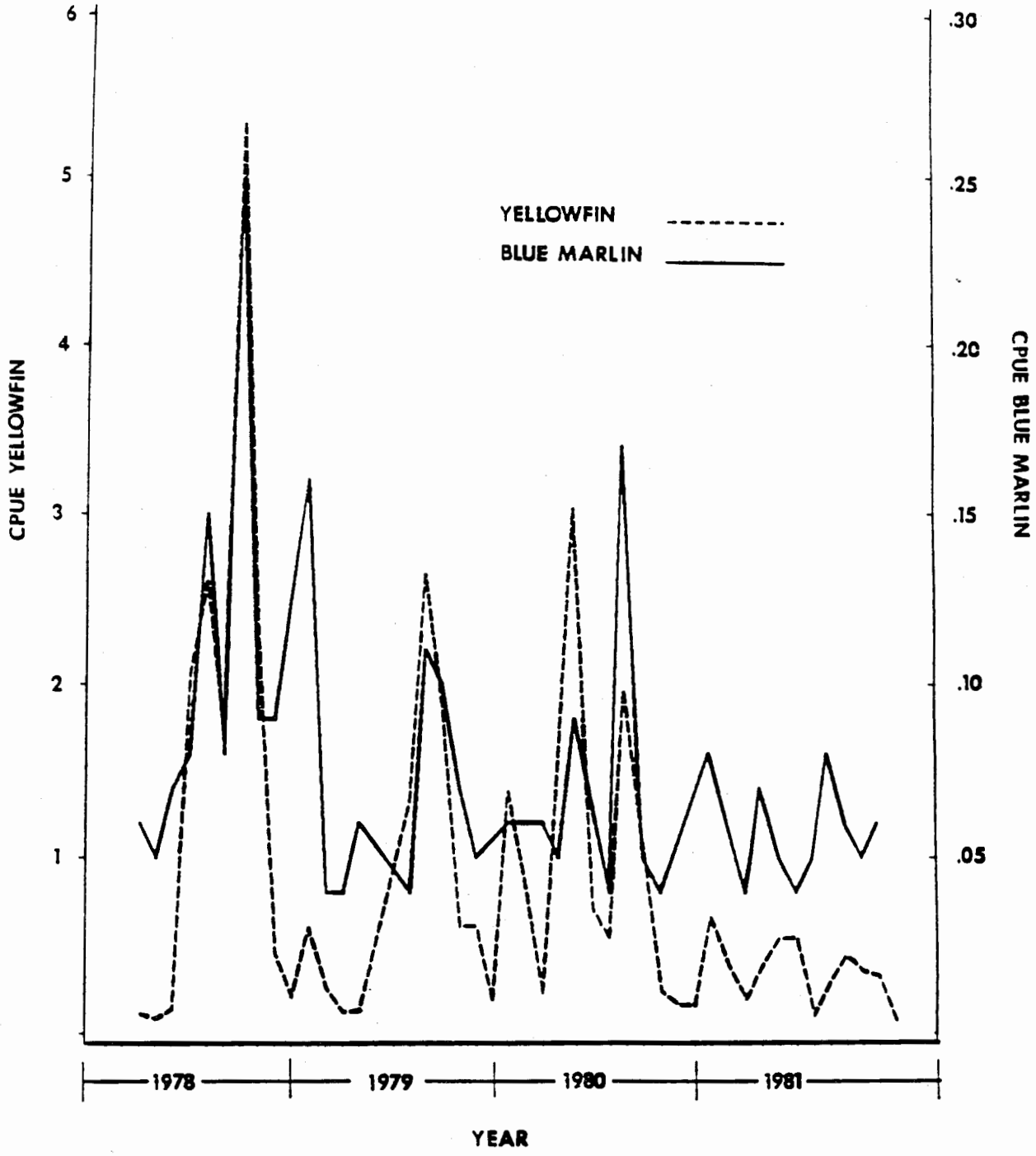

Figure 1. CPUE (catch/100 hooks) of yellowfin tuna and blue marlin observed during the foriegn observer program, 1978-1981.

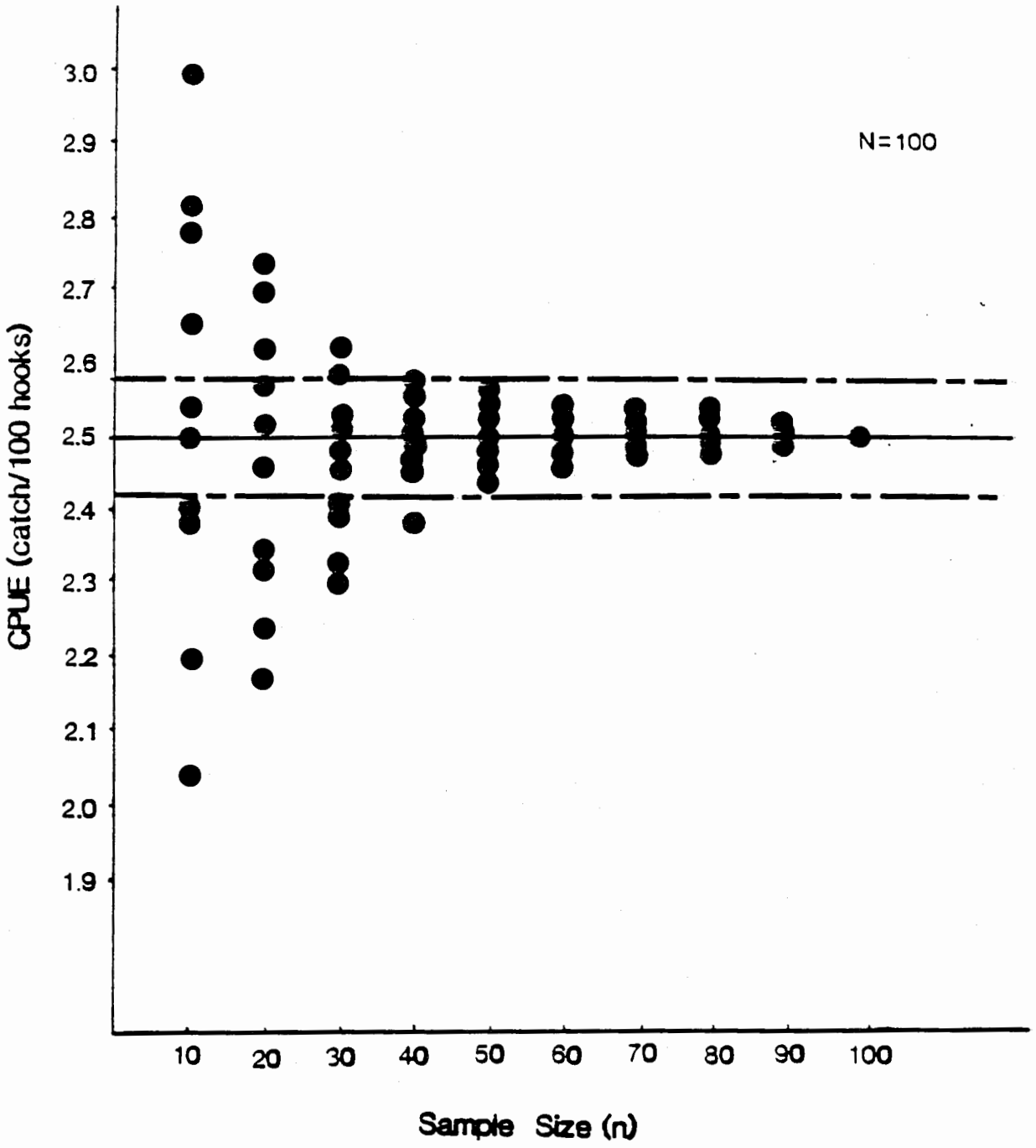

Figure 2. Monte Carlo simulation method for estimating the number of sets necessary to accurately estimate CPUE of yellowfin tuna within 95% confidence intervals.

SUMMARY OF OCEAN PELAGICS PANEL DISCUSSION

- In looking at tuna data sets, it should be noted that the Gulf Council entered into direct negotiations with the Japanese Tuna Association. This caused the Japanese in 1979 to voluntarily agree to cease fishing in the Gulf of Mexico except for the months of January through April.
- No domestic tuna longline sets were observed to catch turtles or marine mammals. This is in contract observation of Japanese longlines, which were observed to catch both.
- In observer sets of sharks retained, the whole shark, not just the fins, is retained and recorded.
- Although the Asian/American boats tend to run longer lines, the trend has been towards shorter lines, i.e., six to fifteen or eighteen miles, and fewer hooks such as the six mile set having 300 hooks. These boats are usually not out for longer than seven or eight days at a time.

SESSION IV

CRABS, LOBSTERS & MOLLUSKS

A SURVEY OF THE RECREATIONAL BLUE CRAB FISHERY IN TERREBONNE PARISH, LOUISIANA (GRANT NO. NA89WC-H-MF005)

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INTRODUCTION

The recreational blue crab fishery is thought to contribute significantly to total harvest of the species, although estimates of recreational fishing pressure and harvest varies widely between states along the Gulf of Mexico. Additional survey data is needed to more accurately define the recreational blue crab fishery.

METHODS AND RESULTS

A survey of the recreational blue crab fishery in Terrebonne Parish, Louisiana was implemented in March,1989 and is to continue through February, 1990. The survey was designed to sample the three major segments of the fishery: (a) land-based fishermen whose primary objective is crabbing; (b) shrimp trawlers who retain crabs as bycatch; and (c) campers who utilize primarily crab traps. Several complimentary surveys were utilized to incorporate the advantages and minimize the disadvantages of each survey:

1. A roving clerk intercept survey along the roadsides to characterize land-based crabbing along roadsides and bayous.

2. An access point intercept survey of recreational shrimp trawlers to quantify the incidental harvest of crabs.

3. A randonmized mail survey of individuals purchasing a salt-water fishing license in Terrebonne Parish to determine overall percent participation in recreational crabbing and other

characteristics of the fishery.

4. A randomized mail survey of individuals purchasing a recreational crab trap license in Louisiana to estimate crabbing effort and harvest with traps.

The roving clerk intercept survey schedule will include one weekend day and one weekday every two weeks from April through September. Data has not been summarized.

Approximately 225 shrimp trawlers were interviewed in May, June, and August. Data has not been summarized.

A total of 752 and 602 questionnaires were sent to licensed saltwater angler and recreational trap fishermen, respectively. The total design method of Dillman (1978) was utilized. By August 25 a return rate of approximately 65% and 67% were obtained for the angler and trap survey, respectively, and questionnaires are still being returned. No data has been summarized.

PRESENTER: Dick Waller

HARVEST POTENTIAL OF THE DEEP SEA RED CRAB, Chaceon quinquedens, AND DISTRIBUTION OF THE GENUS IN THE GULF OF MEXICO

Grant Number NA89WC-H-MF021

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INTRODUCTION

Deep water crabs of the family Geryonidae are widely distributed throughout the world oceans. Species of Geryon (some species have been transferred to the genus Chaceon) form the basis of deep water fisheries along both sides of the Atlantic. Eastern Atlantic fisheries for C. maritae exist off southwest Africa. Commercially exploitable quantities of C. maritae have been found off the Ivory Coast, Congo and Angola.

A fishery for C. quinquedens (red crab) was initiated in the northeastern United States in the early 1970s with an annual catch of 2,500 metric tons reported in 1980. Other western Atlantic species of Chaceon supporting limited commercial fisheries include C. inghami off Bermuda and C. fenneri (golden crab) off Fort Lauderdale, Florida.

National Marine Fisheries Service trawl data and survey information from Texas A&M suggest that geryonid crabs are present throughout the Gulf; however, these data are scant and somewhat contradictory. Initial efforts at fishery development in the Gulf of Mexico were hampered by lack of information on areal and bathymetric distribution patterns of geryonid crabs. Data from MARFIN Project NA87WC-H-06142 identified seasonal, geographic, and bathymetric distribution patterns of C. fenneri and C. quinquedens in the northeastern Gulf. Comparable data were lacking for the central and northwestern Gulf. The present project was designed to address harvest potential and reproductive biology of C. quinquedens, and to determine bathymetric distribution of geryonid crabs in the central and northwestern Gulf of Mexico.

SUMMARY OF RESULTS

Two cruises were completed aboard the Gulf Coast Research Laboratory's vessel R/V Tommy Munro. Five stations (1,6-9) were sampled during each cruise (Figure 1). Sample depth was varied in May and August to adequately cover known bathymetric

distributions of C. fenneri and C. quinquedens. Depths sampled in May were 270, 370, and 470 fathoms. In August, traps were set at 170, 470, and 570 fathoms with the exception of Area 1. In Area 1, traps were set at 470, 570, and 1000 fathoms.

Catch records, size, sex, and bathymetric distributions for C. quinquedens for samples east (MARFIN Project NA87WC-H-06142) and west of the Mississippi River are listed in Table 1. Red crabs west of the river showed deeper depth distribution than did those crabs taken east of the Mississippi River. A single crab was taken at 370 fathoms west of the River, with the remainder of the catch occurring at depths of 470 fathoms and greater. Highest catches were in Area 1 in the north central Gulf. Mean size of females was 117.0 mm in carapace width. Males averaged 130.0 mm in carapace width. Eighty-one percent of the crabs east of the river were equal to or greater than 114.0 mm carapace width (minimum commercial size in the Atlantic fishery) as compared to 62% of those crabs west of the river. Overall male to female ratio was 1:1.6. Analysis of reproductive data is incomplete. Timing of oviposition for females west of the river in May 1989 was similar to data for females collected east of the river in May 1987.

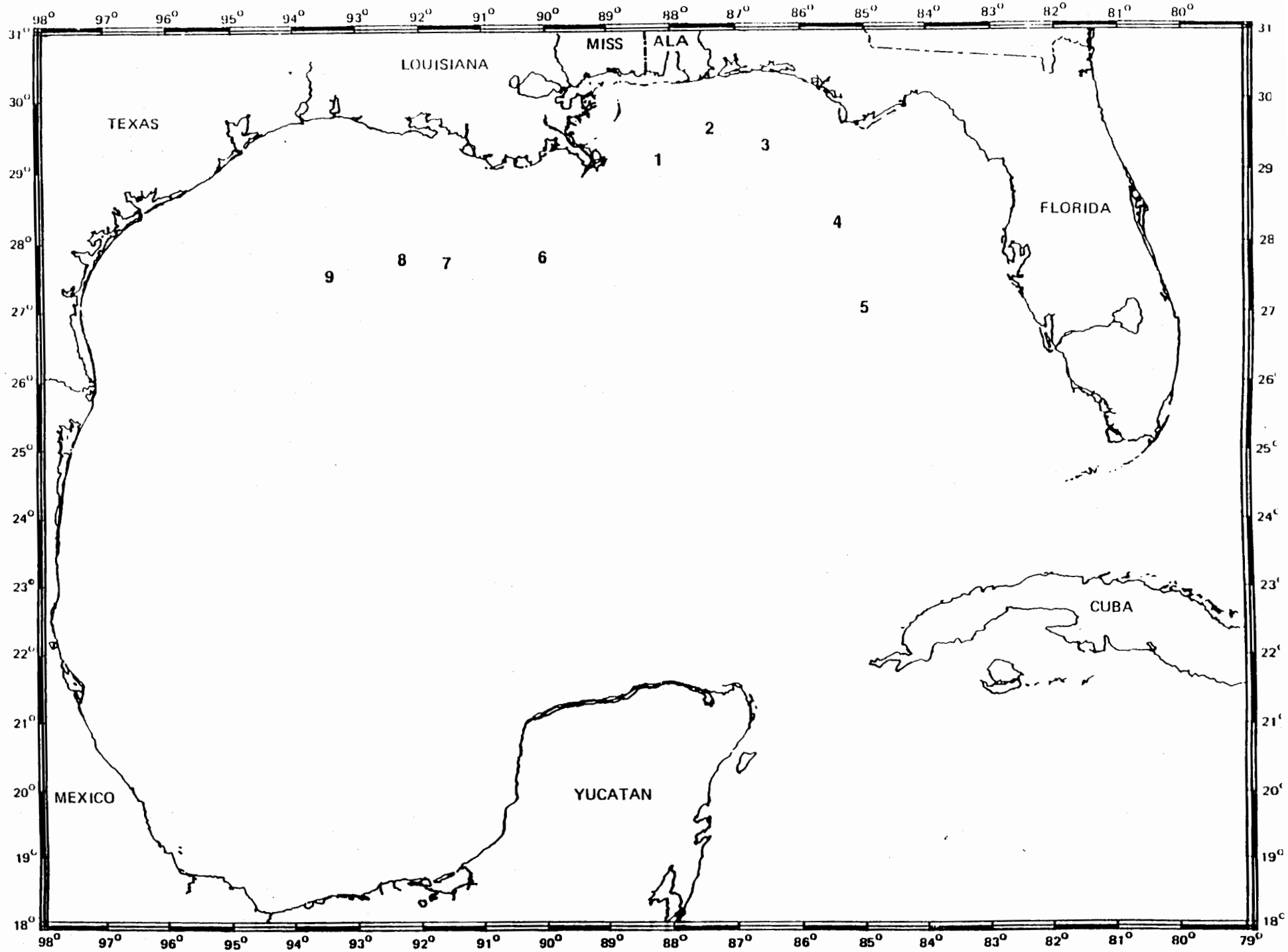

Figure 1. Location of Stations.

Table 1. Summary of catch data of Chaceon quinquedens in the Gulf of Mexico.

Date	Area	Depth	Males				Females				Total No.	Ratio M/F
			Carapace Width				Carapace Width					
			Mean	Max	Min	No.	Mean	Max	Min	No.		
East of Mississippi River												
05/06/87	5	370	127	157	103	79	107	122	92	2	81	39.5:1
02/24/88	5	370	127	150	96	90	106	122	89	26	122	3.5:1
05/08/87	4	370	127	141	115	25	98	106	90	5	30	5:1
08/09/87	4	370	128	141	112	38	122	122	122	1	39	38:1
12/10/87	4	370	132	145	117	12	107	116	100	3	15	4:1
02/26/88	4	370	128	146	93	39	116	116	116	1	40	39:1
05/12/87	3	370	-	-	-	-	123	129	118	2	2	
02/17/88	3	370	-	-	-	-	117	117	117	1	1	
05/13/87	2	370	131	145	118	26	114	133	96	77	103	1:3
08/05/87	2	370	132	146	121	39	116	139	96	95	134	1:2.4
12/01/87	2	370	133	143	124	21	125	128	122	3	24	7:1
02/14/88	2	370	130	150	117	53	117	136	99	99	152	1:1.9
Central Mississippi River												
05/15/87	1	370	134	152	123	29	118	146	99	192	221	1:6.6
08/03/87	1	370	135	159	125	28	121	138	100	153	181	1:5.5
12/18/87	1	370	137	143	122	10	125	144	111	20	30	1:2
02/28/88	1	370	133	148	122	52	124	138	100	92	144	1:1.8
12/07/88	1	370	134	149	120	47	125	137	111	22	69	2.1:1
05/15/89	1	370	133	147	122	42	116	144	93	148	190	1:3.5
08/18/87	1	500	135	156	117	78	117	138	96	117	195	1:1.5
12/06/88	1	500	133	142	123	16	116	127	102	20	36	1:1.3
12/07/88	1	500	132	151	107	22	115	126	101	22	44	1:1
05/15/89	1	470	132	145	108	45	114	133	95	90	135	1:2
08/12/89	1	470	133	148	123	62	115	137	95	106	168	1:1.7
08/12/89	1	570	132	147	118	98	114	132	94	56	154	1.8:1
08/14/89	1	1000	127	133	123	3	114	123	103	16	19	1:5.3
West of Mississippi River												
05/13/89	6	470	143	143	143	1	120	140	64	10	11	1:10
08/10/89	6	570	129	140	120	8	118	132	102	18	26	1:2.3
05/11/89	7	370	-	-	-	-	140	140	140	1	1	
05/11/89	7	470	140	140	140	1	128	139	110	28	29	1:28
08/08/89	7	470	138	141	136	4	129	142	114	16	20	1:4
08/08/89	7	570	139	151	127	2	126	137	117	19	21	1:9.5
05/09/89	8	470	-	-	-	-	118	125	112	6	6	
08/06/89	8	470	135	140	130	2	130	142	109	11	13	1:5.5
08/06/89	8	570	95	137	63	40	109	131	76	13	53	3.1:1
05/07/89	9	470	130	136	125	2	114	135	98	64	66	1:32
08/04/89	9	470	125	144	89	9	111	127	92	68	77	1:7.6
08/04/89	9	570	120	139	95	8	110	131	85	23	31	1:2.9

An Economic Analysis of Leasing Activities in the Louisiana Oyster Industry

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Introduction

Louisiana, with a 1988 harvest of almost $31 million, accounts for 25-35% of the nation's oyster production. Though large and an essential element of the nation's oyster supply, economic and financial information specific to Louisiana's oyster industry is lacking. Particularly, little is known of the leased-based operations in the Louisiana oyster industry which are responsible for more than 70% of the state's annual oyster production. Because these leased-based operations can constitute the core reef rehabilitation efforts within the state, the overall objective of this project is to provide an economic analysis of the Louisiana oyster leasing situation.

This will be accomplished by

(a) identifying in a business sense the stability among lease owners

(b) specifying sales agreements between oyster lease buyers and sellers and to use these values to examine the relative economic position of the industry

(c) examining locational movement in leasing arrangements; and

(d) identifying leases serving as collateral for loans for the purpose of determining leverage capacity which might be available for future reef rehabilitation efforts by leasees and to collect particular information on these leases such as acreage, area, etc.

Results

Through 1987, the Louisiana Department of Wildlife and Fisheries has recorded in the neighborhood of three-thousand transfers of leases. Because each transfer often involves several leases, the number of leases transferred, as recorded by the Louisiana Department of Wildlife and Fisheries, runs into the tens of thousands. Efforts continue at Louisiana State University to record all relevant information on all transfers dating back to the early-to-mid 1950's. Information being collected includes:

(a) the number of each transfer

(b) the number of leases involved in each transfer

(c) the acreage of each lease in each transfer

(d) the parish in which each lease is located

(e) a more detailed description of location of each lease that has been transferred

(f) the names of persons/companies involved in each transfer

(g) terms of sales involved with each transfer.

Each lease that has been transferred is being tracked to present to determine how often it is transferred, whether leases in certain areas are transferred more often than leases in other areas, whether there is a relationship between the terms of sales and frequency of transfers, etc. This analysis, dating back to the early to mid 1950's will cover approximately 75-85% of all transfers recorded by the Louisiana Department of Wildlife and Fisheries and the majority of all leases issued in the state since the early 1900's.

Leases serving as collateral for loans, dating back to the early 1970's, have also been identified. Information collected with respect to these loans include:

(a) name of borrower

(b) principal amount

(c) annual rate of interest

(d) leases used as collateral (lease number, acreage, and location)

(e) other collateral used for loan.

Leases not renewed have been auctioned for the past several years. Data on these auctions include:

(a) lease number and acres

(b) location of lease

(c) previous owner and high bidder

(d) high bid.

This information will be collected and tabulated and merged with other data being collected to examine the characteristics of these auctioned leases vis-a-vis other leases in the state.

SUMMARY OF CRABS, LOBSTERS & MOLLUSKS PANEL DISCUSSION

- The Louisiana private lease oyster area is about 300,000 acres.
- In the area off Louisiana and Mississippi, the catch of deep-sea red crabs has been about 200-250 crabs using 6 or 8 traps at a depth of 370-470 fathoms. The sampling rate was three times per year.

SESSION V
ESTUARINE FISH I

Coordinating, Planning and Progress-Reporting Activities of the Cooperative State-Federal Research Plan for Red Drum in the Gulf of Mexico (NA88WC-H-MF196)

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INTRODUCTION

Historically, red drum have been an important component of both recreational and commercial fisheries in the Gulf of Mexico with both sectors of the fishery conducted primarily in the estuarine areas. Increased consumer demand in the early 1980's saw total landings increase from 8 million to 17 million pounds during the period 1979-1986, and much of the increase occurred on the offshore spawning stock. In view of the continuously expanding efforts by both commercial and recreational fishermen, an urgent need arose to manage offshore and nearshore segments of the fishery if conservation and maintenance of the resource was to be effected. However, biological information on size and age composition of offshore schools was inadequate and recruitment of red drum from the estuaries to the offshore spawning stock was thought to be dangerously low.

A meeting of state and federal fishery management agencies in May 1986 undertook to define areas of information need, devise research efforts to answer these needs, and identify the most appropriate and expeditious mechanism for securing funding and develop a research plan. It was decided to use an existing cooperative State-Federal Program, Southeast Area Monitoring and Assessment Program (SEAMAP), to coordinate planning efforts. The SEAMAP Red Drum Work Group, composed of leading university, state and federal management specialists, developed a coordinated research plan specifying objectives, tasks and sampling schemes to meet red drum management needs. This "State-Federal Cooperative Program for Red Drum Research in the Gulf of Mexico: A Three-Year Plan" (Gulf States Marine Fisheries Commission, 1986) is a comprehensive document of information needs in order to permit wise management and use of the Gulf's red drum resource.

RESULTS

Under this umbrella program thirteen separate projects, both single and multi-year, have been conducted by the states, universities and NMFS to examine the red drum resource. MARFIN support to these research projects has provided much-needed management data in many areas: stock identification and assessment, age and growth, migration and the economics of the recreational catch. New assessment techniques have been investigated including aerial surveys and back-calculations from egg and larval densities to estimate spawning biomass. The age

structure of the offshore adult population for this long-lived fish has been determined, and estimates of the escapement rates of juveniles from estuarine waters calculated.

The specific objectives for this coordinating, planning and progress-reporting project are (1) to facilitate planning of cooperative activities concerning red drum research and enable evaluation of the Cooperative Program's status and progress through the SEAMAP Red Drum Work Group; and (2) to prepare and distribute information on the Program's progress to all interested persons and organizations via the newsletter Sciaenops.

The Economic Value and Policy Implications of Recreational Red Drum Success Rate in the Gulf of Mexico
NA87WC-H-06146

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Introduction

This research was completed July 1989 with MARFIN funds under the State-Federal Cooperative program for Red Drum Research in the Gulf of Mexico. The goal of the project is to provide information to the Gulf Council and other state regulatory agencies that can be used to draft and implement a viable red drum fishery management plan for EEZ and state territorial waters. This research is among the few serious non-market economic studies of Gulf recreational saltwater fishing. The final report details six specific tasks to accomplish the goal, as listed below.

1. Socioeconomic profiles
2. Test catch hypotheses:
   - Ho: Sporting motive: red drum catch has no influence on recreational fishing effort
   - Ha: Consumptive motive: red drum catch has an influence recreational fishing effort: if Ha is true, determine whether success rate elasticity magnitude is greater than the "Green" coefficient presented at the Florida gamefish hearings
3. Travel cost models of red drum sportfishing: (a) continuous pooled site models, (b) discreet/continuous Heckman model, and (c) discreet choice multiple site multinomial logit model--data sources: NMFS 1986 MRFSS intercept survey and the NMFS 1981
4. Socioeconomic Survey intercept/phone follow-up (SES) Marginal welfare effects (net benefits) associated with changes in red drum catch allocations to anglers
5. Economic impacts (income and employment) associated with changes in recreational red drum allocations
6. Policy implications and recommendations

Major Findings

Socioeconomic profiles indicate red drum target anglers, who average slightly less than 40 years of age and live closer to home than other angling groups, rank catching fish only behind sport as the primary motivation for fishing. The 1981 SES indicates red drum anglers are more likely to be retired and are skewed toward a lower end of the income distribution than other angling groups. Red drum anglers overwhelmingly respond that number, size and species of fish caught are the primary reasons for trip satisfaction, though the level of satisfaction did not differ significantly from other groups. This

conclusion is corroborated with a discreet logit model of trip satisfaction. There is no current species specific profile data.

The study rejects the null sporting hypothesis in favor of the alternative consumptive motive that red drum catch significantly affects fishing effort. Success rate magnitudes estimated with the Heckman sample selection model are elastic. All else constant, an increase of 10 percent in expected red drum catch would, on average, tend to raise red drum fishing effort by a bit more than 10 percent. In analyzing impacts, however, a more conservative central tendency elasticity that eliminates highs and lows is adopted to avoid any overstating of recreational impacts from substitution effects.

Travel cost demand models, both continuous and discreet choice, performed very well, considering the data constraints. Empirical performance is greatly improved by incorporating theoretically sound catch behavior derived from the angler utility function, and specifying the second generation labor supply model. A significant interaction effect of red drum catch with other popular estuarine species is uncovered, and helps to account directly for species substitution. Discreet models account for site substitution.

The most conservative estimates of per trip marginal net benefits for increases in expected red drum catch rates of 10%, 25%, 50% and one whole fish per outing are $4.04, $9.40, $16.92, and $26.08 for 1986 respectively. Conversely, welfare losses for decreases in expected catch of 10%, 25%, and 50% are -$4.46, -$12.01 and -$28.78, respectively, which are greater than respective gains from the same percentage increase. Anglers are hurt more by taking fish away than they are benefitted by giving fish to them.

Table 1 aggregates net benefits (losses) from changed red drum allocations over the Gulf region on an annual basis. True benefit effects lie between the low and high red drum participation rates, but policy implications rely on the more conservative numbers. Thus, net user benefits accruing to Gulf sportfishermen from catch increases of 10%, 25%, 50% and one fish range from $10.34 million to $66.77 million. If only the EEZ is considered with 1985 allocations as a baseline, a reallocation that year from the commercial sector which increases recreational catch by 10% or 50% is conservatively estimated to generate between $338,000 and $573,135, or between $1.7 million and $2.9 million of recreational net benefits, respectively. By state, the highest valued per-trip marginal benefit rankings, in descending order, occur in Mississippi, Florida and Louisiana; Alabama displays consistently lower marginal values. Table 2 shows total welfare losses associated with a one fish bag limit by state, aggregated over all annual trips.

Baseline and allocation-changed economic impacts of Gulf red drum sportfishing are summarized in Table 3, with direct and multiplier induced effects listed. The largest impacts are felt in the marine services and wholesale/retail trade sector, followed by service stations and eating/drinking places. The greatest employment impacts (not shown) occur in the eating/drinking and service station sectors. The hotel, motel and lodging sector is the least impacted sector in terms of either

income or employment. Table 4 shows large "net" income gains from the baseline by reallocating red drum from the commercial to the recreational fishery.

Policy implications suggest a general pattern of allocating wild red drum stocks toward the recreational fishery, especially in state territorial waters with high recreational net benefit values. If an overall TAC is implemented in the future on biological grounds (SSR), fisheries managers can still move the fishery toward optimum economic yield by achieving a higher level of net societal benefits. This is accomplished by maintaining the higher benefit sector at historical or slightly lower allocations initially, and then gradually raising them as SSR increases in the long run. This reallocation policy would continue until the net benefit flows are approximately equal for both recreational and commercial sectors. At the present time, recreational net benefits (consumer's surplus) exceed commercial net benefits (producer's surplus).

As for the retail and wholesale consumer of red drum as seafood, aquaculture of red drum is a feasible technology that can be incorporated into an efficient management scheme to accommodate market supply. Equity compromises in the short run to compensate industry losses must eventually give way to the necessary moves toward more efficient use of the red drum fishery resource for all users.

Table 1

Marginal Net Benefits From Recreational Red Drum Reallocation Policy in the Gulf of Mexico 1986

Change in Catch per Trip	1986 Pounds of Red Drum (Thousands)	Marginal Change in Recreational Benefits	
		Low Participation Rate (Million Dollars)	High Participation Rate (Million Dollars)
+10%	668.3	10.34	17.57
+25%	1670.8	24.06	40.89
+50%	3341.5	43.32	73.60
+1 Fish	-	66.77	113.45
-10%	-668.3	-11.42	-19.40
-25%	-1670.8	-30.75	-52.24
-50%	-3341.5	-73.68	-125.19
1 Fish Bag Limit	-2339.1	-45.88	-77.95

Table 2

Welfare Losses in the Gulf Recreational Red Drum Fishery Caused By a One Fish Bag Limit (Millions of 1986 Dollars)

Region	Low Participation	High Participation
Louisiana	-4.83	-8.22
Mississippi	-2.64	-4.30
Alabama	-.12	-.21
Florida	-10.53	-51.90
Gulf[b]	-51.00	-77.99

[a]Welfare losses are based on the most conservative state figures and Gulf weighted averages estimated with the multi-site LMNL model.

[b]Gulf welfare losses are adjusted for Texas. State losses do not sum to the Gulf total because of the Texas adjustment, and the fact that individual scores are not a weighted average.

Table 3

Economic Impact of Changes in Red Drum Sportfishing Catch Rate Per Trip in the Gulf of Mexico for 1986 (Millions of 1986 dollars of income)

Red Drum Participation[a]	Low								High							
Impact Change	Change in Income From Baseline Caused by a Change in Red Drum Allocation								Change in Income From Baseline Caused by a Change in Red Drum Allocation							
	Baseline Income		10 percent Increase		50 Percent Increase		One Fish Bag Limit		Baseline Income		10 Percent Increase		50 Percent Increase		One Fish Bag Limit	
Type of Impact[b]	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total
Eating and Drinking Places	20.60	39.6	1.02	1.96	5.14	9.87	-3.61	-6.93	34.97	67.14	1.75	3.36	8.74	16.78	-6.12	-11.75
Service Stations	20.70	35.2	1.03	1.75	5.17	8.79	-3.63	-6.17	35.19	59.82	1.76	2.99	8.80	14.96	-6.16	-10.47
Wholesale and Retail Trade	26.50	49.0	1.32	2.44	6.62	12.25	-4.65	-8.60	45.06	83.36	2.25	4.16	11.27	20.85	-7.89	-14.60
Hotels, Motels and Lodging	5.20	10.3	.26	.51	1.30	2.57	-.91	-1.80	8.83	17.48	.44	.87	2.21	4.38	-1.54	-3.05
Marine Services	37.90	76.2	1.88	3.78	9.44	18.97	-6.65	-13.37	64.30	129.24	3.22	6.47	16.07	32.30	-11.25	-22.61
Gulf Impact	110.90	210.3	5.51	10.44	27.67	52.45	-19.45	-36.87	188.35	357.04	9.42	17.85	47.09	89.27	-32.96	-62.48

[a]Low participation is based upon the bottom line 18 percent red drum participation rate. High participation is based upon the 17 percent rate of red drum sportfishing participation. As discussed in Section 2.2, the true impact values lies between the high and low rates.

[b]Direct impacts do not include multiplier effects. Total impacts measure the direct, indirect, and induced (household) impacts exerted by recreational anglers among the various business sectors.

Table 4

Net Economic Impact of Reallocating Red Drum From the Commercial Fishing Sector to the Recreational Fishing Sector Using 1985 Seasonal Allocation Patterns (Millions of Dollars)

Marine[a] Price Change Scenario	Scenario 1 Marine Price Unchanged		Scenario 2[a] Marine Price Increase	
Increase in[b] Recreational Allocation	+10%	+50%	+10%	+50%
Recreational Impact Gain	5.51	27.67	5.51	27.67
Commercial Impact Loss	-.42	-2.12	-.51	-4.24
Net Economic Impact of Reallocation	5.09	25.55	5.00	23.43

[a]Prices are nominal averages for the Gulf in 1985.

[b]Scenario 2 assumes that the marine price of red drum per pound will rise as marine supply is reduced by assuming a price elasticity of marine red drum demand of -2. [Source: Bell (1978)].

[c]Allocational changes are based upon the 1985 experience, which is more typical of historical recreational-commercial patterns than the 1987-1989 period of emergency regulation.

POPULATION GENETIC STUDIES OF RED DRUM IN THE GULF OF MEXICO

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This project was designed (i) to determine if significant population substructuring (discrete breeding units) exists within the red drum fishery, (ii) to estimate relative levels of mixing (migration) between and among nearshore and offshore red drum sample localities, and (iii) to provide critical scientific information necessary for sound management of the Gulf of Mexico red drum resource. It was initially proposed that sequence variation in mitochondrial (mt)DNAs and allelic variation at polymorphic nuclear gene loci would be examined among both nearshore and offshore red drum from the northern Gulf. Funds for the project, however, were not received until the middle of March, 1989, with the result the no data for this project have yet been procured. Approximately 40% of the samples have been obtained (ca 190 fish), and appropriate tissues have been removed for both mtDNA and protein electrophoresis. The study summarized below represents a two year project designed to obtain base line data on genetic variation among nearshore red drum taken from the Gulf and the Atlantic coasts of the southeastern United States. The study was supported by the Sea Grant College Program and is presented here to update current information on the genetic structure in the red drum fishery.

Red drum specimens were collected in 1987 using gill nets, pound nets, haul seines, purse seines, and hook and line. A total of 474 fish was collected from 14 different sampling localities (Table 1). Thirteen of the samples were from nearshore localities (bays or estuaries) and one sample was from offshore in the Gulf. The majority of individuals taken from nearshore localities were yearlings from the 1986 year class as judged by total length. All of the offshore fish were mature adults. Tissue samples of white muscle, liver, brain, and eye (for protein electrophoresis) and heart, spleen, and kidney (for mtDNA analysis) were taken from each fish and stored in liquid nitrogen. Vertical starch gel electrophoresis and histochemical staining were used to resolve the protein products of 42 presumptive gene loci. Restriction enzyme digestion, horizontal agarose gel electrophoresis, Southern blotting (using cloned red drum mtDNA fragments), and autoradiography were used to resolve restriction fragment length polymorphisms (RFLPs) of red drum mtDNAs. All procedures used are to be published elsewhere.

Allelic variation at nine polymorphic protein-coding loci (Table 2) was studied among all 474 individuals. The mean number of alleles over the polymorphic loci was 3.8, and the average heterozygosity over all loci examined (H) was estimated as 0.047. The heterozygosity values for each polymorphic locus are shown in Table 2. These data indicate that red drum have "normal" levels of genetic variability and suggest that the perceived decline in red drum abundance, at least in the Gulf, has not affected the genetic variability base of the species. Significant heterogeneity in allele

frequencies using the G-test was found at a locus for acid phosphatase among samples from the Gulf, at the locus for alcohol dehydrogenase between pooled samples from the Gulf and Atlantic, and at the locus for adenosine deaminase over all samples, among samples from the Gulf, and between pooled samples from the Gulf and Atlantic. A Chi-square test on arcsin square-root transformed allele frequencies. however, detected significant heterogeneity only at the locus for adenosine deaminase for the pooled comparison of Gulf versus Atlantic samples. For several reasons, the latter is the preferred test, suggesting that the only heterogeneity observed which may be statistically defensible is that between red drum in the Gulf versus those in the Atlantic. Wright's F_{st} values [which represent a measure of the reduction in heterozygosity of a sample due to nonrandom mating between samples] over all polymorphic loci ranged from 9.0 to 27.5 (mean F_{st} = 0.019), and estimates of the effective number of migrants (N_em) per generation using Wright's island model ranged from 9.0 to 27.5 (Table 2). Since, in theory, populations will not diverge genetically from one another as a function of genetic drift if the effective number of migrants is greater than one, the estimates of F_{st} and N_em indicate the absence of subdivision among the red drum samples. Additional evidence for high gene flow and a lack of genetic differentiation among all red drum samples were provided by an analysis of conditional allele frequencies (following Slatkin) and by high levels of genetic similarity (following Nei).

Mitochondrial DNAs have now been examined from 9-15 individuals (151 total) from all 13 nearshore samples. The DNAs from the single offshore sample (near Grand Isle, LA) were too degraded for analysis. Forty-seven (47) mtDNA geneotypes or haplotypes have been identified among the 151 individuals using 16 different, six-base recognition enzymes. Of these, six halotypes were found in eight or more individuals, thirty-three were found in three or fewer individuals, and twenty-three were found only in one individual each. Sample heterogeneity using the six halotypes found in eight or more individuals was tested using arcsin, square-root transformations and the "V" statistic. No significant heterogeneity overall, among the Gulf or Atlantic samples, or between the Gulf and Atlantic samples was detected at five of the haplotypes. Significant heterogeneity ($P<0.05$) was detected only between the Gulf and Atlantic samples for halotype #11 (identified as the halotype which possesses the most common restriction pattern for all 16 enzymes). Estimated F_{st} values, based on untransformed mtDNA haplotype frequencies (following Weir and Cockerham), were 0.061 among the Atlantic samples, 0.079 among the Gulf samples, and 0.087 overall. Using Wright's island model, these F_{st} values yield N_em estimates of 3.85, 2.91, and 2.66, respectively.

Based on both protein and mtDNA data, red drum from the nothern Gulf and the Atlantic coast appear to be weakly subdivided despite appreciable levels of gene flow. Red drum within the nothern Gulf and along the Atlantic coast, however, appear to comprise single, randomly mating populations. Further studies to further test this hypothesis are now in progress.

TABLE 1. Red drum sampled during 1987

Locality	Sample Size	Method of procurement	Individuals providing local assistance
Atlantic coast:			
1. Oregon Inlet, NC	15	Angling	None
2. Pamlico River, NC	23	Pound net	Jeff Ross[1]
3. Georgetown, SC	18	Angling	Dennis Allen[2]
4. Charleston, SC	34	Angling	Charlie Wenner[3]
5. Hilton Head, SC	50	Angling	Fuzzy Davis[4]
Gulf coast:			
6. Sarasota Bay, FL	49	Haul seine	Mike Murphy[5]
7. Riviera Bay, FL	24	Angling	None
8. Apalachicola Bay, FL	24	Angling	Chip Bailey[5]
9. Ocean Springs, MS	50	Gill nets	Tom McIlwain[6]
10. Hopedale, LA	50	Angling	Chuck Wilson[7]
11. Offshore, LA	28*	Purse seine	Andy Kemmerer[8]
12. Grand Isle, LA	50	Angling	Rickey Cheramie[9]
13. Galveston Bay, TX	32	Gill nets	Andy Landry[10]
14. Port Aransas, TX	27	Angling	Rich Tillman[11]

*Sample obtained by the National Marine Fisheries Service, Pascagoula, MS

1 North Carolina Division of Marine Fishes
2 Baruch Marine Laboratory, University of South Carolina
3 South Carolina Wildlife Department
4 Private fishing guide
5 Florida Bureau of Marine Research
6 Gulf Coast Marine Laboratory
7 Center for Wetlands Resources, Louisiana State University
8 National Marine Fisheries Service
9 Private landowner
10 Texas A&M University at Galveston
11 Texas Agricultural Extension Service

TABLE 2. Summary data on genetic variation in red drum

Locus	#Alleles	$\underline{h}$	F_{st}	N_em
Acid phosphatase-2	2	0.162	0.020	12.25
Adenosine deaminase	11	0.703	0.027	9.01
Alcohol dehydrogenase	4	0.495	0.025	9.75
Esterase-1	2	0.167	0.016	15.37
Glutamate-oxaloacetate transaminase-1	4	0.214	0.020	12.25
Glucose phosphate isomerase-B	3	0.062	0.009	27.53
Peptidase-B	3	0.027	0.017	14.46
Peptidase-D	3	0.081	0.017	14.46
Peptidase-S	3	0.062	0.021	12.25
	$\bar{x}$ = 3.8	0.047	0.019	12.91

Life History Studies of Red Drum Populations in Mississippi

Grant #'s
NA86-WC-H-06137 & NA87WC-H-06127

James Ray Warren & Dr. Thomas D. McIlwain
Gulf Coast Research Laboratory
P.O. Box 7000
Ocean Spring, MS 39564

Introduction

A study of the life history, distribution and migration of red drum in Mississippi's coastal waters was initiated in October 1986 and has continued through September 1989. Sampling design included seines, beam plankton nets, variable mesh gill nets and bongo nets to be taken at various locations in or near the four Mississippi estuarine systems (Figure 1). These samples have provided information on seasonal occurrence and abundance of larval, juvenile and sub-adult red drum from the time they enter Mississippi Sound until they migrate out of the system.

Summary of Results

Recruitment of postlarval red drum into Mississippi's inshore waters was indicated by small fish appearing in shoreline BPL samples as early as September and continuing to be present as late as November (Figure 2). Peak immigration occurred in October each year. Small juvenile fish occurred in beach seines October through May (Figure 2). Fish taken in the BPL and seine samples represented 0-age class fish.

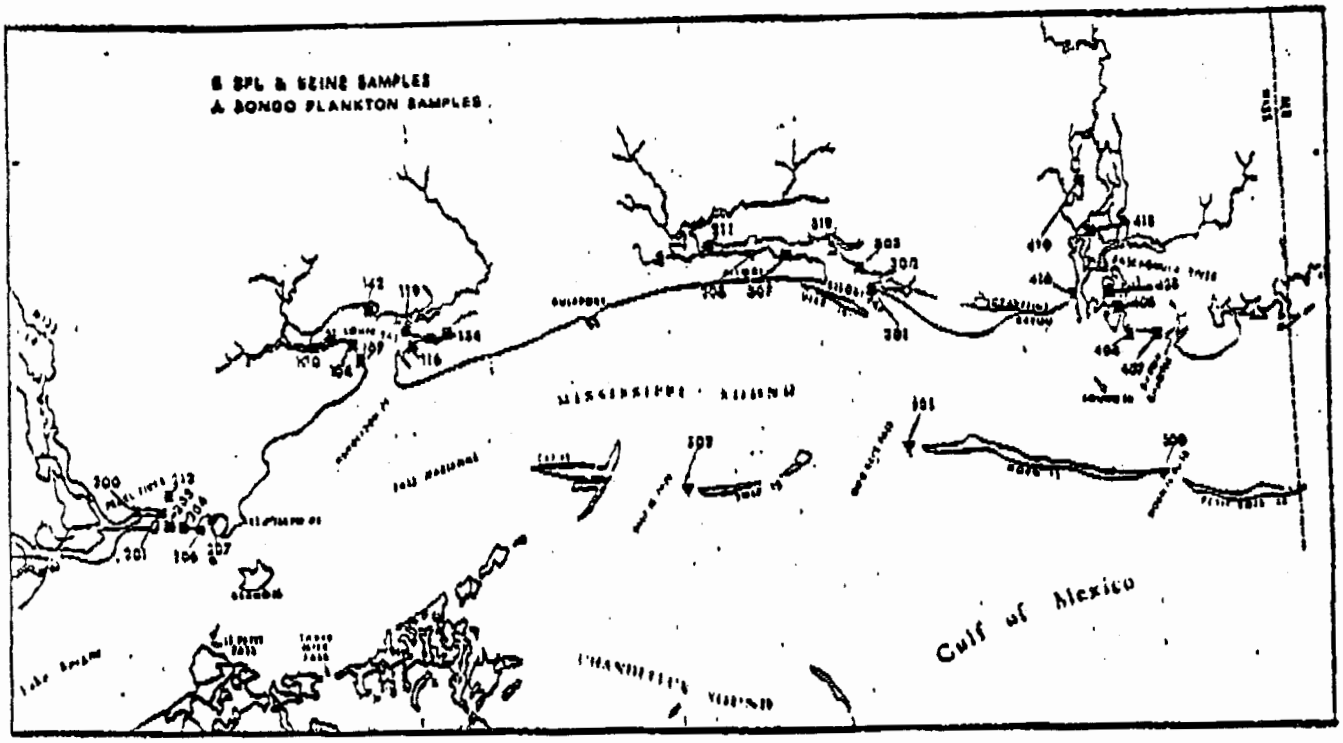
Sub-adult red drum were present in gill net samples during all months (Figure 2). These fish were most prevalent during early spring and late fall.

Length distribution by month for all gear-types/samples showed the presence of 0-age and 1-age year classes in inshore waters with very few older fish captured (Figure 3). Monthly length-frequency distributions of tagged fish returned by sports fisherman indicated that exploitation by this method operated on fish that were age 1+ (10-20 in.,Figure 3) but less that 2 years of age. These data are further supported by recreational creel survey data (Figure 3). Creel data was supplied by Mississippi Department of Wildlife, Fisheries and Parks - Bureau of Marine Resources.

A total of 912 subadult fish were tagged from October 1986 through July 1989. A total of 192 fish have been returned through July 1989 giving an overall return rate of 21 %. Most of these returns (167) were from hook and line fishermen giving a 18.3 % return rate for this gear. This relatively high return rate indicates considerable mortalities inflicted on 1-age to 2-age class fish inshore. The notable absence of fish above 20 inches (approximately 2 year of age) could possibly be contributed to the mortality inflicted by the hook and line fishery for this species in Mississippi's inshore waters.

Tag returns indicated that most fish moved very little. When fish moved in excess of 10 miles, that movement was generally toward the east. One fish was reported caught 278 miles from the release site. Most (77%) moved less that 5 miles and of those 47% moved nowhere.

Tagged fish were at large from 0 to 691 days. Distribution of days at large by thirty-day intervals indicated that the return of tagged individuals was relatively constant over the first six months at large.



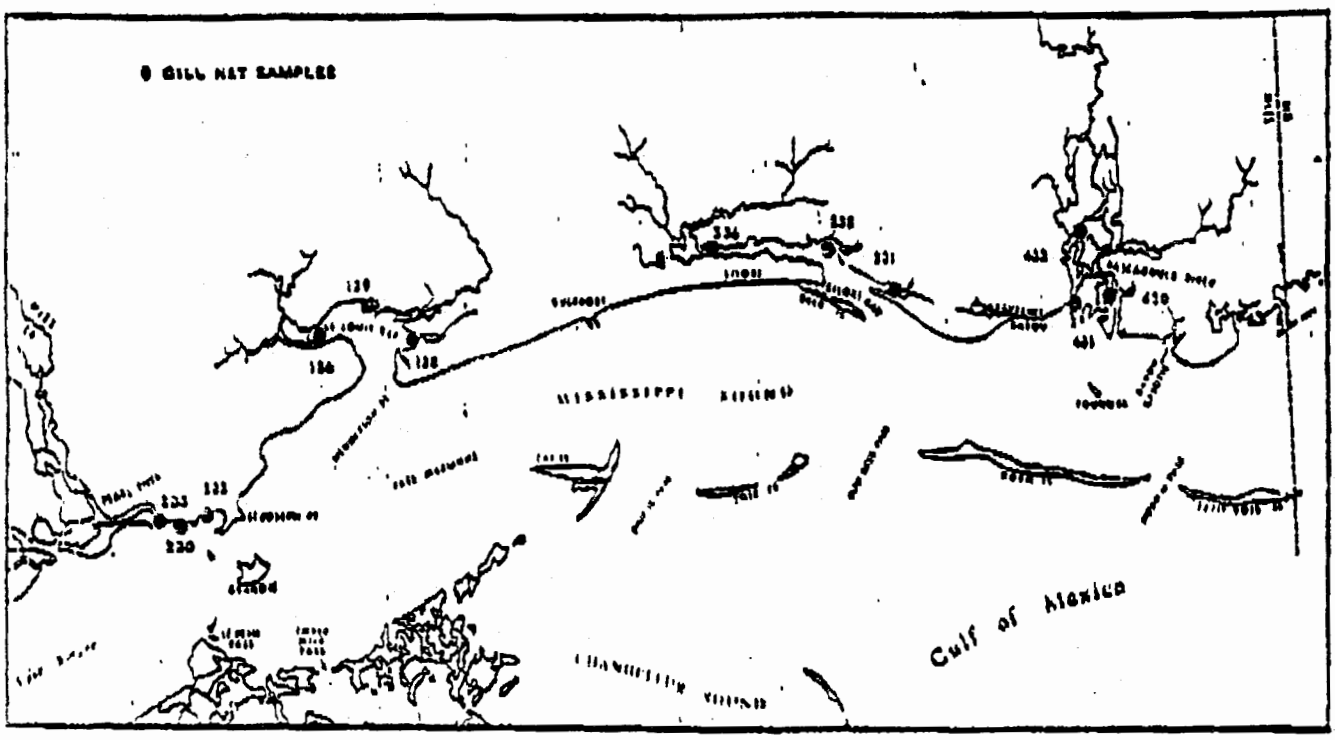


Figure 1. Sampling stations for red drum in Mississippi.

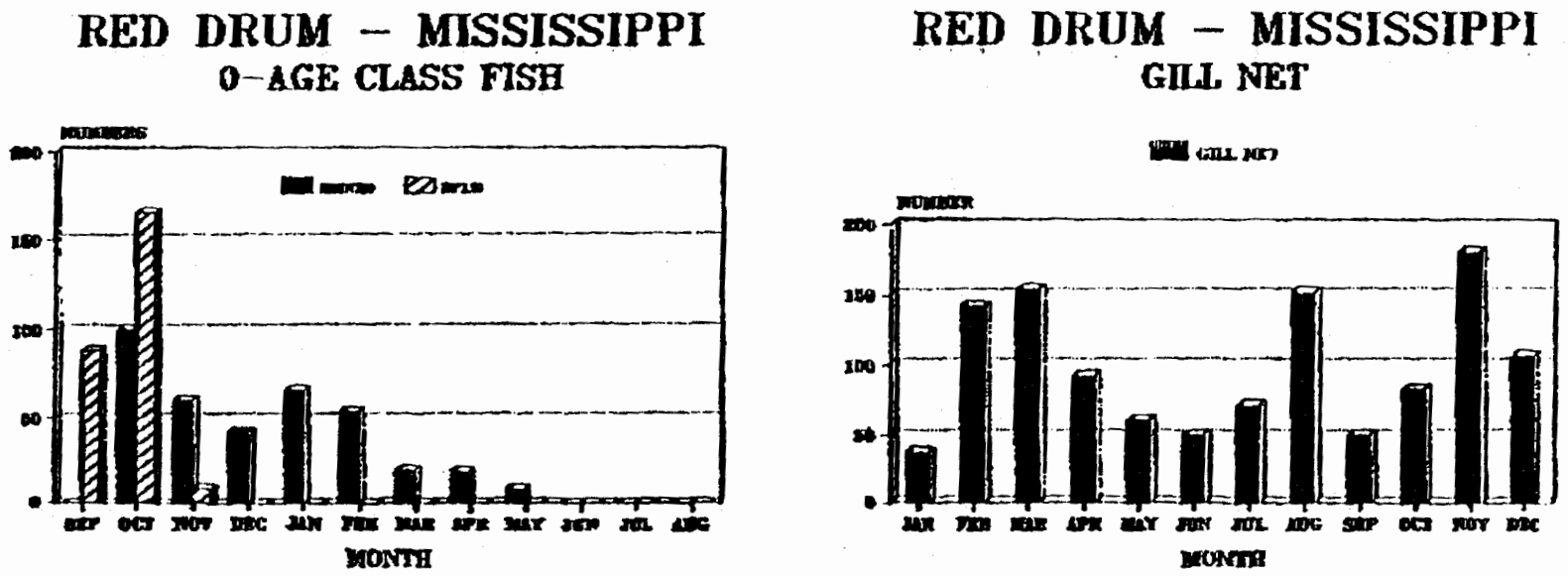


Figure 2. Catch by month of red drum in MRFSS, Seines and Gill Nets in Mississippi.

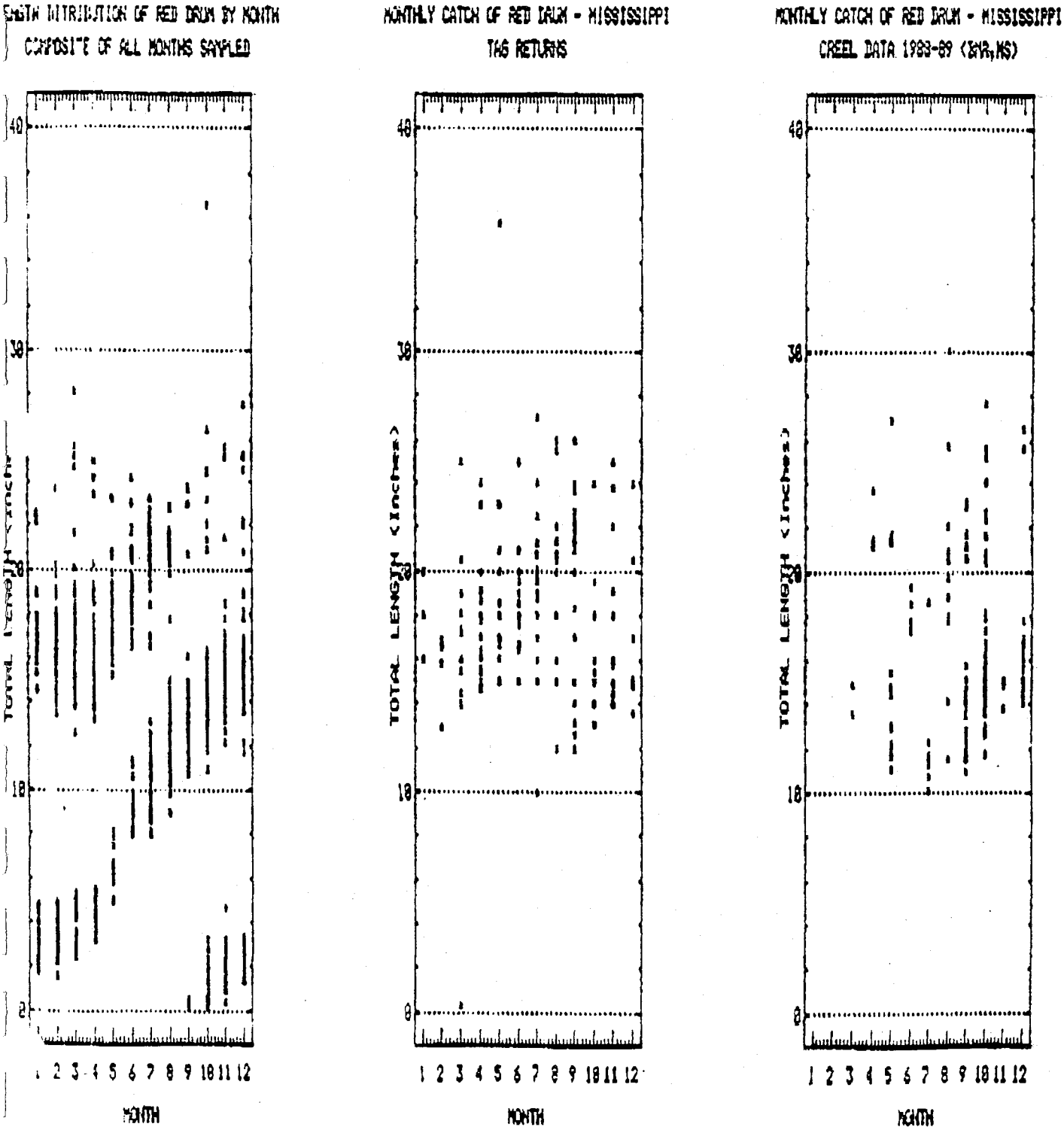


Figure 3. Length distribution by month for red drum in Mississippi.

TAG/RECAPTURE AND AGE VALIDATION OF RED DRUM IN FLORIDA
Grant # -- NA88-WC-H-MF192

Michael D. Murphy, and Ronald G. Taylor. Florida Marine Research Institute, 100 Eighth Ave SE, St. Petersburg, Fl 33701-5095.

Introduction:

The red drum resource along the Gulf coast of Florida has apparently been growth overfished, and without proper management will become recruitment overfished when the population reaches equilibrium with fishing mortality. Due to their longevity and late maturation, the intrinsic ability of red drum to support a fishery, especially on juveniles, is quite low. However, determination of levels of exploitation that can be supported without overfishing requires detailed information on growth, mortality, and recruitment. Especially difficult to measure for red drum are the various components of mortality and how these components change as the fish grow. Because red drum inhabit heavily fished inshore (estuarine) waters as subadults, and then apparently move to nearshore open Gulf habitats as they mature, detailed information on how fishing mortality and emigration change during this transition is needed to accurately assess the effects of fishing on potential abundance or yield. For instance, assessments that do not distinguish emigration (if it occurs) from fishing mortality would suggest a much more severe overfishing problem than actually exists.

The validity of ages determined from red drum hard parts also needs to be established before age-based stock assessment methods can be used with certainty. Presently, it is assumed that red drum deposit one opaque band on their otoliths per year. However, if multiple bands are deposited, then growth and mortality have been underestimated.

Summary of Results:

The first objective of this project was to estimate age-specific fishing mortality rates for subadult red drum during their transition from estuarine to nearshore Gulf habitats. Tag return data showed that the probability of recapture declined for fish older than age 2, and that few fish older than age 3 were captured within the estuary (Table 1). For all tag return data collected thus far, overall estimates of age-specific return rates adjusted for tag loss, tag mortality, and non-reporting were: 23% yr^{-1} for age 0 fish, 55% yr^{-1} for age 1, 52% yr^{-1} for age 2, and 16% $^{-1}$ for age 3. No returns were reported for fish tagged when age 4 or older. Given our estimate of pooled total annual mortality for fully recruited ages (0.91), these return rates correspond to estimates of conditional fishing mortality rates of 75% yr^{-1} for age 2 and 35% yr^{-1} for age 3.

The relatively moderate estimates of fishing mortality with respect to the high observed rates of disappearance from the estuaries suggests that a large component of the observed decline in numbers of fish with age is not due to fishing. These large reductions in numbers with age may be attributable to movement out of the estuary to nearshore Gulf waters or to other areas where they are less vulnerable to our sampling efforts. Paradoxically, there was little direct indication of any movement of fish out of the estuarine areas to nearshore Gulf waters. Only about 5% of tag returns came from fish tagged in the estuary and recaptured in nearshore Gulf waters. Most returns (85%) came from fish recaptured within the estuary less than 1.0 km from their release site.

The second objective of this project was to develop a method for validating age determination of adult red drum. During the first year (1986/87) we found that an intramuscular injection of 25 mg oxytetracycline/kg body weight provided a good florescent mark on otolith sections without incurring any obvious physical damage to the fish. Adult red drum injected during 1986/87 and held in captivity for 19 months deposited one opaque band on their otoliths. During the second and third years of this project (1987/88 and 1988/89) we have extended our observations to include fish injected and released back into the wild (Table 2). These data confirm that the observed number of opaque bands on red drum otoliths corresponds to their age, at least through age 27, and that the observed life span of red drum along the Gulf coast of Florida is approximately 25 years.

Table 1. Number and predicted ages of tagged (T) and recaptured (R) red drum by project year. Only recaptures of fish caught within one year of tagging are shown.

PREDICTED AGE	PROJECT YEAR 86/87 T	R	%	87/88 T	R	%	88/89 T	R	%	TOTALS T	R	%
0	13	1	7.7	-	-	-	1	0	0	14	1	7.1
1	209	31	14.8	92	15	16.3	148	29	19.6	449	75	16.7
2	278	35	12.6	153	7	4.6	387	88	22.7	818	130	15.9
3	124	3	2.4	7	1	14.3	77	7	9.1	208	11	5.3
4	4	0	0	-	-	-	-	-	-	4	0	0
5	1	0	0	-	-	-	-	-	-	1	0	0
6	-	-	-	-	-	-	-	-	-	-	-	-
7	1	0	0	-	-	-	-	-	-	1	0	0
8	1	0	0	-	-	-	-	-	-	1	0	0
TOTALS	631	70	11.1	252	23	9.1	613	124	20.2	1496	217	14.5

Table 2. Fork length (mm) and opaque band counts and measurements (mm) for red drum recaptured after being marked with 25mg oxytetracycline/kg body wt. . Fish tagged on 26 August 1986 were held in an outdoor pond while all others were released into the wild.

TAGGING		RECAPTURE		DAYS	OPAQUE	DISTANCE (um) TO		
DATE	LENGTH	DATE	LENGTH	FREE	BANDS	OUTER BAND	OTC BAND	PENULTIMATE BAND
26Aug86	900	11Mar88	979	563	4	250	425	575
26Aug86	1070	11Mar88	1075	563	11	200	288	375
26Aug86	1080	11Mar88	1109	563	16	100	150	213
26Aug86	1070	11Mar88	1090	563	17	150	275	375
16Jan87	970	2Aug88	978	564	16	75	175	188
16Jan87	1035	2Aug88	1042	564	14	75	163	200
15Jan87	727	20Sep87	773	248	2	263	250	725
22Aug88	948	16Aug89	955	359	11	200	313	375
23Aug88	987	16Aug89	1000	358	16	50	100	188
23Aug88	999	16Aug89	1003	358	11	125	188	325
23Aug88	1100	16Aug89	1100	359	27	63	100	188
2Aug88	1040	16Aug89	1048	379	16	63	125	188
2Aug88	975	16Aug89	980	379	9	150	225	338
2Aug88	1020	16Aug89	1025	379	18	88	113	200
2Aug88	1015	16Aug89	1018	379	18	100	175	263

PRESENTER: Sam Rogers

Identification of Red Drum Fishery Stock and Establishment of a Multivariate Model for Growth and Body Condition (Grant# NA88WCAMF195)

Stuart G. Poss, James S. Rogers, James M. Grady,

and

Robert C. Cashner

Gulf Coast Research Laboratory, P.O. Box 7000, Ocean Springs, MS 39564 and Department of Biological Sciences, University of New Orleans, New Orleans, LA 70148

Introduction

The red drum, Sciaenops ocellatus, fishery in the Gulf of Mexico is a large and important commercial and recreational resource with an impact that extends well beyond the Gulf Coastal region. The pressure placed on this valuable resource by commercial and sports fishermen necessitates a comprehensive study of the biology of this species. Understanding the degree of population subdivision among red drum populations is crucial to an overall management plan for this species. The primary objective of this project was to assess the level of population subdivision among Gulf Coastal populations of red drum using multivariate statistical analysis of morphometric and meristic data and allozyme and isozyme electrophoresis, two techniques that are sensitive to localized genetic differentiation.

Summary of Results: Data accumulated via use of the MorphoSys imaging system and meristic counts were analyzed using a variety of multivariate statistical methods as specified in the original contract proposal. Analyses of these data and data from subsamples examined electrophoretically reveal that appreciable differentiation among red drum populations throughout the Gulf of Mexico and the southern

Atlantic Seaboard into local or regional stocks has not occurred to an extent that would warrant recognition of independent stocks for fishery management purposes. Although it is concluded that no regional differentiation in body shape has taken place, one anomalous and unexplained difference is reported from one sample from Eastern Texas. However, these same fish analyzed electrophoretically do not reveal differentiation of these populations. The meristic and electrophoretic data sets are otherwise in concordance with the morphometric data, revealing no significant differences in means among seven regions of the range. These observations are consistent with a model of high levels of gene flow as advanced by Ramsey and Wakeman (1988).

Ocelli number, previously reported as evidence of weak differentiation of western Gulf of Mexico specimens by Ramsey and Wakeman (1988) can not be substantiated by samples examined in this study. However, one extreme individual taken from Bay Boudreau, Louisiana, with a mean of 84.5 spots, influences the statistics. Inclusion of this specimen results in marginal statistical significance but presents a problem of data interpretation.

Although application of alternative techniques may discover significant levels of differentiation unobserved for the variables sampled here, this would be unexpected, based on almost uniform conformity of the meristic, morphometric, and electrophoretic measures of differentiation. It is probable that initial concerns regarding capture and restocking at different sites are unwarranted and that costly measures required for multiple stock management are unnecessary.

PRESENTER: Gary Zumwalt

Red Drum Stock Identification from X-Ray Microanalysis of Otoliths and Scales (FY89:NA89WC-H-MF018)

Paul R. Ramsey and Gary S. Zumwalt
Department of Zoology and Department of
Petroleum Engineering and Geosciences
Louisiana Tech University

Energy dispersive spectrometry (EDS) may be an inexpensive, rapid, and accurate means of stock or natal site indentification. The methodology is based on the observation that fish incorporate trace elements from their environment into their calcareous hard parts such as otoliths and scales. Use of the method has not been reported previously for fisheries in the Gulf of Mexico. We proposed to couple EDS with a scanning electron microscope (SEM) to differentiate local populations of red drum; scales from other sciaenids like black drum and spotted seatrout and the otolith from offshore red drum will be examined as appropriate specimens are available.

Introduction

Initial analyses of the basal organic (fibrillary) layer of red drum scales revealed significant qualitative and quantitative differences among three inshore samples: Mosquito Lagoon, Florida--Atlantic; Vermilion Bay, Louisiana--Gulf; and Port Aransas, Texas--Gulf. These first elemental spectra were collected by gluing single scales to SEM blocks and exciting the proximal (fish-skin) side of the scale focus.

System Optimization

The first task was to optimize the EDS/SEM system for scale analysis.

* A take-off angle of 49^{o} gives the highest number of x-rays per second at the receiver and results in the greatest accuracy in measuring minor elemental constituents.

* The acceleration voltage controls both the number of elements excited and the sphere of excitation. An acceleration voltage of 15K was chosen to minimize the sphere of excitation (so individual layers can be examined) and still excite elements down to zinc.

* Total x-ray counts are at least 3,500 for the most common elements because spectra are collected and processed for 200 live seconds at 3.5 nA with a dead time of less than 15 percent.

Sample Preparation

Analysis of individual scales was a slow process and inexact because dried scales will curl to varying degrees. The second task was to design a mounting system which would standardize the scale geometry and allow comparison of similar sites on different scales.

A Scale-Teflon Sandwich. In our pilot study, we found that heavy metals and other elements not used in the calcification of the scales were stored in the inner fibrillary layer. But, examining only the bottom (or inner) surface precluded examination of year-class deposition. Additionally, conventional embedding media used to stabilize and section the scales introduced spurious results by smearing during the polishing or by actual penetration. However, Teflon (TM) is flexible, relatively inert, and easily recognized by the EDS/SEM system. To present each sample to the EDS/SEM at the same angle, 12 scales from each location were mounted in a teflon-scale "club sandwich" with outer, plexiglass braces.

The Polished Cross-section. The sandwiches were sectioned to give a cut-and-polished surface with embedded cross-sections of scale foci. Scales were oriented by drilling a hole through the focus and passing a wire through each scale. Teflon sheets--touching the wire--were placed between each scale and clamped with two plexiglass strips by nylon bolts. The wire was removed, and the blocks were milled with a fly cutter and polished to 600 grit. Finally, the blocks were sputter-coated with carbon before analysis by the EDS/SEM system.

Sample Selection. We chose 10 coastal collections of red drum scales retained from a previous study--South Texas to northeastern Florida (Table 1 and Figure 1). Six males and six females were chosen from each location. Detected elements include those from atomic weight 19-65: F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Cu, Fe, Ni, and Zn.

Summary of Results

Collection of spectra from the baseline group of red drum samples is continuing. Several unique spectra/elemental profiles are worthy of note at this time (Figure 2).

After the analysis of the 10 red drum scale samples, samples of otoliths and material from black drum and spotted seatrout will be examined. In addition to the geographic analysis, elemental profiles will be analyzed for effects due to sex and age/size.

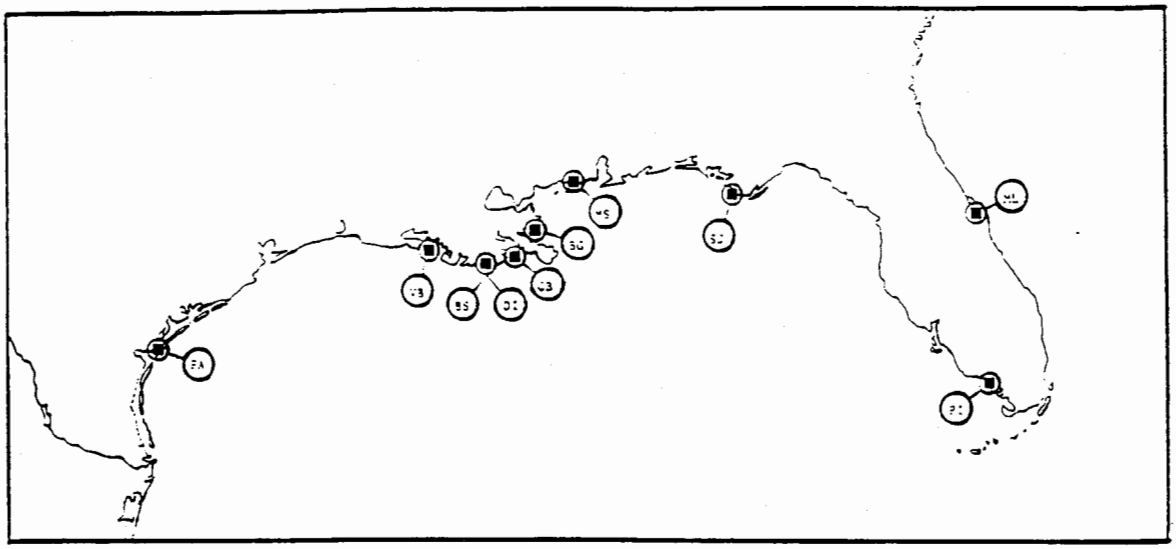


Figure 1. Red drum collection sites for scales used in x-ray microanalysis.

Table 1. Red drum sample locations and sample sizes for x-ray microanalysis of 14 elements.

Mosquito Lagoon, FL	25
St. Joseph Bay, FL	50
Pine Island, FL	50
Mississippi Sound, MS	20
Bay Gardene, LA	56
Caminada Bay, LA	49
Bay Sainte Elaine, LA	61
Derniere Islands, LA	14
Vermilion Bay, LA	55
Port Aransas, TX	36
N = 12 (6 males + 6 females)	

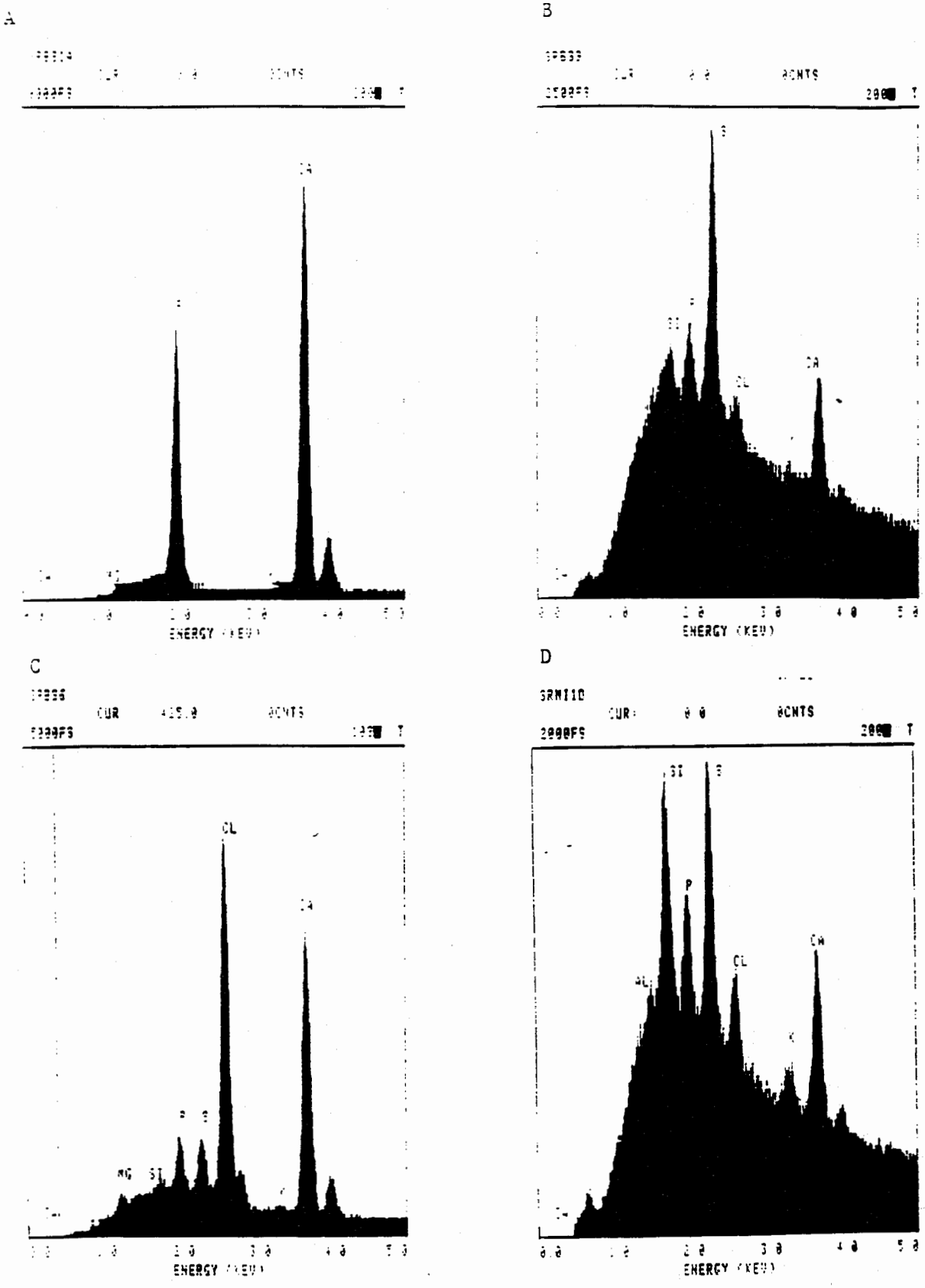


Figure 2. Red Drum energy spectra: (A) Osseous layer from Bay Sainte Elaine, LA (B & C) Fibrillary layer from Bay Sainte Elaine, LA; (D) Fibrillary layer from Vermilion Bay, LA.

Louisiana Red Drum Research

Joseph A. Shepard
Louisiana Department of Wildlife & Fisheries
Seafood Division, Finfish Section

Charles A. Wilson, Ph.D.
Sandra J. Russell
Richard E. Condrey, Ph.D.
Louisiana State University
Coastal Fisheries Institute, Center for Wetland Resources

"Louisiana Red Drum Research" is a cooperative research effort between the Louisiana Department of Wildlife and Fisheries' Finfish Section and Louisiana State University's Coastal Fisheries Institute, Center for Wetland Resources to provide needed information for the management of red drum. The project began October 1, 1986 and has been funded through September 30, 1989. The following are brief summaries of our progress to date.

Red Drum Tagging

Since 1986, 5,991 juvenile red drum have been marked with internal anchor tags and released in coastal Louisiana. Five hundred twenty-eight red drum have been recaptured by both commercial and recreational fishermen for a total return rate of 9 percent. Based on predicted age at length, the highest return rates were from fish 0-1 year old in 1986-1987, prior to size restrictions, and fish 2 years old in 1988-1989 in response to a 16-inch minimum length restriction. No returns were received from fish tagged at predicted ages 3 and older.

Catch Effort and Bioprofile Sampling

The goals of this portion of the project were to (1) obtain catch and

effort data from commercial vessels landing adult and juvenile red drum caught in inshore and nearshore (state) waters of Louisiana, and (2) to collect length, weight, and sex composition data from these commercial catches. Full-time fieldwork began October 1, 1986 and ended January 15, 1988 when the inshore red drum fishery was closed. Part-time sampling has taken place from June 1988 through September 1989 on recreationally caught red drum and red drum by-catch of other fisheries. A total of 963 gill net interviews, 67 trammel net interviews, 38 rod and reel interviews, and 1 otter trawl interview were obtained during this study, and 7,025 fish were measured. Additionally, during the spring and summer of 1989, one port sampler accompanied black drum gill net and strike net fishermen on their trips to record red drum by-catch. He made 8 trips and measured the 40 red drum caught by 12 sets. Recreationally caught red drum were weighed and measured at several of the major fishing tournaments during the summer of 1989.

Age Structure, Growth Rates and Reproductive Biology

Red drum aging validation continues to indicate the formation of one annulus per year in otoliths. Age frequency distributions generated by otolith analysis continue to indicate similarities in year-class distributions between years for offshore populations. A relatively low number of red drum are present in younger year-classes. Strong and weak cohorts can be followed through successive years in the population.

There is great variability in size and age, therefore length or weight cannot be used to accurately estimate age for red drum after the first few years of life. In order to accurately model growth, separate growth curves have been fitted for immature and mature life stages. Maximum age of fish sampled was 38 years.

Stock Assessment of Red Drum

We have continued our stock assessment work on red drum and have presented the results to the Red Drum Scientific Assessment Group of the Gulf of Mexico Fishery Management Council. Our final synthesis is likely the form of a stochastic population model which is intended for use in assessing future rates of escapement.

We are in the process of conducting our second cooperative red drum aerial survey with menhaden spotter pilots. We have adapted the computer technology developed at the NMFS Pascagoula Laboratory for recording the flight patterns and sightings of our cooperative pilots. We will be testing and refining this technology in anticipation of developing a routine monitoring procedure which will be of benefit in measuring the recovery of the stock.

Grant Number: NA88WC-H-MF190

Age Class Structure of Exploited Red Drum From The Inshore and Fishery Conservation Zone. North Central Gulf of Mexico

R. Vernon Minton and Mark Van Hoose

Alabama Department of Conservation and Natural Resources
Marine Resources Division

ABSTRACT

Alabama's MARFIN red drum project was initiated to improve on life history and related information for red drum. Hatchery produced red drum were secured and transported to Alabama Marine Resource's Claude Peteet Mariculture Center as the initial phase in the production and release of tagged phase 2 fingerlings. Presently 38,152 fingerlings have been harvested tagged with internal tags and released. A total of 260 fish have been reported captured from hatchery releases since the initial release on September 3, 1987. Compass directional movement appears to be random with no strong movement in any specific direction. Most of the fish (83%) were captured within 8 kilometer or less from the release point. The hatchery fish appear to be fully recruited into the fishery after approximately 150 days. The highest percentage of captures has occurred in the 150-180 day group. In addition to hatchery tagging 227 wild red drum have been tagged since the initiation of the project. Fifty-seven fish have been recaptured. The highest percentage (43%) were recaptured 8 kilometers from the release point. Most showed little movement (46%). Using fishing, tagging and natural mortality estimates approximately 65% of the wild 1+ fish in Alabama do not survive to age 2+. From 1988 wild caught data, of the 110 age 1+ fish tagged, 30 tags have been returned to date. A cryptic tagging study found that only 45% of tagged red drum are reported. Therefore, it is assumed that 37 tagged red drum were caught and not reported. Tagging mortality, as estimated from the condition of tagged fish at release in 1988 (bleeding or not bleeding), was 3% or three fish. No quantitative measurement of natural mortality of age 1+ red drum in Alabama exists, but it is assumed to be very low. Using a figure of 2%, or 2 fish, for those tagged in 1988, gives a final total of 72 out of the 110 age 1+ fish tagged in 1988 not reaching age 2+. Tagging of hatchery-reared and wild red drum in Alabama inshore waters demonstrated high levels of inshore recreational exploitation at ages 1 and 2. Of the 90 wild fish tagged since October 1987, 24 have been harvested. These fish showed little movement from release sites.

Figure 1. Number of Wild Caught and Hatchery Reared Red Drum Tag Returns by Kilometers Moved from Release Point

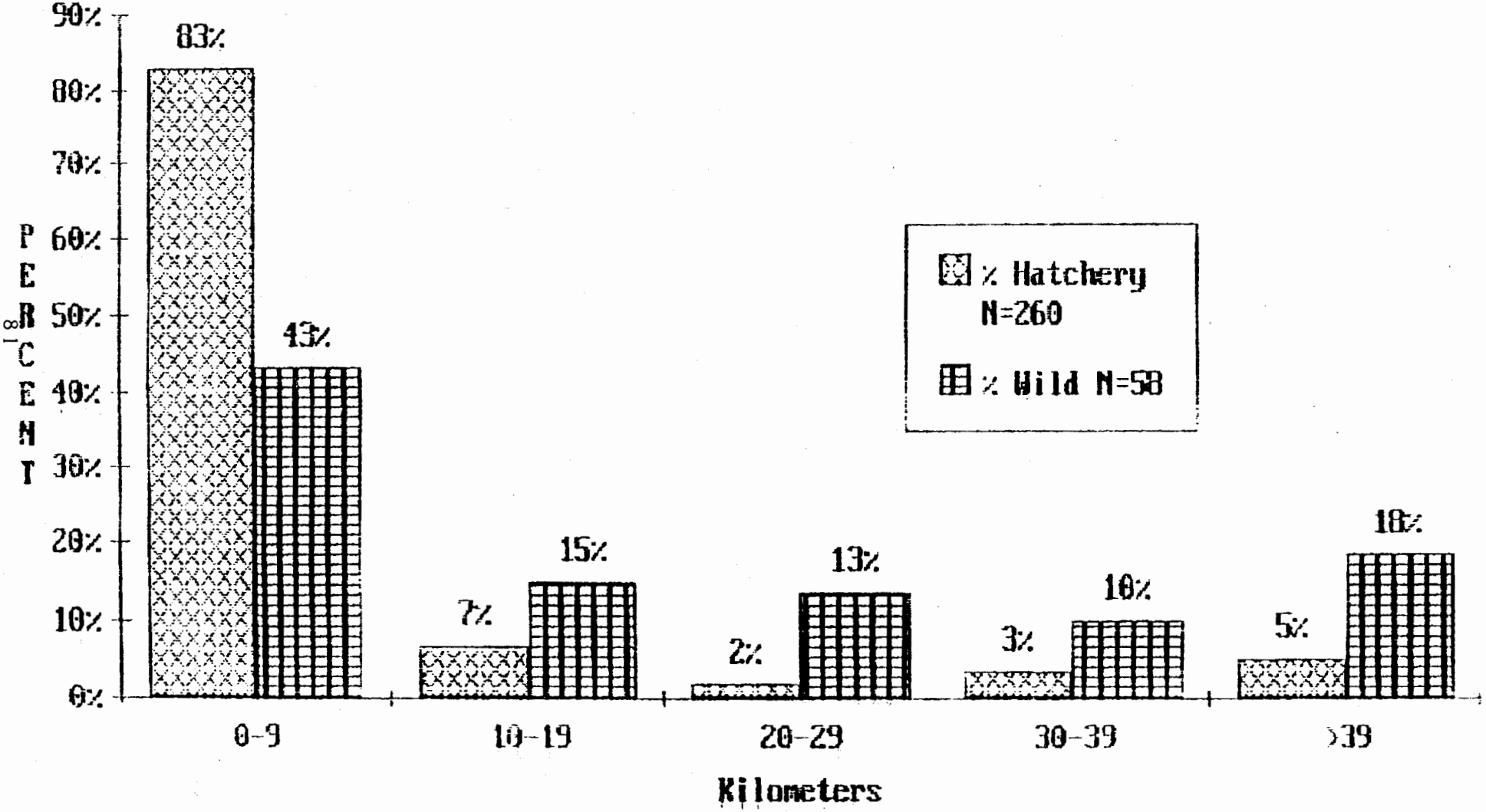


Figure 2. Direction of Movement for Hatchery Reared and Wild Caught Red Drum by Percent

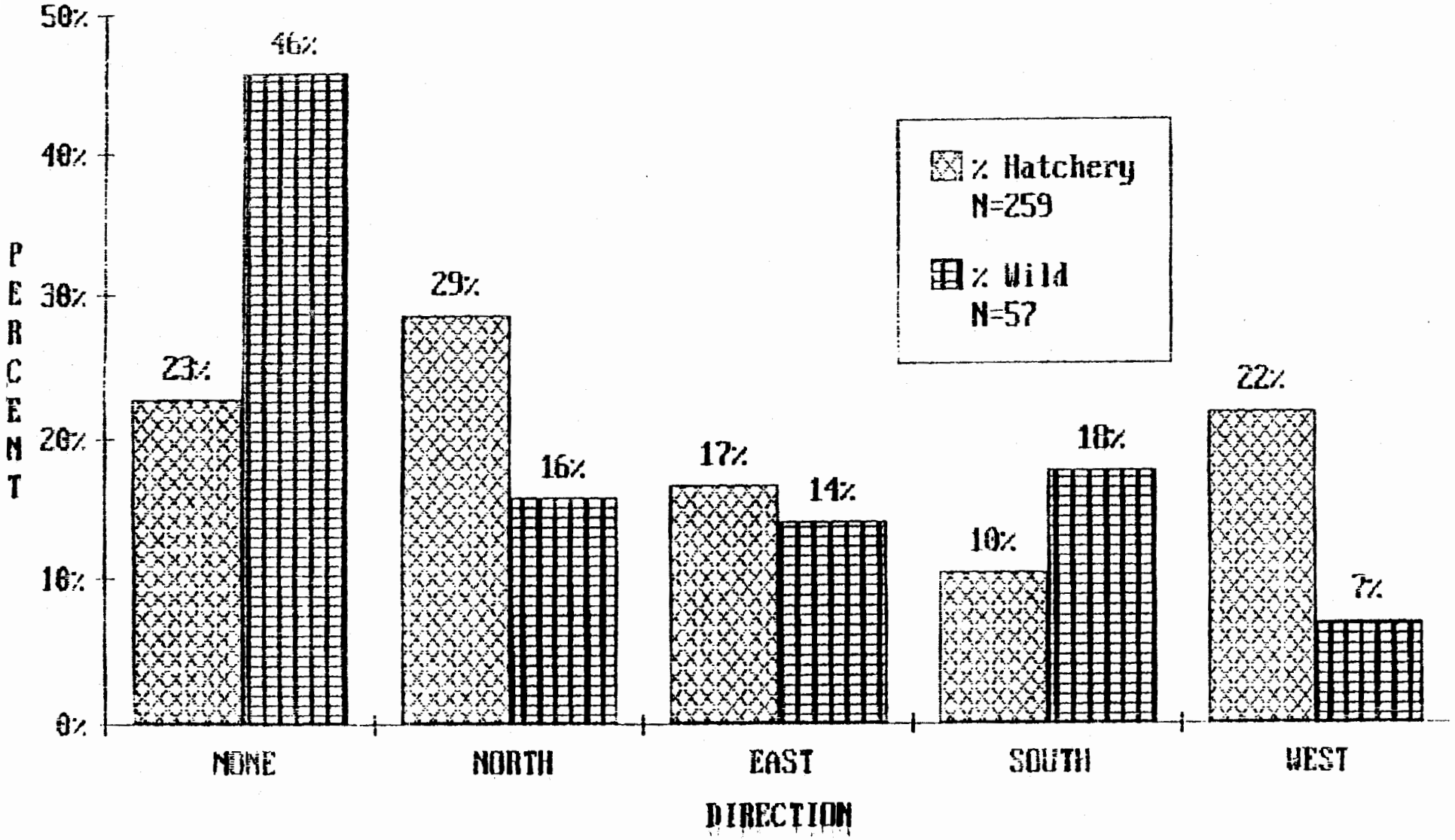
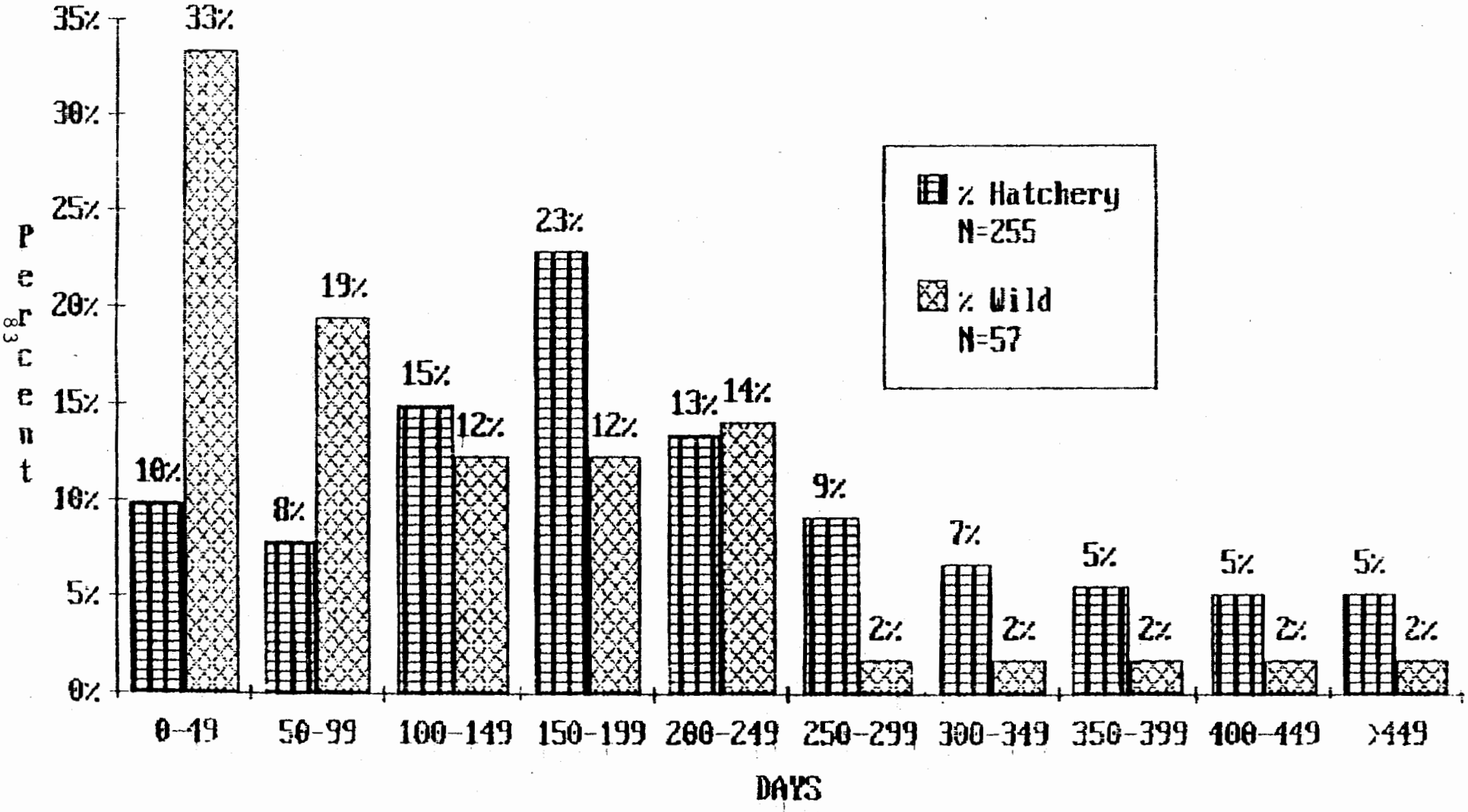


Figure 3. Percent Recapture by Days From Release for Hatchery Reared and Wild Caught Red Drum



ESTABLISHMENT OF A COORDINATED CENTRAL TAGGING ACTIVITY FOR RED DRUM (SCIAENOPS OCELLATA) AND MANAGEMENT OF RED DRUM TAGGING DATA FOR THE GULF OF MEXICO AREA

WALTER R. NELSON

MIAMI LABORATORY, NATIONAL MARINE FISHERIES SERVICE

Introduction

In 1987, development of the Cooperative Tagging System database (CTS) was initiated at the Miami Laboratory of the National Marine Fisheries Service's Southeast Fisheries Center (SEFC) to manage the tagging data generated by the Cooperative Red Drum Research Program. The project objectives are to: 1) develop a standardized format for data entry and archival; 2) allow user-friendly data entry and retrieval by all cooperators; 3) track tag numbers and reward payments to ensure that duplication is avoided; 4) provide periodic summaries of the data to cooperators; and 5) allow expansion of the system to include additional species.

Summary of Results

During the first year of the project, the database design was completed and software development was initiated. The design was developed in cooperation with participating researchers and was documented in a preliminary report distributed for review to researchers in all MARFIN tagging projects. CTS is designed as a distributed system, in which data will be entered and retrieved locally with microcomputers and will be centrally stored on a mainframe computer at the SEFC. The Data Management Division of the SEFC Economics and Statistics Office devoted the project's second year to programming the CTS microcomputer software and

developing a user's manual that completely documents the system.

The development of CTS is now in its third year. In March 1989, Data Management distributed the prototype microcomputer system and user's manual to MARFIN researchers for review. A team from the Miami Laboratory conducted a comprehensive review of the system, including how well CTS operates on a microcomputer and how well the manual instructs the user in running the program. Based on technical and editorial comments, Data Management is redesigning the user interface portions of the CTS software and revising the user's manual. The changes are being made using a team approach with 130 man-hours per week allotted to the project. The revised microcomputer system and manual are now scheduled for completion in November 1989. The CTS project has served as a prototype for the Data Management Division and is establishing programming standards and procedures to be used in future SEFC database development.

Data entered into the system during the first year of operation will be archived on a microcomputer because the mainframe version will not be operational until late 1990. A contractor hired by Data Management began the mainframe programming in late 1988; however work was soon suspended when the contractor requested more detailed specifications. These have been resubmitted, and work is scheduled to resume in February 1990 and to be completed at the end of FY90.

STOCK ASSESSMENT FOR GULF OF MEXICO RED DRUM

C. PHILLIP GOODYEAR
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Commercial landings statistics for red drum have been collected since 1880 and have been compiled annually since 1950. Gulfwide, the reported annual commercial landings totaled from about 1 to 3 million pounds until 1970. During the 1970s the total commercial landings increased to a peak of 5.3 million pounds in 1976, then subsided to a minimum of 2.4 million pounds in 1982. Commercial landings then increased dramatically and reached an all time high of 13.7 million pounds in 1986. Most of this increase was landed in Alabama and was taken from statistical grid 11 in the EEZ by the newly developed purse-seine fishery. Estimates of the recreational harvest of red drum substantially exceeded the commercial landings prior to 1985 when the two were about equal. In 1986 the commercial landings were about double the weight of the recreational harvest. The commercial harvest declined after 1986 and reached a historic minimum in 1988 because of conservation actions. Recreational harvest estimates for 1988 are not yet available but are expected to show the same pattern.

Total mortality in the adult stock prior to the increase in the purse seine-fishery was estimated to be about 0.213 (19.2 percent) per year. Most of this was attributed to natural causes, but recreational harvest and commercial bycatch also contribute to mortality of the adults. Calculations in this assessment assumed a natural mortality rate of 0.2.

Estimates of recruitment to the offshore stock declined about 90 percent after 1974 and remain depressed. Simulation analysis was used to reconcile the estimated size of the spawning stock with landings estimates. The results indicate that about one-third of the decline in recruitment to the offshore stock can be explained by increased fishing on juveniles, inshore. The other two-thirds of the decline appears to be the result of a combination of reduced recruitment of juveniles into the population and unreported landings. The spawning stock biomass will decline to about 10 percent of the pre-1974 level if mean recruitment to the juvenile population does not change and if fishing rates on juveniles is permitted to return to levels typical of the early 1980s.

Spawning stock biomass per recruit for the adult population sampled from the north-central Gulf of Mexico in 1987 was estimated to be about 28 percent of the unfished level and would decline to about 13 percent if the estimated 1986 fishing mortality rates were maintained and no harvest of adults occurred. Thus, the average escapement rates for the estuaries contributing recruits to the

adult stock sampled in the north-central Gulf of Mexico would have been around 13 percent in 1986. This estimate is interpreted as an upper bound on the average escapement rate and is applicable to those estuaries which provided the recruits to the adult population sampled offshore.

The apparent decline in recruitment argues for the continuation of strict conservation measures and for increased monitoring of the age composition of both the juveniles within estuaries and the adults offshore.

In light of the decline in recruitment, several research and monitoring activities are required to provide future management advice. The cause(s) for the decline in recruitment should be assessed and the adequacy of the 20 percent spawning stock ratio goal for red drum should be reexamined. In addition, the age distributions of the red drum offshore must continue to be monitored, and the age distributions of the juveniles inshore should be monitored through actual age determinations of representative samples of the inshore populations. These latter studies would also contribute information for assessments of the effectiveness of state regulations.

SUMMARY OF ESTUARINE FISH I PANEL DISCUSSION

- Stratification by size and age of the red drum in the Apalachicola Bay Study needs to be taken into account.
- Completed data analysis on almost four hundred red drum show 77 distinct mitochondrial DNA genotypes. Partial data on two hundred more fish indicates about one hundred fifteen different MTDNA haplotypes.
- 94% of the time, random samples taken of two red drum show different genotype. This information could be useful in the development of a genebe tag.
- The success rate elasticity for red drum is probably 35-50%.
- The relationship between catchability and availability is difficult to access. The demand model coefficients are determined from the relationship between trips taken and catch.
- The indirect approach of models is used. Past actions of anglers are looked at and put into a demand model and the results come from calculated coefficients.
- Marking red drum scales can be done very effectively using feeding processes at the hatchery. Current elements used are copper, zinc and nickel and fish take these elements readily. The problem lies in how long the fish actually retain these elements.
- Declining juvenile red drum recruitment could be part of a cycle of years of very high and very low recruitment.

SESSION VI
ESTUARINE FISH II

Larval food, growth, and microhabitat selection: Factors affecting recruitment of estuarine-dependent fishes in the northern Gulf of Mexico (NA89WC-H-MF029)

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SUMMARY OF COLLECTIONS: As of August 24, 1989 we have collected a total of 648 drop samples. Samples through #586 have been sorted, and fishes through #492 (dated May 26, 1989) have been identified. Based on a preliminary analysis of 379 samples collected over a two year period from Barataria Bay, Louisiana, we documented the importance of the euryhaline marsh edge as a nursery habitat for fishes. More than 3,888 fishes belonging to 44 taxa were identified, with 19 species making up more than 99 percent of the total catch. These principal taxa were divided evenly between resident and seasonal species. The 5 most abundant species were 1) Gobiosoma bosci, 2) Gobionellus boleosoma, 3) Anchoa mitchilli, 4) Myrophis punctatus, and 5) Brevoortia patronus. Prominent among the seasonal species were the young of year of 5 sciaenids, including two target species. The seasonal dynamics of recruitment to the marsh edge by early life history stages of major fish taxa follows a chronology that can be roughly depicted as follows: pinfish and spot appear from the early to late winter; menhaden and worm eels appear in the late winter and early spring; silverperch and silversides appear mid-spring; naked goby, bay anchovy and spotted seatrout appear in the late spring and early summer; bay whiff and blackcheek tonguefish appear in late summer; and red drum, croaker, and darter goby appear in early to mid-autumn. The marsh edge presents a complex of spatial and temporal factors affecting the dynamic fish communities inhabiting them.

Densities of all fishes varied across seasons. Total densities were low during the winter, followed by a summer build up and peak, and an autumn decline. The range of average densities was 2.2 to 35.6 fishes/m^2 and the weighted grand mean was 18.6 fishes/m^2.

Besides seasonal variation in total densities, there was also a component of variation attributable to water depth that was described by a quadratic equation. A significant quadratic relationship suggests that a sufficient range of depths were sampled to bracket the responses by early life stages of fishes to depth in marsh-edge habitats. Density ranged from 0 to 352/m^2 and the highest densities occurred in the 20 to 50 cm depth range.

The range of temperatures measured across seasons varied from 10 to 36°C, with a seasonal high in midsummer and a winter low. Salinities also varied seasonally from 2 to 31.2 ppt, but fluctuations reflected our sampling protocol along salinity gradients within seasons. However, the lowest mean salinity occurred in the early spring and corresponded with the lowest mean density of fishes.

Four sciaenids were captured in adequate numbers for preliminary analysis during the period. Spot (Leiostomus xanthurus) was the seventh most abundant species and accounted

for 4.0% of all fishes. Unlike most fish taxa, spot recruited at relatiyely high densities during the winter months (0.82 to 9.56/m^2). They were absent or sparse from spring through autumn (up to 0.065/m^2) and were only represented by larger individuals (100 mm TL). Peak abundance occurred in March 1988 when individuals were about 14 mm TL. Red drum (Sciaenops ocellatus) was the eighth most abundant species in the total catch (3.6% of total). Small juveniles appeared at the marsh edge during only 2 months in the autumn at densities of 0.09 to 9.85/m^2. The autumn size range was from 8 to 21 mm TL, but abundance peaked when individuals were 10 to 13 mm TL. The spotted seatrout (Cynoscion nebulosus) was the thirteenth most abundant species, but only accounted for 1.0% of all fishes. Young of year were present throughout the summer and abundance peaked in mid-summer (0.28 to 0.76/m^2). Numbers began to decline in early autumn (0.02 to 0.15/m^2) and reached a low in winter. Size ranges ranged from 7 to 84 mm TL. The croaker (Micropogonias undulatus) was the fourteenth most abundant species and accounted for 0.8% of all fishes. The timing of croaker recruitment compared well with that of red drum. Autumn densities of croaker ranged from 0.67 to 1.30/m^2 at a size range of 9 to 15 mm TL. Larger individuals (23 to 35 mm TL) were also present during late winter and early spring at densities of 0.05 to 0.09/m^2.

Microhabitat Analysis: Our preliminary analysis of the seasonal occurrence of fishes indicates that marsh-edge habitats are important to our target species and many other fishes (and invertebrates) that are of direct commercial and sport value in themselves or indirectly as forage species. Now that we are entering Year 2 of this study, we are beginning to accumulate sufficient samples to begin microhabitat analyses for the target species to tease out factors like temperature, depth, and salinity that affect recruitment and in tern relate them to other aspects of this study (i.e., daily growth rates and diet).

Food Habits: Dietary analysis of 77 fish specimens of 2 target species is in progress. Preliminary evidence suggests that the spotted seatrout is an epibenthic predator at a very early age, while the red drum relies on zooplankton (one species of calanoid copepod) for a longer period of time. Size-related dietary shifts were observed in spotted seatrout in which a larger size range of specimens have been examined.

For Cynoscion nebulosus, 25 individuals from 10 to 30+ mm TL were examined. Eighty-eight percent had at least some food in their digestive tract. If food was present, gut fullness was high for all size classes. Mysid shrimp were the most common food, with a frequency of 80% while comprising 56% of the items by number. Second were calanoid (zooplanktonic) copepods, with a frequency of 20% while comprising 40% of the dietary items. The importance of calanoids decreased with fish length while the importance of mysids increased. Nevertheless, all size classes had mysids in their guts. Tanaids and amphipods were also prey items.

For Sciaenops ocellatus, a total of 52 specimens from 5 to 15 mm TL were examined. Of these, 41 had some contents in their digestive tract, and gut fullness was high. Prey items were very similar among red drum specimens perhaps because of the relatively uniform size of those examined. Calanoid (zooplanktonic) copepods were most common, with a >90% frequency

and harpacticoids (benthic and epibenthic) copepods were second with a 20% frequency. Numerically, calanoids were overwhelmingly the most common prey item. The stomach contents of 15 red drum were identified to species. Results show a marked selection of one species (Acartia tonsa) which comprised virtually all of the calanoids observed. On the average, there were 22 Acartia per red drum.

Ageing: An ageing technique was developed whereby individual otoliths were extracted and embedded in Spurr resin blocks. Sections of blocks containing otoliths were subsequently ground and polished until growth rings were visible. We are using an image analysis system to measure and record daily growth increments from lots of 20 postlarval fishes. Initial efforts enabled us to interpret 12 of 19 red drum otoliths from three separate drop samples taken during October 1987. Measurements of otoliths recorded in microns included otolith radius (i.e., anterior axis from primordium to edge) as well as the widths of the three outer increments as an indication of recent growth hsitory. Preliminary analyses of 19 red drum tell us about size related relationships which can be used to describe recent growth histories of fishes collected in different microhabitats or must be accounted to appropriately compare recent growth histories of individuals of slightly different sizes (i.e., in an ANCOVA). First, otolith radius is a good indicator of fish growth, as there is a significant positive linear relationship between otolith dimensions (i.e., otolith radius) and fish length (Figure 1). Second, fish length is clearly related to age in days over the size range considered, as fish length increases with age (Figure 2). Finally, recent growth is positively related to fish length, as shown by a significantly increasing relationship between the last complete growth increment and fish length (Figure 3).

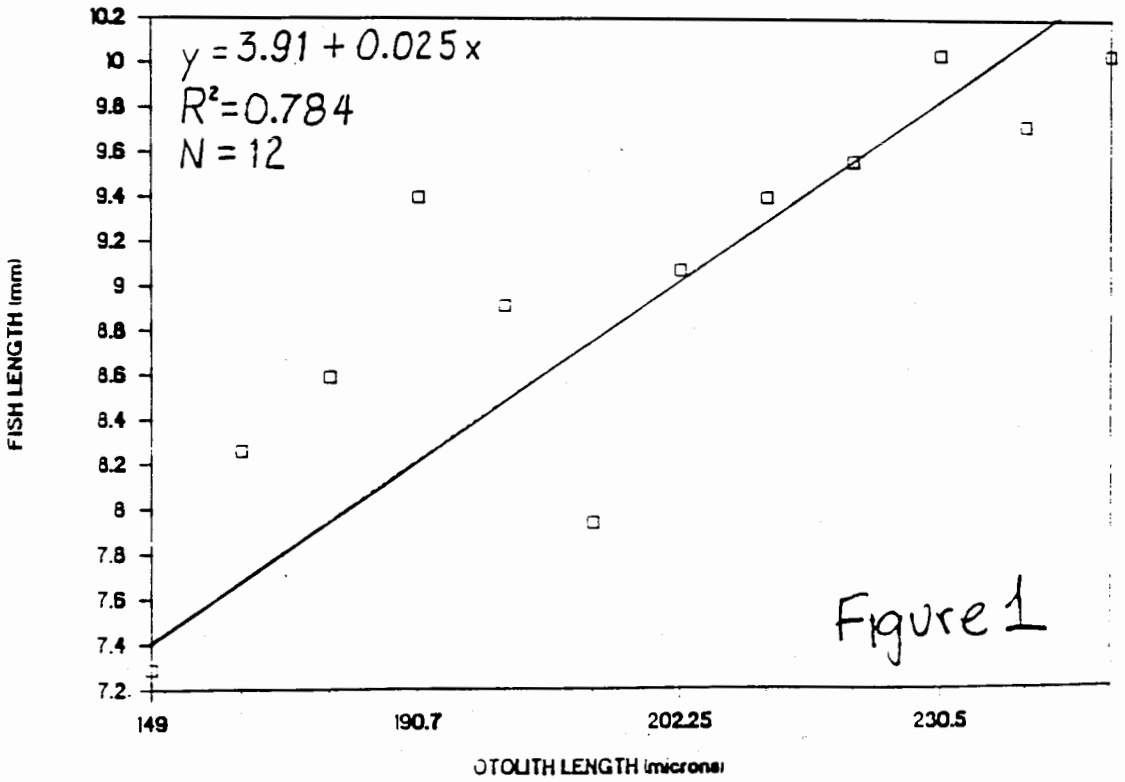

Figure 1

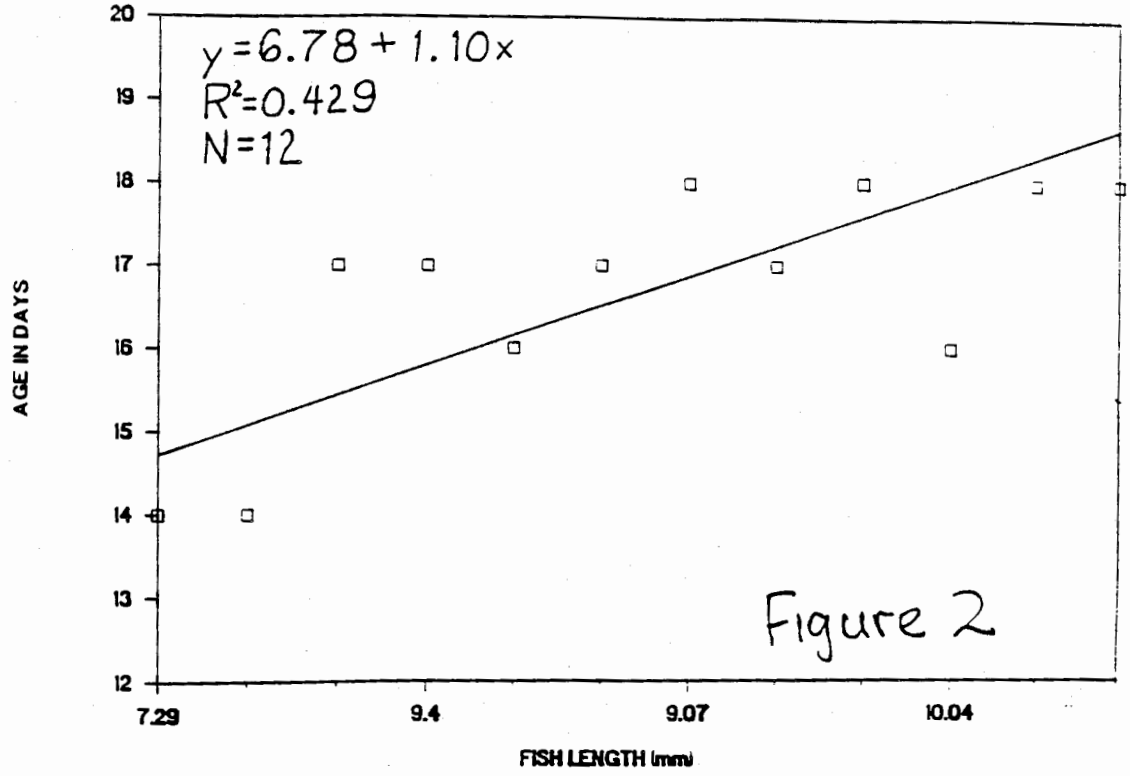

Figure 2

LAST COMPLETE GROWTH INCREMENT

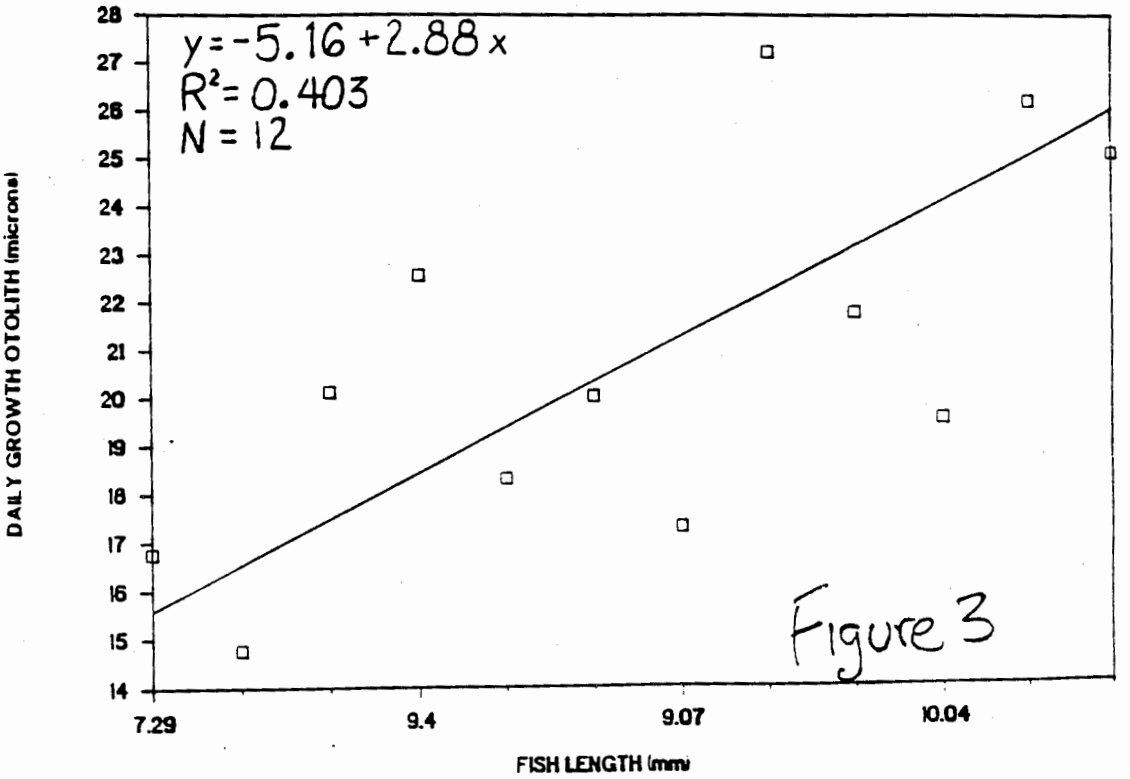

Figure 3

Age Structure, Growth Rates, and Reproductive Biology of Black Drum in the Northern Gulf of Mexico

Grant # NA89WC-H-MF017

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Objectives of this project included: continued validation of black drum age estimates using otoliths; estimation of age of black drum captured by various fisheries gears to determine year-class structure and growth parameters; determination of spawning duration, frequency, and batch fecundity (number of eggs spawned); determination of age and size at maturity. These data were compared with previous years' data to determine annual variability. This is a one year project, however work will be continued with MARFIN funding for the next three years.

Black drum were sampled monthly from commercial landings. More frequent sampling was performed during spawning. A total of 1085 fish have been sampled during this project-year. Fork length, weight, and sex were recorded and otoliths (sagittae) and gonads removed. Female gonads were prepared for sectioning and histological examination. Otoliths were sectioned for age determination.

Otolith age estimations were validated by marginal increment analysis. Otoliths formed one annulus per year, and primary months of annulus formation were December-March, the same as in previous years. Von Bertalanffy and power growth models were fit to the length- and weight-at-age data, though neither curve modeled growth of young fish well. Separate growth curves for immature and mature fish, or a four parameter model, appear to be necessary to obtain an adequate fit to the data.

Age-frequency distributions were obtained for random samples of gill net and haul seine fisheries landings in Louisiana waters and compared to age distributions from previous years (Figure 1). The fishery continues to be dominated by four or five strong year classes, and dominant year classes are similar for each year and gear. The 1985-89 years classes (ages 4-9 in 1989) were in low relative abundance for all gears. The majority of black drum in schools of primarily mature fish are greater than 13 years of age. The 1986 year-class (age 3 in 1989) appears to be relatively strong in inshore gill net catches.

Over the period July 1987 through August 1989 early stage cortical alveolar (CA) oocytes were found in ovarian tissues taken in late October to early November samples (Figure 2). By December of each year later stage vitellogenic oocytes (V) were common indicating imminent spawning. Postovulatory follicles (POF), definitive evidence of recent spawning, were first detected in mid-January of both 1988 and 1989. Cessation of spawning, as indicated by late stage atresia of yolked oocytes, occurs in mid to late April.

Increases in both male and female gonosomatic indices (GSI) correspond to the late autumn increase in oocyte maturation (Figure 3). Mean monthly GSI for both sexes show precipitous increases beginning in November and peak in March. A return to near resting levels is noted by May. No secondary peaks in GSI of either sex are observed.

Black drum have been determined to be group synchronous, batch spawners. Spawning frequency, or the number of days between individual spawning events, has been estimated as 3.5 days and 6.6 days for the 1988 and 1989 spawning seasons, respectively. The mean number of mature ova produced by female black drum per clutch, or batch fecundity, has been estimated by direct counts as 1.35 million (range 0.2-6.1 million). Based on observations of POF, female black drum do not appear to achieve sexual maturity before age five. Size at maturity data show a minimum length of 630 mm total length and 4.2 kg mass.

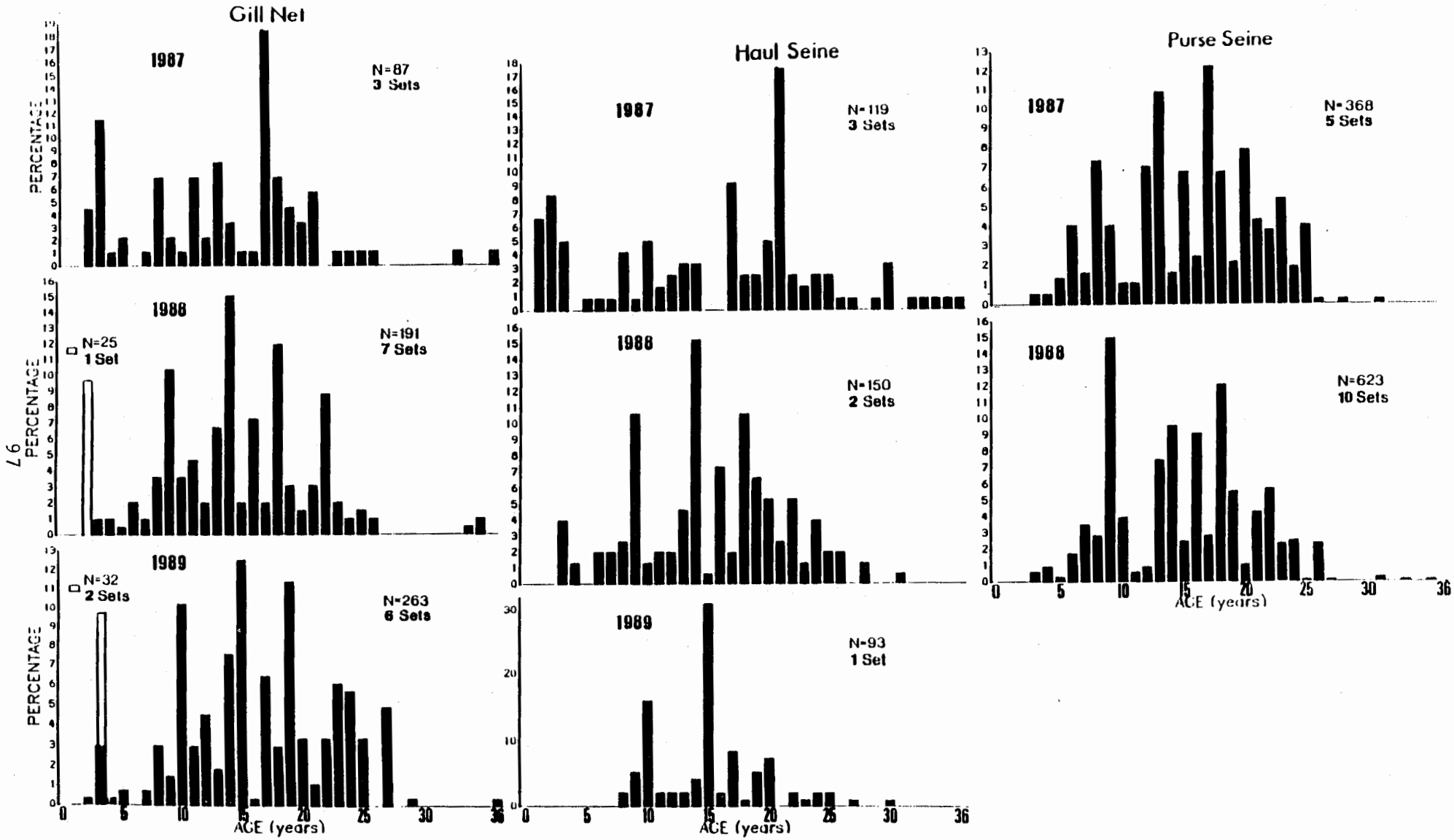

Figure 1. Age percent frequency distributions for black drum randomly sampled from fisheries catches off Louisiana, by sample year and gear. (Open bars in 1988 and 1989 gill net samples represent sets for which mean age was less than 5 years; percentage is 10 times that indicated).

FIGURE 2

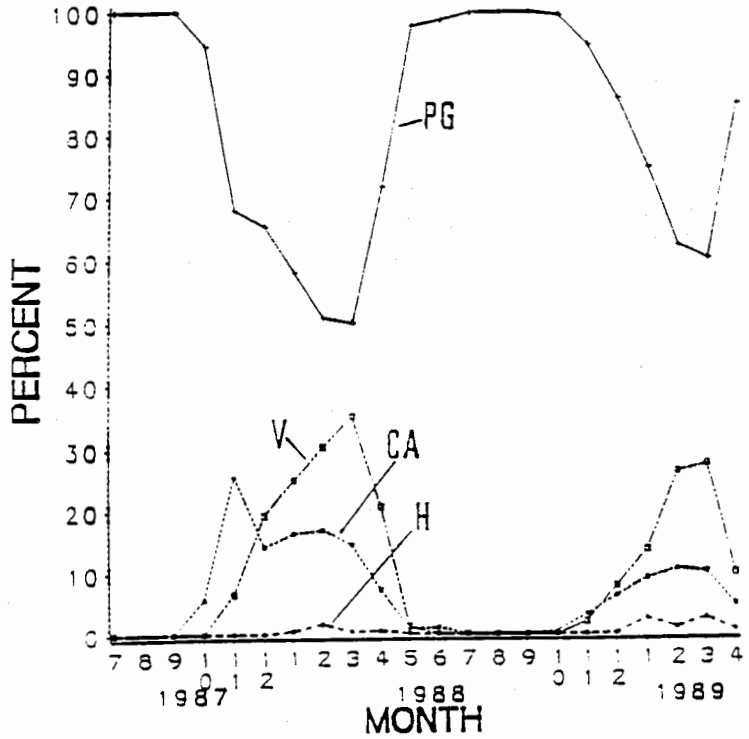

Figure 2. Mean percent occurrences of four stages of oocyte maturation in black drum. PG = primary growth oocytes. C = cortical alveolar oocytes, V = vitellogenic oocytes, H = hydrated oocytes.

FIGURE 3

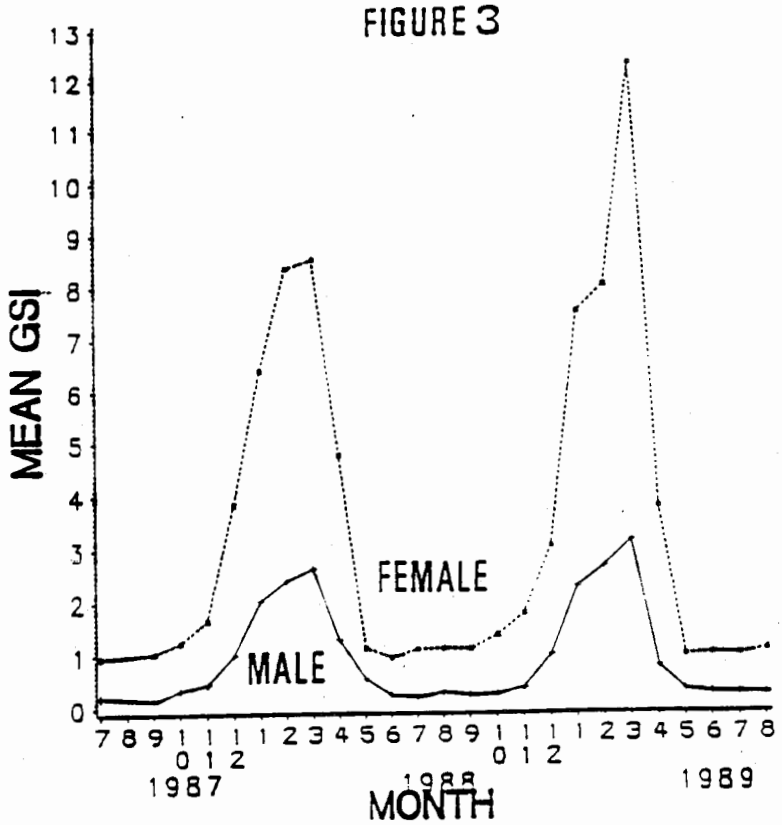

Figure 3. Mean monthly gonosomatic indices (GSI) for male and female black drum. GSI computed as gonad weight/eviscerated body weight.

POPULATION ASSESSMENT OF BLACK MULLET IN THE EASTERN GULF OF MEXICO

Grant #NA89WCHMF003

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SEPTEMBER 1989

Introduction:

The MARFIN program supports a major portion of the State of Florida's black mullet research program. The goal of this project is to provide a scientific data base for assessment and management of black mullet in the eastern Gulf of Mexico. The objectives of the project include: 1) analysis of fishery statistics, based on the Marine Fisheries Information System trip ticket data, to examine annual and seasonal trends in catch and effort; 2) analysis of biological data, based on monthly samples from commercial and experimental operations along the west coast of Florida, to determine size/age compositions, gear selectivity, growth and mortality rates, spawning duration and timing, age/size at maturity, and genetic composition; 3) analysis of data from mark/recapture experiments, conducted in four major systems along the west coast of Florida, to provide estimates of growth rates, mortality rates, and migration and movement; 4) fishery independent measurements of population size/density based on data collected from larval/juvenile and hydroacoustic surveys in Tampa Bay; and 5) determination of the effects of climatological variability on the schooling, population aggregation, offshore spawning migration, and fishery production in Tampa Bay System.

Summary of Results:

The seasonal trends of catch, effort, and catch per trip was dominated by large catches made during the spawning months (October-January) in response to increased availability of fish (as a result of intensified aggregation and schooling) and market demand for roe. The number of trips, catch, and catch per trip declined in the spring and summer due to lower availability of fish, a smaller market and lower price. The amount of mullet produced during the spawning season for the roe industry was a major portion (approximately 50%) of the total annual production.

Monthly length composition data were used to develop seasonal length frequencies associated with common gears used in each of the four study areas along the west coast of Florida. Seasonal data on length frequencies also included samples from non-selective gears (i.e., haul seines, purse seines, and cast nets). Commercial catches can be summarized: 1) gill nets were the most common gear used for harvesting mullet in Florida; and 2) mesh sizes gradually increased concomitantly with seasonal growth (i.e., in Tampa Bay region, 2-7/8" to 3" in winter, 3-1/8" to 3-1/4" in spring, 3-1/4" to 3-1/2" in early summer, 3-1/2" to 3-3/4" in late summer, and 4" to 4-1/8" in fall). The length-frequency data from various mesh sizes in the gill net fishery were used to develop seasonal selection curves to be used in black mullet stock assessment.

The relationships between fork length and total length with calculated regression equations for the four study areas were reported. Using a non-linear least-square model, seasonal length-weight relationships were calculated for mullet in Tampa Bay-Charlotte Harbor region. Age analysis indicate that otoliths cross-section radal distances were directly proportional to, and highly correlated with body length for mullet populations in the four major areas. These relationships were used to back-calculate lengths at ages. Non-linear least-square models, fitted to the observed length-at-age data, provided the growth parameters of the von Bertalanffy equations by sex. Sex-related differences between growth parameters were tested within and between regions using a Hotelling's T-test and significant differences were found to exist in all comparisons. Using the age-length key approach, the age compositions of the black mullet populations (sampled from non-selective gears) were

determined. Catch curves were generated and total mortality rates were estimated.

The gonosomatic index (GSI) and histological examination of morphological types of gametes in mature and immature gonads were used to determine peak spawning periodicity and size/age at maturity by sex in the four study areas.

Electrophoretic analysis based on samples collected seasonally from eight locations along the east and west coast of Florida indicated no evidence for genetic substructuring of black mullet populations in Florida. In general, allele frequency variations among samples within locales were as great or greater than variation among locales. This was true for locales as distant geographically as Pensacola Bay and the northeast (Atlantic) coast of Florida.

A total of 25,641 black mullet have been tagged and released since the inception of the program in October 1986 in Tampa Bay, Charlotte Harbor, Apalachicola Bay, and Pensacola Bay. During this period 8.8% (2268) of the marked fish were recaptured. The percent returns varied in time and area. Monthly recapture rates showed seasonal patterns parallel to the fishing effort, with higher percent returns during the spawning season. Rates of recovery and/or reporting were higher in the Charlotte Harbor and Apalachicola Bay regions than in the Tampa Bay and Pensacola regions.

Mark/recapture data were used to examine the inter- and intra bay system movement patterns of black mullet. Black mullet along the west coast of Florida show little inter-system movement, tending to stay within the same bay system in which they were released. In Tampa Bay, mullet exhibited little intra-system mixing, generally moving toward the mouth of the bay during September to December (spawning period), then either moving directly offshore or northward along the coast until leaving for offshore waters to spawn. Mullet then return to their original bay system after spawning and move to shallow, protected waters during spring months, where they stay until the next spawning season. A canonical discriminate analysis based on return data indicated good separation between the four systems, with most of the overlap between Charlotte Harbor and Tampa Bay.

Growth rates estimated from mark/recapture studies were generally higher than values calculated from the biological sampling program. Since the majority of data with positive growth rates were from spring and summer months, it is possible that growth rates from mark/recapture studies represent seasonal pattern observed in mullet growth with higher rate during spring and summer months.

Two larval mullet cruises were conducted during the 1987 spawning season. A November 1987 cruise was cut short after only two days because of adverse weather conditions. During the December 1987 cruise, 148 black mullet larvae and pelagic juveniles were collected. Overall, larval mullet were less abundant in December 1987 than in January 1987, even though the stations sampled during the December cruise extended further out into the predicted spawning area than did the January cruise. This may indicate more spawning occurs at these particular stations during January than December, an observation supported by juvenile collections. The size distribution of larvae shows that at the time of the December cruise, spawning took place about 280 km offshore. When length-frequency data from January and December 1987 cruises were combined by distance offshore, they showed that most larvae <3 mm occurred between 160 km and 280 km offshore. More small larvae were collected inshore during January than during December and this may indicate a shift in spawning area as the season progresses.

The Juvenile survey of the 1987/1988 season concentrated on channel net sampling of recruitment to Long Bayou at the mouth of Tampa Bay. This net captured low numbers of difficult-to-sample querimana stage black mullet. The densities recorded were much lower than the abundance observed in the bayou: however, these densities appeared to be proportional to the numbers of mullet entering the bay and, therefore, may potentially be of use as a recruitment index. The relative densities of mullet, recruiting to Long Bayou through the tidal pass, indicated that recruitment peaked in late February/early March. Preliminary information on otolith aging of these mullet indicates that it takes black mullet about 1.5 months to reach Tampa Bay from offshore spawning grounds.

As a continuation of the 1986 hydroacoustic pilot study, acoustic surveys on black mullet were conducted during the 1987 and 1988 spawning seasons (November-December) in the Manatee River System in lower Tampa Bay. Echo-integrator data, collected using a fixed-survey in 1987 and a mobile-survey in 1988, provided time series on mullet school density and migration timing. These data were used to determine the patterns in fishing effort, exploitation, catch-per-unit-of-effort, and catchability in relation to mullet schooling aggregation (availability) and offshore migration during mullet roe season.

The analysis of climatological data integrated with daily time series of population densities (from hydroacoustic experiments) and mark/recapture data indicated that black mullet schooling activities peak during active cold front events during the spawning season. An active cold front was associated with strong northwesterly winds, a drop in temperature and barometric pressure, and precipitation on some occasions. Mullet schools emigrated from inshore waters during the passage of an active cold front. Commercial catch, effort, and catch per trip increased significantly during active cold front events. Days with cold front events contributed approximately 49% of the total mullet production during the roe mullet season.

Assessment of Mullet Landings and Identification of Essential Indicators and Economic Data Base Towards Establishment of MSY in the FCZ, Gulf of Mexico
NA88WC-H-MF191

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ABSTRACT

INTRODUCTION

The roe-mullet industry in Alabama has come under quite a lot of criticism in recent years. With the concern about overfishing due to the roe mullet industry of primary note. Data produced by this MARFIN initiative has provided a viable data base to address these criticisms.

SUMMARY OF RESULTS

Mullet samples were taken on 23 occasions during 1988-89 with 1,448 individual fish measured. Mullet were sampled at roe-mullet houses in Mobile and Baldwin Counties and length, weight and roe weight measured and otoliths were collected. Otoliths have previously been determined to be the more reliable method for aging mullet.

During 1988-89 approximately 2.4 million pounds of mullet were utilized in the roe-mullet industry. Over 262,ØØØ pounds of mullet roe, valued at $1.77 million were produced during 1988. The state of origin for the roe-mullet produced in Alabama were: Louisiana, 34%; Florida, 39%; and Alabama/Mississippi, 27%;.

Four plus age classes dominated the mullet fishery during 1988; where as in 1987 3+ and 4+ age classes dominated the catch. The Graham-Schaefer curve for the Gulf of Mexico mullet fishery indicated that the 1988 harvest was slightly above MSY. The Alabama roe-mullet industry in 1988 provided employment for numerous Gulf Coast fishermen and approximately 13Ø Alabama processing plant employees.

Fishery Independent Characterization of Population Dynamics and Life History of Striped Mullet in Louisiana (Grant No. NA88WCHMF-197)

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Introduction

Striped mullet, *Mugil cephalus*, are worldwide in distribution, being found in the coastal waters and estuaries of tropical and subtropical zones of all seas. Although numerous studies have been conducted worldwide (see Pillay 1972 and Oren 1981) on different aspects of striped mullet life history, biology and population dynamics, still the resultant literature tends to be confusing, particularly when applied to a specific area like Louisiana where little research has been previously done. Data for northern Gulf of Mexico populations, particularly Louisiana are limited, and for the most part, consist of isolated observations from survey studies.

Summary

We are completing our second year of a three year study on all size classes of striped mullet in Louisiana. Samples have been obtained from the Louisiana Department of Wildlife and Fisheries Finfish Section coastal monitoring program via gill nets, trammel nets, and bag seines. Our sampling protocol remains the same as previously described (Proc. 1st Ann. MARFIN Conf., 1988).

Marginal increment data from striped mullet sagitta are consistent with an interpretation of a single annulus formed each year between April and June (Table 1). Virtually all otoliths examined between August and March possessed a translucent margin. Some mullet from April through July had otoliths with opaque margins. We also examined the degree of completeness of the opaque and translucent margin to see if this analysis was also compatible with a single annulus concept. Figure 1 shows the results of this analysis (see Thompson, Render, Allen and Nieland 1989 for more details) agreeing with our suggestion of a single annulus formed between April and June.

A comparison of mean size at age of Louisiana striped mullet using fork length (FL) at age found a near linear growth rate to age three. Beyond this age, growth rates assumed a typical asymptotic pattern with lengths leveling off near 350 mm (Figure 2). However, a comparison between otolith weight vs. age classes and may prove to be a better estimator of age (Figure 2).

Based on the criteria that maturity is reached when 50% of the individuals of a population develops functional gonads (ovarian or testiclar gonadogenesis), Louisiana striped mullet males are mature around 200 to 220 mm FL and females around 220 to 230 mm FL. All Louisiana's mullet samples below 160 mm FL were immature and indistinguishable sexually. All males above 280 mm FL and all females greater than 290 mm FL were mature (Table 2).

A comparison of previous age at sexual maturity data (Brusle 1981) shows that Louisiana striped mullet are within the range of most Gulf of Mexico studies. Most males mature in their second year, although some do not spawn until their third year; most females spawn for their first time when they are three, although some produce their first mature oocytes at the end of their second year of life.

Since the commercial mullet fishery in Louisiana is directed at mature ovaries, we examined the reproductive cycle in detail. Examination of H & E slides showed ovarian reorganization commenced in mid-July. By late August and early September, two size classes of primary growth oocytes are evident. In early October, a dominate group of cortical alveolar oocytes have matured, eventually leading to an ovary consisting mostly of vitellogenic eggs. No hydrated ovaries have been found during the study. From January through March, there is a wide range of ovarian stages, resulting from post-spawning mullet recovering at different rates of atresia. By March most ovaries have regressed to a small resting state possessing only primary growth oocytes.

Our investigations indicate that Louisiana striped mullet possess little interpopulation allelic heterozygosity. MDH-2, ME-2, ADH, and G-6-PDH show the greatest degree of variation. Rare alleles have been noted for LDH-2 (slow-Figure 3a) and PGM-1 (fast-Figure 3b). Most enzymes are monomorphic (Figure 3c) for Louisiana striped mullet. Among those loci showing heterozygosity, no geographical pattern of variation is evident.

Table 1. Percent of each margin type showing the relationship of degree of completeness[1] of a opaque vs. translucent margin in Louisiana striped mullet sagitta, showing annulus formation between April and June.

Month	OPAQUE			TRANSLUCENT		
	1	2	3	4	5	6
J					16.7	83.3
F	0.5					99.5
M						100.0
A	7.6	5.0			2.5	84.9
M	17.4	39.2	30.4	4.3		8.7
J		22.2	27.8	27.8		22.2
J			5.4	70.3	24.3	
A				26.9	73.1	
S			.9	31.0	58.4	9.7
O					25.2	74.8
N				.9	29.1	70.0
D					24.7	75.3

[1] Opaque: "1" = 0 to 1/3 complete, "2" = 1/3 to 2/3, "3" = 2/3 to completely formed

Translucent: "4" = 0 to 1/3 complete, "5" = 1/3 to 2/3 complete, "6" 2/3 to completely formed

Table 2. Estimated size of maturity for Louisiana striped mullet.

Fork Length (mm)	Imm. M	M	Imm. F	F
160	(100)[2] 1	0		
170	(100) 1	0		
180	(100) 3	0	(100) 1	
190	(50) 1	1	(0) 0	
200	(100) 2	0	(0) 1	1
210	(66) 2	1	(0) 0	0
220	(14) 1	6	(100) 2	0
230	(31) 4	9	(43) 3	4
240	(0) 0	19	(17) 1	5
250	(12) 3	22	(21) 4	15
260	(16) 4	21	(2) 1	48
270	(8) 2	22	(4) 3	68
280	(0) 0	12	(0) 0	71
290	(0) 0	18	(0) 0	79
300	(0) 0	13	(0) 0	71

[1] Imm. M = immature male, M = mature male, Imm. F = immature female, F = mature female.

[2] Number in () is percent of sample that is immature for that size class.

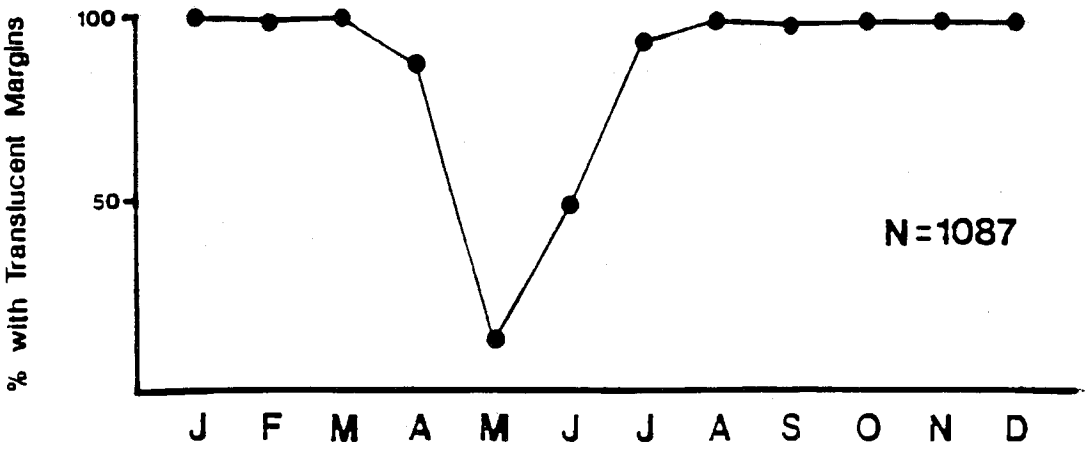


Figure 1. Relationship of percent of striped mullet otoliths with translucent margins and time, 1987-1989.

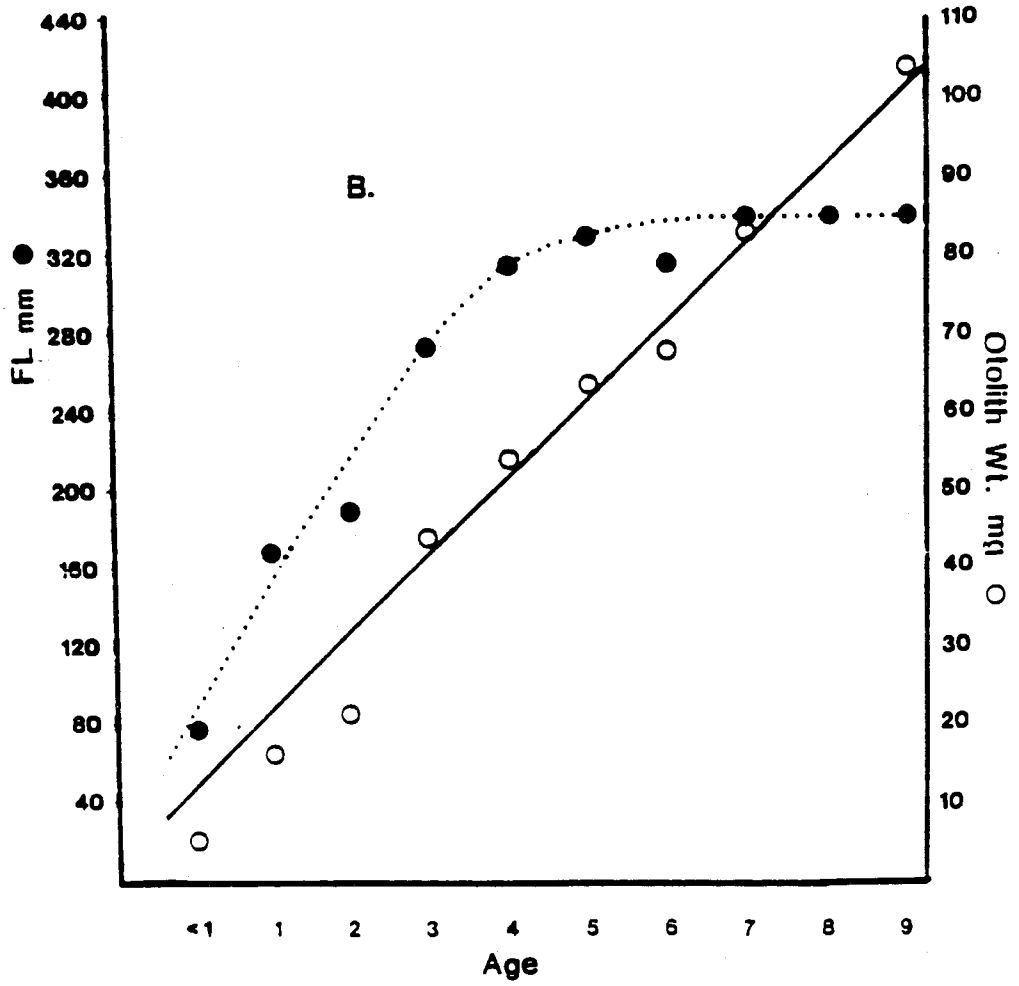


Figure 2. Growth relationship between age vs. fork length compared to age vs. otolith weight for Louisiana striped mullet.

Figure 3a. Electropherogram of G-6-PDH dimer from liver tissue of Louisiana striped mullet.

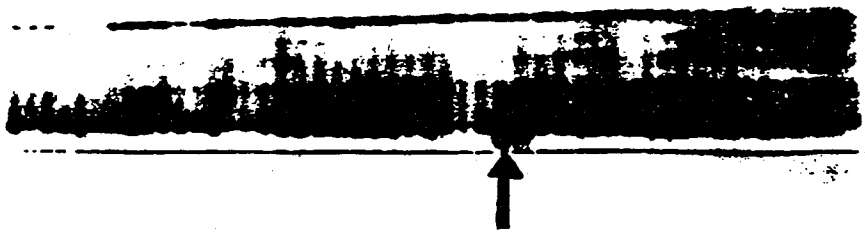


Figure 3b. Electropherogram of LDH-2 and -3 tetramers from eye extract of Louisiana striped mullet. Slow allele of LDH-2 is noted by arrow.

Figure 3c. Electropherogram of PGM monmer from muscle tissue of Louisiana striped mullet. Rare fast allele is noted by arrow.

SUMMARY OF ESTUARINE FISH II PANEL DISCUSSION

- The roe mullet fishery is mainly for females. Males are caught incidentally depending on the mesh sizes used. Since females bloat with eggs, they can be caught with larger mesh sizes that will exclude some of the males. Another reason for catching mainly females (up to 100%) is that the males and females may be geographically separated.
- In addition to the roe mullet fishery, the foodfish fishery targets the small males. They use smaller mesh nets with 2 1/4 - 2 1/2 inch mesh, whereas fishermen using 4 1/4 inch mesh nets mainly catch females.

SESSION VII

COASTAL PELAGICS AND MENHADEN

SUPPLEMENT LENGTH AND SEX FREQUENCY DATA AND CATCH PER UNIT OF EFFORT INFORMATION FROM THE COMMERCIAL FISHERY FOR SPANISH MACKEREL (Scomberomorus maculatus) OFF WEST FLORIDA

Dr. Nelson M. Ehrhardt
Rosenstiel School of Marine and Atmospheric Science
University of Miami

Introduction

This is the second year of a three year project designed to improve the data base used to assess Spanish mackerel stocks in the eastern Gulf of Mexico. Objectives are: 1) to design and implement a 3-year frame survey to collect supplementary size frequencies and catch per unit of effort in the commercial fishery off the west coast of Florida, and 2) to evaluate accuracy and precision of the information presently gathered by various other sources. This project is part of the National Marine Fisheries Service cooperative mackerel research efforts in the southeastern Atlantic.

Summary of Results

Field work was implemented at the on set of the 1988-1989 fishing season in southern Florida (December 1988). Sampling effort was allocated according to an experimental sampling design developed and implemented during the 1987-1988 fishing season. The experimental design includes several strata and randomized elements according to areas, sub-areas, and fleets. Samples consisted of all fish contained in one 100-lb bail of fish randomly drawn from each 2500 lb of fish landed by each sampled vessel. All fish were measured to the nearest 0.5 cm, and sub-samples consisting of the first 3 fish in a length class were separated for biological measurements (sex, weight, etc.) and otoliths extraction. Total landings per sampled vessel, number of sets, and characteristics of the gear were also recorded.

During the period December 1988 - March 1989 a total of 12,242 Spanish mackerel were measured from samples randomly drawn from 830,952 lb of fish landed in West Florida. The data collected have been submitted to the National Marine Fisheries Service to be included in the annual Spanish mackerel stock assessment analyses. A summary of statistics collected since the start of the project indicates the following progress:

Fishing Season	1987-1988	1988-1989
Sample Size	6,473 lb	16,460 lb
Catch Sampled	369,260 lb	830,952 lb
Number of Fish Measured	3,720	12,242

Length frequency data collected by the Florida Department of Natural Resources (FDNR) and National Marine Fisheries Service (NMFS) were evaluated relative to the supplementary information

collected by this project. Results indicate that FDNR data are representative of incidental Spanish mackerel landed by the pompano fleet but not of Spanish mackerel landed by Spanish mackerel run-around gillnetters. NMFS data collected in Key West differ from data collected in Key West by this project. Discrepancies emerge from differences in experimental design, sample size and the use of raising factors based on estimated sample size of NMFS records derived from highly variable length-weight relationships.

KING AND SPANISH MACKEREL MIGRATION AND STOCK ASSESSMENT STUDY IN THE SOUTHERN GULF OF MEXICO

KAREN M. BURNS AND BRUCE D. FORTUNE

MOTE MARINE LABORATORY
1600 CITY ISLAND PARK
SARASOTA, FLORIDA 34236
(813) 388-4441

Introduction

Objectives:

1) To determine the movement and migration of king (KM) and Spanish mackerel (SM) in the southern Gulf of Mexico
2) To obtain length/frequency and CPUE data for king and Spanish mackerel captured in Mexican waters.
3) To acquire the Mexican Historical Landings Data for king and Spanish mackerel for the southern Gulf of Mexico.
4) To procure king and Spanish mackerel specimens for electrophoretic studies.
5) To collect king and Spanish mackerel otoliths for age determination.
6) To attempt to capture king and Spanish mackerel larvae in neuston plankton tows.

Schedule:

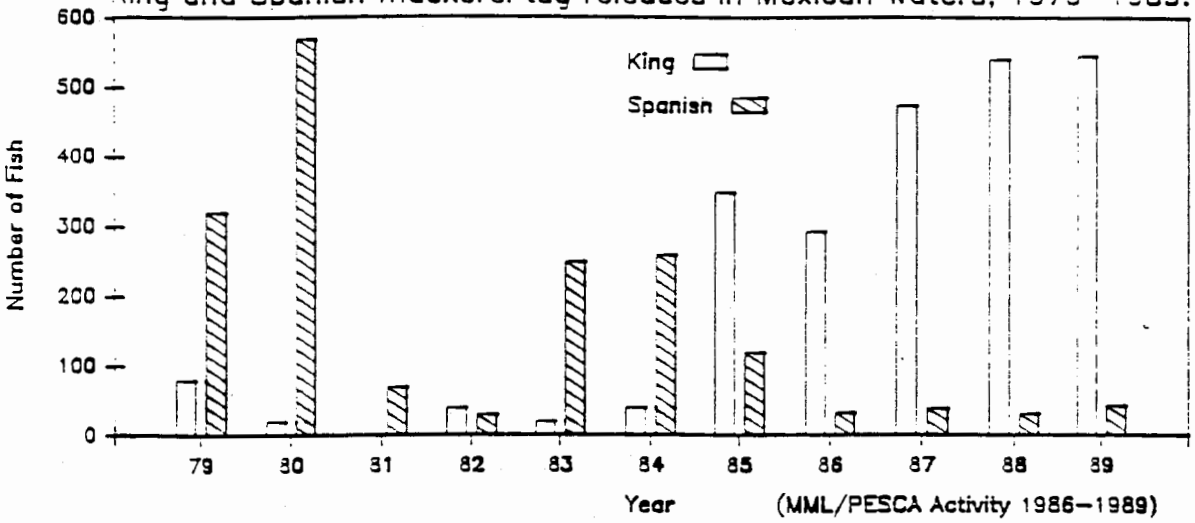
This project is of one year duration. However, 1989 is the fourth consecutive year Mote Marine Laboratory (MML) has conducted this research in cooperation with the National Marine Fisheries Service (NMFS-Panama City Laboratory) and the Mexican Instituto Nacional de la Pesca (INP) under the auspices of the MEXUS-GULF Agreement.

Summary of Results

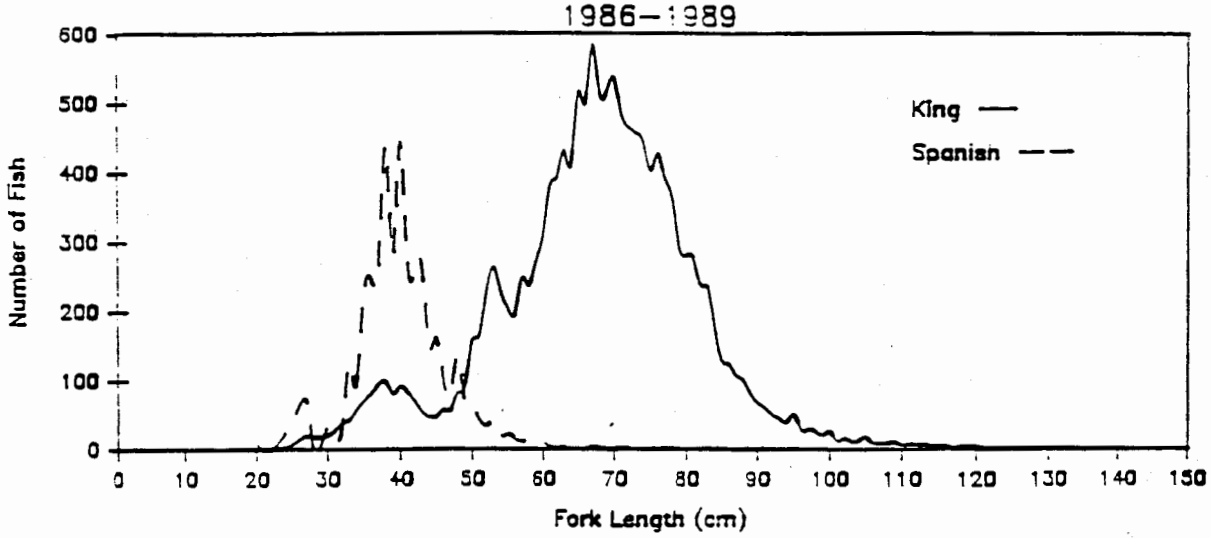
To determine movement and migration patterns for king (Scomberomorus cavalla) and Spanish (Scomberomorus maculatus) mackerel during 1989 in the southern Gulf of Mexico, 546 king (KM) and 43 Spanish (SM) mackerel were tagged off Mexico. These results increase the four-

year tally to 1,855 king and 147 Spanish mackerel tagged. Tagging efforts occurred off the Yucatan Peninsula in winter (January-April) and off Veracruz in spring (April-May). From January 1-August 31, 1989, twenty tags (18 KM, 2 SM) have been recovered. In four years, 140 tags (131 KM, 8 SM) have been recovered under MML's Rapid Reward System. Length/frequency measurements for king (4,762) and Spanish (2,270) mackerel were recorded during 1989 making a total of 14,800 king and 4,134 Spanish mackerel measurements for the past four years. In 1989, 2,105 CPUE data were obtained, providing a four-year total of 3,354. Historical Landings Data (1982-1987) for both species from all Mexican Gulf Coast States, have been obtained and sent to NMFS-Panama City. Data are reported by year, month, state, port and weight (in thousands of pounds). The 1988 Landings Data have been requested. In 1989, 406 adult mackerel and 103 juvenile king mackerel samples have been sent to NMFS-Panama City for electrophoretic studies. A four-year total of 1,786 mackerel samples (777 king, 406 Spanish, 200 cero and 403 juvenile king) have been sent to NMFS-Panama City for electrophoresis. Otoliths from adult king (200) and Spanish (151) mackerel were collected during 1989. Combined with the 86 pairs of king mackerel otoliths collected last year, the total number of king mackerel otoliths is 286. Right otoliths were sent to NMFS-Panama City, the left to INP-Mexico City. MML and INP personnel conducted three plankton cruises during January and February 1989 off Campeche and Yucatan in an attempt to obtain mackerel larvae. No mackerel larvae were collected. The 1989 values and four-year totals are not final as work is continuing in Mexico through December, 1989.

King and Spanish mackerel tag releases in Mexican waters, 1979–1989.



L/F summary for king and Spanish mackerel from Mexican Gulf Coast States 1986–1989



Otolith collection size range summary for king and Spanish mackerel from Mexican Gulf Coast States, 1988–1989.

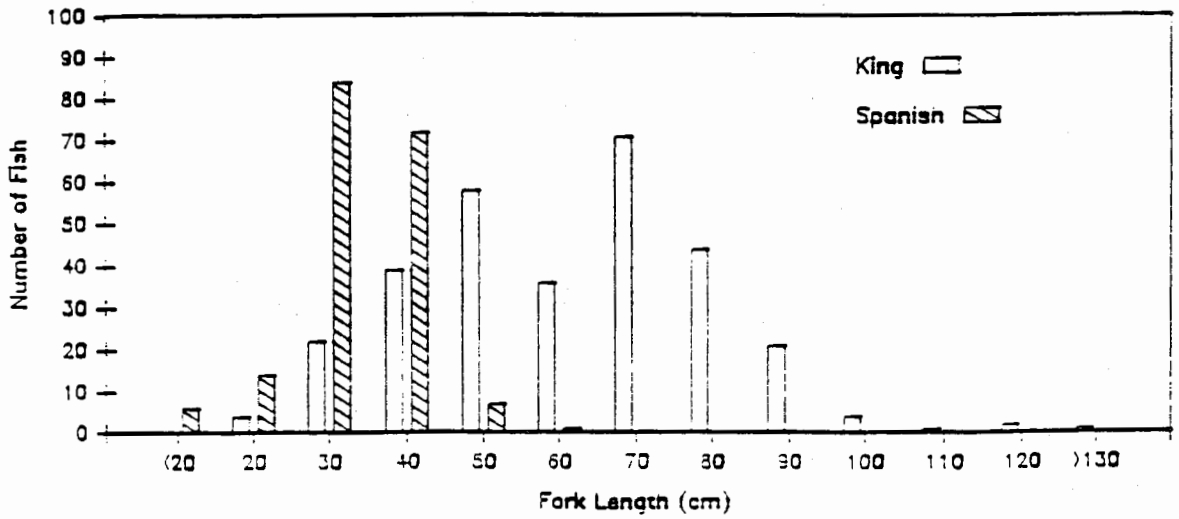


Fig. 1. Number of Mackerel Tagged off Mexican Gulf Coast States (1986-1989).
Fig. 2. Significant Tag Returns within Mexico [103 and (1)] and from Veracruz, Mexico, to the U.S.
Fig. 3. Important Tag Returns from Texas to Mexico.
Fig. 4. Significant Long Distance Tag Returns Between U.S. and Mexico. Range of Days of Freedom: 207-896.

Fig. 1

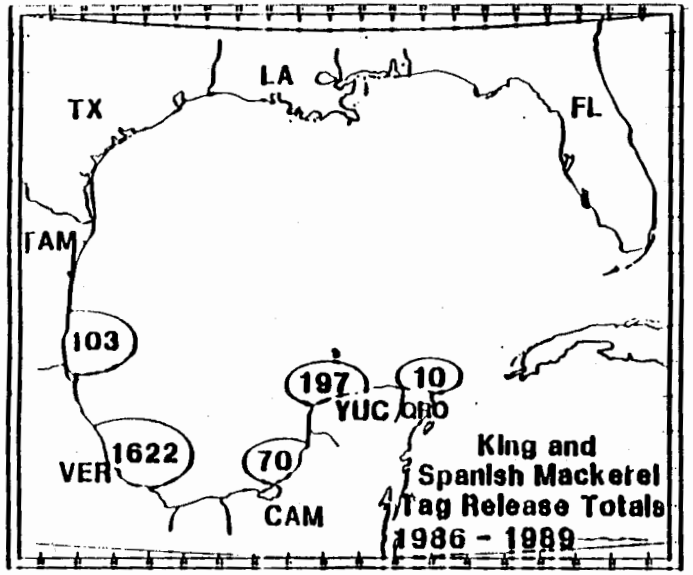


Fig. 2

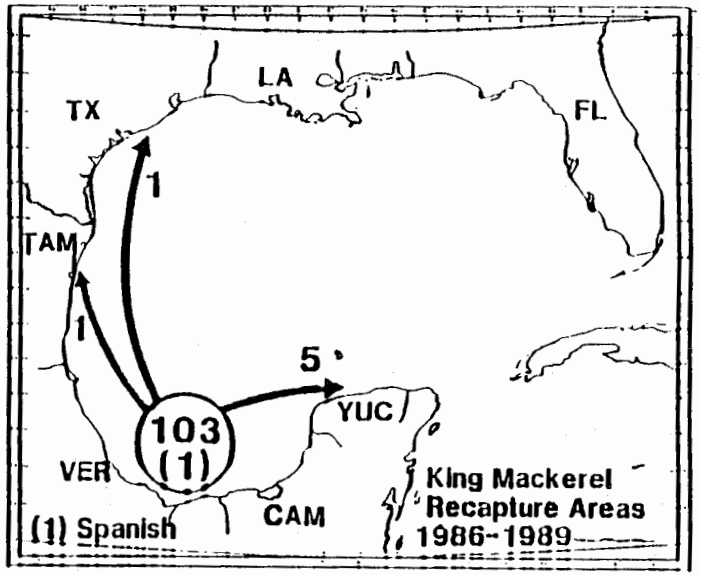


Fig. 3

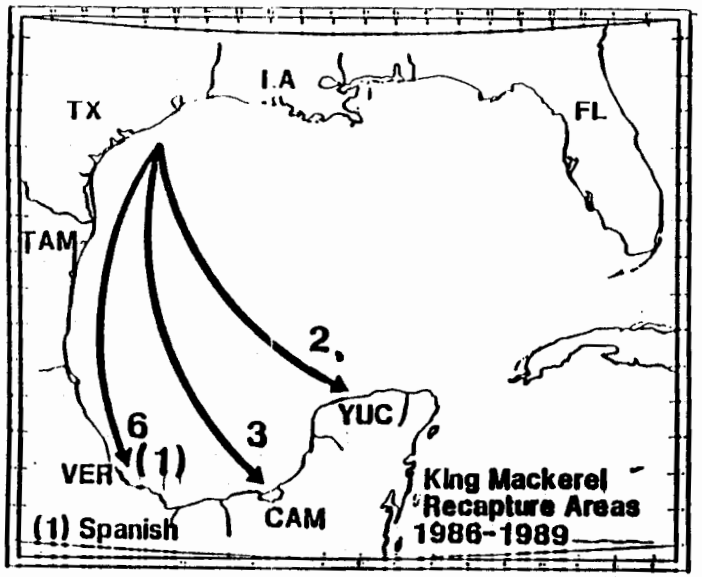
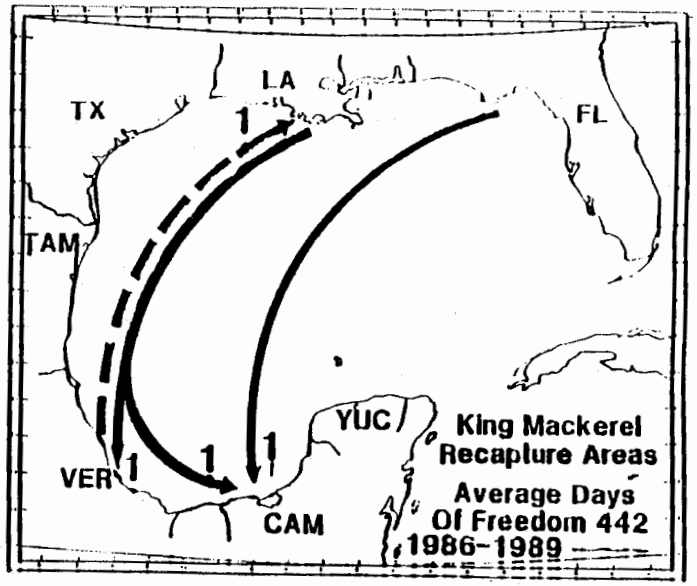


Fig. 4



PRESENTER: Steve Breland

MS/NMFS King and Spanish Mackerel Sampling Program (MARFIN Grant No. NA89WC-H-MD008)

ABSTRACT

The purpose of this grant was to provide supplemental biological information on King and Spanish Mackerel data collected gulf-wide. The supplemental information on the mackerel caught in and near Mississippi waters will be used to form fisheries management decisions for mackerel stocks in the Gulf of Mexico.

King and Spanish Mackerel biological data were collected from fish houses, charter boats, fishing tournaments and recreational fishermen. All fish were measured to the nearest centimeter and if possible sex was determined. The heads were removed for otolith and tissue samples. The only information that could be obtained from the commercial fish houses was length information. Almost all of the otolith and tissue samples came from the recreational sector.

A total of 330 Spanish Mackerel were measured. Of these 261 otolith and tissue samples were obtained and sent to the Panama City Lab for analysis. Almost all fish were caught hook and line.

A total of 54 King Mackerel were measured and sexed; and 52 otolith and tissue samples were collected. Of the King Mackerel measured all were caught hook and line. Collection was done from October 1988 to present.

APPLICATION OF A MULTI-USER UTILITY PER RECRUIT ANALYSIS FOR RESOLUTION OF CONFLICTS BETWEEN RECREATIONAL AND COMMERCIAL SECTORS IN THE GULF OF MEXICO KING MACKEREL FISHERY

Dr. Nelson M. Ehrhardt
Rosenstiel School of Marine and Atmospheric Science
University of Miami

ABSTRACT

The goal of this project is to provide a method for reducing conflict among commercial user groups in the Gulf of Mexico king mackerel fishery by identifying the set of target options in which both user groups will benefit in the long term. Specifically, the objectives of the project are to 1) develop and make available a multi-user utility per recruit model and describe its use in reducing user conflicts, 2) demonstrate the applicability of the method to the Gulf of Mexico king mackerel fishery system and draw conclusions, in so far as possible, based on existing information, and 3) summarize data needs for improved analyses and the expected benefits from obtaining the additional information.

The project was implemented in the spring of 1989 and a multi-user utility per recruit model is presently being developed. An essential component in the model building process has been the review of the Gulf of Mexico king mackerel fishery in order to develop possible formulations for the utility functions to be incorporated in the multi-user yield per recruit model structure. Utility functions are being derived based on the value judgement as to the relative importance of one dollar of commercial utility versus one unit of recreational angler satisfaction. Commercial utility (benefit) per recruit has been taken to be the net age-specific revenue. For the sport fishery utility is being considered in terms of demand based on angler satisfaction constrained by the economics of recreational fishing and the effects of changes in king mackerel fishing success (catch rates and bag limits) relative to substitute species.

EXPANDED KING MACKEREL AND REEF FISH BIOPROFILE AND CATCH AND EFFORT DATA COLLECTION AND ANALYSIS PROGRAM IN LOUISIANA

MARFIN Project #NA89WC-H-MF012

Sandra J. Russell
Coastal Fisheries Institute
Center for Wetland Resources
Louisiana State University
Baton Rouge, LA 70803-7503

The principal investigator has been gathering catch/effort information and length and sex composition data from the king mackerel and reef fish fisheries in Louisiana since 1983 under the auspices of the State/Federal Cooperative Fishery Statistics Program. Around 1985, the state/federal funding was reduced and the port samplers CFI had left were increasingly forced to focus more on collecting landings statistics than on conducting trip interviews. Also at this time, concern arose over the apparently overexploited king mackerel fishery in the Gulf, and the Gulf Council expressed a need for more individual trip and catch data. Thus, CFI's expanded king mackerel sampling was funded by the MARFIN Board in 1986 for three years. The scope of this project was broadened in 1987 to include reef fish since the reef fish management plan was up for amendment and the stock assessment committees needed more data.

The cumulative objectives of this study were to expand the catch and effort, sex, length, and age composition data collection from the recreational and commercial king mackerel and reef fish fisheries in Louisiana beyond that already being gathered by the State/Federal Cooperative Fishery Statistics Program, to determine whole-to-gutted weight conversion factors for king mackerel and reef fish, to obtain muscle tissue samples, otoliths, and eye lenses as needed by the NMFS-Panama City Lab for genetic and age/growth studies, and to initiate a reproductive study of red snapper in the northern Gulf of Mexico.

In November 1986, a port sampler was hired to interview boat captains, measure subsamples of their catches, and attend fishing tournaments to obtain biological samples in the Grand Isle and Venice port areas. His job was expanded in October 1987 to include going to sea aboard reef fish vessels once a month to obtain whole/gutted weights from a range of sizes of snappers, groupers, and mackerel. These were to be used in updating the NMFS conversion factors which are used for reporting landings and monitoring quotas. This aspect of the project was discontinued in October 1988 due to a lack of cooperation from the fishermen, but whole red snappers were purchased from the dealers whenever possible to obtain gonads for the beginning of the reproductive study. Port samplers from other CFI projects were occasionally contributed data as needed.

All data collected during this project were computerized at LSU, and have been (or will be) taped and sent to the Southeast Fisheries Center

in Miami for incorporation into its TIP data base.

From October 1986 through July 1989, CFI port samplers conducted 394 commercial vessel interviews (125 mackerel trolling, 126 bandit, 19 buoy, 45 longline, 39 handline, 24 multiple gear, and 16 tuna longline), and measured 9,705 fish (3,114 king mackerel, 3,170 red snapper, 974 vermilion snapper, 571 yellowedge grouper, 464 tilefish, 195 greater amberjack, 417 miscellaneous groupers, 79 miscellaneous snappers, and 721 other reef fish and coastal pelagics ranging from bigeye to wahoo). At the request of the NMFS-Panama City Lab, they have collected 302 otoliths, 831 muscle tissue samples, and 55 eye lenses from king mackerel, and have shipped approximately 200 whole Spanish mackerel to the Lab. Conversion factors were developed for snappers, groupers, tilefish, and king mackerel. Approximately 100 red snapper gonads have been preserved for later histological analyses, but problems associated with obtaining whole fish has prevented the collection from being completed this year.

The character of the reef fish and king mackerel fisheries changed drastically during the three years of this project. Landings are now more widespread along the coast than they were in 1986, and Grand Isle can no longer be considered the dominant port for both fisheries. Fleet size has been greatly reduced, but the remaining fishermen are experienced and have seen significant increases in their catch per effort during the last year (Figure 1).

King mackerel and red snapper populations appear to be rather healthy in this part of the Gulf as seen from the length frequencies (Figures 2 and 3) and catch/effort data. Since there are apparently resident populations of these two species present year-round off Louisiana's coast with attendant fisheries unique to each group, and the same probably holds true for the other Gulf States, the Gulf of Mexico Fishery Management Council should consider managing them as individual units or groups of units, rather than arbitrarily dividing the Gulf into eastern and western sectors. With reduced fleet sizes in these fisheries, this would be an excellent time to implement some sort of limited entry management plan.

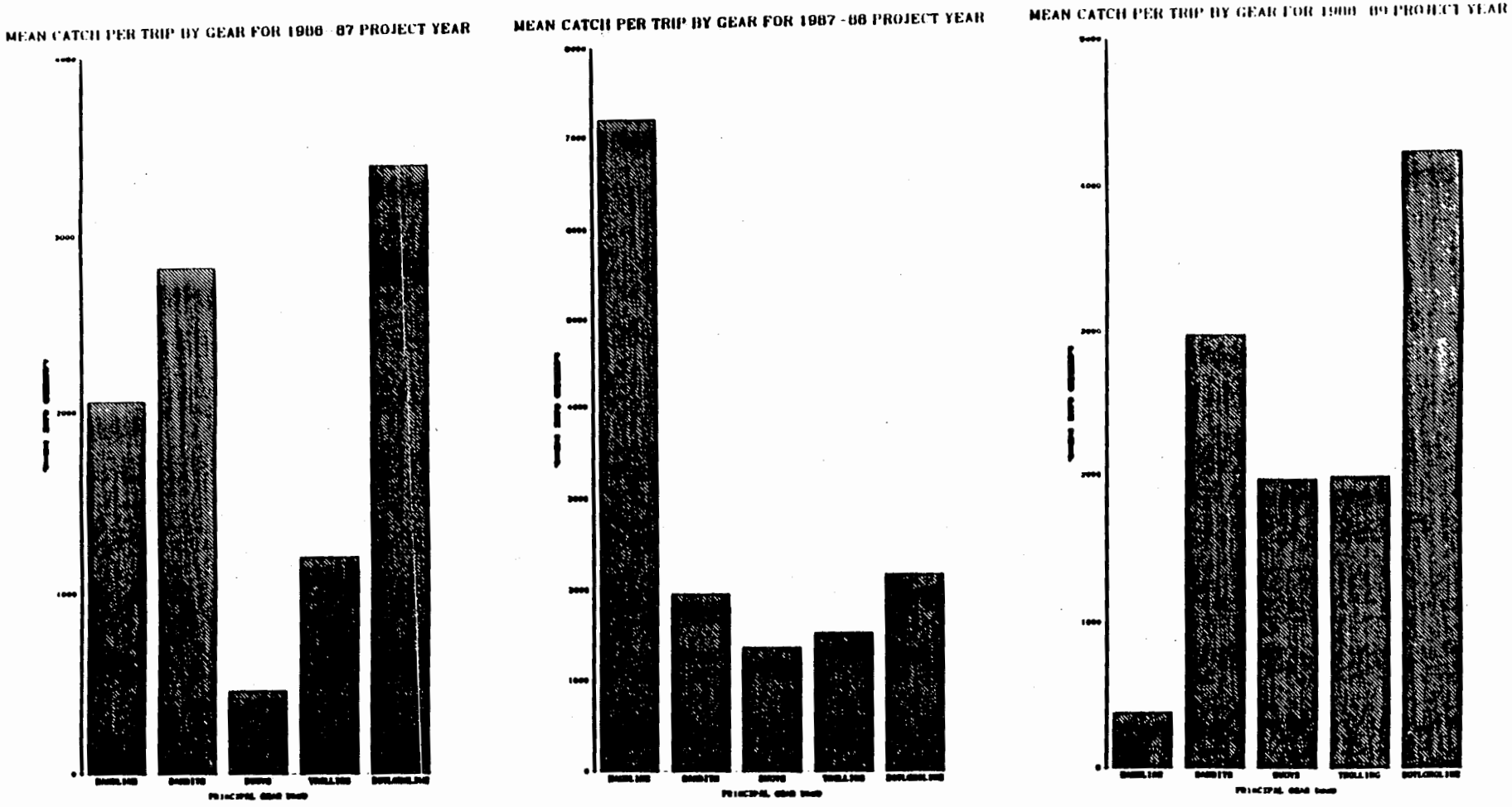
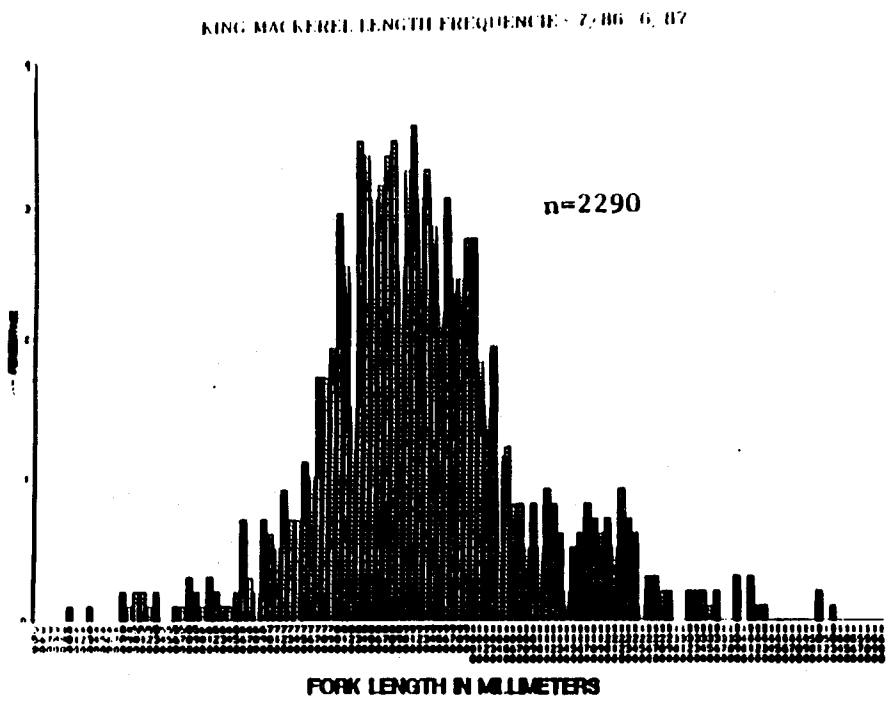
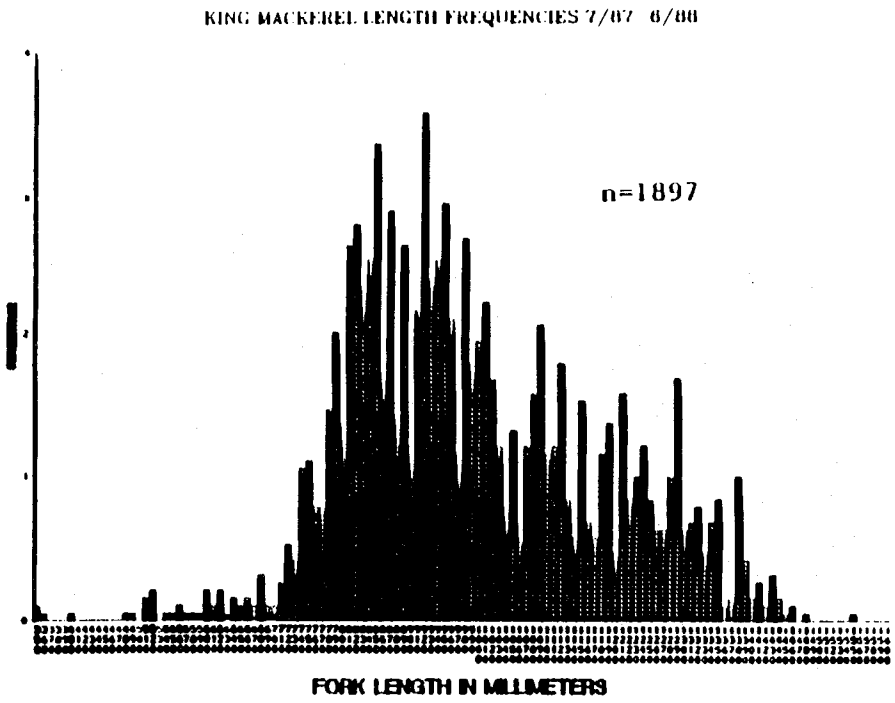

MEAN CATCH PER TRIP BY GEAR FOR 1986 -87 PROJECT YEAR
MEAN CATCH PER TRIP BY GEAR FOR 1987 -88 PROJECT YEAR
MEAN CATCH PER TRIP BY GEAR FOR 1988 -89 PROJECT YEAR

Figure 1.


KING MACKEREL LENGTH FREQUENCIES - 7/86 - 6/87
n=2290
FORK LENGTH IN MILLIMETERS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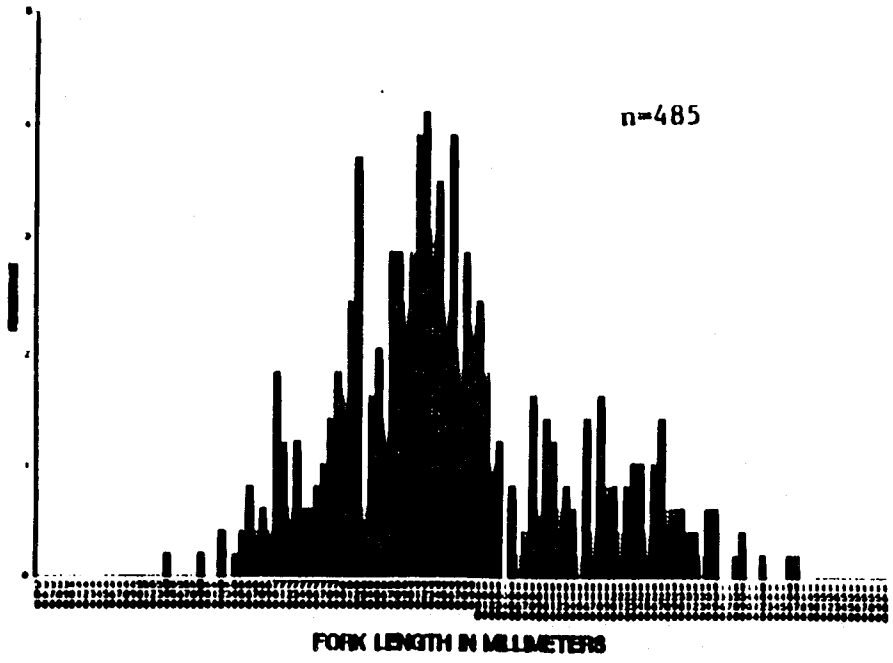
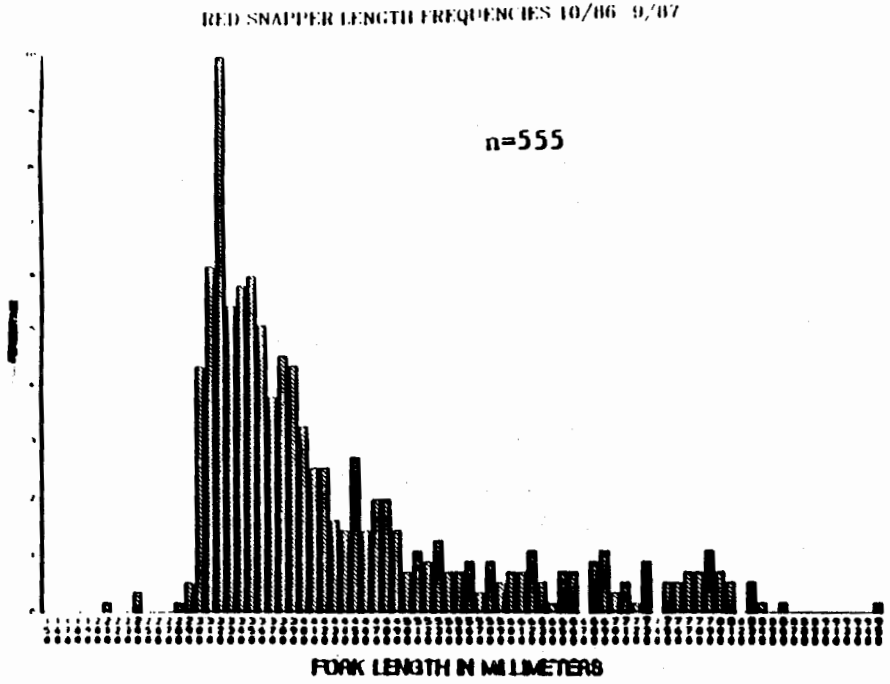

KING MACKEREL LENGTH FREQUENCIES 7/88-6/89
n=485
FORK LENGTH IN MILLIMETERS

Figure 2.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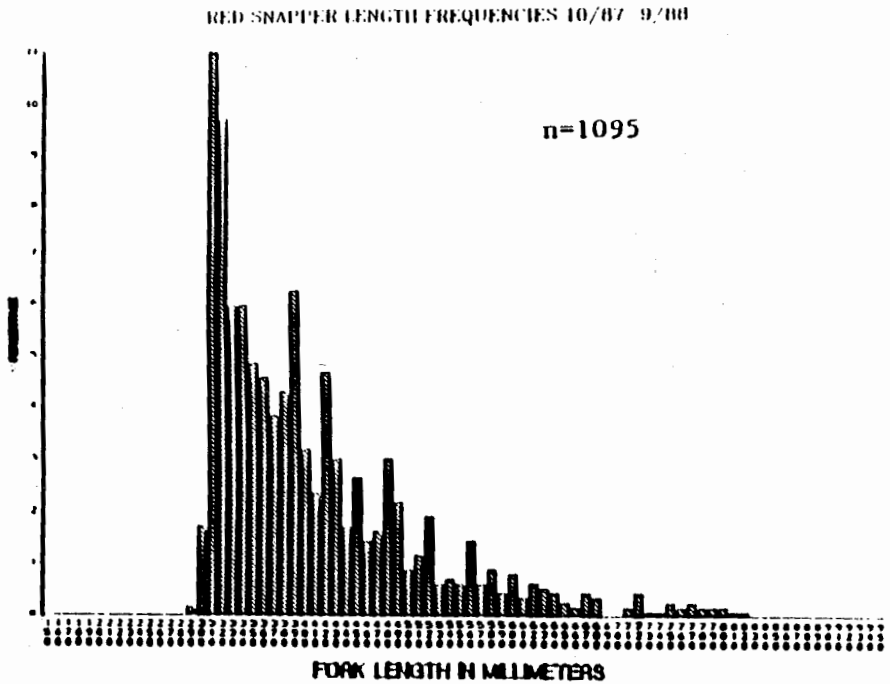
FORK LENGTH IN MILLIMETERS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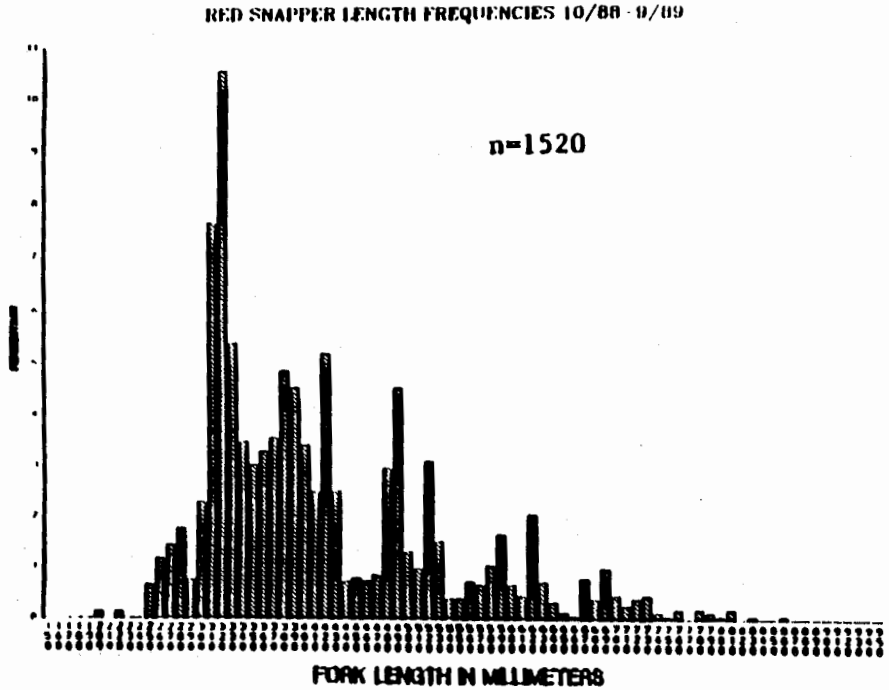

RED SNAPPER LENGTH FREQUENCIES 10/88 - 9/89
n=1520
FORK LENGTH IN MILLIMETERS

Figure 3.

King and Spanish Mackerel Research in the Southeast

Investigator: Eugene L. Nakamura
NMFS/SEFC Panama City Laboratory
3500 Delwood Beach Road
Panama City, FL 32408

The objectives of this project were to supplement existing data bases and to obtain new information on stocks of king and Spanish mackerels in order to determine the status of stocks and to establish acceptable biological catch limits. The following results were obtained.

Length frequencies: Data bases were re-formatted so that data on lengths may be categorized by species, sex, area, month, and fishing method for immediate use in stock assessment analyses. Approximately 12,500 king mackerel were sampled, about 4,000 from the gulf and 8,500 from the Atlantic, and approximately 4,900 Spanish mackerel were sampled, about 2,300 from the gulf and 2,600 from the Atlantic.

Otoliths: Otoliths were sampled for age determinations. Otoliths from approximately 1,300 king mackerel were sampled, 800 from the gulf and 500 from the Atlantic. Otoliths from approximately 800 Spanish mackerel were sampled, 450 from the gulf and 350 from the Atlantic. These otoliths were used to age the fish. The age data along with the length and sex data were used to develop age-length keys. The keys are used in converting length frequency data to ages for virtual population analyses.

Muscle tissue: Electrophoresis was conducted on muscle tissue of 344 Spanish mackerel. All fish were from both the U.S. and Mexican (Yucatan and Tampico) Gulf of Mexico. Preliminary analysis (cluster analysis) indicates eastern and western groups of Spanish mackerel in the Gulf of Mexico.

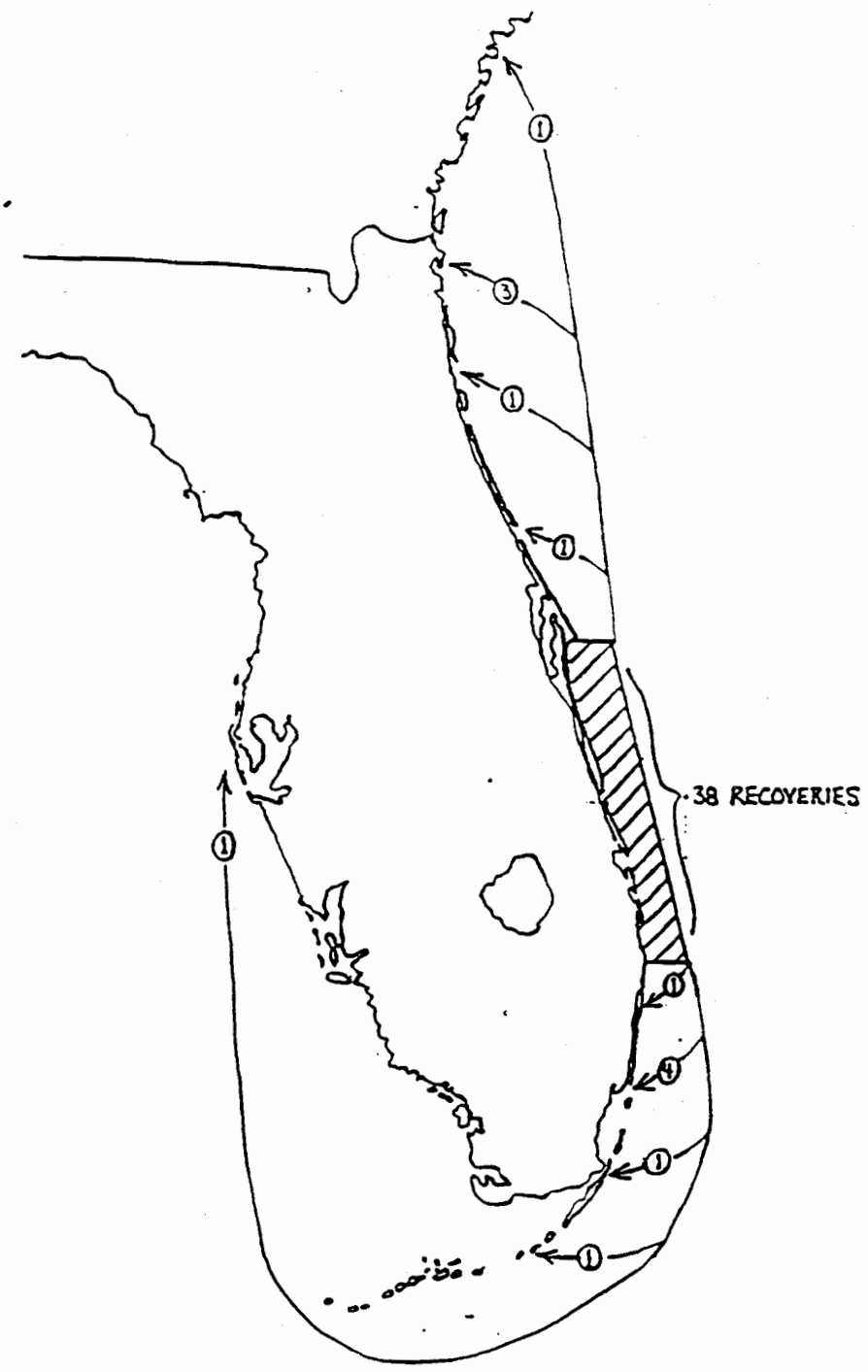
Muscle tissue for electrophoresis from about 1,500 gulf king mackerel were sampled. Electrophoretic data were used to determine the proportions of mixing of the western and eastern gulf king mackerel. The results indicated again that in the northern gulf during the warm months, the proportion of western fish declines from Texas to Florida and the proportion of eastern fish declines from Florida to Texas.

Tagging king mackerel in southeast Florida: From December 6, 1988, through April 14, 1989, 2,043 king mackerel were tagged and released in southeast Florida in order to determine the nature of mixing of the two migratory goups. As of August 15, 1989, 52 tagged fish have been recovered (2.54% recovery rate). Six recoveries were to the north and 8 recoveries to the south of the tagging area. One recovery was made in the Gulf of Mexico (see figure).

Acceptable biological catches: Stock assessment personnel determined ABCs for the 1988-89 fishing year as follows:

Stock	Fishing year	Million pounds ABC	TAC
Atlantic			
king mackerel	Apr 1, 1989 to Mar 31, 1990	6.9-15.4	9.00
Spanish mackerel	Apr 1, 1989 to Mar 31, 1990	4.1-7.4	6.00
Gulf			
King mackerel	Jul 1, 1989 to Jun 30, 1990	2.7-5.8	4.25
Spanish mackerel	Jul 1, 1989 to Jun 30, 1990	4.9-6.5	5.25

Total allowable catches were established by the fishery management councils, as required by the fishery management plan, the TACs were set within the range of ABCs.



Recoveries of king mackerel tagged and released off southeast Florida (cross-hatched area) from December 6, 1988, through April 14, 1989. Arrows indicate direction of movement: numbers in circles indicate numbers of recaptured fish.

COLLECTION, PRESERVATION, STORAGE, AND SHIPPING FOOD GRADE GULF MENHADEN (FGGM) FOR NEW PRODUCT TRIALS

(Grant No. NA89WC-H-MFØ22; Start : Ø7-Ø1-88 End : Ø9-3Ø-89)

T. M. Miller, Marine Chemurgics
1834 J. Bell Ln., Newport, NC 28570

J. W. Stuart, Empire Menhaden Co., Inc.
P. O. Box 98, Empire, LA 7ØØ5Ø

W. B. Wallace, Wallace Menhaden Products, Inc.
P. O. Box 12Ø2, Mandeville, LA 7Ø47Ø

INTRODUCTION

The overall goal of this project is to increase the value of Gulf menhaden by use of stringent preservation measures during collection, handling, and storage - to qualify it as "Food Grade Gulf Menhaden" (FGGM) to be used to produce oil and protein products for human foods.

Menhaden landings (1983-1988) averaged 2.67 billion pounds, of which 74% were from Gulf of Mexico. Gulf prime crude menhaden fish oil production (281 million pounds) was 14.2% of the fish weight, for which the industry received $39.6 million, a low return for much fishing and processing effort.

FGGM is made from live fish, rapidly chilled to Ø de C, or superchilled, for further processing in unfrozen, or frozen form. Frozen FGGM has excellent shelf life that can assure a supply between fishing seasons.

Economic feasibility of processing depends on complete utilization of the whole fish, achieved by segregating the parts to produce fish oil, broth, mince, puree, and surimi for human food intermediates, and nutrient-rich byproducts for special animal feed applications.

Manufacturers, institutions, and consumers can improve seafood recipes through the use of these intermediates to provide functional properties, enhance flavors, and supply healthful fats and proteins. Medical research has extended this perception of health giving benefits that menhaden can provide, because it is potentially the No. 1 domestic source of long chain omega-3 fatty acids.

A specific project goal is to prepare and supply research and development groups in government, universities, and private industry with descriptive literature concerning FGGM, samples of the fresh or frozen fish, and demonstration products made from FGGM.

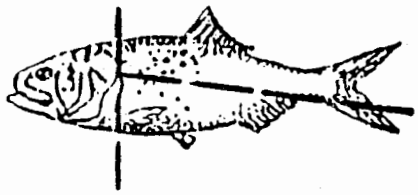
SUMMARY OF RESULTS

Rapid chilling of live fish was accomplished by loading them along with salt into insulated boxes, and then using paddles to assure uniform contact of fish with coolant. Figure 1. illustrates a way to accomplish large scale chilling.

A runboat was used to collect live fish from the nets of the menhaden fleet and initiate rapid chilling in the containers. These were unloaded and shipped for immediate processing, or to a freezing and storage facility. The fish varied in length and weight. Suitability for specific end uses was examined, as it relates to size, composition, and yields. Table 1. shows data for a size that is frequently encountered.

Freezing the whole fish was tried with blast freezers, refrigerated brine, or liquid nitrogen, with no important differences. Random packing in moisture and oxygen resistant bags provided FGGM that was in acceptable condition for many uses after six months. Improvements now being evaluated include compacting whole fish in gelatin coated blocks, and use of glazes and protective packaging.

Hand or automated dressing of frozen FGGM starts with removing the heads, then lateral cuts to separate backs from belly flaps.



Processing options for producing food grade fish oil, broth, puree, and mince were tried in pilot plant experiments. One of the options for making intermediates appears in Figure 2.

These intermediates were successfully used and demonstrated in a variety of fish and shellfish dishes which included chowders, fish cakes and balls, sauces, stuffings, salad dressings, casseroles, and sausages.

Sausages which contained 75% fish meat, entirely menhaden or combined with other species, were produced, evaluated by taste panels, and served at two seafood festivals. Half of the participants rated the sausages as "acceptable" and persons over forty rated them higher. A casing manufacturer's test kitchen judged them "promising", offered equipment, and use of their pilot plant.

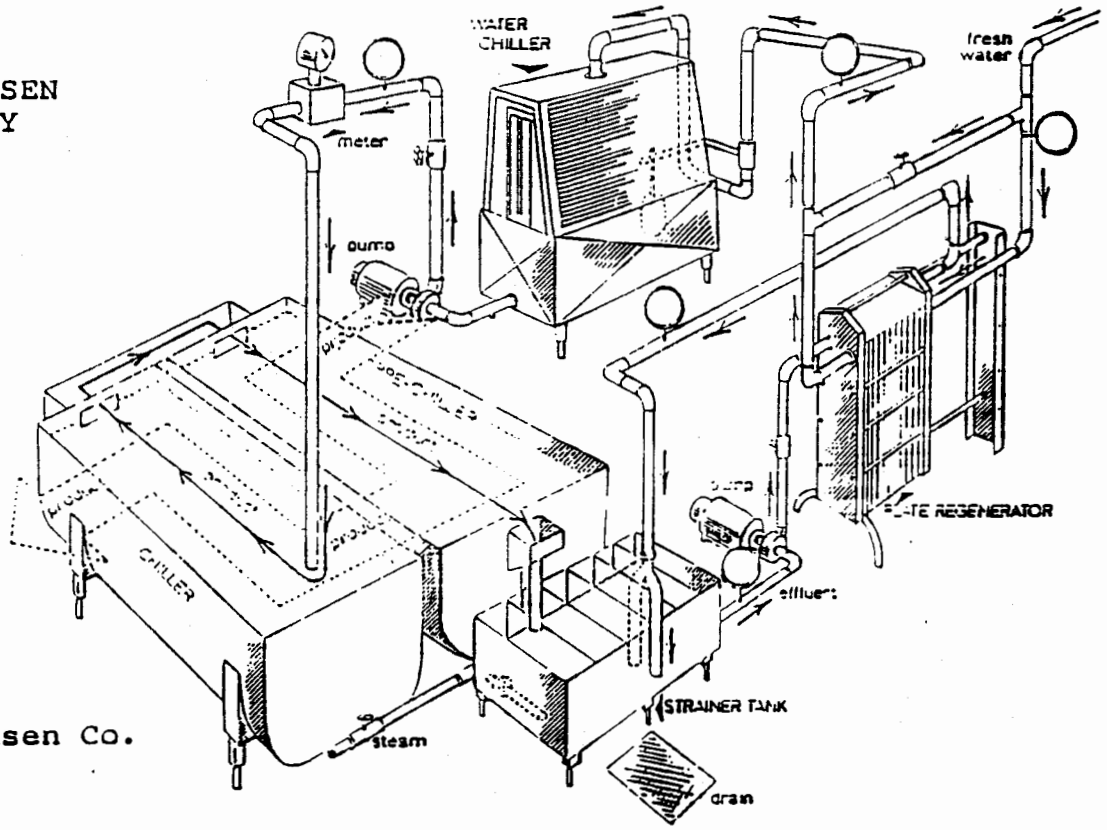
A 38 page manuscript, entitled, "Fresh-caught Gulf Menhaden for Foods and Feeds", March, 1989, was prepared and distributed to initiate contacts with potential FGGM users.

Ongoing work includes collections and shore handling of Gulf menhaden, commercial freezing, packing and storing, and processing experiments in a Louisiana plant.

FIGURES AND TABLE

Figure 1.

CHESTER-JENSEN
BTU RECOVERY
SYSTEM



Source:
Greg Hart,
Chester-Jensen Co.

Table 1. - TYPICAL COMPOSITION OF FGGM & PARTS

Whole fish (A) - Av. fork length 185 mm, av. wt. 126.9 g.
Dressed heads (B) - 14.0% of total weight
Dressed backs (C) - 36.3% of total weight
Belly flaps (D) - 24.5% of total weight
Waste (E) - 25.2% of total weight

	A	B	C	D	E
Proximate Composition	(percent by weight)				
Moisture	61.27	61.15	64.13	58.31	59.14
Fat	13.85	16.14	14.24	23.14	20.57
Protein	13.29	14.16	17.22	16.55	10.01
Ash	4.61	7.03	3.50	4.15	5.19
Amino Acids	(percent of protein)				
Aspartic acid	9.16	8.84	9.54	9.23	9.78
Threonine	4.28	3.66	4.34	4.22	4.28
Serine	3.89	4.13	3.97	3.83	4.64
Glutamic acid	14.39	13.54	14.97	14.46	13.61
Proline	5.46	6.79	4.98	5.33	5.21
Glycine	8.03	10.86	7.21	8.18	9.28
Alanine	7.22	7.46	6.81	7.07	7.33
Cystine	0.31	0.67	0.55	0.75	1.44
Valine	4.24	3.69	4.30	4.12	3.95
Methionine	3.25	2.98	3.40	3.42	3.30
Isoleucine	3.90	3.06	4.05	3.96	3.86
Leucine	6.98	5.73	7.65	7.31	7.01
Tyrosine	2.61	2.52	2.82	2.63	2.39
Phenylalanine	3.42	3.23	3.59	3.21	2.84
Histidine	2.29	1.82	2.27	2.22	1.30
Lysine	7.85	6.05	8.11	7.78	6.19
Ammonia	1.29	1.19	1.20	1.37	1.64
Arginine	6.87	8.34	6.79	7.30	6.30
Tryptophan	0.76	0.77	0.77	0.79	0.68
Taurine	1.01	0.78	0.69	0.62	1.24
Hydroxyproline	2.42	3.89	3.01	2.24	3.14

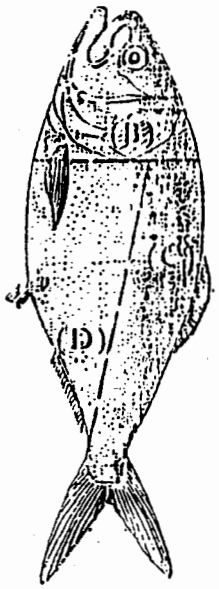
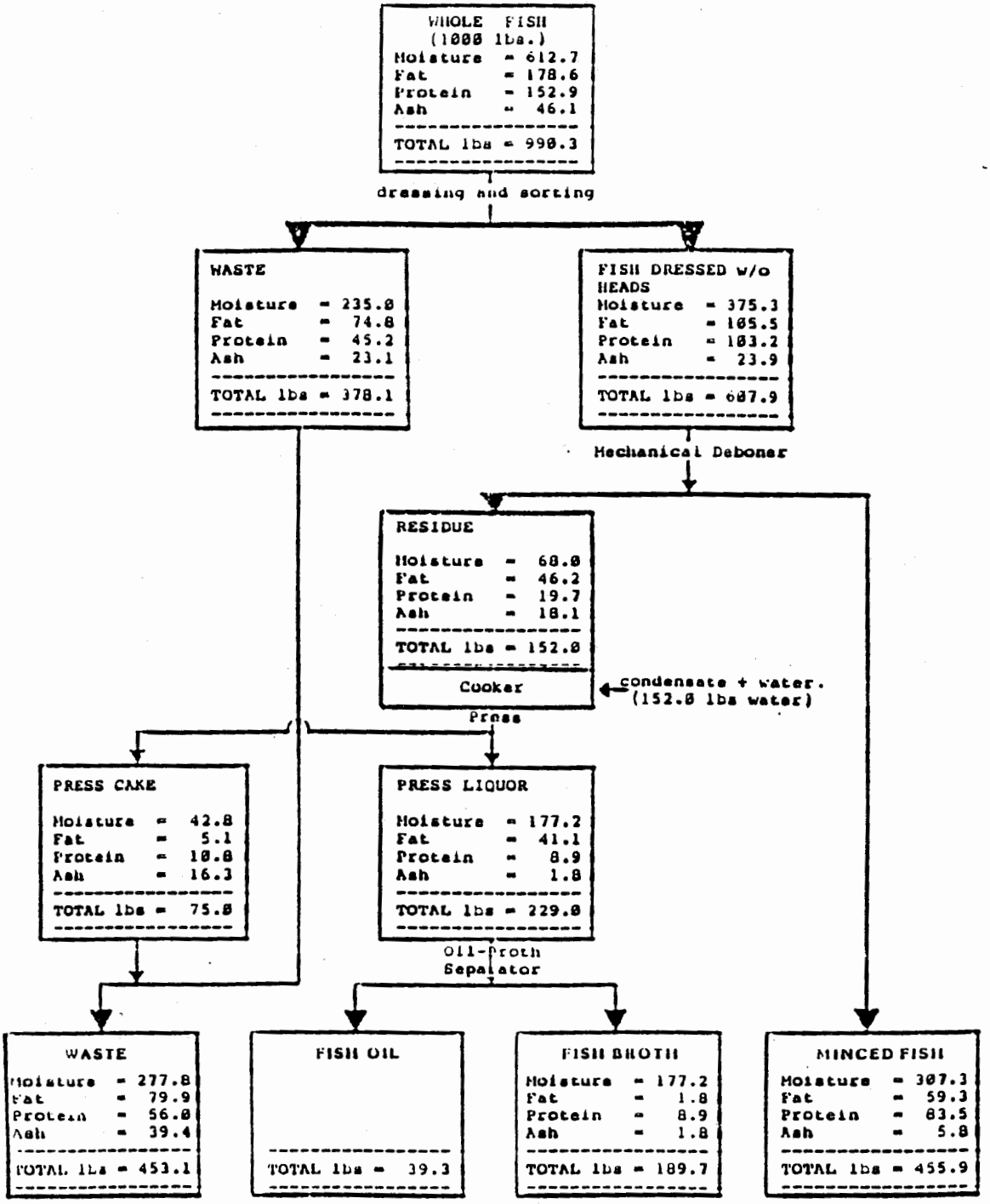


Figure 2. - FGGM PROCESSING OPTION



THIS PROCESSING OPTION PRODUCES NUTRIENT-RICH WASTE, FISH OIL, FISH BROTH, AND MINCED FISH WHICH ARE INTERMEDIATES FOR FURTHER PROCESSING INTO FOODS AND FEEDS

SUMMARY OF COASTAL PELAGICS AND MENHADEN PANEL DISCUSSION

- It could prove to very labor intensive and subsequently expensive to try to record the catches of commercial and recreational fishermen who are selling directly to restaurants and other outlets, since they would not be using commercial fish houses where the catches are presently recorded.
- King mackerel tagging is now being done mainly in the Gulf off Mexico. Tagging for stock identification has essentially been completed.
- Tagging of large king mackerel in Louisiana indicates a resident population in Louisiana that migrates essentially between Texas and Louisiana but does not appear east of the Mississippi River. One recovery has been made in Mexico.

SESSION VIII

MARINE MAMMALS AND ENDANGERED SPECIES

PRESENTER: Allen Foley

Systematic Survey of Stranded Turtles for NMFS Statistical Zones 4 and 5 (Grant # NA89-WC-H-MF002)

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St. Petersburg, Florida 33701-5095

Introduction

All of the species of sea turtles found in Florida waters are listed as threatened or endangered. Their protection has become a conservation priority for the State of Florida, as well as the federal government. Florida's implementation of turtle excluder devices (TEDs) reflect its commitment to conserve sea turtle populations. Systematic sampling of sea turtle strandings before and after TED implementation provides one method of measuring the effectiveness of these devices.

The Sea Turtle Stranding and Salvage Network (STSSN), created in 1979 and coordinated by National Marine Fisheries Service (NMFS), has documented strandings of sea turtles along the Gulf and Atlantic coastal states. These data were often collected in an opportunistic and sporadic manner. This project, initiated November 1, 1987, is designed to assess and improve the reliability of stranding and salvage reporting in NMFS Statistical Zones 4 and 5, increase the geographical area of coverage, and ensure surveillance of beaches during winter months. This report summarizes the results of this project from its initiation to June 30, 1989.

Aerial surveys are conducted weekly from Hurricane Pass (Clearwater) to Big Marco Pass (Naples), weather permitting. This encompasses National Marine Fisheries Statistical Zones 4 and 5. Surveys are flown at an altitude of 300 feet at 70 mph over the beaches and sandy coastal islands. An offshore return leg, flown two to five miles off the beach at various altitudes depending on seeing conditions, was added to the aerial surveys beginning January 31, 1989, allowing us to count shrimp trawlers anchored off of the surveyed coast.

Department of Natural Resources personnel respond to strandings in the St. Petersburg and Fort Myers area when necessary. STSSN participants respond to all other reported strandings. The appropriate STSSN participant is contacted if a stranded carcass is sighted from the air.

Gross external examinations are conducted on all carcasses and necropsies are performed on fresh or unusual specimens, following the guidelines of Wolke and George (1981). Stranding reports for NMFS Zones 4 and 5 are collected, and analyzed for types of stranding and possible trends.

Results

Three hundred and thirty sea turtle strandings were reported in the survey area from November 1, 1987 to June 30, 1989; 278 loggerheads, Caretta caretta; 30 Kemp's ridleys, Lepidochelys kempi; 16 green turtles, Chelonia mydas, 1 hawksbill, Eretmochelys imbricata and 5 unidentified.

Gross external examinations were conducted on all reported carcasses. Various external injuries, parasites and abnormalities were noted and documented. Twenty-six necropsies were performed during the survey period; 8 Kemp's ridleys, 15 loggerheads, 2 greens and 1 hawksbill. Necropsies can supply important information about the strandings. The value of the necropsy is directly related to the condition of the carcass, but even a decomposed carcass reveals useful information, such as prey species, sex and overall health of the animal prior to death.

Eighty four aerial surveys have been flown since the inception of the project, including 18 with offshore return legs. Twenty-nine loggerhead carcasses and 8 live swimming loggerheads were observed.

Correlations have been observed between the number of strandings and the level of shrimping effort in the survey area. The number of strandings increase in the late winter and early spring annually, coinciding with the peak pink shrimping season in this region. This correlation was most striking in early 1989 off of Lee County. A spokesperson for the Southwest Florida Shrimpers Association testifying at a Marine Fisheries Commission hearing stated that there were 50 to 75 boats fishing off of Lee County and up to 500 boats from Tampa Bay to Tortugas during the early Spring, 1989. During that period there were 82 sea turtle strandings in Lee County.

Results of our systematic survey indicate that the STSSN provides comprehensive coverage of the survey area. Continuation of this project through the period of TED implementation in Florida will make it possible to monitor changes in frequency and type of strandings in the survey area, and thereby allowing the assessment of the effectiveness of TEDs.

Edward Klima

IMPROVED SEA TURTLE STRANDING AND SALVAGE NETWORK (STSSN) IN SHRIMP STATISTICAL SUBAREAS 17-21, SOUTHWESTERN LOUISIANA AND TEXAS

Documentation of sea turtle strandings on a systematic, year-round basis offers one of the simplest and most cost-effective ways of determining temporal-spatial distribution and year to year trends in sea turtle mortalities at sea. Under this continuing MARFIN project, barrier beaches in Texas and southwestern Louisiana are surveyed at least semi-monthly year-round.

For each stranding, and to the extent possible, surveyors identify species, determine size, sex, location, condition, external injuries, mutilations, fouling and abnormalities. Completed standardized stranding forms (field data sheets) are submitted to the State Coordinators of the STSSN. Sea turtle carcasses are provided to Texas A&M University for necropsy, food habits analysis, curation, etc. (under the NMFS-TAMU Cooperative Agreement). The surveys are coordinated with other projects, including those conducting necropsies of sea turtle carcasses (TAMU), documenting debris-entanglement events through barrier beach sampling surveys, conducting radio- and sonic- tracking studies, and rehabilitating live-stranded sea turtles (NMFS Galveston Laboratory). Live-stranded sea turtles are collected for rehabilitation, tagging, release and tracking by other projects at the Galveston Laboratory.

The surveyed coastline encompasses the entire Texas coast from the Rio Grande River to the Sabine River (excluding the Padre Island National Seashore surveyed for strandings by National Park Service - NPS, and the Wynn Ranch portion of Matagorda Island, surveyed for strandings by the U.S. Fish and Wildlife Service - FWS), and the southwestern Louisiana coast from the Sabine River to the Mermentau River. It represents all accessible barrier beaches in Texas and southwestern Louisiana where turtles can be found stranded.

This project represents one means of testing the working null hypothesis that sea turtle strandings are not caused by man. There are a number of assumptions underlying the testing of this hypothesis, including but not limited to the following: (1) those who might take sea turtles incidentally (e.g., when shrimping without TEDs, when using explosives for petroleum platform removal, when sportfishing, etc.) do not mutilate them in such ways that prevent their carcasses from floating onto a beach, (2) stranded sea turtles exhibit evidence or lack thereof of natural or man-caused trauma, etc. that provide evidence of injury, exhaustion or death followed by stranding, (3) strandings on a given beach reflect impacts within the adjacent coastal waters in which man's at-sea activities take place, rather than in more distant waters, and (4) sea turtle strandings represent a significant portion of the total at-sea mortalities (non-consumptive).

A total of 815 sea turtle strandings (preliminary data) were documented along surveyed barrier beaches from 1986-August 1989. Loggerheads (40%) and Kemp's ridleys (39%) dominated the strandings. April

(24%) was the peak month for strandings, but a minor secondary peak occurred in August. Galveston (22%) and Nueces (18%) counties in Texas, and Cameron Parish (17%), Louisiana, exhibited the largest numbers of strandings. Most strandings occurred on beaches in Shrimp Statistical Subarea 18 (33%). Out of 744 dead-stranded sea turtles, 167 necropsies were performed.

Out of 71 live-stranded sea turtles, 10 were released immediately and 22 after rehabilitation. Another 25 currently are being rehabilitated, and 14 died in captivity after attempts at rehabilitation. One turtle is permanently handicapped by severe injuries, and although it has recovered it cannot be released.

Though sea turtle strandings have been linked to commercial shrimping activity and petroleum platform removal using explosives, it is recognized that there are many other causes of at-sea mortality in sea turtles, including entanglement in discarded fishing gear, ingestion of debris or tar, capture by hook-and-line fisherman, etc. Assuming that shrimping has been a major cause of sea turtle strandings in Texas and southwestern Louisiana, use of TEDs in these areas should result in a substantial reduction in sea turtle mortality and strandings, especially in Statistical Shrimp Subareas 17-19 known to produce large quantities of shrimp. Use of TEDs would not be expected to be accompanied by a major reduction in sea turtle strandings on the surveyed coasts if shrimping were not a major cause of sea turtle mortality and strandings.

- The no-wound category encompasses sea turtle carcasses for which no cause of death can be found. Necropsies are performed on fresh carcasses that do not indicate any fast-acting-disease caused-death.
- With regard to plastic as a possible cause of death, a blockage of the gastrointestinal tract would generally be characterized by a long period of non-feeding or non-absorption of food. Few strandings show plastic ingestion as a causative factor. In a turtle with a lot of barnacles and an evident loss of weight, plastic could be a factor to be considered in the no-wound category.
- There is little evidence that there is a difference between a turtle that drowned and one that did not.
- If TEDs are implemented and effectively enforced, and if this results in a dramatic decrease in the no-wounds category, it suggests that turtles in this category have drowned in shrimping nets.

SESSION IX

SHRIMP

PRESENTER: Bob Jones

"CONTINUED INTRODUCTION OF TEDS AND ENHANCEMENT OF SHRIMP TRAWL SELECTIVITY IN THE GULF SHRIMP FISHERY"
NA87-WC-H-06126 (10/1/87 - 9/30/89)

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Gulf & South Atlantic Fisheries Development
Foundation, Inc.
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Tampa, FL 33609
(813) 286-8390

Introduction and Problem:

Due to the prominence of the shrimp fishery, trawls represent the principal fishing gear in the Gulf of Mexico. The gear is essentially non-selective as to target species, and therefore may harvest species such as sea turtles which are regulated by the federal government under the Endangered Species Act. While work has been done by the National Marine Fisheries Service (NMFS) and its predecessor, the Bureau of Commercial Fisheries, to create more selectivity to target species through such trawl adaptation as turtle excluder devices or finfish separator trawls, the technology has not been readily accepted and improved upon by the shrimp fishery. Based upon the continued lack of technology development and transfer in the shrimp harvesting industry and the pending imposition of stringent federal guidelines for sea turtle protection, the Foundation sought and received MARFIN funding to attempt to continue the introduction of TEDs and enhance their design in the Gulf shrimp fishery.

The project objectives:

1. To expedite and expand the introduction of the various trawl excluder devices (TEDs) in the Gulf shrimp fishery; and

2. To assist members of the shrimp industry in developing devices or variations in trawl designs which would enhance selectivity in the trawl operations.

In summary, the work attempts to expand existing cooperative shrimp industry, sea grant, and NMFS efforts to develop and refine TEDs for Gulf shrimpers; to familiarize shrimpers with the various designs and their use; to aid in the ease of adapting these specialized trawl devices; and to assist industry members in developing devices or variations that achieve greater efficiency while meeting the regulations imposed by the Endangered Species Act. A "two-pronged" approach was developed. The Gulf sea grant extension programs from Texas to Florida were contracted to achieve certain tasks in the area of TED technology transfer. In general, these tasks were:

1. To assist shrimpers in adapting existing TED designs into their vessel operations;

2. To assist members of the industry in developing devices which would achieve greater selectivity;

3. To adapt existing technology and develop new designs for TEDs which would effectively catch shrimp and exclude marine turtles on all types of bottom conditions;

4. To support the transfer of existing TED technology;

5. To facilitate efforts by the industry in compiling and desseminating information on new TED developments, field-trial results and refinements of existing TED designs;

6. To field and direct questions from shrimpers on TED installation, trouble-shooting, etc.;

7. To coordinate the acquisition of various devices for industry trawls; and

8. To provide a coordinating mechanism for industry to utilize NMFS, Sea Grant, other industry and state specialists; and to continue to conduct workshops for netshop owners and related shrimping supported services.

In conjunction with the sea grant efforts, an industry driven project was established enlisting the talents of the major trade associations in the Gulf of Mexico. While the sea grant university system was attempting to disseminate existing information on TED designs, less burdensome adaptations to these trawls were sought, and innovators solicited from the shrimp industry to submit designs for new adaptations to turtle excluder devices. Of new designs submitted, a limited number were selected for testing for shrimp retention and turtle exclusion.

In summary, a broad based and eclectic approach to TED technolgoy development transfer was envisioned as the basis for the MARFIN TED work funded by the Foundation. While numerous successes resulted in education and development, chronic uncertainty on the final implementation of TED regulations caused interest in technology development and transfer to vacillate. Currently, the project is being recommended for an extension in performance period.

ASSESSMENT OF BYCATCH IN THE LOUISIANA SHRIMP FISHERY
Grant No. NA89WC-H-MF006

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Louisiana Department of Wildlife and Fisheries
Post Office Box 189
Bourg, Louisiana 70343

Abstract

A one-year study designed to document the bycatch of shrimp trawlers and wingnetters in coastal and offshore Louisiana waters began January 1, 1989. Actual field work began April 21, May 22, or June 5, dependent upon opening dates of the shrimp seasons.

Samples were gathered from coastal Louisiana from sampling grids; those grids are the same as NMFS grids utilized for landings/harvest data. Approximately 36 samples are scheduled monthly in offshore trawl, inshore trawl and inshore wingnet areas.

Samples thus far have revealed most bycatch is juveniles of various species; Atlantic croaker, spot, bay anchovy, cutlassfish, flatfish, and assorted crab species comprised the bulk of all 20 liter samples analyzed.

Introduction

The shrimp fishing industry in Louisiana is one of the nation's largest. Recent NMFS data indicate landings of shrimp in Louisiana ranks among the top three nationally on an annual basis, and most often first.

This fishery is accomplished in three basic modes: a) offshore trawling, b) inshore trawling, and c) wingnetting. Landings of various marine species which are not utilized has and is a matter of contention in various schools of thought. This

aspect of the fishery is largely undocumented, although well-known. This study will provide quantitative data relative to number and species of those organisms removed from existing populations, but not utilized.

Summary

In samples collected thus far, major components of the bycatch have been identified. Several problems were recognized, and some modifications to the project were necessary. Data continues to be collected, and no final analysis has been made.

Title: Shrimp Fisheries Management to Increase Economic Returns

Grant #: NA88-WC-HMF-199

Investigators: Dr. Wade L. Griffin, Department of Agricultural Economics, Texas A&M University, College Station, TX 77843-2124. Bruce McCarl, Department of Agricultural Economics, Texas A&M University, College Station, TX 77843-2124. Chris Oliver, Department of Agricultural Economics, Texas A&M University, College Station, TX 77843-2124.

Introduction: This is the third year of a three year project. The first year was to rebuild the GBFSM to analyze the Texas closure and other policy strategies. The second year was to develop a mathematical programming model to determine management policies that would maximize consumer and producer surplus. The third year of the project was to analize alternative management policies with both models in conjunction with the Texas Parks and Wildlife Department. The mathematical programming model was developed for an economic evaluation of possible shrimp harvesting regulations off the Texas coast in 1985. The model was used to see how the existing shrimping pattern differs from the optimal patterns under the prevailing biological conditions, the characteristics of the shrimp fleet operating in Texas waters, and the market conditions of 1985. The mathematical programming model was completed and a final report was submitted to MARFIN and it will not be reported on in this review.
Unlike the mathematical programming model, GBFSM has much greater detail in both inputs and outputs and is designed to compare the different policies based on the fishermen reacting to the market by increasing (or decreasing) effort during the season and increasing (or decreasing) vessels in the fleet from year to year based on market conditions and rent. Most of the model was rebuilt in the first year of the project in conjuction with the Texas Parks and Wildlife Department. An attempt was made to redistribute days fished and landing data from depth zone to policy zone. After a year of trying to use the redistributed data it was determined that the results were invalid. GBFSM was tuned in the summer of 1989 in conjunction with the Texas Parks and Wildlife Department. We are now in the process of analyzing the Texas closure to 200 miles. Also the model use to be used on a monthly time step and the decision making process for increasing or decreasing days fished and number of vessels works only for a monthly time step. Since we have gone to a 2.5 day time step in the model, the decision making process will have to be rebuilt.

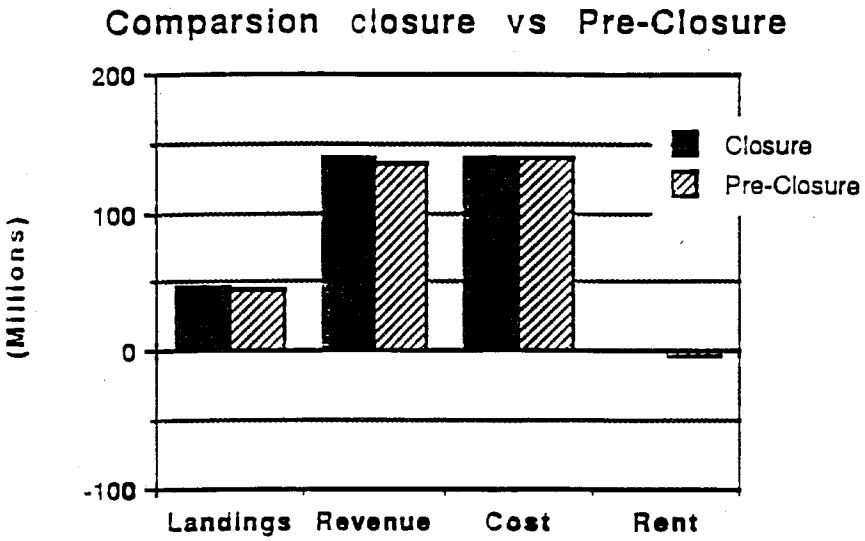
To analyze the Texas closure with the current version of the model, pre and post fishing patterns in depths greater than 5 fathoms offshore were used in the model while holding all other things constant. The pre-closure fishing patterns were the average days fished for the period 1963-1980 and the post-closure fishing patterns were the average days fished for the period 1981-

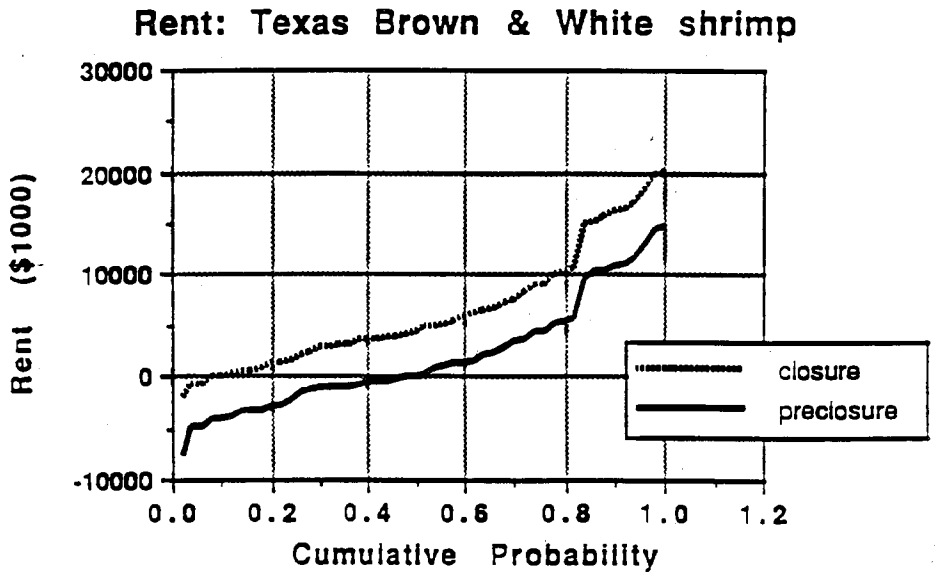
1985. The inshore and 1-5 fathoms offshore fishing patterns were held constant at the average days fished for the period 1981-1985. The pre-closure fishing patterns in depths greater than 5 fathoms were inflated to the same total level as the post-closure fishing patterns. Days fished had to be increased 1.9% for brown shrimp and 33.7% for white shrimp. Two different types of runs were made to analize the closure. The first was a deterministic run and the second was a stochastic run. The stochastic run was made to see if varying recruiment made a difference in the results of the closure policy.

Summary of Results: Brown shrimp landings increased 3.8% due to the closure and the change in the count law. White shrimp increased 7.6% due to the increase in days dished and a change in the count law. The overall increase in landings was 4.9%.

Revenue increased 4.8% for brown shrimp and 1.7% for white shrimp. Total costs increased 1.4% for brown shrimp and remained constant for white shrimp. Overall revenue went up 3.9% and overall cost went up 1%.

The closure adds $3.3 million in rent to the brown shrimp fishery and $0.7 million in rent to the white shrimp fishery. It should be noted that with these positive rents that additional fishermen will enter the fishery and dissipate these rents.


Comparsion closure vs Pre-Closure
200
100
0
-100
(Millions)
Closure
Pre-Closure
Landings
Revenue
Cost
Rent


Rent: Texas Brown & White shrimp
30000
20000
10000
0
-10000
Rent ($1000)
closure
preclosure
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Cumulative Probability

Title: Economic Impact of TEDs on the Shrimp Industry

Grant #: NA89-WC-HMF-024

Investigators: Dr. Wade L. Griffin, Department of Agricultural Economics, Texas A&M University, College Station, TX 77843-2124. Chris Oliver, Department of Agricultural Economics, Texas A&M University, College Station, TX 77843-2124.

Introduction: In order to measure the economic impact of shrimp lost due to use of TEDs (by all vessels in all depths simultaneously) the GBFSM bioeconomic fishery simulation model was utilized. For example, a 5% loss of shrimp due to the use of a TED device is applied to all depths where TEDs were required. The 5% that are lost at any given depth are then allowed to continue growing and migrating to other depths where they may be caught by subsequent fishing effort. They also die of natural mortality. This means that part of shrimp lost due to the TED device may be harvested at a different time, in a different depth zone, and at a larger, more valuable size. The simulation model was used in order to correctly depict this phenomenon.

For this analysis, landings and effort data were utilized from the 1963-1985 time period. The Gulf of Mexico was divided into 4 major shrimp fishery regions and each region analyzed independently. Region 1 considered only pink shrimp while region 2-4 considered

Region	Statistical Grid	Target Species
1	1 - 7	pink shrimp
2	8 - 12	brown & white shrimp
3	13 - 17	brown & white shrimp
4	18 - 21	brown & white shrimp

only brown white shrimp. The simulation model was tuned (using average effort from the historical period 1963-1980) to accurately depict actual landings from same period. To validate the accuracy of the simulation the tuned model was first applied against the average effort for the period 1981-1985 to see how well it predicted average landing for this same period. In the second step of validation, actual effort was applied for each year (1963-1985) and the model simulation was run to match landings for each year. Using 1985 as a base year, the appropriate economic data was applied in the model to establish base landings, revenue, and rent. Various TED loss scenarios were then run to compare results to the base run. This was the preliminary analysis for the project and was conducted on the basis of target species only for each region. Effects relative to secondary species and by-catch are not included in this analysis.

Summary of Results: Under the 5% loss as well as under all loss scenarios, the decrease in landings and revenue was less than the associated Ted % loss. This is a result of lost shrimp being allowed to grow and migrate to other depths to be caught at a larger size. Because of this, the more shallow offshore depths fisheries will suffer more than the further offshore fisheries. For any given region, the decrease in landings of larger shrimp is less than the decrease in landings of smaller shrimp.

Because of different fishing patterns in the 4 regions, some regions will be more impacted by the TED loss than others. The Florida pink shrimp fishery, for example, is predominantly an offshore fishery from 11 to 20 fathoms in which the benefit of smaller shrimp escape 0 to 10 fathoms cannot be realized fully. The Texas fishery for brown and white shrimp, on the other hand, would appear to suffer the least impact from the use of TEDs. This is because the fishing effort is more evenly distributed throughout all depth zones enabling the fishery to realize the benefits of near shore shrimp escape. Again, the near shore vessels will suffer at the expense of the vessels which fish further offshore. Because of the greater number of vessels that fish further offshore, however, these offshore vessel class will suffer a greater overall loss in rent to the fleet. The overall results of the analysis are summarized in the following tables:

OVERALL IMPACTS UNDER VARIOUS SCENARIOS: REGION 1

ALL VALUES IN 1000's	△ LANDINGS	△ REVENUE $	△ RENT $
5 % TED LOSS (offshore) →	- 516 (-3.66%)	-1,224 (-3.5%)	- 1,135
5 % TED LOSS (bay & offshore) →	- 519 (-3.68%)	- 1,229 (-3.5%)	- 1,160
10 % TED LOSS (offshore) →	- 1,046 (-7.4%)	- 2,488 (-7.1%)	- 2,053
20 % TED LOSS (offshore) →	- 2,154 (-15.3%)	- 5,147 (-14.8%)	- 3,982
30 % TED LOSS (offshore) →	- 3,330 (-23.6%)	- 7,991 (-23%)	- 6,044
REDUCED TOW TIME (offshore) →	- 1,592 (-11.3%)	- 3,796 (-10.9%)	- 3,001

OVERALL IMPACTS UNDER VARIOUS SCENARIOS: REGION 2

ALL VALUES IN 1000's	△ LANDINGS	△ REVENUE $	△ RENT $
5 % TED LOSS (offshore) →	- 372 (-2%)	-1,302 (-2.4%)	- 1,461
5 % TED LOSS (bay & offshore) →	- 596 (-3.2%)	-1,686 (-3.1%)	- 1,788
10 % TED LOSS (offshore) →	- 747 (-4%)	- 2,618 (-4.8%)	- 2,370
20 % TED LOSS (offshore) →	- 1,508 (-8%)	- 5,291 (-9.8%)	- 4,217
30 % TED LOSS (offshore) →	- 2,283 (-12.2%)	- 8,021 (-14.8%)	- 6,104
REDUCED TOW TIME (offshore) →	- 1,126 (-6%)	- 3,948 (-7.3%)	- 3,289

OVERALL IMPACTS UNDER VARIOUS SCENARIOS: REGION 3

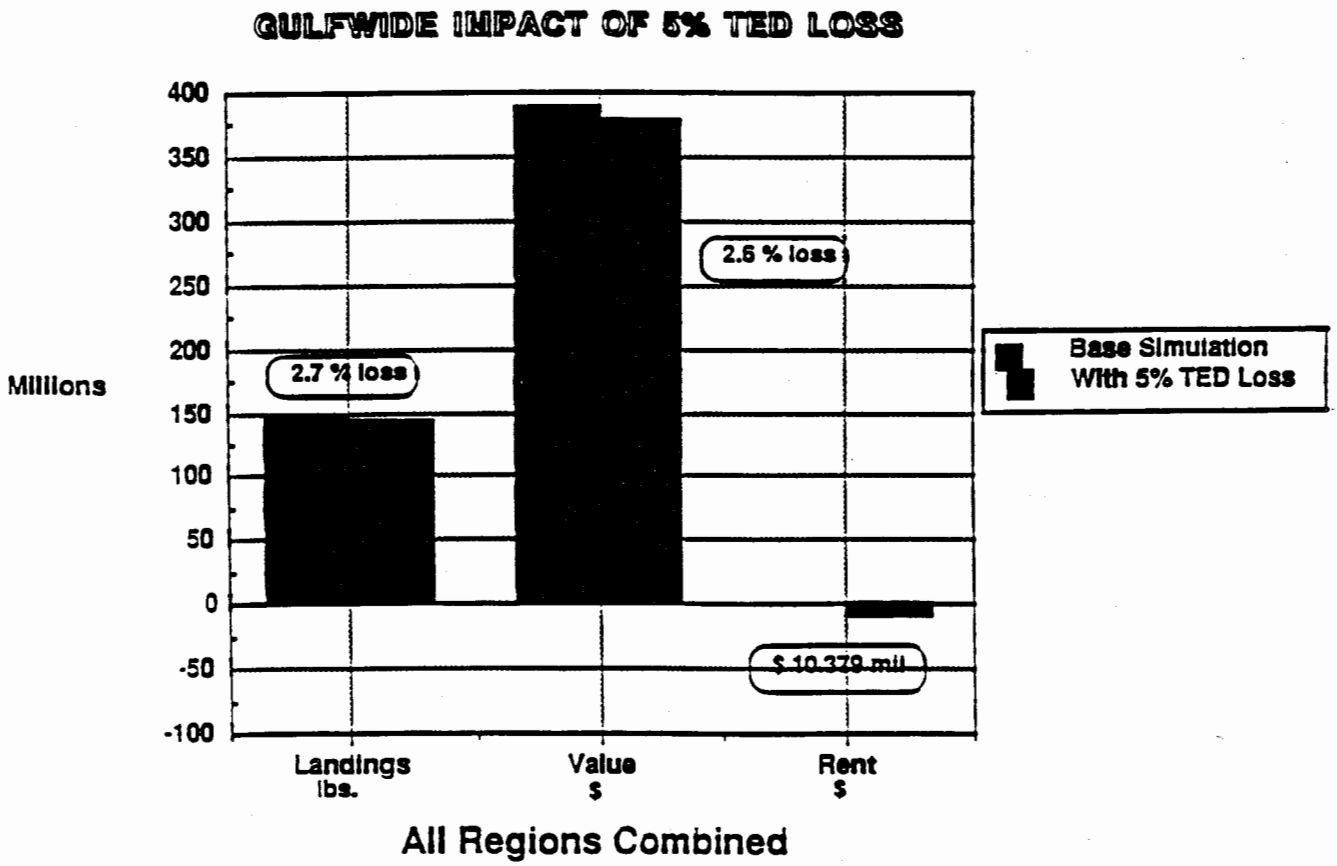
ALL VALUES IN 1000's	△ LANDINGS	△ REVENUE $	△ RENT $
5 % TED LOSS (offshore) →	- 1,607 (-2.4%)	- 3,728 (-2.35%)	- 3.623
5 % TED LOSS (bay & offshore) →	- 1,883 (-2.8%)	- 3,533 (-2.3%)	- 3,615
10 % TED LOSS (offshore) →	- 3,284 (-5%)	- 7,672 (-4.8%)	-6,307
20 % TED LOSS (offshore) →	- 6,862 (-10.3%)	- 16,260 (-10.3%)	- 12,158
30 % TED LOSS (offshore) →	- 10,765 (-16.2%)	- 25,883 (-16.3%)	-18,719
REDUCED TOW TIME (offshore) →	- 5,035 (-7.6%)	- 11,845 (-7.5%)	- 9,149

OVERALL IMPACTS UNDER VARIOUS SCENARIOS: REGION 4

ALL VALUES IN 1000's	△ LANDINGS	△ REVENUE $	△ RENT $
5 % TED LOSS (offshore) →	- 1,443 (-3.1%)	-3,751 (-2.7%)	- 4,160
5 % TED LOSS (bay & offshore) →	- 233 (- .5%)	+ 100 (+ .1%)	- 1,388
10 % TED LOSS (offshore) →	- 2,955 (-6.3%)	- 7,738 (-5.5%)	- 7,403
20 % TED LOSS (offshore) →	- 6,198 (-13.2%)	-16,474 (-11.8%)	- 14,502
30 % TED LOSS (offshore) →	- 9,759 (-20.8%)	- 26,324 (- 18.8%)	- 22,497
REDUCED TOW TIME (offshore) →	- 4,539 (-9.7%)	- 11,974 (-8.5%)	- 10,847

OVERALL IMPACTS UNDER VARIOUS SCENARIOS: GULFWIDE

ALL VALUES IN 1000's	△ LANDINGS	△ REVENUE $	△ RENT $
5 % TED LOSS (offshore) →	- 3,938 (-2.7%)	- 10,005 (-2.6%)	- 10,379
5 % TED LOSS (bay & offshore) →	- 3,321 (-2.2%)	- 6,348 (-1.6%)	- 7,951
10 % TED LOSS (offshore) →	- 8,032 (-5.5%)	-20,516 (-5.3%)	- 18,133
20 % TED LOSS (offshore) →	-16,722 (-11.4%)	-43,172 (-11.1%)	- 34,859
30 % TED LOSS (offshore) →	-26,137 (-17.9%)	-68,219 (-17.6%)	- 53,364
REDUCED TOW TIME (offshore) →	-12,292 (8.4%)	-31,563 (8.1%)	- 26,286



An Economic Assessment of the Louisiana Inshore Shrimp Fishery

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Introduction

The Louisiana inshore shrimp fleet is as complex as it is diverse. The commercial shrimp fishermen operate approximately 15,000 to 18,000 boats ranging in size from 20 feet to larger than 50 feet, employ several different gear types, and shrimp from several days a year to more than one hundred.

Though the Louisiana inshore shrimp fishery is of significant value to Louisiana and the region, only limited economic research effort has been directed at this fishery. Recent changes in the inshore shrimp fishery have led to questions regarding the ability of the fishery to absorb additional investment and employment, and has emphasized the need for timely economic and socioeconomic analysis. The overall goal of this project is to provide such an analysis.

Data pertaining to 514 commercial inshore shrimpers were collected and analyzed for purposes of characterizing the Louisiana inshore shrimp fishery. Data collected and analyzed include:

1) background on the captain/owner, i.e. experience, employment and affect of the recent economic decline; 2) effort and mobility spent shrimping in state inside and offshore waters; 3) boat characteristics, electronics, and gear types used; 4) quantities and revenues of shrimp and by-catch harvested; 5) capital investment, variable and repair costs, overhead expenses, and annual fees; and 6) opinions regarding different management issues.

Results

Two year averages show a 41% increase in shrimping trips taken in state waters between 1977 and 1988. Although the number of all shrimping trips increased significantly during the past 12 years, total landings increased by only 5.6%. More recent trends show the fastest increase in shrimping trips (17.6%) between 1985/86 and 1987/88, coupled with a 20% decrease in landings.

One factor suspected for contributing to the increase in trips may be due to movement into the shrimp fishery or increased shrimping effort

among workers displaced as a result of the recent decline in economic activity in offshore oil and gas related sectors. Survey results show that 16% of commercial shrimpers in 1987 decided to shrimp and/or increase their shrimping intensity to compensate for recent economic losses in their communities. These shrimpers expended an average of 40.5% more effort in total shrimping hours in 1987 than those whose shrimping activity was not directly affected.

Generally, two types of nets were utilized for taking saltwater shrimp from state inside and outside waters--butterfly nets and trawls. The majority (72%) of all shrimpers surveyed reported using exclusively trawls. 15% exclusively butterfly nets, and 13% used a combination of both trawls and butterfly nets. Preliminary findings do not show a correlation between gear type and net financial returns though catch with trawls exceed catch with butterfly nets, ceteris paribus. This is due to the lower costs of operation associated with wing nets.

Cost and revenues data indicate that seasonal net revenues varied among both part- and full-time boats, with boats having deck lengths between 20-30 feet yielding the greatest seasonal net revenues. The portion of variable costs spent on fuel and oil, and food by boats 20 feet or larger decreased substantially as boat length increased, but expenditures on ice (full-time boats), labor and repairs increased with boat size. Depreciation and interest accounted for the majority of the total fixed costs of full-time boats surveyed, and the larger, more costly boats had the greatest incidence of making interest payments thereby contributing to the increasing rate of total fixed costs relative to total revenues.

As boat size increased, costs increased proportionately to pounds harvested. This factor, however, was partially offset by the higher prices received by larger full-time boats. The percentage of total catch harvested from offshore waters and the average price per pound increased as boat size increased. Boats less than 20 feet harvested shrimp exclusively from inshore waters and received an average price of $.94 per pound, while boats larger than 50 feet harvested 66% of their catch from inshore waters and 34% from offshore, and received average per pound prices of $1.37 and $1.60, respectively.

Shrimp prices were also often dependent upon who was purchasing the catch. Generally, fishouses paid the lowest price per pound while out-of-home sales returned the highest prices. (Available data, however, do not indicate if higher prices were due to larger shrimp sizes.)

A Regional Analysis of the U.S. Shrimp Import Market With Industry Implications

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Introduction

Imports represent the largest and a growing share of total U.S. shrimp supply. They averaged 135 million pounds (heads-off) during 1960-62 and contributed 52% of the total U.S. shrimp supply. Imports increased to 432 million pounds annually during 1983-85 and represented 70% of U.S. shrimp supplies. The 1988 imports of 598 million pounds (raw headless basis) represent almost 80 percent of the 767 million pound U.S. shrimp supply and are almost 40% more than 1983-85 imports.

With the recent proliferation of shrimp aquaculture in some of the South American and Asian countries, most notably Ecuador and China, patterns in shrimp trade have noticeably shifted. For example, North American countries, primarily Mexico and Panama, accounted for more than 50% of U.S. shrimp imports by volume in 1970. Asian countries represented another 27% while South American countries supplied the U.S. with 20% of its shrimp imports. By 1988, relative shares had virtually reversed themselves. Asian countries supplied the U.S. with just less than 50% of its 504 million pounds (product weight) of shrimp imports while North American countries provided just over 20% of total U.S. shrimp imports.

The proliferation of U.S. shrimp imports and the changing regional origin of these imports need to be evaluated in the context of their impact on the U.S. shrimp industry. This evaluation serves as the overall objective of this current study.

Results

All data relevant to completion of this project, excluding some minor variables, have been collected and automated. These data include:

1. Import statistics
    - i. U.S. shrimp imports by country (1960-88)
        - a. poundage (product and raw headless weight)
        - b. value in U.S. dollars
    - ii. Japanese shrimp imports by country (1960-88)

a. poundage (product weight only)

b. value in yen

2. Exchange rate data for approximately 160 countries (1960-88) in

i. nominal terms

ii. real terms

3. Production of shrimp by country (1960-87)

4. Key economic information (e.g., income, CPI, etc.) for both the United States and Japan (1960-87)

All data have been formatted and automated. Final consideration is now being given to the type of model to be used for analysis, which depends critically upon whether traded shrimp is a differentiated or homogenous product in the world market. For example, the Armington trade model, which differentiates commodities by kind and origin, can be employed if shrimp is differentiated in world trade. Sources of differentiation can include quality differences, procurement risk, etc. If traded shrimp is not a differentiated product a more traditional trade model will be employed.

The Role of "Small" Shrimp in Determining Economic Returns
NA89WC-H-MF010

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Introduction

An often discussed aspect of the Gulf of Mexico shrimp fishery is the potential for securing more economic returns. A means proposed to achieve such returns is to manage for larger, higher priced shrimp. Two major impediments to an evaluation of the merit in pursuing such a goal are: (1) a lack of a working definition of size counts considered to be "small", and (2) lack of a comprehensive measure of value of shrimp other than that reported at the dockside level. The focal point of the project is the Louisiana shrimp industry. Since the "small" shrimp industry is primarily northern Golf based, focusing on the Louisiana industry, at least initially, will provide a good indicator. Specific objectives are:

1. To document the historical trends in Gulf size composition of shrimp landings, size composition of shrimp imports, and ex-vessel prices by size.

2. To analyze alternatives available in selecting demarkation points between "small" shrimp and other sizes.

3. To develop value-in-use estimates of shrimp size utilization at the processing level.

4. To report the implications of more comprehensive measures of shrimp value-in-use estimates.

Summary of Results

The project began on March 1, 1989 as a one year project. To date, therefore, the results are those of progress not findings.

The investigators have obtained all necessary data available from secondary sources. The issue of designating a count beyond which shrimp are considered small for the analysis was resolved. Previous research by the investigators focused on 50 count and small tails. This will be continued but 68+ tails is to also serve as a focal point.

Monthly ex-vessel prices for the shrimp smaller than 68 count were obtained from the National Marine Fisheries Service. Access to this data permits the formerly opened ended 68+ category to be divided into four categories. These data serve as the base from which value in use, value added, can be measured. Value added by a firm is the residual of gross receipts minus the costs of goods and services purchased from other firms. Thus, the investigators will be focused on the labor, wage, interest, depreciation, rent, tax, and profit components of shrimp products. There being no suitable secondary data sources for value added to "small" shrimp, the investigators are collecting primary data through use of a consultant. The consultant will collect processing cost data from eight shrimp peeling firms, three breading companies, and two canning companies. The data collection process is therefore focused on firms primarily involved in "small" shrimp use. This procedure will yield the first available value added data for "small" shrimp. When combined with harvest level value added data, a complete value in use portrayal will result.

Evaluation of the Impact of TEDs on Shrimp Catch Rates in the Gulf of Mexico

Edward F. Klima

Grant No. 89NMFS05

The National Marine Fisheries Service, in cooperation with the shrimp industry, initiated a TED Evaluation Program in the Spring of 1988. The overall objective of the program is to determine the effects of commercial utilization of certified TEDs on commercial shrimp trawlers in the South Atlantic and Gulf of Mexico. The program is aimed at determining catch rates of shrimp for TED-equipped trawls and trawls without TEDs in selected shrimp fishing areas of the southeast region.

The U.S. Federal Government implemented mandatory use of TEDs in the Gulf of Mexico and South Atlantic in 1988. However, the State of Louisiana sued the Federal Government and the courts upheld the regulation. The U.S. Congress revised the date of implementation to May 1, 1989, for all except the Cape Canaveral, Florida area.

Trained observers have been placed on shrimp vessels operating off of Texas, Louisiana, Alabama, Mississippi, Florida, Georgia and South Carolina. Through 1988, trained observers have collected information on 39 trips from commercial vessels fishing for 2750 hrs. The difference of catch rates of shrimp between TED and standard nets have varied by area and season ranging from a loss of 37% to a gain of up to 38%. Three turtles have been caught in the Gulf of Mexico and 17 in the South Atlantic, all in the non-TED nets.

Table 1. Ted Evaluation Project Summary. Comparison of TEDs to Standard trawls by geographic area with additional information on vessel participation, number of trips and observer days, and the number of turtles captured during the study through July 10, 1989.

	GA	SC	E. Fl	S. Fl	W. Fl	TX	LA	LA*
TED vs Standard Trawl Trip by Trip	-29% to +10%	-13% to -6%	-13% to -3%	-37% to -3%	-11% to +11%	-33% to +38%	-37% to +15%	-45% to -23%
Number of Vessels	1	3	3	2	2	6	6	1
Number of Trips	9	4	5	3	3	16	10	2
Number of Observer Days	49	16	52	24	43	126	115	30
Number of Hours Fished	398.4	67.2	322.9	182.4	393.4	1067.9	1554.6	388.8
Number of Turtles Captured in Standard Nets	4	1	23	0	9	0	3	0
Number of Turtles Captured in TED-Equipped Nets	0	0	0	0	1	0	0	0
TED used for research	Georgia TED	Norrison TED	Georgia TED	Georgia TED	Georgia TED	Georgia TED	Georgia TED	Biloxi Hybrid
Time Per Turtle Capture in Hours	99.6	67.2	14.3	none caught	39.3	none caught	518.2	none caught
Total Shrimp Catch in TED Nets (lbs)*	3,969	1,311	8,274	3,117	2,507	10,313	12,185	1,057
Total Shrimp Catch in Std Nets (lbs)*	4,697	1,405	8,916	3,675	2,613	10,806	12,391	1,440
TED's vs Standard Trawls Pounds*	-728	-94	-642	-558	-106	-493	-206	-383
Percent difference in TED net vs Standard net*	-15	-7	-7	-15	-4	-5	-2	-27

* These data were collected simultaneously on a quad-rigged vessel with a Georgia TED. Therefore, the number of observer days and fishing hours are not duplicated in the totals printed in the text.

PRESENTER: Will Seidel

TED TECHNOLOGY TRANSFER

INVESTIGATORS

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INTRODUCTION

The objective of the TED Technology Transfer project was to support adoption of TED technology in the southeastern United States by assisting the commercial shrimp industry, Sea Grant, and Federal and state agencies with TED expertise developed within the Mississippi Laboratories. The objective was to be accomplished through workshops and by conducting training and problem-solving activities on commercial shrimp vessels. The project also provided gear expertise support to an impact study conducted by the Galveston Laboratory to determine the economic effect of TEDs on the commercial shrimping industry. Overall, the goal was to assist the commercial industry in adopting TED technology under the endangered species regulations and minimize the impact of the introduction of TEDs.

A series of legal and other type delays moved the regulation implementation date for TEDs from May 1989 to currently September 22, 1989. The various actions during this period impacted activities and accomplishments significantly. Strong industry reactions to the TED regulations in some parts of the southeastern United States resulted in fewer workshops and on-vessel demonstrations.

SUMMARY OF RESULTS

TED technology transfer assistance was provided to individual fishermen, industry associations, Sea Grant, and state and Federal agencies. Supplemented with endangered species base funding by the Southeast Fisheries Center, the project maintained four trained personnel to provide direct technical assistance to net shops, TED manufacturers, individual fishermen, and designers of new TEDs. Assistance provided included construction of TEDs, instruction in the installation, tuning, and operational use of TEDs, and trouble shooting and problem solving on-board commercial vessels.

Whenever possible, the first level of technology transfer was to conduct a group workshop to provide information to as many people as possible in a short period of time. Data from evaluations of all certified TEDs, test results of new TED designs, and reported problems with different TED designs under different conditions of use were provided. Considerable support was provided in the introduction of a modified Georgia style grid TED which has been found to be an effective device at a relatively inexpensive cost. Video tapes describing the operation and advantages and disadvantages of the different certified TEDs were developed

and distributed to fishing organizations, other researchers, gear technologists, and individual fisherman.

TED demonstrations and workshops were conducted in Georgia, Florida, South Carolina, North Carolina, Louisiana, and Alabama. A total of twelve demonstrations and eleven workshops were conducted in these areas. Technical assistance was also provided to the NMFS Galveston Laboratory in installing and tuning TEDs on vessels participating in their economic impact study. Most of these activities ended after the series of delays in TED implementation. A list of the workshops and demonstrations is presented in Table 1.

A significant effort of the TED Technology Transfer project has been to provide data and information to individuals and fishery managers (Table 2). Information to fishery managers attempting to reach an acceptable compromise between commercial fishing interests and turtle protection actions have been extensive. Complete data summaries, reports and pertinent information on historical TED research was provided to the National Academy of Science panel directed to review research on sea turtles and TEDs. An indepth workshop was held at the Mississippi Laboratories in Pascagoula to investigate the relationship between sea turtle mortality in shrimp trawls and tow duration. The workshop brought together an expert group of analysts, statisticians, sea turtle physiologists and biologists, and trawling gear specialists to analyze sea turtle capture data bases collected by researchers since 1978. The workshop resulted in three reports representing the best estimates of the effect of tow time on sea turtle mortality and shrimping efficiency.

A turtle excluder device certification experiment was also conducted through the base funded TED Technology Transfer capability of the Mississippi Laboratories. Operational cost of the study was supported by MARFIN and is reported separately. This study was accomplished to determine if an alternate certification technique could be developed to support certification of new TEDs if the current technique of towing TEDs in the Cape Canaveral, Florida, ship channel was not available. The study was successfully completed and recommendations made to the Southeast Regional Director.

Internationally, presentations and papers were submitted at three meetings: (1) The Ninth Annual Sea Turtle Workshop, Jekyll Island, GA, March 1989; (2) World Symposioum on Fishing Gear and Fishing Vessel Design, St. John's Newfoundland, November 1988; and (3) Selective Shrimp Trawl Workshop, St. John's Newfoundland, November 1988. Travel for the speaker to attend the meetings in Newfoundland was paid

for by the workshop sponsoring group. Technical information on TTD design and use was also provided to the countries of Mexico, Colombia, England, Australia, Canada, Brazil, Finland, and the Philippines.

Table 1. List of TED demonstrations and workshops.

1.	Bon Secour, AL	November 1988
2.	Lafitte, LA	December 1988
3.	Bon Secour, AL	November 1988
4.	Bon Secour, AL	March 1989
5.	Bon Secour, AL	March 1989
6.	Ft. Myers, FL	March 1989
7.	Ft. Myers, FL	May 1989
8.	Brunswick, GA	May 1989
9.	Beaufort, SC	June 1989
10.	Eddings Pt., SC	June 1989
11.	Savannah, GA	June 1989
12.	Mayport, FL	June 1989
13.	Bon Secour, AL	June 1989
14.	Snead's Ferry, NC	July 1989
15.	Supply, NC	July 1989
16.	McClellandville, SC	July 1989
17.	Beaufort, SC	July 1989
18.	Richmond Hill, GA	July 1989
19.	Savannah, GA	July 1989
20.	Fernandina Beach, FL	July 1989
21.	Tarpon Springs, FL	July 1989
22.	Brunswick, GA	August 1989

Table 2. Requests for TED technical information.

Michael Midgell	Snead's Ferry, NC
John Schafer	Fort Myers, FL
Jim Bahen	NC Marine Resource Ctr.
Kathy Love	Spring, TX
Diego Luis Munoz Sosa	Bogota, Colombia
Gabriel Walker	Niceville, FL
Paul Raymond	Florida Marine Patrol
Richard Perry	Tampa, FL
Lindsey Aquillad	Lake Charles, LA
Janice Wilson	Clearwater, FL
F.R. Short	Venus, TX
John Baker	Cocoa, FL
K.J. Taylor	Lymington, England
Dr. Jeanne Mortimer	Gainesville, FL
Tony Reisinger	Texas A&M Sea Grant
Rick Monaghan	NC Dept.of Natural Res.
Jose Vidal	Mexico City, Mexico
Mike Dredge	Queensland, Australia
Kenneth Pearce	Raleigh, NC
Dr. Allsop	Vancouver, B.C., Canada
Dr. Ellen Pikitch	University of Washington
Julie Huntington	Marine Institute, St. John's Canada
Phillip Conolly	Itijai, S.C., Brazil
Peter Suuronen	Helsinki, Finland
Mike Siglar	Juneau, Alaska
Suzie Herrington	Largo, FL
Paul Christian	Georgia Sea Grant
Sinky Boone	Darien, GA
Steve Parrish	Supply, NC
Dr. Bill Hosking	Alabama Sea Grant
Gary Graham	Texas A&M Sea Grant
Dr. David Bankston	LSU Sea Grant
Margaret Davidson	SC Sea Grant
Marion Clarke	FL Sea Grant
Gene Nakamura	NMFS Panama City, FL
John Wynn	Mobile, AL
Chadd Angier	Watertown, MA
Bob Thomas	New Orleans, LA
U.S. Coast Guard	Mobile, AL
David Cottingham	Washington, DC
Ralph Andrews	Fort Myers, FL
Beaufort Golden	East Point, FL
Dave Harrington	Georgia Sea Grant
Bob Jones	Southeastern Shrimp Assn.
Allen Suhonen	Houston, TX
Scott Highton	Sauslito, CA
S.P. Hunnicutt	La Porte, TX

Table 2. Requests for TED technical information (continued).

John Andrew Nelson	Bon Secour, AL
Romeo B. Trono	Quezon City, Philippines
Alan Huff	FL Bur. of Marine Research
Sally Murphy	SC Dept.of Natural Res.
Charles Karnella	NMFS, Washington, DC
Jack Woody	U.S. Fish & Wildlife Serv.
Pamela Shepard	Maine Dept. of Marine Res.

Table 3. Papers and video presentations.

Papers

Fish Behavior and Trawl Design: Potential for Selective Trawl Development. John W. Watson. Proceedings of the World Symposium on Fishing Gear and Fishing Vessel Design. St. John's Newfoundland, Canada. November 1988.

A Comparison of Methods for Evaluating Trawling Systems. Ian K. Workman, John W. Watson and John F. Mitchell. Proceedings of the World Symposium on Fishing Gear and Fishing Vessel Design. St. John's Newfoundland, Canada. November 1988.

A Method for Evaluating the Exclusion of Juvenile Sea Turtles from Turtle Excluder Devices (TEDs). John F. Mitchell. Proceedings of the Ninth Annual Sea Turtle Workshop. Jekyll Island, GA. February 1989.

Videos

Turtle Excluder Device Evaluations. NMFS, SEFC, Mississippi Laboratories

Soft TED Evaluations. NMFS, SEFC, Mississippi Laboratories.

Texas Sea Trials of TEDs. Texas A&M Marine Extension Service.

North Carolina TED Laboratory and Field Trials to Reduce Shrimp Loss. North Carolina Marine Resource Center.

SMALL TURTLE TED CERTIFICATION STUDY

INVESTIGATORS

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INTRODUCTION

Objectives of the Small Turtle TED Certification project were:

1. Conduct an experiment to determine if a procedure using headstarted Kemp's ridley turtles and scuba divers could be developed as an alternate technique to certify new TEDs.

2. Conduct field tests using the experimental procedure, and video tape diver-released turtle encounters with the new TED designs for study and evaluation by a panel of technical experts.

3. Convene a panel of technical experts to evaluate results of the field tests, determine if the technique can be used as a certification method, establish efficiency results for each of the new TEDs tested, and recommend modifications to the test protocol.

4. Make recommendations to the Southeast Regional Director on use of the technique and resulting performance of each new TED tested.

SUMMARY OF RESULTS

The diver-conducted study using small headstarted turtles to determine escape efficiencies of new TED designs was conducted during May 1989 off Panama City, FL. Need for the study developed when certification trials of new TED designs were attempted during March 1989 using the current procedure of towing devices installed in a trawl in the Cape Canaveral ship channel. Very few turtles were encountered, and the test could not be completed. This development made it necessary to try and develop an alternate method to certify new TEDs in the event sea turtles did not return to Cape Canaveral in sufficient numbers for certification testing.

The experimental procedure was based on results of a small turtle/TED evaluation study funded by MARFIN and conducted during August 1988. The technique employed scuba divers to release headstarted ridley sea turtles into TED-equipped trawls. Video cameras were used to document each test and provide for a review of results by TED manufacturers and a panel of technical experts. Results of the field tests are presented in a project report "Soft TED Evaluations, Video Documentation, and Small Turtle Test".

A review panel was convened in June 1989 to review the results of the certification experiment, evaluate the feasibility of the procedure as a protocol for certifying new TED designs, determine if test results could support recommending any of the new TED designs for certification under the endangered species regulations, recommend modifications to the procedure, and finally make recommendations to the Southeast Regional Director concerning the study results. Results of the technical panel review were prepared in a report "Turtle Excluder Device Certificaion Experiment Results and Recommendation". Review of this report has been completed by the panel members, the Southeast Center Director, and final draft submitted to the Southeast Regional Director.

In addition to the above reports, a video report was produced entitled "Soft TED Evaluations" which documents the test procedure and results of the experiment. This report is intended as an educational aid for technology transfer purposes.

SUMMARY OF SHRIMP PANEL DISCUSSION

- Reduction of white shrimp recruitment in the shrimp model to the point of predicting actual landings indicates the impact of additional effort.
- Lost shrimp are not presumed dead in the model. The assumption is made that if the shrimp are lost through the TED, they will continue in the fishery and possibly be recaught.
- The model takes into account that if TEDs are used, an increase in cost per pound of shrimp results due to a decrease in efficiency. However, there is also a reduction in cost because fewer shrimp have to be processed. The model assumes that the level of effort is held constant. Increased effort would probably increase landings. but the model does not take this scenario into account.
- The probability of one universal TED being used is slight. Different TEDs are being used successfully in different areas.
- The analysis concerning Louisiana trips inshore and offshore, average length of trips, and actual number of days fished does not allow for efficiencies of vessels, e.g., net size or single or double rigging.

SESSION X

GENERAL

A VIDEO TRAINING PROGRAM FOR FISHING TOURNAMENT DIRECTORS AND MANAGERS TO FACILITATE SAFETY, RESOURCE AWARENESS AND SUCCESS IN FISHING TOURNAMENTS

GRANT # NA87WC-H-MARFIN:
R/MARFIN-2

INVESTIGATORS:

JAMES C. CATO
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Sea Grant Extension Program
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INTRODUCTION:

The basic concepts for this project came from the presentations of the 1987 Fishing Tournament Directors Conference sponsored by Florida Sea Grant and held in Miami in 1987. Video's taken at that conference were used to develop the content and outline for this series of videos. On site filming of tournaments during the Project provided additional content for the videos.

The Project was completed on schedule inclusive of a 90 day extension to enable time to plan and publicize the final review and premier viewing. The Project ended on the 31st of August, 1989.

SUMMARY OF RESULTS:

This Project was actually completed on the 30th of August with a final review viewing at the Broadcast Quality, Inc. facilities in Miami. This was the third and final review which included suggested edits and improvements from previous reviews. Tournament managers, NMFS and Sea Grant representatives, outdoor writers and individuals that donated boat time and other amenities or assisted with the Project, were invited to view the final product.

There was a resounding voice of approval of the video series. The critical eye of outdoor writers and tournament managers found the videos to be educational, informative, accurate and of use to them in orienting and preparing for the next tournament and encouraging conservation measures. They suggested that the product was timely and useful to established tournaments as well as those contemplating starting a fishing tournament.

The Project: "The Tangle-Free Tournament: Guidelines for Planning and Conducting a Successful Fishing Tournament" is a five part video which includes the following: Tape 1 - Introduction; Tape 2 - Organization, Sponsorship & Promotion; Tape 3 - Safety, Liability and Insurance; Tape 4 - Judging the Catch; and Tape 5 - Fishing Tournament Formats.

Although the video was targeted at fishing tournaments of the Gulf of Mexico, the concepts are generic and can be used in most geographic areas for both fresh and saltwater tournaments. The group reviewing the series believed that the

video series would be useful throughout the nation and possibly in international tournament circles. All who worked on the project and those who have reviewed the final product are excited as to the potential impact of the series. It is anticipated that the series will promote more effective conduct of fishing tournaments, conservation of our fisheries resources and create an awareness toward improving the quality of our marine environments.

Sets of the five tape series will be distributed to Sea Grant programs in Texas, Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina and Puerto Rico. Gulf Coast states departments of natural resources and fish and wildlife will offered copies of the series. National Marine Fisheries Service regional offices will receive a copy for use in their region. The U.S. Fish and Wildlife Service will have a copy available for distribution.

Any organization desiring a copy will have access to a free loan copy from any of these organizations mentioned in the previous paragraph or can purchase their own copy. Tapes can be purchased individually for $15.00 or $50.00 for the five tape set. Cost of the series is based on expense of materials, duplication and handling for tapes produced in excess of those financed by the grant for free distribution.

A publicity plan has been established to get visibility for the series in prominent magazines and relevant media. The current president of the Outdoor Writers Association participated in the final review and plans to do an article announcing the availability of the tapes. The article will be sent to all media relevant to sportfishing and tournament interests.

Anyone interested in purchasing or borrowing a set of the tapes directly from Florida Sea Grant should contact:

Mr. Jay Humphreys, Coordinator
Sea Grant Communications Office
Florida Sea Grant College Program
Building 803
University of Florida
Gainesville, FL 32611

Or Phone: 904-392-2801 / 904-392-1837 / 904-392-5870

Biological, Fishery, and Product Assessments of the Keoghfish, an Underutilized and Unmanaged Gulf of Mexico Resource (NA88WCHMF200)

George H. Burgess

Florida Museum of Natural History

University of Florida

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INTRODUCTION

The keoghfish or giant snake eel, *Ophichthus rex*. is a mildly exploited Gulf of Mexico resource that is found in localized concentrations in soft mud-bottomed areas from the Yucatan Peninsula, Mexico to the offing of the Mississippi River, Louisiana. In recent years it has begun to appear in the by-catches of established deep-water snapper-grouper and shark fisheries, and has become the bait-of-choice of shark fishermen working off of Louisiana.

An 18 month MARFIN-supported study was conducted by biologists and seafood scientists from the University of Florida and University of Central Florida with the objectives of characterizing of the eel's habitat and associates, gathering basic life history information, documentating existing and potentially improving commercial harvest methods, testing on-board and primary dockside handling methodologies, performing detailed analytical assessments of the flesh and evaluating the potential utlization of the skins in tannery operations. Coinvestigators on this project are Franklin F. Snelson, Stephen J. Walsh, Steven Clark, Kevin G. Abbott, Larry E. Barton, and W. Steven Otwell. Additional funding was provided by the Florida Sea Grant Program, the National Underwater Research Program, and the Griffis Foundation.

SUMMARY OF RESULTS

Eleven monthly samples of eels were obtained between March 1988 and February 1989 resulting in 316 specimens for biological and seafood analyses. We made five trips on leased commercial vessels to obtain fishery data and biological specimens in April, May, August, October, and February. Standard longline sets were made at three stations located off the southeastern coast of Louisiana in depths of 139-180 feet, 180-250 feet and 285-490 feet; occasionally a fourth or fifth set was made at one of these stations. The May trip, funded independently of MARFIN, yielded catch data from a site removed from our standard quarterly sampling localities but at equivalent depths. Thirty eels from varying depths, times, and size classes were retained for dissection in the laboratory. The remainder of the eels and the by-catch were quantified and measured in the field. A NURP-funded submersible trip made in August also provided valuable ecological information.

Longline fishing resulted in catches of giant snake eels (N=544) and by-catch (N=487) in approximately equal numbers. The by-catch was dominated (96.9%) by sharks, especially the Atlantic sharpnose shark, *Rhizoprionodon terraenovae* (68.2%). By-catch catch-per-unit-effort (CPUE) was highest in the summer and fall, from the hours of 2100-0100, and at depths of 139-250 feet. Highest eel CPUE rates occurred during the winter and spring and during the hours 1300-2100. Eel CPUE increased slightly with greater depth of capture.

Comparisons of the fishing efficiencies of 6/0 circle and 10/0 straight hooks resulted in in higher eel catches with the 10/0, higher by-catches with the 6/0, and more returns of unbaited 6/0 hooks. The circle hooks also proved harder to unhook. For these reasons it appears that 10/0 straight hooks are preferable gear. Using 10/0 hooks, we found that about 1/4 of the returned hooks contained fish (giant snake eels 11.9%, by-catch 14.6%). The remaining 3/4 was about equally

divided among baited (38.8%) and unbaited (34.7%) hooks. A marked summer/fall increase in by-catch and unbaited hooks was noted. Lowest numbers of empty returns and by-catch occurred from 0100-0500 hours, highest numbers from 2100-0100. No efficiency patterns as related to depth were observed.

Larger total lengthed (TL) eels were found in deeper waters. Yearly pooled lengths produced a "normal" distribution. Seasonally, length-frequencies were somewhat skewed towards larger individuals in October and February. Year classes cannot be distinguished by examining seasonal length-frequency distributions, a finding consistent with age and growth data.

Females ranged in TL from 101-212 cm (mean = 156.1) and weight from 1.35-19.0 kg (mean = 7.2); males from 83-183.5 cm (mean = 140.7) and 0.75-11.95 kg (mean = 5.0). Age and growth parameters were estimated using otoliths sectioned with a low-speed ISOMET saw and read under a compound microscope with transmitted light. Females examined had 6-30 (mean = 11.9) rings, males had 4-18 (mean = 10.6) rings. Eels with 8-15 rings varied widely in TL, indicating differential growth rates. Marginal increment analysis suggests that rings are laid down biannually in the winter and late summer/fall. Length/age, length/weight, and length/girth regressions were calculated and a von Bertalanffy growth function equation determined.

Aspects of reproductive biology were ascertained from gross examination of whole specimens and microscopic study of gonad samples. The sex ratio of specimens from the entire sampling period was highly skewed, with females outnumbering males by 4.13:1. Both sexes reach sexual maturity at a TL of about 160 cm and age class 9 to 11. A pronounced unimodal seasonal cycle was evident in both sexes as determined from the gonosomatic index (GSI = [gonad weight{g}/body weight{g}] X 100), the gonad index (GI = [gonad weight{g}/TL{mm}^{3}] X 10^8), and histological preparations. The relative gonad indices of both sexes increased

abruptly beginning in late autumn and reached a peak from February to April. Maximum relative gonad mass corresponded to peak vitellogenesis in females and spermatogenesis in males. As inferred from gross and microscopic examination, spawning occurs over an extended period from early January through early or mid-April. During the breeding season, testes of mature males were packed with lanceolate-shaped spermatozoa. Ovaries of breeding females consisted primarily of large (mean diameter = 1.03 mm) vitellogenic ova and relatively few, smaller oogonia. Fecundity estimates ranged from 9.19×10^5 to 2.53×10^6 ova produced per female. The number of ripe ova was positively correlated both with female body weight and TL. However, based on a limited sample, it appears that females do not spawn their entire clutch of ripe eggs in a given season, hence actual fecundity may be considerably less than predicted.

Giant snake eels primarily feed on decapod crustaceans, bony fishes, and a stomatopod. An index of relative importance (IRI) based on % occurrence, % volume and % number was utilized in ascertaining food habits. Infaunal and epifaunal food items were equally important. Fewer species of invertebrates than fishes were consumed, but invertebrates were about half again as important in the diet as fishes. Invertebrates were dominated by two epifaunal crabs, *Callinectes similis* and *Portunus spinicarpus*, an infaunal crab, *Raninoides louisianensis*, and the infaunal mantis shrimp *Squilla empusia*. Twenty-seven species of fishes were eaten with burrowing anguilliform fishes (eels) representing almost half of the total identified fish IRI. Decapods were twice as important to males as to females; fishes were three times as important to males as to females. Stomatopods were eaten by females but by virtually no males. Infaunal food items were most important from February to June, epifaunal items from June to December. Diurnal feeding patterns included an increased importance of stomatopods from 1300-0100 hours, increased dependence on fishes from 0700-0100, and decapods utilized

around the clock, peaking from 1300-0700. Peak feeding occured between 1300-1900. Fishes and mantis shrimp were most important to larger eels, decapods to smaller eels.

Eel flesh was evaluated for consumer appeal, nutritional content, yield, and shelf-life. The meat has a pure white color and firm texture. The high protein, low fat content makes it nutritionally appealing to the consumer. The lean flesh has a mild cooked flavor and it has had excellent consumer acceptance. The giant snake eel appears most suitable for specific domestic markets and traditional international markets where this type of food product is already an acceptable food item of choice. The abundant number of bones and low final yield of the marketable product has made marketing the most challenging food science aspect of this project.

Title: Undertake Additional Data Development and Analysis of Recreational Fisheries in the Florida Keys, Grant # NA89WC-H-MF019.

Name and Address of Investigator: David B. Rockland, Sport Fishing Institute, 1010 Massachusetts Avenue, Suite 100, Washington, D.C. 20001

Introduction: In 1986 and 1987, the Sport Fishing Institute (SFI) undertook a study to estimate the economic impact of the sport and commercial fisheries of the Florida Keys. The study involved an extensive 12-month data collection period (October 1986 to September 1987). The following primary survey efforts were include:

1) Daily counts of the numbers of sport fishermen on bridges and embankments by the Florida Marine Patrol (approximately 300 counts were made).
2) Intercept interviews of bridge and shore fishermen by a creel clerk (295 usable responses).
3) Mail-back surveys were distributed by captains of guide, charter, and partyboats (336 usable responses).
4) Monthly reports of the number of guide and charter trips were obtained from the booking offices and individual captains.
5) A survey of commercial fish houses to obtain marketing and margin data (24 usable responses).
6) A survey of local businessess that provide goods and services to sport fishermen to obtain data on employment and revenue by product (63 usable responses).
7) A mail survey of registered boaters in Dade and Broward counties (554 usable responses).

These data sets were analyzed in a previous report from the perspective of deriving economic impact estimates for the economies of Monroe County and the State of Florida. The purpose of the current project is to take advantage of the data sets that were developed for the earlier study and undertake additional analyses of those data. Specifically, the goal here is to use the developed data to analyze the economic value anglers place on sport fishing and their responses to changes in fishing success.

Results: The various surveys used to collect data from anglers, included questions that enable analyses of the economic values of sport fishing. Estimates of the value placed on sport fishing are possible with both the Travel Cost Method and the Contingent Valuation Method. Both of these techniques are being applied to the data sets developed for offshore, guide, charter, partyboat, shore and private boat anglers.

The various surveys contained questions regarding the likely responses to changes in fishing effort if fishing success were to change. These questions included how many extra days would be spent on a trip to the Keys and how many extra trips to the Keys would respondents make if fishing success doubled. Questions as to whether respondents who are non-residents would still come to the Keys if they could not go sport fishing, and whether residents would live in the Keys if they could not sport fish, were asked.

Responses to these questions are being analyzed and causal relationships developed with the respondent's catch on the trip when surveyed, socioeconomic characteristics, and other relevant variables. These analyses are exploring each angle in the data in terms of understanding the relationship between fishing success and fishing effort.

Results from this project are due by the end of January 1990, and work is progressing on-time and on-budget.

ABSTRACT

An Analysis of Regulatory Changes on the Economic Structure of the Eastern Gulf of Mexico Finfish Industry (Grant NA 86WC-H-06122)

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Introduction

Florida provides a major portion of the domestic supply of mullet. This important fishery provides flesh for human consumption as fresh, frozen, salted, and smoked flesh, as well as roe. This study determines the current interrelationships mullet shares with other estuarine species, primarily seatrout, in the commercial seafood production and marketing system. It also analyzes the impacts of alternative resource management policies. Data utilized for the study came from the National Marine Fisheries Service Statistics Office, the Florida Department of Natural Resources Trip Ticket Program, a 1987 survey of primary (fishhouses), and a 1988 survey of secondary handlers of mullet products.

Summary of Results

Florida provides 85 percent and 62 percent of mullet and seatrout, respectively. From 1977-88, combined black mullet and seatrout landings, on average, represented 24 percent of all finfish landed in Florida and 15 percent of total dockside value. Mullet and seatrout landings have been trending downward; from 1981 to 1988, black mullet landings have decreased by 52 percent. Individual fishermen in the estuarine fishery target a complement of species. Although mullet and seatrout are the primary species targeted, others (including flounder, croaker, mojarra, and other species) are landed. Of the 4,937 fishermen in the fishery, 3,240 targeted mullet and 3,975 seatrout. Approximately 90 percent of the landings were attributed to 2,137 fishermen who produce a combination of mullet, seatrout, and other species. Some fishermen produced only one species.

Trip ticket data indicated that 313 Florida firms were first handlers of mullet (i.e. purchased from fishermen). Most of these were located in Gulf Coast counties. On the Gulf Coast, a total of 31 firms reported mullet landings of over 100,000 pounds, representing 46 percent of the total mullet landings. Of those firms who purchased mullet from fishermen, most of the larger firms were located in the southern region of the state (Lee, Collier and Monroe counties). However, buyer concentration was greatest in the northern region of the state (Gulf to Escambia counties). Statewide, a total of 33 firms reported mullet sales of over 100,000 pounds, representing 70 percent of all mullet handled. The firm size distribution among sellers implied a low degree of concentration.

Mullet sales accounted for an average 11.2 percent of gross sales for secondary handlers of mullet. This value ranged from 95 to 0.3 percent. Of the 44 firms responding to the survey, 80 percent of the mullet sales were made by 10 firms. Only 16 percent of the firms indicated horizontal integration (ownership of more than one plant). Over half of the plants reportedly purchased product directly from fishermen. In addition, 58 percent of secondary handlers are integrated forward into retailing seafood. However, the total volumes involved are small.

Primary handlers purchased 35.2 million pounds of mullet in 1986. Seventy percent came from fishermen, 13 percent from their own boats, and 15 percent from other fishhouses. About 80 percent of the mullet was subsequently sold in the round. About 70 percent was sold frozen. Ninety-two percent was sold for human consumption, while the remainder was sold for bait. All secondary handlers purchased mullet in the round or processed products from Florida sources. Ninety percent of the firms purchased mullet from primary handlers, while 20 percent sold product to primary handlers. In addition, about 25 percent sold to other U.S. wholesalers. Other outlets included foreign wholesalers, retail food stores, foodservice, and direct consumer sales through retail outlets and restaurants.

The consequences of potential alternative resource management policies were assessed for mullet and seatrout fishermen. Three policy alternatives were assessed for mullet: (1) total elimination of mullet landings during the mullet roe season, (2) limiting the landings of roe mullet during each of the roe months to a volume equivalent to the average monthly mullet landings in the three-month period immediately preceding the roe season, and (3) reducing the roe mullet production by 50 percent from what would have been realized in a base year. The options examined for seatrout landings from those landings reported during a base year. The range in reductions was 10 to 50 percent, with incremental reductions of 10 percent.

Tables and Figures
(presented at conference)

TITLE: Educational Tools for Marine Recreational Fishermen to Promote Wise Use and Conservation of Gulf Fishery Resources

PRINCIPAL INVESTIGATOR: Ronald L. Schmied
Special Assistant for Recreational Fisheries
National Marine Fisheries Service
9450 Koger Boulevard
St. Petersburg, FL 33702

INTRODUCTION:

The purpose of this project is to promote marine fisheries conservation and encourage ethical behavior by marine recreational fishermen in the Gulf of Mexico area. The basis for this project is as follows.

Nationally, saltwater angling participation more than tripled between 1955 and 1985 and participation rates (percent of U.S. population fishing) jumped from 3.9 percent to 7.8 percent. Analysis conducted by the Sport Fishing Institute indicates that by the year 2025, salt-water fishermen will require 211 million man-days of fishing -- 40 percent more than in 1985. Notably, in 1986, the Gulf of Mexico region already accounted for over 25 percent of all U.S. saltwater anglers and trips, 28 percent of the total fish caught and approximately 34 percent of all MRF-related economic activity in the U.S. This share is likely to continue and perhaps even increase in the future if anglers join state and federal fishery managers to conserve fishery resources and related habitat.

Unfortunately, the prognosis for saltwater angling in the Gulf area is sobering. Populations of most species traditionally targeted by anglers are stressed and, in some cases, overfished. State and federal regulations have proliferated to reduce recreational and commercial fishing pressure on these stocks so they can rebuild themselves. Continued growth in saltwater angling in the region linked with the current condition of our resource base, will likely require further catch reductions in the future.

Two options are available to meet our fishery conservation goals in the Gulf. We can either impose more external controls (regulations) to prevent additional resource problems or we an encourage anglers to exercise voluntary restraint. Most would agree it would be far better to reach our goals with a minimum of regulations. This translates into less government intrusion into the sport and less cost to taxpayers for expensive regulatory and enforcement programs. Wide-spread angler adherence to a personal conservation ethic holds great promise for rebuilding and maintaining robust Gulf fishery resources.

NMFS Southeast Region is committed to working with anglers to establish an acceptable angler ethics program. Considerable progress had been made prior to this project in developing educational materials and programs particularly relating to increased angler use of non-traditional species, development of an expanded cooperative gamefish tagging program to promote non-consumptive angling, and development of a video training series to help tournament directors conduct more effective, conservation-oriented tournaments. This MARFIN project, which was initiated under a 1987 grant and is being continued under a 1989 grant, was designed to accelerate and complete development of the key remaining educational materials needed to field the region's angler ethics education program.

SUMMARY OF RESULTS:

Goal 1 (1987 Project) - Inform anglers of federal saltwater sportfishing regulations and encourage their compliance.

Accomplishments - 80,000 copies of a regulations brochure entitled "Fishing Facts for Recreational Anglers Fishing in Federal Waters of the Gulf of Mexico" were printed, and roughly 60,000 have been distributed. The remaining brochures are being distributed with an insert advising anglers of regulatory changes that have occurred since the original printing. Under the 1989 MARFIN grant, the entire brochure is being revised, and reprinted in-house. Distribution will occur this fall with additional updates made and distributed as needed during 1990.

Goal 2 (1987 Project) - Educate saltwater anglers on proper catch and release techniques.

Accomplishments - A 28 minute broadcast quality video was produced under contract with Mark Sosin Communications of Boca Raton, Florida. Also produced were three public service announcements (60 seconds, 30 seconds, 15 seconds). Using funds obtained under the 1989 MARFIN grant, approximately 230 copies of the video were made, 200 of which have been distributed at no cost to state fishery agencies, Sea Grant programs, NMFS Laboratories, Fishery Management Councils, Regional Marine Fishery Commissions, and sport fishing organizations. Approximately 30 copies have been retained in the Regional Office for a loan program. NOAA Public Affairs has taken our PSAs and combined them with Marine Plastic Pollution PSAs and has distributed them nationally to all major public T.V. stations.

Notably, this production has been extremely well received with loan copies requested from organizations nationwide and from several foreign countries. Other NMFS regions are considering producing a similar video -- the Northeast Region has obtained money and will start production September 1989. The Southwest Region has solicited proposals under the

Saltonstall-Kennedy grant program to develop an angler ethics program plan based on the Southeast model.

Other accomplishments include printing of 20,000 copies of a "NMFS Catch and Release Quick Reference Card" that summarizes key points leading to the successful release of fish. The entire 20,000 cards were distributed in two months. Using 1989 MARFIN funds, another 100,000 of the cards were printed and are being distributed.

Goal 3 (1989 Project - Accelerate angling ethics through development and application of appropriate educational tools.

Accomplishments - In addition to the other activities mentioned under Goals 1 and 2 that were funded under the 1989 MARFIN grant, a 22" x 28" four color poster and a companion 5-3/4" x 3-3/4" sticker have been developed to promote "ethical angling practices" and is in the process of being printed through the Government Printing Office. These products, which were developed by a commercial artist, will entreat anglers to "rise to the challenge of ethical angling" by conforming to ten specific outlined behaviors. When completed in October, this poster will be distributed to marinas, tackle shops, charter/headboats, fishing piers and other agents for public display. The stickers will be made available to anglers at many of these same locations in hopes that they will affix them to their tackle boxes and boats to remind them of this challenge.

SUMMARY OF GENERAL SESSION PANEL DISCUSSION

- Study sites for the assessment of the keoghfish were pure mud bottom. Tile fish and yellow edge may be found on soft bottom, but tend to be found near hard bottom. The eels require soft, flat bottom away from any relief.

CLOSING REMARKS

Dr. Angelovich congratulated all who participated in the Second Annual MARFIN Conference. He stated that valuable information and data were presented on the resources in the Gulf of Mexico which would not be available if not for the MARFIN program. This information will prove very useful to the Board who will help determine priority areas for future research.