MACKEREL WORKSHOP REPORT

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by

C. Bruce Austin
Joan A. Browder
Robert D. Brugger
J. Connor Davis

Results of a workshop to examine
the Spanish and king mackerel
fisheries from the systems viewpoint,
held in Miami on April 28 and 29, 1977

Workshop sponsored by the
National Marine Fisheries Service
Southeastern Fisheries Center
Miami, Florida

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1978

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C. Bruce Austin P. I.

BACKGROUND ON THE BIO-SOCIO-ECONOMIC FISHERY PROFILE WORKSHOPS

C. Bruce Austin P.I.

Sponsor

The workshops were sponsored by the Southeast Region, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce, under Contract No. 03-6-042-35137.

Objectives and Scope

The purpose of the workshops was to obtain necessary, but presently unavailable descriptive and quantitative socio-economic information for systems modeling, through workshops comprised of people directly working "in" the fisheries (e.g. fishermen and processors) as well as from those working "on" the fisheries (scientists and administrators).

Choice of Fisheries and Workshop Participants

The choice of fisheries was determined by mailing a questionnaire to people knowledgeable about fisheries in the southeast region. The questionnaire recorded why these people considered the fisheries they selected to be the most appropriate for such workshops.

Northern Gulf croaker (Micropogon undulatus) and mackerels (king, Scomberomorus cavalla, and Spanish, Scomberomorus maculatus) were chosen after discussions with National Marine Fisheries Service and State officials. These species ranked near the top of the questionnaire recommendation list, had minimum overlaps wtih other studies, encompassed a wide range of issues, and are economically important.

Those that responded to the questionnaire also recommended individuals working "in" and "on" the fisheries whom they believed would be

the most knowledgeable about general fishery, biological, and economic factors. Persons were categorized according to; fishermen, processors, scientists, and administrators. Utilizing these names as a starting point, workshop participants were selected on the basis of providing information on all the important aspects of the fisheries (general, biological, socio-economic) and as representing specific interest groups.

Table 1. Croaker Workshop Participants

Mark Chittenden, biologist, population dynamics, Texas A & M University, College Station, Texas

John Christiansen, manager, Quaker Oats (processes croaker into pet food), Pascagula, Mississippi

Albert Jones, biologist/administrator, fishery management plans, Southeast Fisheries Center, NMFS, Virginia Key, Florida

Jimmie Martin, industrial (pet food) croaker trawl fisherman, Pascagula, Mississippi

Charles Roithmayr, biologist/administrator, general fishery information, Pascagula Laboratory, NMFS, Pascagula, Mississippi

Grady Seamen, food croaker trawl fisherman, Bayou La Batre, Alabama

Kent Seamen, Seamen Seafood (handles fresh and frozen food croaker), Bayou La Batre, Alabama

Charles Sebastian, charterboat captain, Grand Isle, Louisiana

David Summersgill, Summersgill Enterprises (freezes croaker for crab bait, and animal food) Golden Meadows, Louisiana

Table 2. Mackerel Workshop Participants

Donald Allen, biologist/administrator, general fishery information, Southeast Fisheries Center, NMFS, Virginia Key, Florida

Al Armitt, Vice President, Organized Fishermen of Florida, and a lobster fisherman, Summerland Key, Florida

Dale Beaumariage, biologist/administrator, general fishery information, migration, landings, Florida Department of Natural Resources, Tallahassee, Florida

Frank Breig, handline king mackerel fisherman, Treasure Coast Cooperative, Ft. Pierce, Florida

Harold Brusher, biologist/administrator, recreational fisheries information, Panama City Laboratory, NMFS, Panama City, Florida

Charles Carter, gillnet king mackerel fisherman, Key West, Florida

James Cato, economist, cost and returns, marketing margins, University of Florida, Gainesville, Florida

Leo Cooper, fish house operator (Angelo's Seafood), Marathon, Florida

Tim Daniels, gillnet king mackerel fisherman, President of Middle Keys Chapter of Organized Fishermen of Florida, Marathon, Florida

Roger Farlow, Vice President, Treasure Coast Cooperative, Ft. Pierce, Florida, and a handline king mackerel fisherman

Jeffery A. Fisher, extension agent, Florida Cooperative Extension Service, Panama City, Florida

Garry Graves, fish house operator (Keys Fishery) Marathon, Florida

Edward Houde, biologist, observer, University of Miami, Miami, Florida

Albert Jones, biologist/administrator, fishery management plans, Southeast Fisheries Center, NMFS, Virginia Key, Florida

Charles Manooch, biologist/administrator, general fishery information, mackerel literature, Beaufort Laboratory, NMFS, Beaufort, North Carolina

Eugene Nakamura, biologist/administrator, general fishery information, mackerel literature, Panama City Laboratory, NMFS, Panama City, Florida

Fred Prochaska, economist, cost and returns, marketing margins, University of Florida, Gainesville, Florida

Curtis Ryan, charter boat captain, President of Charterboat Association, Key West, Florida

Deborah Shaw, biologist, general Keys fishery information and natural history, Marine Resource Inventory, Florida Cooperative Extension Service, Key West, Florida

Elmer Stokes, handline king mackerel fisherman, Sebashan, Florida

Tony Storemont, handline king mackerel fisherman, Treasure Coast Cooperative, Ft. Pierce, Florida

Walter Thompson, gillnet king mackerel fisherman, Marathon, Florida

The number of workshop participants was restricted for two reasons. First, it was believed that a small broadly representative group of people would communicate most effectively to yield the most socio-economic information. A major task of the participants was to verify or correct the workshop staff's impressions of the fisheries, as presented in the background papers. These background papers explained methods, outlined the purpose and tasks of the workshops, and served as the primary resource documents.

A second reason for restricting participants was that some self-employed participants could only attend if they were reimbursed for their travel and lodging expenses. Participants employed with public agencies (State or Federal) or large businesses were more able to have their employer cover their travel and lodging expenses.

Workshop Staff

Preparation of background material, logistic support for the workshops, and final reports, were team efforts by the following persons.

C. Bruce Austin, Marine Resource Economist, Assistant Professor, Department of Economics School of Business and Division of Biology and Living Resources, Rosenstiel School of Marine and Atmospheric Science, University of Miami. Principal Investigator.

Joan A. Browder, Systems Ecologist, Consultant (now Assistant Research Professor, Division of Biology and Living Resources, Rosenstiel School of Marine and Atmospheric Science). Primary responsibility: preparation of the mackerel background material.

Robert D. Brugger, Economic Research Assistant, Division of Biology and Living Resources, Rosenstiel School of Marine and Atmospheric Science, University of Miami. Primary responsibility: workshop coordinator, logistic support.

J. Connor Davis, Biology Research Assistant, Division of Biology and Living Resources, Rosenstiel School of Marine and Atmospheric Science, University of Miami. Primary responsibility: preparation of the croaker background material.

James B. Higman, Fisheries Biologist, Research Assistant Professor, Division of Biology and Living Resources, Rosenstiel School of Marine and Atmospheric Science, University of Miami. Primary responsibility: review and edit final workshop reports.

David Kittrel, Graduate Student Research Assistant, Department of Economics, University of Miami. Primary responsibility: assist in preparation of croaker and mackerel background material

Mark C. Ward, Graduate Student Research Assistant, Department of Economics, University of Miami. Primary responsibility: assist in systems modeling.

Special Contributors to the Croaker Workshop

Charles Roithmayr, biologist, Pascagula Laboratory, NMFS, Pascagula, Mississippi. Presented an overview of the Gulf croaker fisheries.

Mark Chittenden, Assistant Professor, Department of Wildlife and Fisheries Science, Texas A & M University, College Station, Texas. Presented an overview of the Gulf croaker stocks.

Special Contributors to the Mackerels Workshop

Deborah Shaw, Key West Cooperative Extension Service, Key West Florida. Presented an overview of the natural history and Florida Keys fisheries for mackerels.

Dale Beaumariage, Chief, Bureau of Marine Science and Technology, Florida Department of Natural Resources, Tallahassee Florida. Presented an overview of the biological work (primarily tagging) done on mackerels by the Florida Department of Natural Resources.

Eugene Nakamura, Officer in Charge, NMFS Panama City Laboratory. Panama City, Florida. Presented a summary of his recently compiled bibliography on mackerel.

Fred J. Prochasha and James C. Cato, economists, Florida Sea Grant Program, Gainesville, Florida. Presented a paper on costs and returns marketing margins in the mackerel fisheries (printed in final workshop report).

Jeffery A. Fisher, extention agent, Florida Cooperative Extension Service, Panama City, Florida. Submitted a report on recreational (private and charter) fishing for king mackerel in Northwest Florida (printed in final workshop report).

Pre-Workshop Preparations

Besides selecting fisheries and participants and arranging logistic support for the workshops, the primary effort of the staff was the

preparation of background papers on the chosen fisheries (coaker and mackerels). The first task was a literature search. This was more complete for croaker than mackerels because the literature search for croaker was also part of another NMFS contract (croaker socio-economic profile, contract no. 03-6-042-35137). As was expected, much more biological information was available than socio-economic or general fishery information.

After completing the literature search, Connor Davis conducted a field trip from Miami to Louisiana and return by car for pre-arranged interviews with croaker fishery people and to observe croaker fishing, processing, handling, etc.

A trip to Pensacola by Joan Browder was made for the purpose of gathering information on the croaker fishery. Joan Browder also conducted field trips from Key West to Sebastian and to Naples for the mackerel (king and Spanish) fisheries.

These field trips served two purposes. They were planned to search out information that was not available in the literature. Little additional written or quantitative information was uncovered, however, industry people provided considerable descriptive socio-economic information that was valuable if it could be organized. This was a task of the workshops. The field trips also offered the opportunity to select workshop participants after initial field interviews determined their ability and desire to articulate and record what they knew about the fisheries.

Background Papers

The information that was assimilated from the literature search and the field trips was brought together into separate croaker and mackerel

workshop background papers. These papers presented the staff's initial "impressions" of the fisheries. They did not purport to be wholly accurate and were not for publication or quotation. When important facts were not known, we sometimes speculated. The purpose of the papers was to provide a starting point for workshops discussions.

Workshops

The croaker workshop was conducted 31 March and 1 April 1977 at the University of Miami's Rosenstiel School of Marine and Atmospheric Science on Virginia Key, Miami, Florida. The mackerel workshop was conducted 28-29 April 1977 at the National Marine Fisheries Service Southeast Fishery Center on Virginia Key, Miami Florida.

Post Workshop Analysis and Final Workshop Reports

The workshop sessions were taped. These tapes were the basis for revising the background papers which are the final workshop reports. These reports were then reviewed by workshop participants. The following sections are the workshop's final bio-socio-economic profile on the croaker fisheries. After the profile are written statements by some workshop staff and participants.

The workshop's final report on mackerels is published as a separate Univeristy of Miami Sea Grant document.

MACKEREL BACKGROUND REPORT

C. Bruce Austin
Joan A. Browder
Robert D. Brugger
J. Connor Davis

INTRODUCTION TO MACKEREL BACKGROUND REPORT

The purpose of this study was to develop a qualitative socio-economic profile of the mackerel fisheries. In the collection of data, emphasis was on people, about which very little has been written, rather than on the biology of the stock, which has been covered in the literature to the extent it is known or is the topic of other current studies. Because this study was of a qualitative rather than a quantitative nature, reported numbers based on the field work and the workshop are gross estimates that received no statistical treatment. Field work concentrated on the commercial rather than the recreational fisheries and was directed at the ports of major activity at the time of the study (winter of 1976-77). This report which is a product of the workshop and preliminary field work and a cursory literature review, provides a general overview of the structure of the mackerel fisheries.

DISTRIBUTION AND BIOLOGY OF KING MACKEREL

King mackerel (Scomberomorus cavalla) are distributed from the Gulf of Maine to Rio de Janeiro, and are found throughout the Gulf of Mexico, the Greater Antilles, and the Lesser Antilles as far south as the Grenadines, (Beaumariage, 1973). Seasonal movements along the Atlantic and Gulf shorelines are apparent, and abundance in Florida fishing areas greatly increases during the winter.

Returns from recent tagging operations of the Department of Natural Resources indicate, however, that the pattern of king mackerel migrations is more complicated than a simple north-south movement. A significant proportion of the fish tagged on the east coast of Florida during the winter rounded the Florida peninsula to be captured in the northern Gulf at such locations as Port Aransas, Texas, and Panama City, Florida (Williams,

unpub.). On the other hand, king mackerel tagged on the southeast coast in the spring eventually were returned from North Carolina and Virginia (Williams, unpub.) Smaller tagged individuals were returned from nearer to the tagging site than larger individuals, which travelled up to 1300 miles (Williams, unpub.). Yet very large individuals weighing 40 to 60 lbs are caught off the Louisiana coast in the winter by charterboat captains (C. Sebastian, pers. comm.), suggesting that at least some older individuals may not undertake seasonal migrations.

The spawning season for king mackerel is protracted, extending from May through August. The eggs are pelagic and occur in greatest numbers near the surface. The locations where larvae and juveniles have been collected provide a general indication of the spawning sites of this species. Larvae of king mackerel make up a significant proportion of the ichthyoplankton in the Gulf Stream off Miami (Schekter, 1971 and Mayo, 1973). They also have been collected off Cape Canaveral, off the Virginia and North Carolina capes, in the Gulf of Mexico northwest of the Dry Tortugas, in the northern Gulf, and off the northeast coast of Yucatan (Wollam, 1970).

Beaumariage (1973) determined some basic life history information for king mackerel from 1968 and 1969 catch data. Males reach reproductive maturity by Age III and females are reproductively mature by Age IV. They grow very rapidly during the first 4 years of life and have a relatively low mortality. Annual survival rate, based on catch data from the east coast handline fishery, is estimated at 0.46 (46%). Maximum life expectancy is estimated at 13 years. A graph from Beaumariage (1973) relating length (log of length in mm) to age is shown in Figure 1. Recruitment to the fishery occurs at Ages II or III, and these two age classes provide the main support for the commercial and sport fisheries.

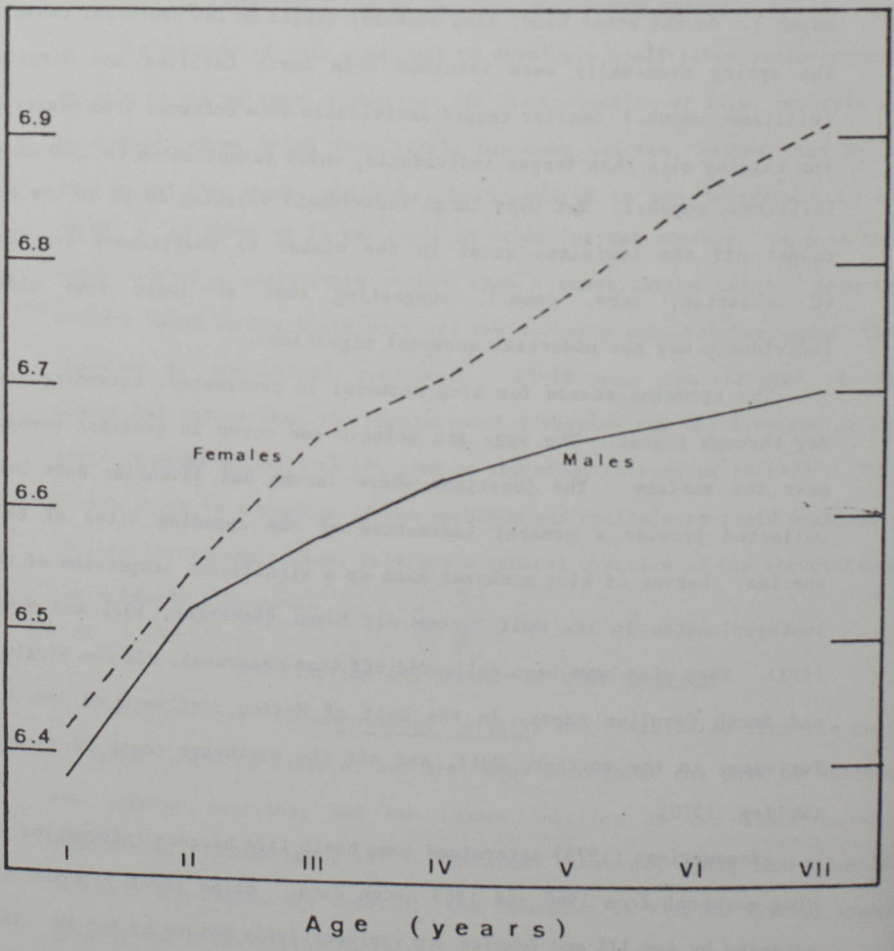

Figure 1. Log of length versus age (relative growth) in king mackerel (from Beaumariage, 1973).

Slightly larger fish may be taken by gillnets than by commercial handlines (Beaumariage, 1973), but the largest fish are taken by recreational fishermen (Gentle, 1977). Differing goals of recreational and sport fishermen may explain the differences in the average size of the catch in commercial and sport handlining. Sport fishermen actively seek the largest fish; whereas commercial fishermen seek the densest schools of fish.

Habits of king mackerel may change with age so that schools of different size fish will be found in different places. To some extent the fish school in groups according to age, and younger fish are presumed to form the largest schools. Prerecruitment size king mackerel sometimes migrate along the beach with Spanish mackerel of the same size and are taken in the nets of Spanish mackerel fishermen (L. Hudgins, pers. comm.). The king mackerel of major importance to the commercial handline fishery are caught almost entirely between the 9 and 13 fathom lines in the Port Salerno-Sebastian area. The fishing grounds in No Man's Land are approximately 60 feet deep. Sport fishermen in the Miami area fish at about 30 fathoms, although they sometimes catch large fish close to shore.

King mackerel feed predominantly upon clupeid fishes such as Atlantic thread herring and scaled sardines, but they also eat penaeid shrimps and squid (Beaumariage, 1973). When occurring at maximum densities, their stomachs are usually empty (Beaumariage, 1973, and fishermen, pers. comm). It has been suggested that the empty stomachs are due to rapid digestion, but the condition might also be due to absence of food. This species might be able to live for some time without feeding by utilizing energy stored as oils.

An annotated bibliography of the king, Spanish, and cero mackerels is in preparation (Manooch, et al., in prep.).

COMMERCIAL FISHING FOR KING MACKEREL

Major Ports

The U.S. commercial fishery for king mackerel is extremely localized, being confined to three main areas, all in Florida. The main commercial fisheries for king mackerel are located along the east coast from Port Salerno to Sebastian and in the Florida Keys, particularly off Key West. The Key West fishery has historically been important sporatically. The Naples area of the west coast of Florida has traditionally been an important area for this fishery, but has not been a major producer for the past 3 years. The Port Salerno-Sabastian area has been a consistent producer for many years. No commercial fishery for king mackerel exists in the northern Gulf, although this is an important species in the recreational fishery there (Brusher, this publication). To give an idea of the distribution of landings per area, the 1965 commercial landings in pounds for the different areas are shown on the map in Figure 2 (NMFS, 1971). The characteristic annual catch pattern for the different areas is evident from plotted monthly landings for the most important counties from September 1969 through December 1975 (Figure 3). King mackerel supports more of a year-round fishery on the Florida east coast than in Monroe or Collier counties. The season in Key West is particularly short, usually consisting of January, February and part of March, and is poor in some years. Percent of the annual landings originating in the three major areas each year from 1964 through 1975 is shown in Figure 4 (from Beaumariage, pers. comm.).

Landings

The annual (Sept.-Aug.) commercial landings of king mackerel from September 1950 through August 1975 are indicated in Figure 5. The increase

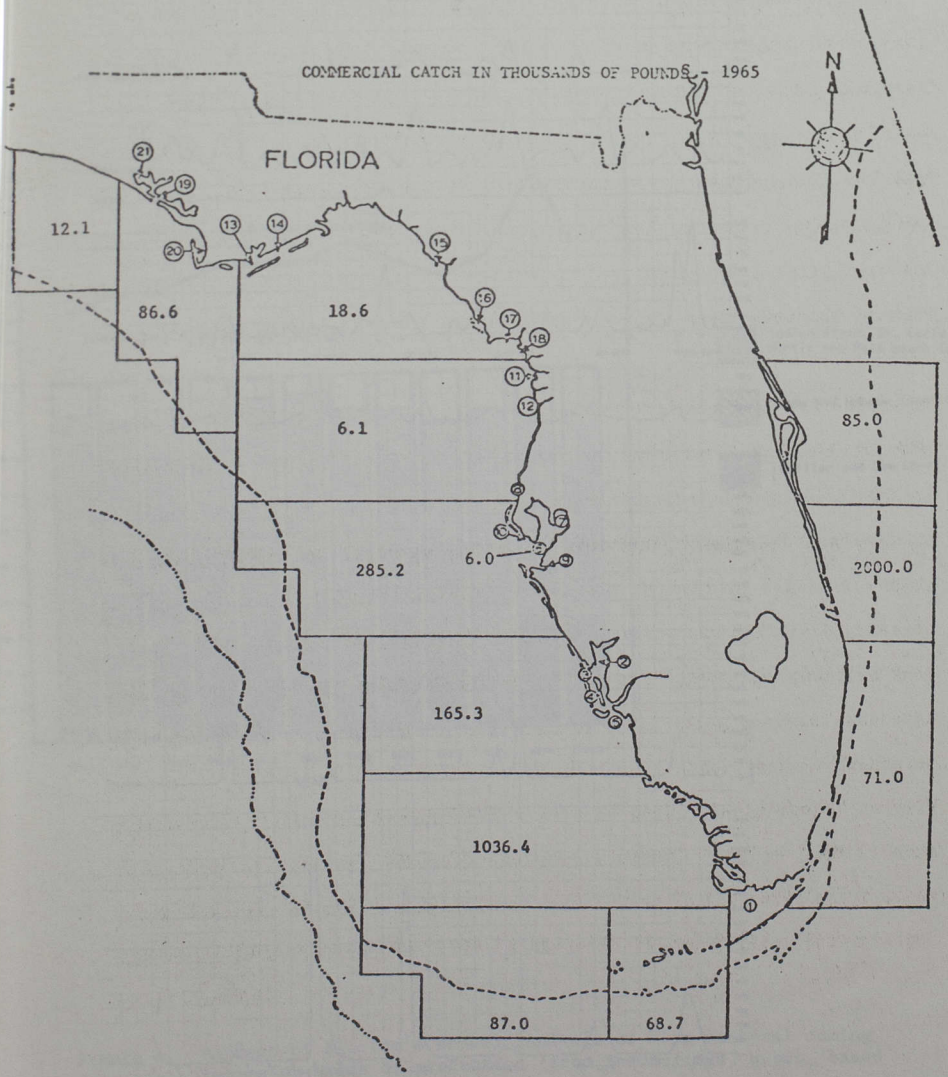

Figure 2. Commercial landings of king mackerel for the different areas off Florida in 1965 (from NMFS, 1971).

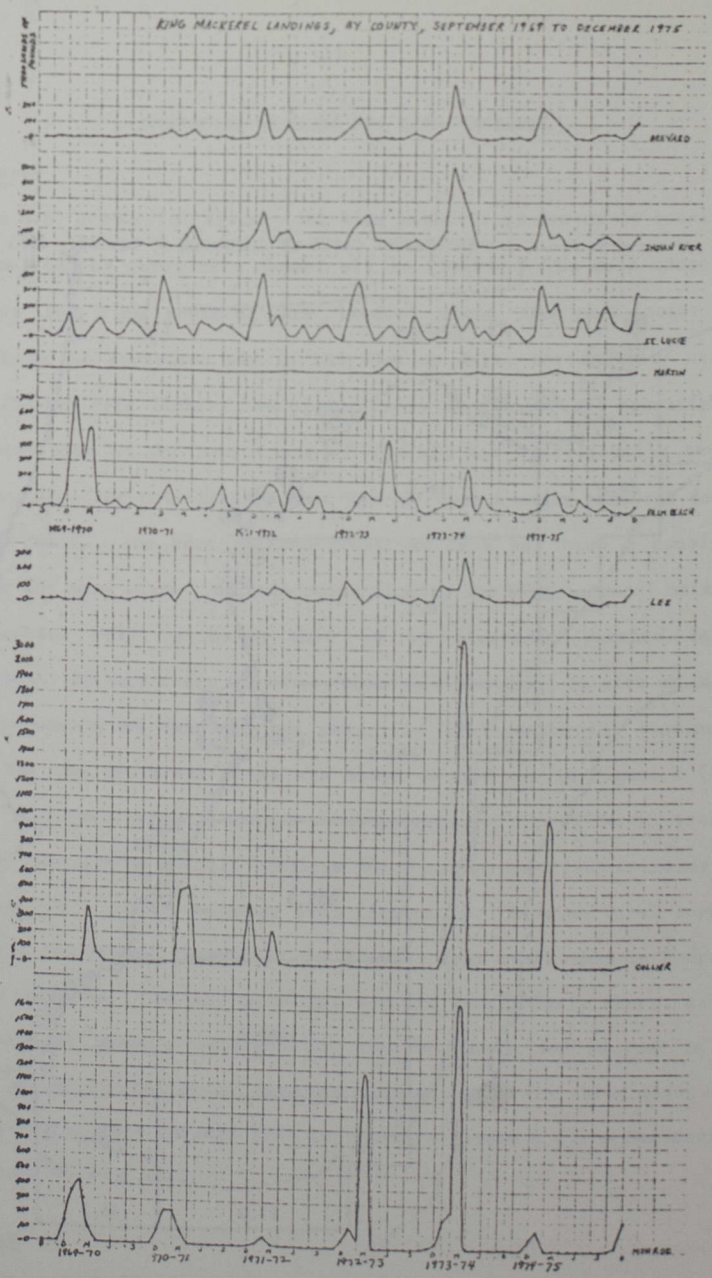

Figure 3. Monthly landings of king mackerel in major Florida counties.

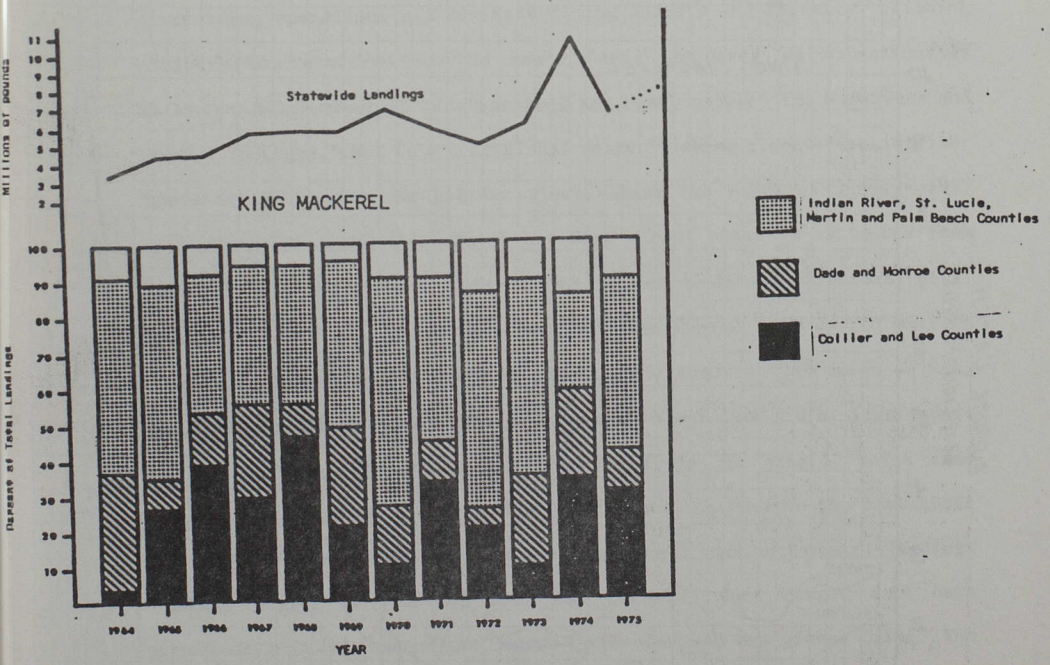

Figure 4. Percent of Florida's annual landings of king mackerel coming from the three major areas of production (from Beaumariage, unpub, based on NMFS data).

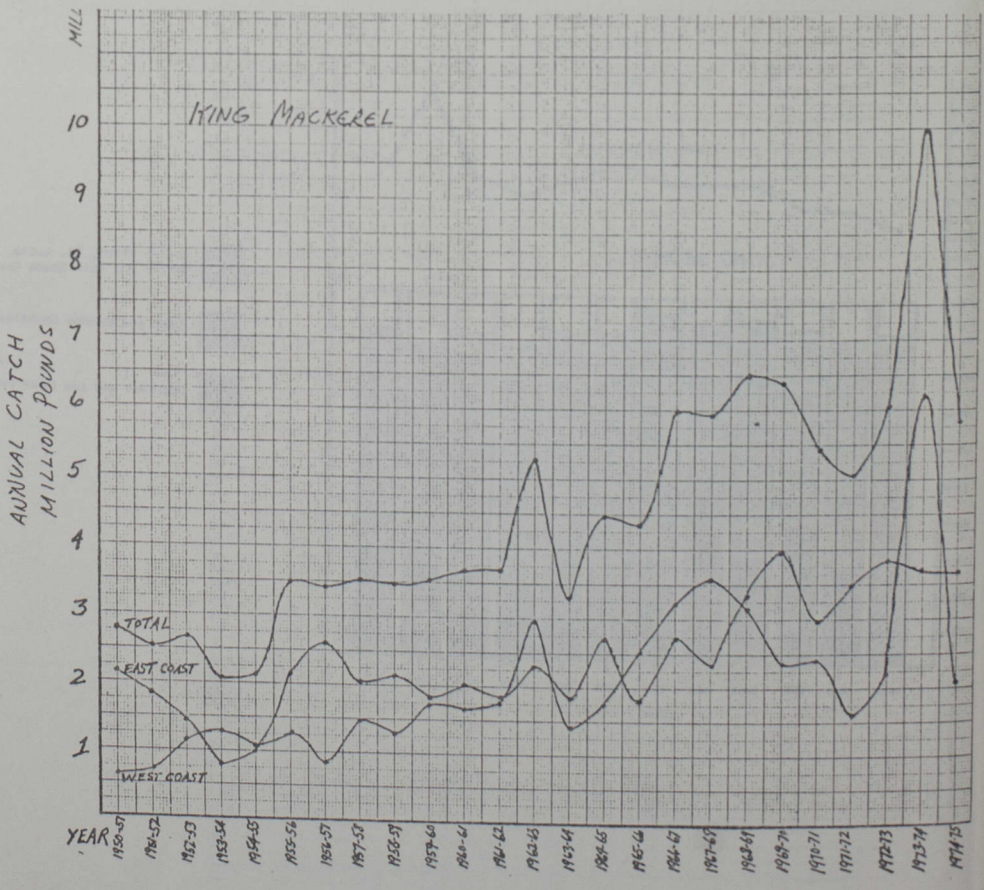

Figure 5. Annual (Sept-Aug) commercial landings of king mackerel from September 1950 through August 1975.

in number of pounds landed in recent years has been accompanied by an increase in the variation in number of pounds landed from one year to the next. The record year was 1974, when the catch was almost double that of any previous year. 1977 was another high-catch year, primarily due to gillnetting operations off Key West during January and February. Fishing activity was centered in "No Man's Land," an area of approximately 25 square miles about 40 miles west of Key West, between the Marquesas and the Dry Tortugas, that is a traditional winter fishing ground for kingfish. The total catch for the gillnet fleet during the month of January 1977 approached 1.5 million pounds at Key West alone, based on estimates from the major fish houses and fishermen at the end of January (various, pers. comm.). Total landings from Key West may have been as high as 2.5 million pounds in February, but lower in March. The total annual catch of king mackerel from the west coast in 1977 was approximately 4.950 million pounds (a preliminary report of NMFS Florida Landings, in prep.), which came almost entirely from Key West. The total annual catch from the east coast was 3.44 million pounds. A previously important year in terms of landings was the winter of 1967-68, when king mackerel were caught with nets southwest of Cape Romano and landed in Naples and Everglades City. The total pounds landed during this event was approximately 3 million (Beaumariage, pers. comm.).

Gear and Technology

Two major changes in fishing technology have recently occurred in this fishery, they are (1) use of gill nets on a large scale, and (2) use of spotter aircraft to locate fish and guide the setting of the nets. The use of gillnets and spotter planes for king mackerel originated in the Naples

area 15-20 years ago and was unique to that area until 5 or 6 years ago, when these techniques were introduced to the Florida Keys. They have been heavily employed in the Keys ever since. The key to success in gilling king mackerel is the practice of pursing the float line, which drives the fish into the net. The replacement of cotton mesh with monofilament mesh, which is less visible underwater, has been another important factor in the increased success of this fishing method. A very heavy lead line and larger boats have recently made it possible for netters to operate in fishing sites such as No Man's Land, where strong winds and currents previously prevented their operation. The nets are nylon mesh with a center band of monofilament mesh. Nets are from 400 to 700 yards long and approximately 26 yards deep. The common mesh being used is reportedly 4 3/4 inches stretched. Power rollers are used to haul in the nets.

The average set of the net yields 8,000-10,000 pounds of king mackerel. Catches as high as 30,000 to 35,000 lb/set have been recorded. The total annual landing of a gillnet boat can exceed150,000 pounds.

The traditional method for catching king mackerel is by handline, or trolling, and a large number of fishermen continue to use this technique. In the Sebastian-Port Salerno area, this is the exclusive method used. Handliners use "bugs" or "squid" (artificial spoons and jigs) as lures, depending on the size kingfish they want to catch. Bugs take the smaller size classes, while squids attract the larger fish. Dead ballyhoo also is used for bait. Some handliners have installed two electric reels. Most have electronic fathometers and loran to help them locate fish and mark good fishing spots. Handliners may land 2,000-4,000 lb/boat/day on a good day and 50,000 lb/boat/yr in a good year.

Size of Fleet

Approximately 30 net boats were reported fishing off Key West (No Man's Land grounds) in 1976-77. Only eight were from the Key West area. The others were primarily from Marathon. Approximately 46 boats resident to the Florida Keys handline for king mackerel. They are primarily in Key West. Handliners from Marathon, Naples, and the Sebastian-Port Salerno area fish in Key West during those winters when the fish are abundant there. At least 234 boats handline king mackerel in the Port Salerno-Sebastian area. At least 85 of these operate out of Ft. Pierce. Many of these operate throughout the year. No king mackerel netters operate in this area. Table 1 estimates the number of boats operating out of each fish company and provides a rough approximation of the number of hook-and-line and net boats in the king mackerel fishery in Florida: 315 hook and line and 30 net boats.

Net fishermen use boats ranging from 45-55 feet in length, valued from $60,000 to $100,000, with crews of 3 to 5 men. Estimated costs of nets range from $10,000 to $16,000. One half the cost is in the monofilament, a Japanese product for which a large import duty (25¢/lb and 32.5% ad valorem) is charged. The import duty adds approximately 37.5% to the selling price (A. Lyons, pers. comm.). Nets must be constantly repaired, because of damage by sharks and rocks; but, with good care and luck, they may last 3 or 4 years before complete mesh replacement.

Handline boats are smaller than net boats. In the Keys, handline boats are 32-40 feet in length, with crews of 2 or 3 men. Single-man boats less than 30 feet in length are commonly used for kingfish in the Sebastian-Port Salerno area.

Fishermen

If the average crew, counting captain, of a net boat is four, then the king mackerel net fishery of 26 boats employs approximately 104 people in Florida. The crew of handline boats with their home port in the Florida Keys is estimated at 115, based on 46 boats with an average crew of 2.5. The number of king mackerel handliners from other ports operating out of Key West this past season was not determined, but probably equals the local group. At least 234 people operating one per boat are employed in the king mackerel handline fishery in the Port Salerno-Sebastian area. At least 18 persons are involved in the king mackerel operations on the west coast. The best estimate is 507 commercial king mackerel fishermen in Florida.

Other Support for the Fleet

When not used for king mackerel, most net boats in the Florida Keys are engaged in the lobster fishery. Many also are involved in the net fishery for Spanish mackerel. King mackerel handliners in the Keys depend on lobster, stone crab, pompano, yellowtail, snapper, or grouper for a portion of their income. King mackerel has become much more important economically in the Keys since the closing of the Bahamas to lobster fishing by U.S. boats, which has increased fishing effort for lobsters in Florida waters and caused the catch per unit effort to decline. In the Sebastian-Port Salerno area some handliners are able to obtain a year-around living from king mackerel (see Figure 4, St. Lucie County).

Problems With Other Species

Sharks are a troublesome and continuing problem for net fishermen, because they tear up the nets, costing the fishermen thousands of dollars per year for repairs, replacement, and lost fishing time. Porpoises are

the main problem for king mackerel handliners. They prey on hooked king mackerel, which sometimes results in arm injuries for the fishermen (Cato and Prochaska, 1976).

PROCESSING AND MARKETING

Primary Wholesalers

Traditionally fishermen sell to local fishing companies called fish houses and the fish houses sell to the secondary wholesalers. Each fish house has a specified group of fishermen to whom free docking facilities are available. The fish house furnishes, for a fee, ice, fuel, and fishing equipment. Cash advances or long-term loans are sometimes made. The fish house provides, to an extent, a guaranteed market for those fishermen with whom informal (unwritten) agreements have been made. The price, however, is not guaranteed, and the fisherman may not know until several days later the value set by the fish house on a given catch. When fish house facilities are overloaded or the market is temporarily saturated due to landings locally or elsewhere, fishermen will be told in advance by their fish house that certain species will not be accepted, or catch limits for each fisherman will be set.

Facilities of a fish house are sometimes overloaded by large catches, and fishermen are asked not to bring in any catches for a few days. In the Florida Keys trucking facilities can be a limiting factor on catches because trucks are limited by state law to bridge loads equivalent to 15,000 pounds of iced fish.

Fish houses pack the catch in ice, find a buyer, and arrange and pay for shipping. The fish are moved in trucks, usually by independent truckers. Fish houses sell directly to local fresh fish markets and

restaurants, the New York Fulton Market, or the freezer companies. Distribution between these markets depends upon relative prices.

Florida fish houses (also co-ops and marinas) dealing in king mackerel are listed in Table 1. Fish houses owned by secondary wholesalers are included. An estimate of the present number of vessels operating out of each fish house is given in the table.

TABLE 1. Fish Houses and Number of Vessels in the King Mackerel Fishery

Location	Fish House, Coop or Marina	Number of Boats	
		Handline	Net
Sebastian	Sembeler and Sembeler Seafood	40	
	Robert Flood	5	
	Sebastian River Marina	4	
Grant	Hudgins	7	
Mico	Neptune Marina	10	
Cape Canaveral	Fisher Seafood	40	
Ft. Pierce	Treasure Coast Co-Op	45	
	Hudgins Seafood	4	
	Charlie's Seafood	35	
	Inlet	1	
Port Salerno	Black's Seafood	8-10	
Jupiter	Flame Restaurant (truck going up coast)	20	
Palm Beach	Hudgins Seafood	20-25	
Boynton Beach		5	
Pine Island	Pine Island Co-op	16	
Naples	Turners Seafood	0	
	Combs	2	
Marco Island	Capri Seafood	0	
Marathon	Pinellis Seafood	0	7
	East Coast	4	3
	Keys Seafood	0	2
	Marathon Seafood	2	5
Lower Keys	East Coast Fish Company	6	
Key West	A & B Lobster House	5	
	Pete Bagle (Stock Island Lobster)	5-6	

TABLE 1. Continued.

Location	Fish House, Coop or Marina	Number of Boats Handline	Net
Key West (cont.)	Ming Seafood	0	5
	Singleton Seafood	8-10	1
	Two Friends Fishery	5	
	Woodsy Niles	7-8	
	Aqua Harvest		4
	TOTAL	315	26

Cooperatives and Fisherman Corporations

Recently a fisherman's corporation was established in Key West. This corporation of five king mackerel net fishermen, organized by Charles Carter, sells directly to a secondary wholesaler in Miami. The corporation currently provides overhead expenditure, docking facilities, boat equipment, and ice for its members and plans to add freezer facilities. The catch is packed with ice directly from the boats and loaded onto trucks. The trucks are furnished by the secondary wholesaler specifically for the day's catch of the corporation members. According to their estimate, each fisherman makes an additional $10,000 a year by dealing directly with the secondary wholesaler, by-passing the local fish house. Obviously only consistently large landings by a group of fishermen attract a secondary wholesaler to such an arrangement.

A fisherman's cooperative in Ft. Pierce is a major receiving station for kingfish in the Port Salerno-Sebastian area. The Treasure Coast Fishery Cooperative provides docking facilities and ice for its members. Packing in ice, obtaining a buyer for the catch, and arranging shipping are services provided to the membership. The fisherman receives the total selling price of his catch minus a set packing and/or freezer fee and transportation fee. The co-op leases freezer storage to provide the alternative of freezing the catch for members when current market prices are low. King mackerel represent 60% of the volume of the Treasure Coast Cooperative. Spanish mackerel, mullet, and bluefish make up the other 40%. Approximately 80% of the catch of king mackerel of this Cooperative is shipped to the fresh fish market. The other 20% is frozen.

The Treasure Coast Fisheries Cooperative was formed in 1974 largely by the same fishermen who organized the Marketing Association (see section on

prices). Some 1971 amendments to the Farm Credit Act made it possible for fishermen's cooperatives to seek financing from farm credit banks such as the Columbia Bank for Cooperatives in Columbia, South Carolina. The Cooperative was started by 34 fishermen, primarily king mackerel fishermen. It has grown to 103 members, each of whom have invested at least $1000. Almost half of the kingfish fishermen in the Port Salerno-Sebastian area are members (kingfish gillnetters are not allowed to join). Since the Cooperative began in 1974, prices to fishermen at fish houses in the area have increased as much as 60%, although the wholesale value of kingfish has been about the same since 1973.

Secondary Wholesalers

Historically, almost all the kingfish sold has been channeled through three secondary wholesalers: Pinellas Seafood of St. Petersburg, American Freezer of St. Petersburg, and Hudgins Seafood of West Palm Beach. Recently two new concerns, Beaver Street Seafood of Jacksonville (Florida Carib of Miami is a subsidiary) and Carlos Seafood of Miami, have entered the market. East Coast Fishery of Miami and National Freezers of Miami also deal in king mackerel on a smaller scale.

Prices

Average annual dockside price for king mackerel was almost constant from 1955 through 1964 and rose very little from 1964 through 1973 (Table 1), despite inflation. Dockside prices do not necessarily directly follow wholesale or retail prices. The retail price is set by supply and demand and the price of competing goods. Wholesale prices are set by Fultons Fish Market of New York and the freezer companies. Dockside prices are set by the local fish houses.

TABLE 2. Landings and Prices

KING MACKEREL

Year	Prod. in 1000 Lbs.	Total Value	Avg. Price Per Lb.,
1945	3,897	$ 575,098	14.76
1950	1,578	218,644	13.85
1951	3,121	467,950	14.49
1952	2,527	453,040	17.93
1953	2,546	432,877	17.00
1954	2,004	260,560	13.00
1955	2,679	322,544	12.04
1956	3,426	380,762	11.11
1957	3,347	384,831	11.50
1958	3,206	340,558	10.62
1959	3,434	362,746	10.56
1960	3,592	407,944	11.36
1961	3,759	444,942	11.84
1962	4,096	520,276	12.70
1963	4,990	544,325	10.91
1964	3,334	383,616	11.51
1965	4,447	606,432	13.64
1966	4,415	642,566	14.56
1967	6,072	847,948	13.96
1968	6,189	966,791	15.62
1969	6,185	1,013,872	16.39
1970	6,710	1,344,449	20.04
1971	5,644	1,292,381	22.90
1972	4,868	1,306,528	26.84
1973	5,929	2,134,712	36.01
1974	10,401	3,271,879	31.46
1975	6,319	2,354,849	37.26
1976	7,622	3,429,645	45.00[b]
1977[a]	8,186	3,515,000	42.94

Source: NMFS Florida Landings.

[a] Preliminary

[b] East coast landings averaged 55¢/lb, west coast landings averaged 35¢/lb

Daily fluctuation in wholesale price is a common occurrence in the fresh fish market. The price that a load of fresh fish will bring at market is not known until the day of arrival at market. This means that the fish house does not know how much will be received for a load of fish when it is shipped.

Pulses of fish sent to market from the gillnetting operations appear to increase the amplitude of the daily fluctuation in the price of kingfish. For instance, between January and April 1977, the wholesale price of kingfish at the New York market fluctuated between 60¢ and 80¢ a pound (J.A. Esquivel, pers. com.). Increasing price fluctuations have discouraged some cautious dealers from handling king mackerel (J.A. Esquivel, pers. comm.). Frozen wholesale prices are less variable, but probably affected to some extent by the fresh fish price.

During 1977, the dockside price for king mackerel on the Florida east coast averaged 20¢/lb higher than the price on the west coast, including Monroe County (Table 2). This is in contrast to the price of Spanish mackerel, which was exactly the same on the two coasts (NMFS Florida Landings, in prep.). Several factors may have contributed to the price differential: (1) the east coast sells to the fresh fish market, whereas very little king mackerel in west coast landings reaches the fresh fish market, and the fresh fish price is generally higher than the freezer price, providing the market is not overloaded; (2) there is a fisherman's cooperative operating on the east coast, which has tended to improve fisherman's share of total sale price (Prochaska, in press); (3): secondary wholesalers paid a higher price for handline-caught king mackerel than for net-caught king mackerel, and all net-caught fish were in west coast landings (American Freezer's advertised wholesale price in May 1977 was 65¢/lb for troll-caught kings 5 lbs and up, 60¢ for net-caught kings 5 lbs and up, and 49¢/lb for net-caught kings less than 5 lbs.

In 1973, acting under the Federal Fishery Cooperative Marketing Act of 1934, a group of fishermen in the Port Salerno-Sebastian area formed the Florida Fisherman's Marketing Association. The organization confronted local fish houses regarding suspected price fixing. The fishermen as a group refused to fish for ex-vessel prices below certain preannounced values based on fishing costs.

The inquiries of the fishermen led to the indictment and conviction in Federal court of Hudgins Seafood and Crane's Fish House for making a cooperative arrangement to fix prices on a product engaged in interstate commerce. In a civil suit, six fishermen sued several fish houses for damages due to price fixing. In another civil suit Pinder Seafood sued Hudgins Seafood for fixing prices artificially high in an effort to eliminate competition. The first civil case was tried in federal court in Miami without a jury; a decision from Judge Eaton is pending. In the second civil case, Hudgins was found innocent.

An economic analysis of the king and Spanish mackerel fisheries on the Florida east coast by Prochaska and Cato, fishery economists at the University of Florida, is provided in this publication. One aspect of their report is a marketing analysis of the king mackerel fishery, showing trends in market margins and fisherman's shares from 1971 through 1974.

With regard to the analysis of Prochaska and Cato, it is important to note that 1973 was the year that the fishermen on the east coast organized and began to question the dockside prices on King and Spanish mackerel set by the fish houses. It was in April of 1973 that the fishermen as a group first threatened to hire an attorney to examine suspected price fixing by fish houses. Therefore, the marketing margins for 1973 and 1974 shown in Figure 3 of their report may not reflect the full past history of marketing margins.

Markets

The main markets for king mackerel are Puerto Rico, New York, Florida, Canada, and Venezuela. King mackerel is marketed fresh (gutted and iced), frozen (whole or steaked), smoked, and as a canned smoked paste. The latter two products are of minor importance compared to the former.

Approximately 75% of the annual catch from the Florida Keys and Florida's southwest coast is shipped frozen whole to Puerto Rico (Ming, pers. comm.; Beaver St. Seafood, pers. comm.); approximately 25% goes to the fresh fish market, principally through Fulton's Fish Market in New York. A much higher percentage of the catch from the Florida east coast Port Salerno-Sebastian area, approximately 65%, goes to the fresh fish market, according to estimates based on 1973 figures (Moore and Prochaska unpub.). The fresh fish market has a turnover of approximately 50,000 pounds king mackerel per week (Ming, pers. comm.). The Florida trade is primarily traceable to the large Cuban population in Miami.

The annual production of king mackerel has approximately doubled since the 1950's (Table 2). Apparently the market has not been saturated to the point where the product cannot be sold at stable prices, although prices vary seasonally according to landings. The market for fresh-frozen king mackerel in Puerto Rico and other Caribbean islands greatly expanded in the late 1960's when modern refrigeration became commonplace in these areas. This accounts for the increase in landings, particularly after 1967, shown in Table 2. The marketing chain is shown in Figure 6.

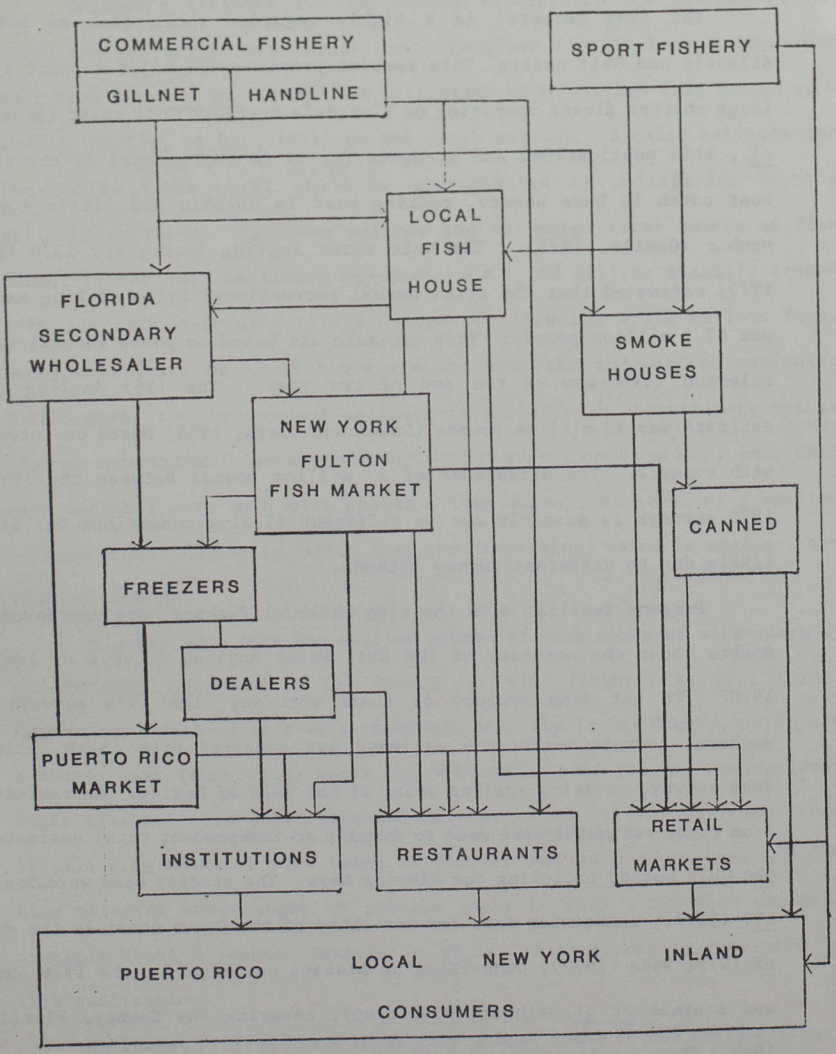

FIGURE 6. KING MACKEREL MARKETING CHAIN.

RECREATIONAL FISHING FOR KING MACKEREL

The king mackerel is a highly regarded sport fish on both the Atlantic and Gulf coasts. This species provides the major support for the large charter fleets operating on Florida's northern Gulf coast (Brusher et al., this publication) and accounts for 14.2% (by number) of the charter boat catch in Dade County, ranking next to dolphin and little tunny in number (Gentle, 1977). The Salt Water Angling Survey for 1970 (Deuel, 1973) estimated that the total annual recreational catch of king mackerel was 62.7 million pounds. This estimate was based on phone interviews with selected fishermen at the end of the year. The 1965 Angling Survey estimate was 90 million pounds (Deuel and Clark, 1968) based on interviews with experts. The difference of 25 million pounds between the 1965 and 1970 surveys is possibly due to different fishing conditions but is more likely due to different survey methods.

Persons familiar with the king mackerel fishery have expressed many doubts about the accuracy of the Salt Water Angling surveys of 1965 and 1970. To get some measure of their accuracy, the 1970 surveys king mackerel recreational catch estimate was compared with catch estimates from surveys covering smaller areas of the Gulf of Mexico. Approximations from these estimates were made to develop an independent total estimate for the Gulf Coast, excluding the Florida Keys. The studies used were Trent et al. (1976), containing data for one-third of the Texas coast in the summer of 1975; Wade (1977), containing an Alabama estimate for the 1976 summer; and Brusher et al. (this publication), covering Bay County, Florida in 1975. These studies cover relatively large parts of the Gulf and the same for adjacent years. The following assumptions were made:

Brusher's estimate for Bay County represented one quarter of the catch for the entire west coast, excluding the Florida Keys. Catch per hour from Trent et al. (1976) was multiplied by an average trip length of 6 hours, (Austin, et al., 1976) to get catch per day. A catch estimate for the entire Texas coast could be approximated by multiplying Trent's estimate by three. By these methods the estimated total number of fish caught in the Gulf excluding Key West, was 1.158 million annually around 1975 and 1976. Deuel's (1973) figure for 1970 was 3.072 million fish. Deuel's estimate was 2.65 times greater than the independent estimate. Furthermore, the independent estimate is probably an overestimate rather than an underestimate because the Bay County survey came during a year when king mackerel were much more abundant than normal, although of a smaller average size. Also it is likely that the Mississippi catch is smaller than that of Alabama.

Slightly more than one million pounds of king mackerel were taken by recreational fishermen in Bay County in 1975 (Brusher, et al., 1976). Recreational fishing is a very important activity in Bay County, which has a charterboat fleet of 65 boats and 5500 registered private recreational boats (Fisher, this publication). Brusher et al. (1976) estimated that 115,555 king mackerel were taken on charter and party boats and 106,000 king mackerel were caught on private boats in 1975. The fish captured averaged about 5 pounds, Brusher et al.'s (1976) report is reprinted in this publication.

Northwest Florida has a total charterboat fleet of 165 boats (Fisher, this publication), including those in Bay County, and king mackerel is the primary species sought by these fleets. The king mackerel season in this area extends from April through November, peaking in June and September.

Approximately 30 charterboats operate in Alabama and 35 in Mississippi (Fisher, this publication). No estimate is available of the number of charterboats in Louisiana, but Captain Charles Sebastian, a charterboat captain operating out of Grande Isle, Louisiana, reports that king mackerel is also an important recreational species in his area, where it is taken throughout the year. Although a larger number of king mackerel are caught in the summer in Louisiana, the size of winter-caught mackerel are much larger, ranging from 40 to 60 pounds.

The Florida Keys are another center for recreational exploitation of king mackerel. The season for king mackerel in Key West is short (approximately 10 weeks, Jan.-Mar.), but intense. Approximately forty-five charterboats of a size suitable for catching king mackerel operate out of Key West. They caught from 200-600 pounds of king mackerel per day during the Jan.-Mar. season of 1977, according to Captain Curtis Ryan, President of the Key West Charterboat Association. At the rate of 200 pounds per boat per day for a 10-week period, the total annual catch of king mackerel in Key West in 1977 was about 0.5 million pounds, approximately the same as the charterboat catch for Bay County the previous year, although Bay County has a much longer season.

No estimates are available on the recreational catch of king mackerel in other Florida Keys, but approximately 40 charterboats operate from Marathon (Fisher, this publication and list currently being prepared by these investigators). In addition to those already mentioned, there are probably 120 charterboats operating on the west coast of Florida. The total charterboat fleet for the western Gulf, including Florida, Alabama, Mississippi, is estimated at 526 boats.

The amount of recreationally caught king mackerel that enters the commercial market is thought to be large, and may consist of almost the entire catch of the charterbaots, although no exact figures are available. At least one company, the Captain Threes Company, obtains all or most of its king mackerel by picking it up on a regular basis from charterboats in Marathon and Key Colony Beach. According to Captain Ryan, an increasing number of charterboat customers are taking their catch with them as opposed to leaving it at the dock.

Further information on recreational fishing for king mackerel is provided by the report by Fisher, which is included in this publication.

KING MACKEREL REFERENCES

1. Austin, C.B., R. Brugger, J.C. Davis and L. Siefert. 1977. Recreational Boating in Dade County 1975-76. Sea Grant Special Report No. 9. 143 pp.

2. Beaumariage, D.S. 1973. Age, growth, and reproduction of King Mackerel, Scomberomorus cavalla, in Florida. Florida Marine Research Publication Number 1. Florida Department of Natural Resources. St. Petersburg. 45 pp.

3. Cato, J.C. and F.J. Prochaska. 1976. Porpoise attacking hooked fish irk and injure Florida fishermen. National Fisherman 56(9) (January).

4. Department of Natural Resources. Unpublished. Summary of King Mackerel tag release/return data; January-October, 1975. 8 pp.

5. Deuel, D.G. 1973. 1970 salt-water angling survey. Curr. Fish. Stat. 6200, 489 pp.

6. Deuel, D.G. and J.R. Clark. 1968. The 1965 salt-water angling survey. U.S. Fish Wildl. Serv., Res. Publ. 67. 51 pp.

7. Gentle, E.C. 1977. The charterboat sport fishery of Dade County, Florida, March, 1976, to February, 1977. M.S. Thesis. Univ. Miami. 162 pp.

8. Manooch, III, C.S., E.L. Nakamura, and A.B. Hall (In prep.). Annotated bibliography of three Atlantic Scombrids: Scomberomorus cavalla (Cuvier), Scomberomorus maculatus (Mitchell), and Scomberomorus regalis (Bloch). National Marine Fisheries Service, Beaufort, N.C., and Panama City, Florida.

9. Mayo, C.A. 1973. Rearing, growth, and development of the eggs and larvae of seven scrombrid fishes from the straits of Florida. Ph.D. Dissertation. Univ. Miami. Miami. 128 pp.

10. National Marine Fisheries Service. 1971. Joint plan for the Spanish and king mackerel fishery. Miscellaneous Publication ____. Washington, D.C. 69 pp.

11. Ocean Science News. 1972 (June 30). The time is long overdue for a federal trade commission investigation. Nautilus Press, Inc. 1056 Nat'l. Press Bldg., Washington, D.C.

12. Schekter, R.C. 1971. Food habits of some larval and juvenile fishes from the Florida current near Miami, Florida. M.S. Thesis. Univ. Miami. Miami. 85 pp.

13. Trent, L., C. Arnold and E.A. Anthony. 1976. Evaluation of the Marine Recreational Fisheries in the Northwestern Gulf of Mexico from Port Aransas to Port Isabel, Texas 1975-76. Unp. Rep. Gulf Fisheries Center, National Marine Fisheries Service. 14 pp.

14. Wade, C.W. 1977. Survey of the Alabama Marine Recreational Fishery. Alabama Marine Resources Bulletin No. 12. 58 pp.

15. Williams, R.O. Unpublished. King mackerel tagging and stock assessment study. Progress Report to the National Marine Fisheries Service. St. Petersburg. Feb. 9, 1978.

16. Wollam, M.B. 1970. Description and distribution of larvae and early juveniles of king mackerel, Scomberomorus cavalla (Cuvier), and Spanish mackerel, Scomberomorus maculatus (Mitchill); (Pisces: Scombridae); in the western North Atlantic. Department of Natural Resources Tech. Ser. No. 61. St. Petersburg, Fla. 35 pp.

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Figure 5. Annual (Sept-Aug) commercial landings of king mackerel from September 1950 through August 1975.

Figure 6. Energetic systems diagram of the commercial king mackerel fishery (see paper at the end of the mackerel profile, New Ways of Looking at Fisheries, by B. Austin for a brief discussion of energetic systems).

Figure 7. King mackerel marketing chain.

Figure 8. Energetic systems diagram of the commercial and recreational king mackerel fisheries.

DISTRIBUTION AND BIOLOGY OF SPANISH MACKEREL

The geographic range of Scomberomorus maculatus, the Spanish mackerel, covers the North Atlanta coastal region from the Gulf of Maine south and the Gulf of Mexico to Yucatan, but not the Caribbean (Powell, 1975). Populations south of Yucatan and along the northern coast of South America to Brazil are now recognized as a separate species (Collette et al., 1978). Spanish mackerel migrate in large schools along the Atlantic coast and along the eastern and western coasts of the Gulf of Mexico. Inshore - offshore movements also are believed to occur (Moe, 1972). The seasonal change in the latitudinal concentration of the population has been correlated with the 68°F isotherm along the Atlantic coastline (Beaumariage, 1970). There is evidence that some individuals winter in the northern Gulf of Mexico as indicated by winter catches in the Pensacola estuary (personal observation) and summer in south Florida by summer catches off Ft. Pierce. Biochemical studies suggest that there is a genetic distinction between fish that migrate along the Atlantic coast and those that migrate along the Gulf coast (M. Chittenden, pers. comm.), contrary to the situation in king mackerel (M. Chittenden, pers. comm.).

Spanish mackerel is thought of as an inhabitant of open nearshore waters, but appears sporadically in estuaries. Spanish mackerel are said to migrate closer to shore than king mackerel and to precede king mackerel, at least when moving northerly along the east coast of Florida (Moe, 1972).

In a study of sport and commercial landings of Spanish mackerel, Powell (1975) found that 42.7% of the fish were 1 year old. Some individuals live at least 8 years (Powell, 1975). Females grow faster and attain a larger size than males. The growth rate slows considerably by Age III. This species may reach a maximum of 10 lbs but 2 to 3 lbs is more common (Lyles, 1971). Reproductive maturity is generally reached by Age III (Powell, 1975), but some females are capable of spawning at Age I (Powell, 1975). Spawning occurs from April into September, but the spawning peak is from June through August. Spawning activity of each female is extended (or repetitive) rather than instantaneous (Powell, 1975), which would tend to disperse the larvae of individuals moving along the coast.

Approximately 300,000 eggs in the ovary of a one pound fish and 1,500,000 eggs in the ovary of a six pound fish were reported in early studies (Earll, 1883). Earll noted that this species was "more prolific than salmon, shad, or whitefish, but much less prolific than many of the gadoids." The eggs float at the surface (Klima, 1959). The hatching period is about 25 hours in water of 77° to 78°F (cited by Klima, 1959). A collecting study in the northern Gulf of Mexico indicated a wide distribution of larvae along the entire coast from Mobile, Alabama, to Cedar Key, Florida (Dwinell and Futch, 1973). On the east coast this species may spawn offshore from Cape Canaveral northward (Moe, 1972). Plankton tows have been made off Ft. Pierce as part of the environmental impact studies for the Hutchinson Island power plant (by Applied Biology, Inc., of Atlanta, Ga.); but larval fish, although preserved and photographed (B. Gibson, pers. comm.), were not identified to family (Beaumariage, pers. comm.).

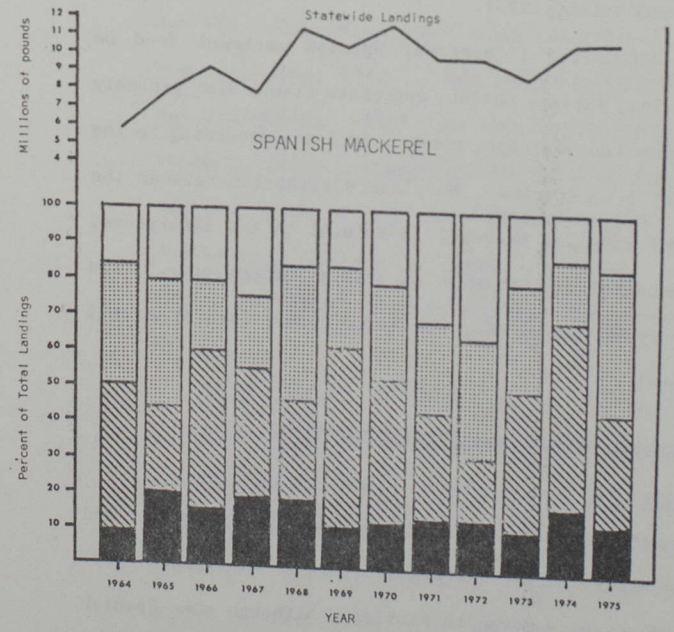
Although Earll (1883) reported that this species spawned in Chesapeake Bay, recent collecting studies in search of Spanish mackerel larvae have been made entirely in open waters rather than in estuaries (Wollam, 1970; Dwinell and Futch, 1973).

According to the scientific literature, Spanish mackerel feed on menhaden and other clupeids, shrimp, mullet, and other fish. Diet probably differs with age of fishes (Beaumariage, pers. comm.) and according to the seasonal availability of prey species. No clear distinction between the diet of Spanish mackerel and king mackerel is evident in the literature, but presumably king mackerel are capable of taking larger prey. The annotated bibliography by Manooch et al., (in prep.) covers Spanish as well as king and cero mackerel.

COMMERCIAL FISHING FOR SPANISH MACKEREL

Major Ports and Landings

The commercial fishery for Spanish mackerel began in the 1800's and was centered around Sandy Hook, Narragansett, and Chesapeake Bay. Gradually the center of activity moved to Florida. Although some Spanish mackerel is taken commercially all along the coast from Virginia to Louisiana, the main fishing activity for this species is concentrated at three locations: the Port Salerno - Sebastian area, the Naples - Everglades City area, and Marathon. Figure 1 from Beaumariage (unpub.) shows the percent contribution of these three areas to the annual landings. Figure 2 shows the seasonal pattern of the landings for the different major counties in Florida. During the winter of 1976-77 the centers of fishing activity for Spanish mackerel were in Florida Bay off Marathon and south of Port Salerno inshore at Gilbert's Bar near Jensen Beach.



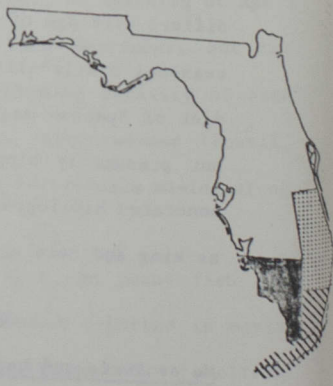


Figure 1. Percent contribution of the three important areas to Florida's total annual Spanish mackerel landings (from Beaumariage, unpub).

Figure 2. Monthly Spanish mackerel landings in important Florida counties, September 1969 through December 1975.

Annual commercial landings of Spanish mackerel vary greatly (Figure 3). This has been true since the earliest record (Earll, 1883). Not shown in Figure 3 are total Florida landings for 1976. According to J. Harkins (pers. comm.) of Pinellas Seafood, the total Florida catch of Spanish mackerel in 1976 was 17.3 million pounds, half again as great as the previous four major years. The phenomenal increase in catch was due to the growing practice and perfection of techniques using deep water nets.

Gear and Technology

The most commonly practiced harvesting method for Spanish mackerel is gillnetting, although beach seining is used at a few locations. Most fishermen now use monofilament mesh, which is superior to nylon mesh because it is less visible.

There now are two different types of net fishing for Spanish mackerel; (1) shallow water small-scale fishing and (2) deep water large-scale fishing. The two types differ mainly in depth of net and size of vessels. Both utilize monofilament mesh with a stretched mesh size of approximately 3 1/2 inches. The deep water nets have monofilament center strips, approximately 7-yards wide, bounded above and below by nylon mesh strips. The larger boats use spotter planes to locate fish and direct the setting of the nets.

In the shallow water fishery both strike ("runaround") and drift nets are used. Strike nets have a mesh of approximately 3 5/8 inches, stretched, and are approximately 800 yards long. The net is set around the school and the mackerel are excited to hit the net. Drift nets may be as much as 1500 yards long. In drift nets, panels for catching mackerel are often alternated with panels for catching other species such as pompano.

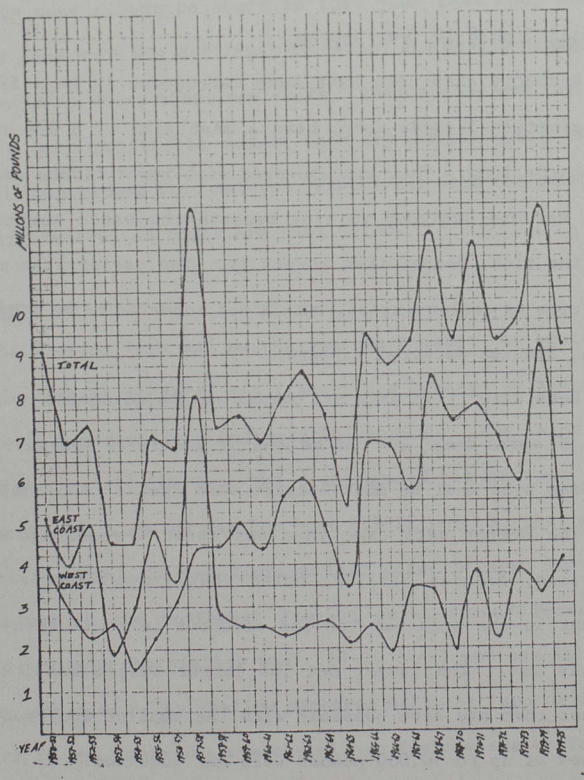


Figure 3. Total annual landings for the east coast, west coast, and both coasts for catch seasons (September through August) 1950-51 through 1974-75.

Drift nets are stretched across the expected path of fish and across the tide. Mesh size is generally larger than that for strike nets, varying between 3 7/8 and 4 1/4 inches, stretched. Both strike nets and drift nets are approximately 7 yards deep, equipped with a float line and a lead line, and will fish 8-10 feet depths.

Recently stab nets have been introduced to this fishery. These are approximately 3 yards deep, have a mesh size of 4 1/4 inches, and may be 1500 yards long. They are equipped with fewer floats and more lead than a drift net and designed to sink beneath the water surface. They are set with the tide, rather than across it. The use of stab nets in some other fisheries is controversial, but is not reported to be a controversial issue in the Spanish mackerel fishery.

Deep water gill nets are strike nets approximately 600 yards long and up to 30 yards deep, and can be used in waters 10 fathoms. The lead line of the deep nets must be much heavier than that of the shallow nets.

The deeper nets came into use about 4 years ago when Port Salerno fisherman, Frances Stiller, noted that large schools of mackerel were present in the area but too far offshore to be taken by the shallow nets then in use. The larger net and larger vessel resulted in much larger catches than had been possible with the smaller equipment. For instance, catches of up to 50,000 pounds were not uncommon.

As this fishing technology became perfected, its success from the point of view of the fisherman increased tremendously until the present season. Quality, however, became a problem of concern to the processor and the consumer. More fish were being caught than could be adequately preserved. The poor quality of large catches led the fish houses to impose a 15,000-pound catch-limit on boats. Another factor, market saturation, may also have been responsible for the catch limits.

In 1976-77 the 15,000 pound catch-limits, combined with a reduction in the number of fishing days caused by rough seas, greatly restricted the catch of the larger vessels. In addition, Spanish mackerel in the Port Salerno area came closer to shore in that year than they had in several years. The deep nets are difficult to manage and easily damaged in shallow water, especially where there are rocks. Indications are that the smaller boats had a more profitable season than the larger boats in the Spanish mackerel fishery around Port Salerno, especially when the overhead costs of the two different-sized boats are considered.

Size of Fleet

In the Florida Keys and on the southwest coast the boats used in the small-scale Spanish mackerel net fishery are between 30 and 40 feet long, equipped with power rollers and powerful engines. The value of a 34-foot boat is approximately $25,000. Net fishermen of the Keys and the southwest coast usually own a second smaller boat (19-25 feet) if they are engaged in the mullet fishery. On the Florida east coast between Port Salerno and Sebastian and on the northwest Florida coast around Pensacola the net fishermen own only the smaller boat (19-25 feet) and use it to catch both mullet and mackerel. The shallow mackerel nets cost approximately $1,500.

Boats in the large scale mackerel net fishery are 42 to 55 feet long and larger. The 42 to 55 feet boats with equipment cost from $40,000 to $75,000. One 63-foot boat with refrigerated seawater storage cost $160,000. The deep nets cost from $10,000 to $15,000.

At least 124 of the estimated 300 net boats operating in Florida Bay in January 1977 were fishing for Spanish mackerel, the other net boats were interested primarily in pompano. These boats and their owners came

primarily from Naples, Marco Island, and Everglades City, as well as from Marathon, the local port. Eight of the 124 boats fishing Spanish mackerel were larger boats equipped with deep nets.

Approximately 67 boats, including those reported in Florida Bay, are capable of operating in the large-scale Spanish mackerel fishery. Some of these boats are also in the gillnet fishery for king mackerel and carry nets of two different mesh sizes (some of these were fishing king mackerel at No Man's Land last season). There are at least 250 boats in the small scale fishery throughout the state. Table 1 is a rough approximation of the boats in the Spanish mackerel fishery according to home port and fish house, prepared with the help of participants at the workshop.

TABLE 1. Fish Houses and Number of Vessels in Spanish Mackerel Fishery.

Home Port	Fish House	Small Scale	Large Scale	Extra Large
Sebastian	Simbeler & Simbeler	20		
Cape Canaveral		10		
Ft. Pierce	Hudgins	7	3	
	Treasure Coast Coop	15	2	
	Charlie's Seafood	5	0	
	Inlet	7-8	6	
Port Salerno	Black's	30	5	
	Altman	6		
Palm Beach	Pinder		2	
Marathon	Angelo's	10		
	Marathon Seafood	3	4	
	Pinellis	4	25	
	East Coast	40		
	Keys Seafood	4		
Naples	Kelleys	3		
	Turners	30		
	Capri		4	
Pine Island		30	2	
Dunedin			1	
Tarpon Springs			2	
Cedar Key			2	
Cortez			4	
Port St. Joe			5	1
Panama City - Pensacola		25		
		250	67	1

Cessna 150's and 172's (single engine planes) are used to spot and direct sets on mackerel. Approximately six are operating; two based in the Port Salerno -Sebastian area and four in the Florida Keys.

Fishermen

As a rough estimate approximately 500 persons, based on 2 per boat, make a living in the small-scale Spanish mackerel net fishery and approximately 268 persons, 4 per boat, make a living in the large-scale net fishery. With a few exceptions, the captains in the small scale net fishery appear to be 55 years of age or older. The average age of captains in the small scale net fishery on the Florida east coast, according to Prochaska and Cato (this publication), is 45.6 years. Most of them have fished all or most of their lives (average fishing experience, 27.3 years, Prochaska and Cato). Many fishermen are very pessimistic about the future of the small net fishery for Spanish mackerel.

Captains of large net boats are approximately the same age as the captains of the smaller boats, but have had even more experience as fishermen (average 33.7 years, Prochaska and Cato). After a poor 1977 season in the Port Salerno-Ft. Pierce area, captains of large scale boats were dubious about the future of deep net fishing for Spanish mackerel. When interviewed, one captain who had been extremely successful in 1975-76 (over 1.5 million pounds landed by his two boats) was considering selling his boat. He believed that the Spanish mackerel fishery alone could not support them and there did not appear to be other fisheries in which boats of this size (50 feet) could profitably operate during the off-season for mackerel.

Approximately six spotter pilots are involved with the mackerel fishery. Several of them scout for king as well as Spanish mackerel.

Identifying a school of mackerel requires skill and experience and only a few people have been successful. Good pilots are in great demand. They receive 10% of the ex-vessel value of the catch set by the spotter pilot.

Other Support for the Fleet

The small-scale gillnet fishery of Florida is not specifically directed to any one species. Most fishermen own nets of more than one mesh size and will catch almost anything available that can be sold profitably. This includes Spanish mackerel, pompano, mullet, bluefish, and croaker (large numbers of croaker were taken with gillnets in the Pensacola estuary from 1969-1975).

Most net fishermen in the Florida Keys, both small-scale and large-scale, operate lobster traps. Spanish and king mackerel are becoming increasingly important to lobster fishermen due to increased competition within the lobster fishery.

Migrations make fishing for Spanish mackerel highly seasonal. Accessibility of fishable schools in any one area is unpredictable because of seasonal variability and yearly variations in migration routes. Some fishermen follow the fish along the coast catching them wherever they have the opportunity. They may cross the Florida peninsula whenever fishing conditions are significantly better on one coast than the other. The variation in annual catch between coasts can be seen in Figure 3.

Problems With Other Species

Sharks are a severe problem for net fisherman. The potential for shark damage to nets increases with depth and increases in temperature. Net fishermen in the Indian River area report problems with porpoises damaging their nets (D. Odell, pers. comm.).

PROCESSING AND MARKETING

Primary Wholesalers

The main primary wholesalers (fish houses) dealing in Spanish mackerel were given in Table 1. In general they are the same as those dealing in king mackerel.

Secondary Wholesalers

The secondary wholesalers of Spanish mackerel are the same as those for king mackerel.

Prices

Ex-vessel prices fell from a 12.81¢/lb. in 1945 to a low of 7.51¢/lb. in 1958. Although the price rose slightly from 1958 through 1972, the 1945 price was not exceeded until 1973. The price rose from 12.54¢ to 17.30¢/lb. between 1972 and 1975. The predominant ex-vessel price during the early 1977 season was 18¢/lb. (Table 2).

Comparing 1945 to 1975 ex-vessel prices for Spanish and king mackerel reveals very different trends for the two fisheries. The dockside price of king mackerel has increased 150% in the 30-year period, whereas the price of Spanish mackerel has increased only 35%. Considering that the cost of living index increased by 112% between 1947 and 1975, the relative economic position of the Spanish mackerel fisherman has considerably worsened. Data from Prochaska and Cato (this publication) suggest that the income of the smaller net fisherman is particularly poor. Both crew and captain of the small scale net boat earn less than the $5/hr labor estimated as a general salary for fisheries.

It is not known why ex-vessel prices have remained so low. Part of the problem is undoubtedly due to the limited markets for this species, the

TABLE 2. Landings and Prices.

SPANISH MACKEREL

Year	Prod. in 1000 Lbs.	Total Value	Avg. Price ¢ Per Lb.
1945	10,638	$1,363,792	12.82
1950	5,890	530,100	09.00
1951	8,244	829,346	10.06
1952	7,796	891,862	11.44
1953	6,519	644,729	09.89
1954	4,949	603,778	12.20
1955	4,814	496,805	10.32
1956	7,455	591,181	07.93
1957	7,831	699,308	08.93
1958	11,138	836,464	07.51
1959	7,002	613,723	08.74
1960	7,717	734,658	09.52
1961	7,146	708,169	09.91
1962	9,447	915,414	09.69
1963	7,528	685,048	09.1
1964	5,882	538,791	09.16
1965	7,784	875,700	11.25
1966	9,185	1,045,253	11.38
1967	7,669	740,825	09.66
1968	11,473	1,155,331	10.07
1969	10,533	1,265,013	12.01
1970	11,674	1,397,275	11.97
1971	9,965	1,138,082	11.42
1972	9,901	1,241,211	12.54
1973	9,397	1,536,601	16.35
1974	10,612	1,902,842	17.93
1975	10,765	1,862,599	17.30
1976	17,337	3,132,404	18.07
1977	11,708	2,506,000	21.40[a]

Source: NMFS Florida Landings

[a] same price on both coasts

marked seasonality of the catch, and relatively poor preservation characteristics. However, a comparison of weekly New York wholesale prices and concurrent ex-vessel prices at fish houses in the Port Salerno - Ft. Pierce area during a particularly interesting period of economic history (the Arab oil boycott of 1973 and the consumer beef boycott of 1973) indicates that ex-vessel prices are not highly correlated with market wholesale prices. Figure 4 shows weekly spreads in New York market wholesale prices and the average monthly ex-vessel price at Port Salerno and Ft. Pierce fish houses. The two most interesting things about the graph are: (1) the lack of correlation between ex-vessel and wholesale prices; and (2) the periods on the graph for which information regarding wholesale prices is missing. Missing values may indicate that no sales were made on these dates or that wholesale prices were not reported to National Marine Fisheries Service on these dates. Hudgins Seafood and Crane's Seafood were convicted of conspiring to fix dockside prices on Spanish mackerel in Port Salerno during this period.

The pricing situation that apparently existed in the Port Salerno-Sebastian area for many years is thought to have been partially responsible for the poor economic position of fishermen and may not be unique to that area, although price fixing charges against fish houses are rare. The accounting books of a number of other fish houses in south Florida were examined during the investigation but no other evidence of illegal activities was found.

Some fishermen strongly support their local fish houses and feel that better communication between all fish houses and their fishermen is needed to improve the relationship between these two segments of the fishing industry. The fishermen expressing this opinion were primarily those

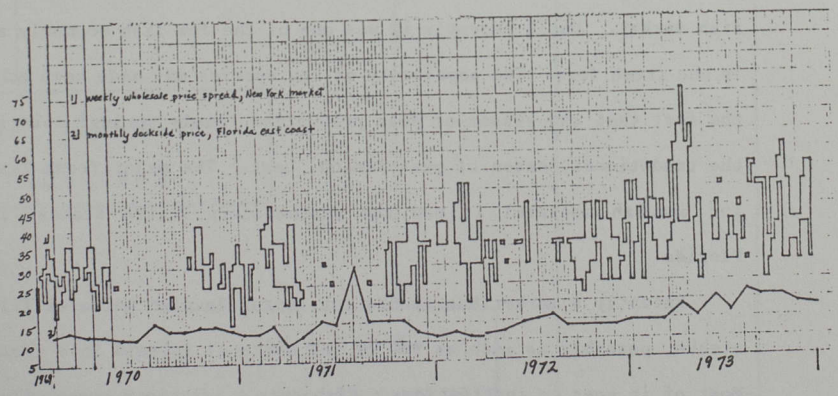


Figure 4. Weekly wholesale price spread, New York market (histogram), and monthly dockside price, Florida east coast. (From National Marine Fisheries Service data.)

handling the largest quantities of fish, who perhaps have a better bargaining position with the fish house than those with smaller catches.

Markets

The marketing chain for Spanish mackerel is outlined in Figure 5. Spanish mackerel has traditionally been an important product in the fresh fish market. Until recently it was one of the few fish commonly available in the fresh form. The popularity of the species may have been enhanced by the fact that the season of peak production (early spring) coincided with the traditional season of peak demand, Lent. The major fresh fish market for Spanish mackerel is now the southeastern United States, including Florida.

Recently a market has opened for frozen Spanish mackerel fillets and steaks, possibly as much as 90% of the mackerel is sold in a frozen form. Most of it goes to institutions. Fish over 1 1/4 pound are preferable for fillets. Fish over 2 pounds are best for steaks. Many of the frozen Spanish mackerel fillets are sold to Morrison's Cafeteria chain, which at present has the capability of using at least 5 million pounds of fish (2.5-3 million pounds of fillets) a year, which amounts to approximately one-half the average total annual landings. The recent increase in the sale of fillets is probably due to a machine that guts and removes the backbone. At least one Miami company ships frozen whole Spanish mackerel three pounds or over to Puerto Rico. This company sells some mackerel less than three pounds to the Miami Seaquarium.

Zoos and aquarium-type attractions that feature large marine mammals are a significant market for Spanish mackerel. For its two operations, the Miami Seaquarium in Miami and Flipper Cisco in Marathon, the Wometco

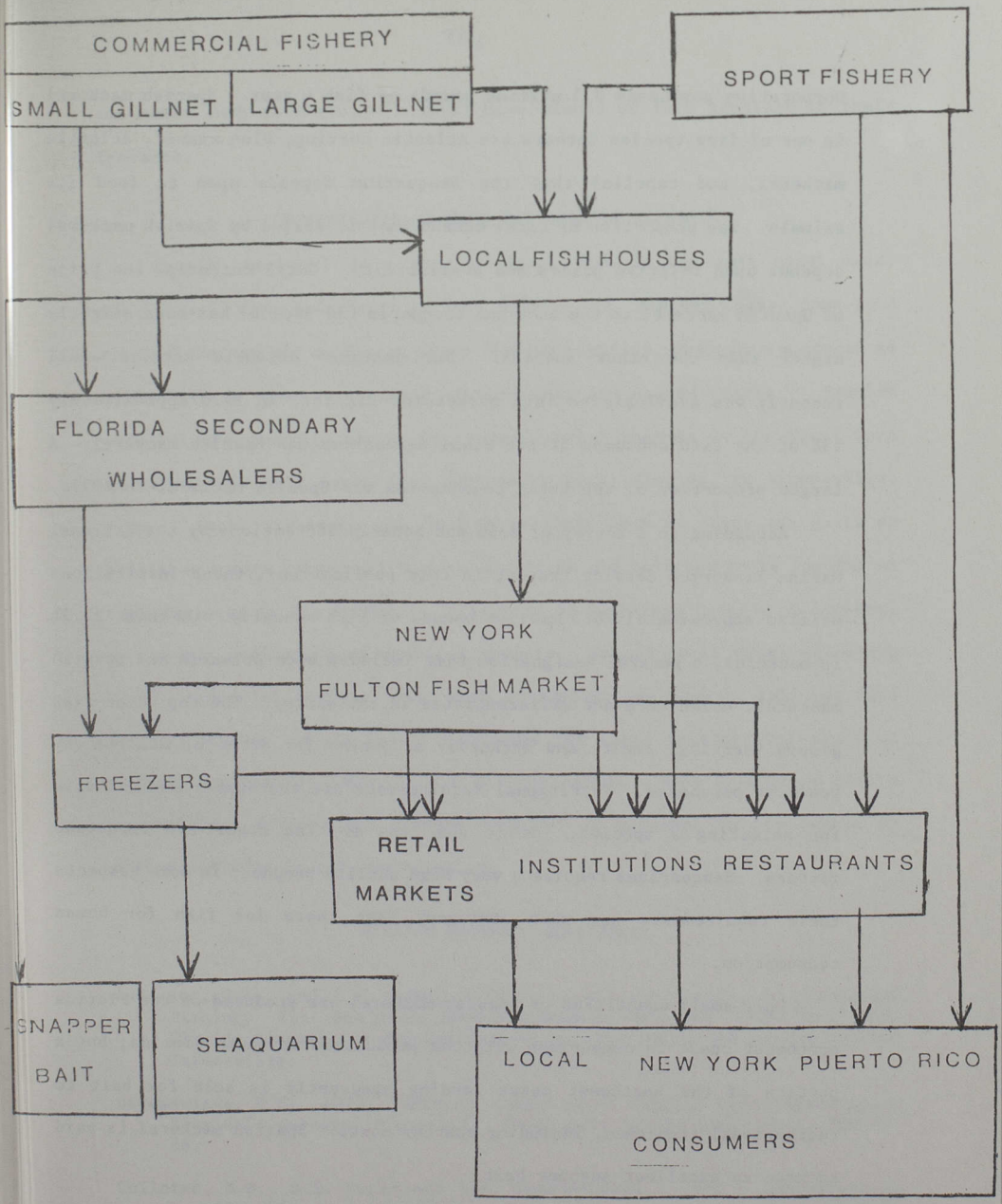


Figure 5. Spanish Mackerel Marketing Chain.

Corporation purchases 0.5 million pounds of fish a year. Spanish mackerel is one of five species (others are Atlantic herring, blue runner, Atlantic mackerel, and capelin) that the Seaquarium depends upon to feed its animals. The proportion of total demand that is filled by Spanish mackerel depends upon relative prices and availability. Until recently, the price of Spanish mackerel to the zoos and seaquaria (30-32¢/lb) has been slightly higher than the other species. For instance Atlantic herring until recently was available to this market for 21¢/lb. In 1976 approximately 13% of the fish consumed at the Miami Seaquarium was Spanish mackerel. A larger proportion of the total consumption was Spanish mackerel in 1977.

According to a survey of zoos and aquaria attractions by the National Marine Fisheries Service (report in this publication), these institutions utilize approximately 6.3 million pounds of fish annually. Of this, 22.3% is mackerel, a general designation that includes both Atlantic and Spanish mackerel, which were not differentiated in the survey. The top three fish groups (herring, smelt and mackerel) accounted for 82.6% of all fishery products purchased. Nutritional requirements are the number one criteria for selecting a species. Price and size are the other two important factors. Seaquariums require a very high quality product; in some respects their requirements are more stringent than those for fish for human consumption.

Only small quantities of Spanish mackerel are produced on the Florida northwest coast in comparison with the production in south Florida; but a portion of the northwest coast landing apparently is sold for bait to recreational fishermen, including charter boats. Spanish mackerel is said to make an excellent snapper bait.

The market was not able to absorb the record high production of the 1975-76 winter-spring season and some of the freezer companies as well as

customers such as Morrison's still have stocks of 1976 landings in their freezers.

RECREATIONAL FISHING FOR SPANISH MACKEREL

Spanish mackerel is a popular sport fish in the east coast area, particularly from Palm Beach to Port Salerno. R. Kleiser (pers. comm.), a sport fisherman and dealer in sport fishing supplies, describes mackerel as being "like a woman: exciting because they are unpredictable." Spanish mackerel are commonly sought by recreational fishermen in the Miami area and along the Gulf coast from Everglades City, Florida, to Brownsville, Texas. Sport fishermen use feeding seabirds such as terns and gulls to help them locate mackerel schools. The birds are believed to be feeding on the same prey as the mackerel. Splashing by porpoises feeding on mackerel is another indication of mackerel schools. According to Deuel and Clark (1968) the total recreational catch of Spanish mackerel in 1965 was 22.6 million pounds. Deuel (1973) estimated the total recreational catch of Spanish mackerel in 1970 at 23.4 million pounds. Some discussion of the recreational fishery for Spanish mackerel is provided in the report by Fisher included in this publication.

SPANISH MACKEREL REFERENCES

Anderson, C.L., and R.H. McNutt. 1971. Costs and returns in commercial fishing. Fla. Sea Grant Marine Economics Ser. Pub. SUSF-SG-73-002. Florida Cooperative Extension Service. Fla. State University System, Gainesville.

Beaumariage, D.S. 1970. Current status of biological investigations of Florida's mackerel fisheries. Proc. Gulf Carib. Fish. Inst. 22, 79-86.

Collette, B.B., J.L. Russo and L.A. Zavala-Camin. 1978. Scomberomorus brasiliensis, a new species of Spanish mackerel from the western Atlantic. Fish. Bull.

Deuel, D.G. 1970. Salt-water angling survey. Curr. Fish. Stat. 6200, 489 pp.

Deuel, D.G., and J.R. Clark. 1968. The 1965 salt-water angling survey, U.S. Fish Wildl. Serv., Res. Publ. 67. 51 pp.

Dwinell, S.E., and C.R. Futch. 1973. Spanish and king mackerel larvae and juveniles in the northeastern Gulf of Mexico, June through October 1969. Marine Research Lab Leaflet Series: Vol. IV-Immature Vertebrates. Contribution No. 224. Fla. Dept. Natural Resources, St. Petersburg, Fla. 14 pp.

Earll, R.E. 1883. The Spanish mackerel, Cybium maculatum (Mitchell). Ag.; its natural history and artificial propagation with an account of the origin and development of the fishery. In: Part VIII, Report of the Commissioner for 1880. U.S. Comm. of Fish and Fisheries, Washington, D.C. 395-426.

Klima, E.F. 1959. Aspects of the biology and the fishery for Spanish mackerel Scomberomorus maculatus (Mitchell), of southern Florida. Fla. Board of Conservation Tech. Ser. No. 27. Marine Lab, Univ. of Miami, Coral Gables, Fla. 39 pp.

Lyles, C.H. 1969. The Spanish mackerel and king mackerel fisheries. Bu. Comm. Fish. C.F.S. 4936, pp. 1-21.

Manooch, III, C.S., E.L. Nakamura, and A.B. Hall. In prep. Annotated bibliography of three Atlantic Scombrids: Scomberomorus cavalla (Cuvier), Scomberomorus maculatus (Mitchell), and Scomberomorus regalis (Bloch). National Marine Fisheries Service. Beauford, N.C., and Panama City, Florida.

Moe, M.A., Jr. 1972. Movement and migration of south Florida fishes. Fla. Dept. Nat. Res. Tech. Ser. No. 69. P. 16.

Powell, D. 1975. Age, growth, and reproduction in Florida stocks of Spanish mackerel, Scomberomorus maculatus. Fla. Mar. Res. Publ. No. 5. 22 pp.

Schaefer, M.B. 1970. Men, birds, and anchovies of the Peru Current - dynamic interactions. Trans. Amer. Fish. Soc. 99: 461-467.

Shaw, D.A., and R.E. Warner. (Draft copy of unpublished manuscript). The mackerel resources of Monroe County and adjacent areas. Marine Resource Inventory. Marine Advisory Program. Fla. Cooperative Extension Service, Key West, Fla. 77 pp.

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MAJOR PROBLEMS OF THE MACKEREL FISHERIES, AS SEEN BY THE FISHERMEN

Joan A. Browder

When participants at the workshop were asked to relate what they believed to be the main problems of the king and Spanish mackerel fisheries, fishermen responded by presenting many general problems of Florida fishermen, as well as problems specific to the mackerel fisheries.

The major concern of the mackerel fishermen attending the workshop was what they consider to be a poor representation of commercial fishermen on the fishery management councils and their advisory panels, in spite of the legislative mandate to the Secretary of Commerce to "attempt to maintain a reasonable balance of interests on each council in making appointments." At present no voting member of either the Gulf or South Atlantic Council is a commercial fisherman. Furthermore, the advisory panels appointed by these councils are suppose to be "composed of persons actually engaged in the harvest of, or knowledgeable and interested in the conservation and management of, a given fishery." Yet the Gulf Council's advisory panel on

coastal migratory and pelagic species, which includes the mackerel, is composed of three processors, five sports fishermen, two charterboat captains, one retired partyboat captain, one marina operator, one sports writer, and one commercial fisherman, who is from Florida. By contrast, the Gulf's advisory panel on groundfish is composed of one distributor, three processors, two sportsfishermen, and five commercial fishermen. The advisory panel to the Atlantic council is made up of five people at the processor level; three commercial fishermen, including the president of the Organization of Florida Fishermen; two people who make a living from recreational fishing; one sportsfisherman-conservationist; and two outdoor writers.

Florida fishermen are just as concerned about who makes the rules as they are about the rules themselves, and they want a fair representation on the fishery management councils and their advisory panels. In the words of one of the king mackerel fishermen at the workshop: "If the councils are going to make the rules that I have to live by, then let me help make those rules. Then we'll make rules that I can live with, and we'll accomplish a lot more in the long run."

Another related concern of the commercial fishermen is that there is not enough biological and ecological information on Florida commercial fish stocks to allow the management councils to do a good job managing these fisheries. State and federal funds invested in scientific research on Florida stocks has been very limited, which the fishermen think is a reflection of lack of public and governmental interest in the well-being of the fisheries as a whole. Although a number of fisheries have been destroyed due to overfishing, putting many people out of jobs, the government has seldom directed research effort to obtaining basic

biological and ecological information about commercial stocks until they are in trouble, when it is almost always too late to save the commercial fleet, if not the stock.

There are no reliable statistics on recreational fishing for king mackerel, although recreational fishing is a very important component of this fishery. Recreational fishing is important throughout the range of this species but particularly important in the northern gulf.

Comparison of the estimates of the Angler's survey with the estimates from the more carefully conducted Bay County study suggest that the Angler's Survey may have overestimated the recreational catch. The difference between the 1965 estimate (90 million pounds) and the 1970 estimate (65 million pounds), which were based on two different survey methods, suggests that neither may be reliable. Any estimate of the quantity of king mackerel presently utilized by domestic fisheries would be grossly inaccurate due to a lack of knowledge of the recreational catch. A sizeable component of the recreational catch enters the market and is counted as commercial catch, but no one has any quantitative estimate of this component.

Fishermen would like to see some of the rich supply of scientific know-how developed by this country invested in learning about valuable commercial fish stocks before they are overfished, so that these fisheries can be regulated in such a way that the fisheries will be maintained on a long term basis. This is particularly relevant to the king and Spanish mackerel fisheries because the rate of exploitation has more than doubled in these two fisheries in the past 5 years. Deep-net fishermen, responsible for the increased exploitation, join fishermen using more traditional gear in saying they want to know if the stock is being hurt by

the current rate of exploitation or new fishing methods. They say that they would participate in a program to limit catches if they were shown that the stock would otherwise be endangered.

King mackerel handliners have charged that the netting operation results in the death of many fish in addition to those which are harvested. They say that larger fish are trapped by the net, and killed but not caught. When net fishing for king mackerel was practiced on the east coast a number of years ago, divers use to retrieve the king mackerel that were killed in the netting operation but not taken in the net. A handline fisherman who was once one of these divers, Vince Cartright of West Palm Beach, described a dive as follows: "Approximately 8,000 pounds were taken in the net; I dived up an additional 2,900 pounds from the bottom." The mesh size was 4 3/4 inches, the same size being used today; the net was cotton, however, rather than monofilament. Estimates of a loss amounting to as much as 25% of the catch may not be unreasonable. Despite the possible importance of this factor to the future of the stock, no scientific study has been undertaken to determine the actual loss or whether or not some differential effect on larger, older individuals might be occurring that would result in a greater pressure on the breeding stock than would be indicated by the catch.

Some long-time handline fishermen think that king mackerel separate into distinct groups that congregate in the same locations year after year. They believe that the absence of the fish from one of these traditional areas during the period of the year when they are usually present means that the stock has been depleted. They site the lack of good fishing off the Naples coast for the past 3 years as evidence that this fishing ground was overfished during the winter of 1974. King mackerel fishing all along both coasts has been very poor since the 1976-77 season.

King mackerel handline fishermen are very vocal in their concern for the future of the king mackerel stock, and they have an even more immediate concern for their own future in this fishery, because the market demand may be even more limited than the biological stock in its ability to absorb the greatly increased rate of exploitation. The handline fishermen may be driven out of business by the expansion of the net fishermen if the market does not increase at a pace that keeps up with the expansion. This could present serious economic and social problems through loss of livelihood to the approximately 367 families now supported by king mackerel handlining. It is not likely that another Florida fishery could absorb these people. As a matter of fact, both the Spanish and king mackerel fisheries have been helping to ease the financial impact of the current crowded situation in the Florida lobster fishery in the Florida Keys. If the mackerel stock were degraded or the smaller scale fishermen were forced out by the expansion of larger scale fishermen, then this would compound the economic problems of fishermen involved in other fisheries such as Florida lobster.

Lack of markets for domestic fish and the dominance of foreign fish on the American market is an important problem to the commercial fishermen, who think that lack of sufficient markets is the main limiting factor on domestic fisheries such as Spanish and king mackerel. The fishermen charge that a powerful lobby of fish importers is maintaining a political climate that favors the marketing of foreign rather than domestic fish. They believe that this is one of many instances where the U.S. government is favoring other interests to the detriment of the American fishery. They wonder why the government doesn't set up some kind of board to buy surplus domestic fish when it is available for use in public institutions and the armed forces or to feed the poor. This way the fishermen could keep their

crew and boats working when the fish are available and not be closed down by a saturated market, and the public would benefit not only on the short term by getting a "good buy" but also by insuring that over the long term domestic fishing products would be available.

There is a concern that king and Spanish mackerel imported into the U.S. may have a significant effect on the market for Florida mackerel. Table 1 shows the amounts of different imported mackerel products passing through the Miami port. Additional mackerel could have passed unnoted as "unclassified" fish. Some mackerel may also enter the country through the Terminal Island, California, port, but figures from this port were not available in time for this report. The available data (Table 1) indicates that imports are relatively small compared to domestic landings.

TABLE 1. Imported Mackerel Entering U.S. Through Miami Port In 1975

Product	Home Country	Imports in 1000 lbs
kingfish, frozen whole	Mexico	94.2
kingfish, frozen whole	Venezuela	43.4
kingfish, frozen dressed	Mexico	16.4
kingfish, frozen dressed	Venezuela	225.9
kingfish, frozen filleted	Venezuela	4.0
mackerel, canned filleted	Portugal	0.4
mackerel, canned in oil	Spain	0.3
mackerel, canned	Japan	29.2
mackerel, frozen whole	Ecuador	6.0
mackerel, frozen whole	Mexico	1.4
mackerel, frozen whole	Nicaragua	4.2
mackerel, frozen filleted	Ecuador	4.2

Data from National Marine Fisheries Service, Miami.

Fishermen are very conscious of the state and federal taxes that they pay on fuel, oil, gear, and capital equipment, particularly because they are feeling great economic stress. Some state that relief from these taxes would stimulate this industry from the bottom up and improve its changes for survival.

Lack of trained personnel was another complaint of fishermen attending the workshop. It is apparently very difficult to find experienced crew members, and public education programs to teach people how to be fishermen do not exist. There are no courses such as those available for electricians, refrigerator repairmen, and other technicians, although a similar background of knowledge is required to operate effectively on a fishing boat. Captains are forced to rely on untrained crews.

Poor public sentiment toward the fishing industry is another problem that bothers fishermen. This problem is reflected in many ways, but one of the more significant is that many bays and canals are being closed to commercial fishing due primarily to the attitude of local people and their governments toward commercial harvesting of fish. As a result, fishermen either can no longer catch certain species in quantity or are forced to go further offshore to fish, thereby encountering greater capital expenses for larger boats and greater operating overhead for fuels.

Fishermen complain that financing opportunities for capital purchases are inadequate. The federal loan system is so unwieldy and full of red tape that this type of loan is out of reach of the average fisherman, because he must hire the services of an attorney or some other professional person in order to obtain it. Loans from local financial institutions are generally limited to a 7 year payback period, often at interest rates that are not fixed but expand with inflation.

In the Florida Keys conflicts are developing between net fishermen, including those that fish for Spanish mackerel, and the trappers that set traps for lobster and stone crabs in Florida Bay. The peak lobster season (August-November) precedes the peak season for mackerel and pompano (November-March), and most experienced lobster trappers have removed their

traps by the time the netting operations are underway, but new lobster trappers, which are abundant, continue to keep their traps out, even when it may not be economically efficient to do so. The stone crab season coincides with the mackerel-pompano season, increasing the potential for conflict between these two fisheries.

Some mackerel fishermen are requesting the State of Florida to close an area of Florida Bay to lobster traps November 15-March 31. They argue that this would significantly improve fishing conditions for mackerel netters and that there would be no substantial change in the catch of legal size lobster in the area.

During the past 4 years the Spanish mackerel catch has increased significantly with the introduction of deep water gillnetting. Favorable economic returns accrued to the larger, more expensive boats during the first 3 years, however, in the season now ending the catch per boat was lower than the earlier years because of a combination of poor weather, location of fish over rocky areas, and catch limits per trip imposed by fish houses.

It appears that smaller boats and shallow-water gear are less profitable than larger boats with deep-water gear during "good" years, however, the smaller boats and shallow-water netting are more sustainable in "poor" years. Given the historical fluctuations in the annual landings, it is questionable if the Spanish mackerel fishery can support the larger, more expensive vessels with higher fixed costs on a long-term basis.

Both king and Spanish mackerel deteriorate rapidly. Quality control is a problem, particularly when fish are landed and processed on a large scale, as in the deep water scale gillnetting operation. Fish may be broken in the net and fish on the bottom of the heap may be both crushed and

subjected to high temperatures. Although ice is used, it is difficult to carry or distribute enough ice to satisfactorily cool extremely large catches. Only one vessel operating in this fishery, the 63 foot vessel from Port St. Joe, is equipped for refrigerated brine.

Apparently it is easier to maintain high quality in mid winter than in the early winter or spring. The difference is possibly not only due to air temperatures but also caused by some factor within the fish themselves; fish caught in early winter and spring usually have food in their stomachs, whereas fish caught in midwinter usually have empty stomachs. The fish keep longer when their stomachs are empty.

Fish houses appreciate differences in quality and sometimes pay accordingly. For instance in Key West in 1976-77 some fish houses were paying 35¢ a pound for handlined kingfish at the same time net-caught fish were bought for 33¢ a pound (T. Pollgreen, pers. comm.). The distinction in quality between net-caught and handlined fish may be lost at the New York market so that handlined fish brings no more than net caught fish, particularly when large volumes are being handled. However, certain fish houses may be associated with a consistently high quality fish and theirs may be the first to be sold at the New York market. Within the trade, some freezer companies are noted for having higher or lower quality kingfish.

The shopper at the retail level is relatively unknowledgeable, and those concerned about maintaining and building a market for kingfish are afraid that poor quality fish may enter certain markets and depress the desirability of kingfish. These people contend that enforcement of Florida laws regarding fish quality should be strengthened, that measures should be taken to give both fishermen and fish houses a greater incentive to strive for high quality, and that the public should be informed that there can be a big difference in the quality of kingfish on the market.

Despite the problems that American fisheries are facing, the fishermen have not seen that the situation concerning government assistance is changing. As one fisherman stated, "When President Carter took office and came before the American people to tell them what he was going to do, he mentioned everybody but the American fisherman." The fishermen warn that the U.S. government and the American people are going to have to make a policy decision about whether or not they want an American fishery. And if they want it, they are going to have to come in soon to help solve some of the problems that have been discussed in this report. Otherwise, with no decision made, we will lose our native fishery and have to buy ALL our fish, not just more of it, from foreign countries, increasing the dependence of the United States upon other nations for the basic supports of life. The fishermen ask this question, "Why should a nation with one of the longest coastlines in the world have to look to other nations for its fish?"

IMPRESSIONS OF THE WORKSHOP STAFF

Joan A. Browder

The following are the thoughts of the workshop staff generated by the workshop.

Possible Causes of Catch Variability

Variability in annual landings in a fishery are normally attributed to (1) variability in fishing effort; (2) variability in the size of the exploitable stock; (3) variability in the catchability of the stock. It is not known which of these are the major factors causing the high variability observed in annual landings of the mackerel, particularly Spanish mackerel. There are no data to document the extent to which fishing effort has varied and very little is known about the ecological parameters that

influence the mackerel stocks. The exploitable stock may fluctuate due to marked differences in the size of the parent stock. Variation in population size due to marked differences in larval survival or recruitment from one year to another is a possible explanation for the fluctuating total annual landings.

Variations in the populations of predators (sharks and porpoises) or prey (thread herring) may also be important factors. Shaw and Warner (draft of unpublished manuscript) point out that the Pacific mackerel, (Scomber japonicus) is believed to have declined due to the combined effect of environmental factors, fishing pressure on the mackerel stock, and fishing pressure on the mackerel's prey, the Pacific sardine (Sardinops sagax).

Figure 1 is an energy flow diagram that shows in abbreviated form the whole biological system of which Spanish mackerel is an important component. The diagram relates a harvestable fish to its food chain, beginning with the sun's energy captured by plants such as phytoplankton. A supply of nutrients provided by mixing forces is important to plant production and factors such as currents and mixing that affect nutrients can cause plant production to vary. The plants support prey species of mackerel larvae such as zooplankton and prey fishes of the mackerel schools such as menhaden. Zooplankton is also a food source of mackerel prey. Mackerel are a food (energy) source of porpoises, sharks, and man.

Many fishermen have strong feelings about the changing catchability of Spanish mackerel. Some feel that city lights, recreational boating, and other human activities along the coast may be causing the fish to migrate further offshore each year. They suggest this as the reason why Spanish mackerel no longer enter Biscayne Bay in large numbers. Other fishermen

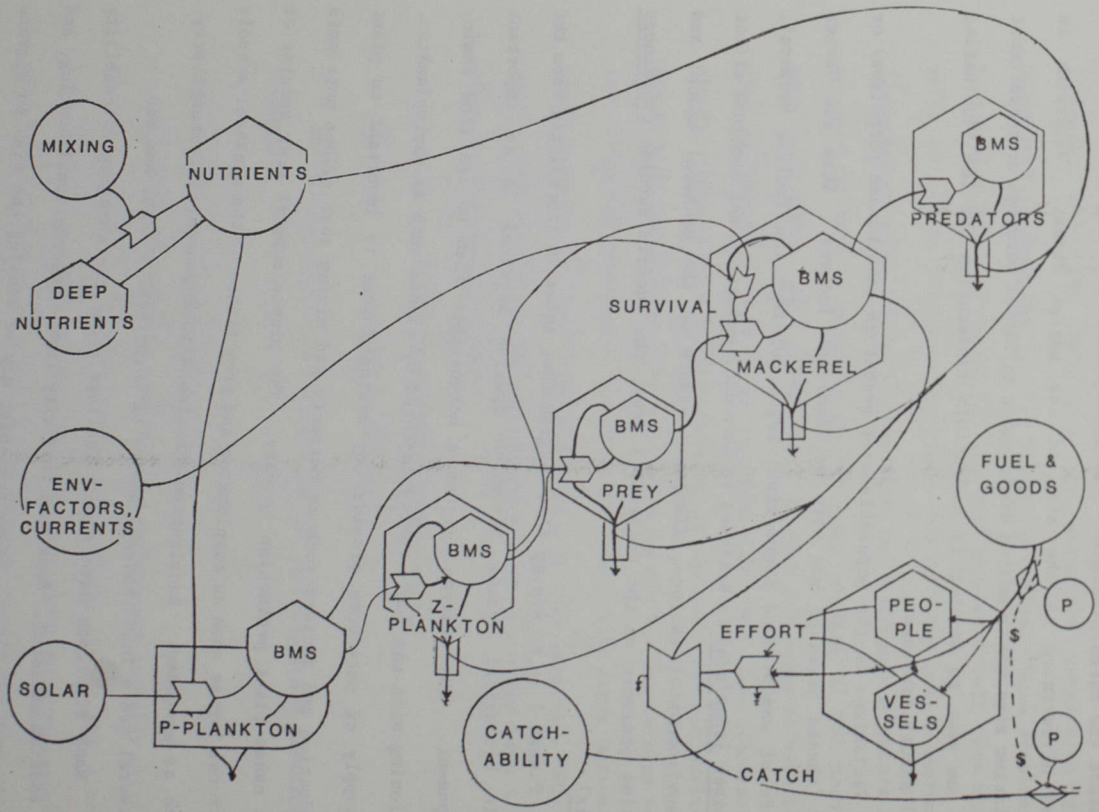

FIGURE 1. ENERGY FLOW DIAGRAM OF MACKEREL SYSTEM.

believe that netting the fish causes the fish to move further offshore. Other's think that cold fronts drive Spanish mackerel to shore and that schools stay further offshore in mild winters. It is possible that these or other factors related to long-term weather cycles may cause migration courses to vary. Hawk Channel on the Atlantic side of Marathon was an important winter fishing site for Spanish mackerel until 4 or 5 years ago. Spanish mackerel no longer appear seasonally in that area. Their absence was thought to be due to mild winters which allowed them to winter further north. However, 1977 was one of the coldest winters on record, but Spanish mackerel did not appear in Hawk's Channel.

Earll (1883) observed that "in moving along the coast, the Spanish mackerel appear to avoid fresh or even brackish water." If this is so, then annual variations in fresh water runoff may affect mackerel's behavior. None of these propositions have been seriously investigated.

Vessel Size

"Size of vessel" was a primary topic discussed from several different standpoints at the workshop, particularly by the fishermen. These discussions were very useful to the staff in providing insight and improving understanding of such factors as why fishermen trade to larger vessels and how vessel size affects the economics of a fishery operation.

Clearly both the fixed costs and the variable costs of a vessel increase with its size. The catch may increase more than proportionally to the costs, so that net returns increase, up to a point; but beyond that point catch will be limited by stock, market, or some other factor, or revenue will be limited by the inverse relationship between catch and price. There may therefore be an optimum vessel size for each fishery and size classes on either side of that optimum will be less economic.

In the mackerel fishery, larger vessels increase the fishing power of the fleet by expanding the range of the fishing operation so that the fleet can carry a larger net and fish further offshore when this is the only place that the stock can be found. This may reduce the variability of the catch from year to year, if catchability rather than variation in recruitment is the main cause of the annual variation in catch. If, however, variation in recruitment rather than catchability is the main cause of annual variation in catch, then larger vessels may be less cost-effective than small ones; because, as the fishermen point out, a fisherman can afford to leave a small boat tied up to the dock, but he can't afford to leave a large boat tied up at the dock. Larger vessels have to be kept working, primarily because of the large fixed costs, including mortgages, associated with them.

Why do fishermen buy larger vessels? Four reasons may be (1) they think the larger vessel will bring larger catches at a lower cost per pound, (2) the larger vessel will give them more mobility and increase fishing power, (3) bringing a greater quantity of fish to a fish house gives them more power to negotiate with the fish house, improving their ex-vessel price, and (4) a larger boat is more comfortable, which helps to hold a crew.

Whether they pay cash outright or assume a mortgage, in most cases a fisherman can only buy a larger vessel if he is making money from the vessel that he has. If there is an optimum vessel size, and a relationship of size to economic returns that looks like a dome (Figure 2), then it is easy to see how a man will be capable of trading to a larger vessel until he ends up with a vessel that is less than optimally economic. If there is a range of vessel size that allows a revenue that equals or exceeds overhead,

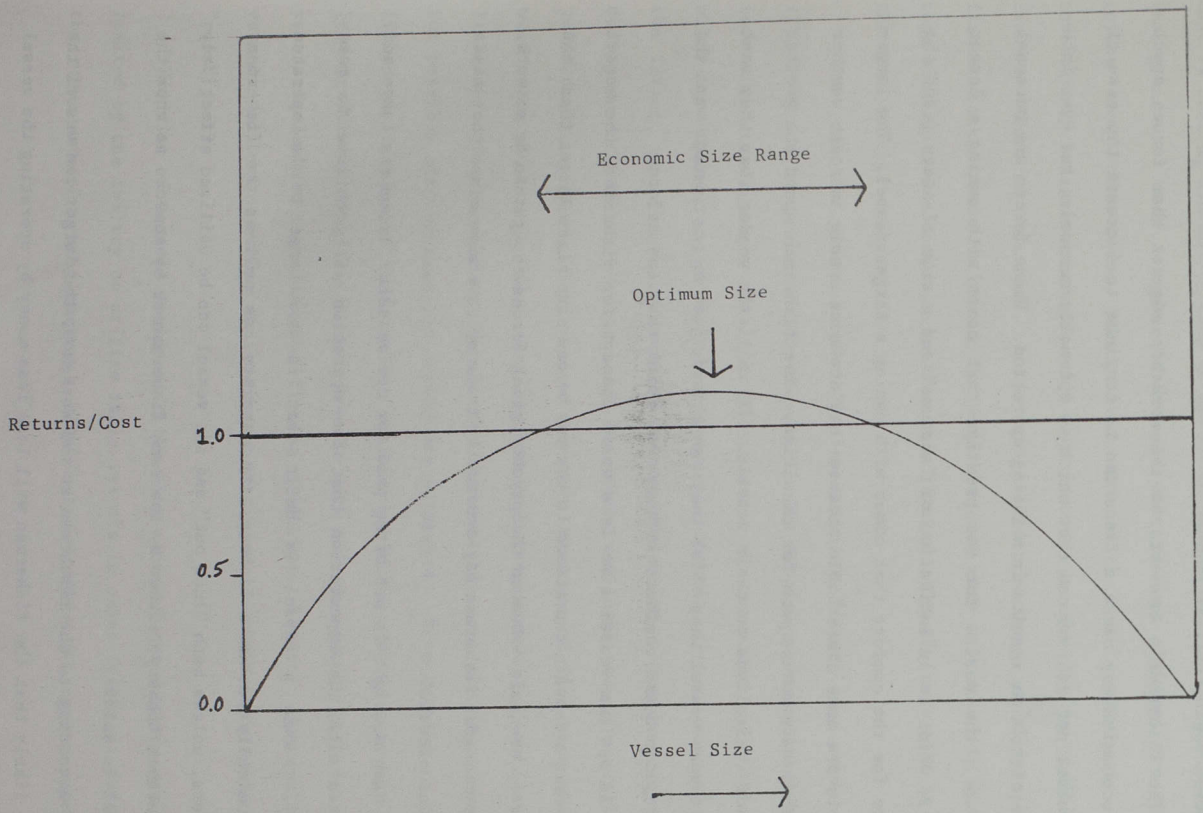

Figure 2. Concept of Optimum Vessel Size for Fishing Operations.

it will not be until the upper end of that range is exceeded that the operation begins to lose money.

The fishermen's comments at the workshop suggest that forces apart from economics may cause a fisherman to continue to increase the size of his vessel not only beyond that which is optimally economic, but even into a size class that results in a losing operation. These forces are personal desires: the desire for the prestige that comes with owning a larger vessel, which is an indication of "success" and a sign of status; and the desire for the comfort that comes with owning a larger vessel. The larger vessels are more comfortable because they are more stable in rough weather and they have more space for amenities. The fishermen spend the greater part of their lives on their vessels. It is little wonder that they want the largest vessel they think they can afford, just as most people want the most spacious and comfortable home they think they can afford.

If optimum vessel size is a valid concept for fisheries, the vessel size that a captain can afford to buy may be one size class larger than that which is economic. Due to the psychological forces thought to be at work, the successful fisherman may eventually trade up to a size class that makes him unsuccessful.

Cash outright is not often paid for new vessels. Loans are taken and granted with the expectation that the operation will continue to make money. When a vessel is built that is too large to be operated economically within a fishery, then society, as well as the fisherman, suffers, unless both "luck out" and the vessel can be utilized effectively in another fishery, either by the same fisherman or by someone to whom the vessel is sold.

According to the fishermen at the Workshop, the larger the vessel the more likely that the fisherman will lose less money by operating the vessel

than by leaving it sitting at the dock. If a fisherman cannot sell a vessel that is costing him money, then he may be forced to operate it even though losing money. When a number of vessels must be kept working even when losing money, it seems likely that the stock could eventually be threatened, because economics will not prevent overfishing by limiting fishing effort in this case. Large vessels under mortgage could possibly fish a stock to near extinction before it becomes more economical to leave them sitting at the dock than to keep them fishing. The ultimate cost is to the fish species and society.

The past few years in the Spanish mackerel fishery may serve to illustrate the conclusions just presented. The Spanish mackerel catch has increased significantly with the introduction of deep water gillnetting, which has required larger vessels. Favorable economic returns accrued to the larger, more expensive vessels during the first 3 years; however, during the 1976-77 season, the catch per vessel was lower than the earlier years due to a combination of poor weather, location of fish near shore over rocky areas that were dangerous to the larger vessels, and catch limits per trip imposed by fish houses, obstensibly as a quality control but possibly also because the market was saturated. From talking to the fishermen, it appears that smaller vessels and shallow-water gear may be less profitable than the larger vessels with the deep-water gear during years of abundant fish and good fishing conditions, however, the smaller vessels and less expensive shallow-water netting may be more sustainable in "poor" years.

The size of vessels employed in the king mackerel net fishery may be limited by the ability to utilize these vessels in other fisheries during the off-season for king mackerel. Unlss the vessels can accrue enough

revenue during the 3-month king mackerel season prevalent where the net vessels are used, then these vessels must be employed in some other fishery during other times of the year. At the present time, the larger the vessel, the fewer the alternative fisheries.

The potential for large gillnet boats from the king and Spanish mackerel fisheries to enter other fisheries does not currently appear very promising. Although some mackerel boats are being fitted for trawls to operate in the shrimp fishery, this particular fishery is already very crowded. The opportunity for a distant water lobster fishery or for a new squid fishery to develop in the Gulf is not known.

The relationship between size of vessel and economics of operation in the mackerel fishery is very interesting and deserves to be studied at length. The purpose of this brief discussion is to raise questions on this topic and not to presume to give answers on the basis of the information gathered for the Workshop, which is not adequate to allow a thorough analysis. An energy analysis and economic analysis of vessel size in the mackerel industry should be very valuable to the industry and to society.

Dockside Price Structure and Fishery Viability

Since the energy squeeze and attendant cost escalation that began in 1974, fishermen have had increasing problems keeping costs below returns so that they can make a living from their efforts. Spanish mackerel fishermen have been particularly affected because of the great disparity between the rate of increase of their costs and the rate of increase of the dockside price of their product. A federal court decision on a Sherman anti-trust law action confirmed charges that price fixing, at least at the level of the local dealers, has accentuated the inflation problem for mackerel

fishermen in the Port Salerno-Ft. Pierce area. Although court cases are rare, it is widely thought that fishermen, particularly those that control relatively small volumes of fish, do not get a fair share of the market value of their product because money passes through many hands before it gets to theirs. Fishermen who control large volumes of fish are in a better bargaining position because of the relative importance of one man to a fish house. Some fishermen have improved their bargaining position by forming marketing associations such as that described earlier in this report, but fishermen are notoriously independent and reluctant to unite, and some unscrupulous dealers have been thought to take deliberate action in an effort to destroy cooperative arrangements among fishermen. The Pine Island, Florida, Cooperative is said to have been destroyed by this method. Marketing analyses and a wider dissemination of material by government agencies might help the fishermen improve their bargaining position.

The present pricing structure is a threat to the healthy functioning of the fishery system because there is no positive feedback to the fisherman. When effort is not rewarded the effort soon ceases.

Durable ecosystems are thought to be characterized by mechanisms which cause organisms at the end of the food chain to exert a positive influence on energy flow at the front end of the food chain. Systems that do not have this "positive feedback" are thought to be easily outcompeted by those that do. Money paid for goods in the economic system is like the positive feedback thought to be necessary to the long term viability of natural systems.

Lacking good positive feedback to fishermen in the form of desirable dockside prices or any other encouragements from either private enterprise or government, it seems likely that fisheries such as the Spanish mackerel

fishery will decline, perhaps being replaced by some foreign fishery which is receiving positive feedback from government or free enterprise. The result will be that the mackerel resource will be unutilized or it will be utilized by a foreign fishery and reach the U.S. from a foreign market, to the detriment of our balance of payments.

The impressions of this staff from the field trips is that the Spanish mackerel fishery is in poor condition. It is made up of elderly individuals who may soon retire and little new recruitment is occurring. It is felt that this must be at least partially due to the seemingly inequitable pricing structure and lack of other positive feedback to American fishermen from society.

Although the current fishermen may keep on fishing because they are not trained or oriented to do other work, they will eventually die and their children will not enter the industry to perpetuate and apply the valuable family storehouse of knowledge about the fishery that may be required for a successful fishing operation.

The interviews conducted during the workshop study indicated that most fishermen in the mackerel fisheries have been a fishermen all or almost all their lives. Most indicated that their fathers or other members of their families also had fished for a living. The fishing operation is often a family enterprise with wives and children actively involved. The interviews taken as a whole gave the impression that there exists a distinct body of people identifiable as Florida fisherman families. These make up the "core" of the mackerel and other fisheries.

Commercial fishing requires highly specialized skills usually obtained only through experience and personalized training such as that handed down from generation to generation. The gradual extinction of a

body of people that incorporate this experience and training in their family structure should not be taken lightly.

LIST OF FIGURES

Figure 1. Energy flow diagram of the Spanish mackerel ecosystem.

Figure 2. Hypothetical curve describing concept of optimum size of a fishing vessel.

WAYS OF LOOKING AT FISHERIES*

C. Bruce Austin

In order to assimilate and interpret the phenomena associated with any complicated real world situation such as a fishery we must have a conceptual "window" through which we can filter the most important facts from the immensely complex world we observe. Care must be taken in selecting the window because it ultimately determines what questions we ask and then try to answer. Numerous disciplines (e.g., physic, biology, see Kuhn, 1962) have historically had significant changes in their "parodigms" (Kuhn's concept of the window).

How we view fisheries has also changed in recent years. For example, the recognition that "fisheries" are comprised of people (fishermen, processors, household consumers) as well as fish stocks requires us to include the economic and social considerations of people as well as biological considerations of fish populations. Such a perspective is particularly important with the assigned economic and social as well as biological responsibilities placed on newly formed Fisheries Management Councils through extended jurisdiction (Fishery Conservation and Management Act of 1976, P.L. 94-265).

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Historical Ways of Viewing the Management of Fisheries

It is generally recognized that common property (non-owned) resources can be overexploited (Hardin, 1962; Schaefer, 1957). Fishery biologists have traditionally viewed the role of fishery management as that of obtaining the maximum sustainable yield (MSY) from the fish stock. When MSY is somewhere between a relatively low stock level and the largest stock sustainable by the environment, if a fishery was "underexploited" (stock too large for MSY), programs to intensify fishing were recommended. If a fishery was "overexploited" (stock too small for MSY) programs to reduce fishing were recommended.

These biological stock criteria policies have two shortcomings. From an ecological perspective, they do not include the impact of the recommended fishing effort level and resulting fish stock on other species that may be influenced because of connections through the food web or incidental catches.

The second shortcoming has been given substantial attention by economists, that is, MSY, nor any other strictly biological criteria, includes how people evaluate fishing or the catch. Fishing (commercial and recreational) occurs because of the benefits it provides to people. How people evaluate fishing and fish are necessary considerations to understand and predict the amount of fishing that will occur and determine the "optimum" amount of fishing and catch to be persued by a fishery management program. The ecological and economic shortcomings of MSY are addressed in the Fishery Management Act (P.L. 94-265). The term "optimum" with respect to the yield from a fishery means the amount of fish:

(A) which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and

(B) which is prescribed as such on the basis of the maximum sustainable yield from such a fishery, as modified by any relevant economic, social, or ecological factor.

This tells us that we must consider what is "relevant" but not exactly what are relevant factors or how relevant factors should be weighted in arriving at the optimum yield. Many people believe that "optimum yield" is not a useful concept because "optimum" can have more than one interpretation. While this is true, it does not imply that optimum yield is not a useful concept. The concept is that of a process, not a solution. That is, it simply affirms that "optimum" must be based on multiple criteria. Legislating that social decisions are complex and there is no single evaluation method is not new. Cost-benefit analysis (Establishment of Principles and Standards for Planning, Federal Register, September 10, 1973) states that all the relevant costs and benefits of a Federal project must be considered.

It may seem unnecessary to many people to legislate that we must consider all the relevant factors. It sounds somewhat like trying to legislate common sense into decision making. Unfortunately, there is a real need to legislate common sense into the formulation of fishery management plans because those that have customarily studied fisheries (biologists and economists) are accustomed to formulating their anlaysis and presenting their results according to criteria that do not consider all the relevant factors that should be considered in formulating fishery management programs. This is one reason that biologists and economists seldom agree on the criteria for fishery management (Roedel, 1975). Biologists tend to think fishery management is for fish yield on the assumption that people fish for fish. Economists assume people fish for

money or pleasure and frequently view fishing as just another sector of the economy that should be analyzed and managed in terms of its relative economic value to the whole economy.

Some economists have strongly advocated that their form of analysis is superior for deriving the "optimum" amount of fishery effort and catch (Crutchfield, 1975). Many biologists and others are not convinced. In the mean time, both groups continue to develop more sophisticated analytical models based on their separate assumptions. The economic models are more recent than biological ones. They began by "piggy-backing" basic population dynamics models (Schaefer, 1957). They have since developed primarily through utilizing continually more sophisticated analytical tools such as control theory (Smith, 1969; Clark, 1977).

Alternative Ways of Viewing the Management of Fisheries

The starting point for any fishery management program is the recognition that people do not "manage" fish, they manage other people. In the process of managing people that utilize fish they indirectly "manage" fish stocks. While it is not reasonable to expect that any singular criteria could satisfactorily derive an "optimum," it is not unreasonable to expect that people will try to formulate such criteria. If there is a value in the concept of "optimum yield" as articulated in the Fishery Management Act, it is that it legislates against grasping for singular criteria solutions to complex problems.

It is likely that fishery management decisions will be, like all other social decisions, some form of political compromise which must be made with or without "satisfactory" information. At this time in the development of fishery policies, perhaps the biggest mistake is to believe we must have a

"complete" understanding of fisheries before we can manage them. This can lead to false conclusions that information must precede actions. In fact, actions will proceed with or without information. Those of us concerned with information must decide that for now we must do the best we can with the available information and hope that in the future information can keep pace with decisions.

Recognizing that: (1) fisheries are complex systems of interconnected biological and economic compartments, and (2) that decisions will be made now on the "best available information," perhaps we need some new tools of analysis. What we "know" is not necessarily how much data we have, but also our ability to organize the available data to draw inference. Decisions can produce unexpected and unfavorable results because of the way we look at a fishery or our inability to follow complicated causal webs as well as from a lack of basic data.

Our (workshop staff) approach to fishery management is based on the premises that there are no "solutions" to optimum yield or other policies, only a range of alternatives. What is required is some method by which we can readily explore the results of different assumptions about fisheries (assumptions based on the best available information) when they are coupled with alternative management policies that might be contemplated. We believe that computer simulated numerical models are the most promising tools of analysis. They have been used with varying degrees of success in business (Forrester 1961, 1968), ecology (Odum, 1971A), engineering (Doebelin, 1972), and other disciplines through both analog and digital computers.

Computer simulated numerical models are capable of handling complex non-linear dynamic systems that more closely represent "real world"

conditions than most analytical models. Since it is not possible to disrupt fisheries (people and fish) by directly experimenting with alternative policies, computer simulated models can (to a limited extent) act as surrogates for the "real thing" on which we can harmlessly experiment and perform various types of analyses.

The information we have thus far assimilated and the contributions of the workshop participants will not result in operational computer simulated numerical models. This is somewhere down the road, but we will organize what information we do have in a way that will attempt to outline the basic "structure" of the fisheries which will record the "compartments" of a fishery system and how they are interconnected. We believe this will be helpful to the Management Councils charged with developing management plans and be the beginning of our attempts to test the practicality of numerical modeling in the form of energetic systems.

An Energetic Systems Window Through Which to View Fisheries

As mentioned earlier, a conceptual window is a filter which helps us ask and then answer questions about complex phenomena. We have chosen an energetic systems parodigm that is a relatively new way of looking at things. Being "new" it is not easily definable in a concise set of principles. It draws on the thoughts of such diverse people as Forrester (business system dynamics, 1961, 1968), Georgesen-Rogen (economics, 1972, 1975), Odum (ecology, 1971A, 1971B), Lehninger (bio-chemistry, 1965), Kleiber (biology, 1961), and Slesser (engineering and economy, 1974). The basic concept that most of these people have in common is that life and all life processes (which include human economic activities) can be best understood in terms of an expanded interpretation of the entropy law (second law of thermodynamics).

For example, individual organizing, ecosystems, business firms, industries, and natural economics all have something in common in that they are "open" thermodynamic systems. The smallest unit of analysis is an energetic "compartment." In a fishery, examples would be a fish stock, fishing fleet (commercial and/or recreational), processors/fish houses, or other businesses in the marketing chain. All compartments have three characteristics in common. First, they are identified as accumulations (stocks) of ordered matter (e.g., biomass of fish, numbers of people and boats in a fleet). The matter is ordered in a fashion that it can do "work" (transform energy in a thermodynamic sense). Second, it takes energy and matter to order matter and to maintain ordered matter in its existing form (e.g., food to maintain biomass, fuel and materials to maintain machines). Third, compartments "work" to import energy and matter from outside sources. When importations are greater than maintenance requirements then a compartment can "grow" (increase or change in form of ordered matter). Conversely, when maintenance requirements are larger than importations then a compartment "declines" (reduction in amount or form of ordered matter).

Fisheries As Energetic Systems Comprised of Connected Energetic Compartments

At the compartment level we are concerned with energy and matter importations and maintenance requirements and changes in ordered matter (growth or decline). Biological compartments such as fish stocks obtain their energy (food sources) and matter (non-organic materials) directly from their environment. As the fish stock (biomass) increases or declines it affects the availability of its energy and matter sources.

Most economic compartments (comprised of people and machines) obtain their energy (food for people, fuel for machines) and matter (already ordered in the form of boats and equipment) through money-commodity exchanges with other economic compartments in the economy. The size of an economic compartment (like a biological compartment) influences the availability of its sources of energy and matter. The most important and obvious connection is between the catch and the resulting size of the exploitable fish stock. Production can also influence the terms of exchange (e.g., ex-vessel prices of catch or cost of purchased energy or materials).

An energetic systems approach does not necessarily conflict with other more established ways of looking at fisheries. Unfortunately, much of the controversy over energetics has been related to it purportedly being an energy theory of human value (Odum, 1976; Gilliland, 1975; Huettner, 1976). In fact, it is a value theory of energy. Energetic systems (or any other form of analysis) will not explain what is of value to people. However, given what is of value to people, energetics offers a "holistic" way to analyze the implications of alternative choices. That is, it offers the only common denominator (energy) that conforms to a set of physical laws (thermodynamics) that can be analyzed at the compartment level (e.g., fish stock, fishing fleet) or system level (e.g., ecosystem, economy) in both biological and economic systems. Other physical units of measurement are not applicable to economic compartments and the most frequent common denominator for economic compartments (money) does not flow in biological systems.

While energetic systems analysis does not necessarily conflict with other forms of biological or economic analyses, it does require different

data and methods of analyses. This workshop will be a start for us to assimilate the kinds of information that will be useful for energetic systems analyses. In the mean time, we believe this information, both descriptive and quantitative, will be very useful in formulating the fishery management plans for croaker and mackerels that will be undertaken in the coming year.

REFERENCES

Clark, C.W. 1977. Mathematical bio-economics; the optimal control of renewable resources. Wiley Inter-Science, New York.

Crutchfield, J.A. 1975. An economic view of optimum sustainable yield. In P. Roedel, ed., Optimum Sustainable Yield as a Concept in Fisheries Management.

Doebelin, E.O. 1972. Systems dynamics modeling and response. Charles Merrill, Columbus, Ohio.

Forrester, J.W. 1961. Industrial Dynamics. MIT Press.

Forrester, J.W. 1968. Principles of Systems Second Preliminary Edition. Wright Allied Press, Cambridge, Mass.

Georgescu-Rogen, N. 1971. The Entropy Law and the Economic Process. Harvard Univ. Press. p. 457.

Georgescu-Rogen, N. 1975. Energy and Economic Myths. Southern Eco. Jour. 41: 347-381.

Gillilard, M.W. 1975. Energy analysis and public policy. Science, Vol. 187 No. 4208, Sept. 26, 1975.

Hardin, G. 1968. The tragedy of the commons. Science 162: 1243-1248.

Huettner, D. 1976. Net energy analysis: an economic assessment. Science, Vol. 192, No. 4235, April 9, 1976.

Kleibr, M. 1961. The Fire of Life. John Wiley and Sons, New York.

Kuhn, T.S. 1962. The Structure of Scientific Revolutions. Univ. Chicago Press.

Lehninger, A.L. 1965. Bioenergetics: the molecular basis of biological energy transformations. W.A. Benjamin Inc., New York.

Odum, H.T. 1971A. An energy circuit language, its physical basis. Systems Ecology, Vol. 2, Academic Press, New York.

Odum, H.T. 1971B. Environment, Power and Society. John Wiley and Sons, New York.

Odum, H.T. and Elizabeth C. 1976. Energy bases for man and nature. McGraw Hill Book Co.

Roedez, P.M. 1975. Optimum sustainable yield as a concept in fisheries management. Amer. Fish. Soc. Spec. Pub. No. 9, Washington, D.C.

Schaefer, M.B. 1957. Some considerations of population dynamics and economics in relation to the management of the commercial marine fisheries. J. Fish. Res. Bd. Can. Vol. 14.

Slesser, M. 1974. Energy analyses in technology assessment. Technology Assessment 2: 201-208.

Smith, V. 1969. On models of commercial fishery. Jour. Pol. Econ. Jan-Feb.

EVALUATION OF THE WORKSHOPS

Workshop Staff

The term "workshop" is probably somewhat misleading. Information flow was primarily uni-directional from the participants to be assimilated and organized by the workshop staff. The purpose of the workshop was primarily to bring industry people together to "extract" as much useful socio-economic information as possible about the fisheries. The informaiton was to be used in two ways. First, to be organized into descriptive socio-economic profiles of the fisheries which are presented in the workshops final reports on croaker and mackerels. Second, the information was to be a first step in obtaining information that would be utilized in system modelling (dynamic numerical modelling through computer simulation).

Pre-Workshop Field Trips and Background Papers

The field trips by Connor Davis and Joan Browder to search out information and select workshop participants was necessary. Even if we could have known who to invite to the workshops (which was greatly influenced by the field trips), these people would probably have declined to attend unless they had personally discussed the workshops with one of the workshop organizers. This illustrates a feature of socio-economic profiles that cannot be over emphasized. Socio-economic studies must begin with an understanding of the "structure" of a fishery. That is, how the people and organizations in the fishery influence each other and the natural resources on which they are dependent. From a systems perspective, this starting point is the same for understanding the biological system of an individual organism, an ecological community, or an economy. The difference is that for the first two, information can be more readily obtained from direct observation without direct "cooperation" from the components of the system being studied. In the case of an economy, understanding how the system works is more dependent on explanations of their roles by people actually in the system. The ultimate result of fisheries studies (biological and economic), as far as industry people are concerned, is an alteration in their livelihood. If they believe it will be positive change, they may cooperate. If they believe it will be a negative change, they may not only refuse to cooperate, but can provide erroneous information as to how their system works.

In short, cooperation from the people in a fishery is absolutely necessary for understanding a fishery. Unfortunately, establishing and maintaining working relationships with people in a fishery is frequently viewed as relatively unimportant public relations-type work by the scientific community.

The considerable time devoted to the background papers was a worthwhile investment because without the foundation for discussion they provided the workshops would otherwise have been virtually useless in their objectives of obtaining socio-economic information that is not in the literature from people actually involved in the fisheries. It was anticipated that industry people would be quicker to correct faulty impressions than to voluntarily offer ones that had not been presented. This turned out to be a correct supposition.

Workshop Format

The workshop had a highly-structured and closely-followed format (see background papers). Most of the sessions were tedious and were recognized by participants for what they were; namely, an attempt to "pump" information from a moderately cooperative, but skeptical, group. Whenever there were differing opinions, a "concensus" (when reached) was obtained in an American Assembly Style format. No "vote taking" was used to resolve disputes. Everyone was allowed an opportunity to express his (or her) views and all views were considered.

Perhaps the most enduring result was that participants became more cooperative and less skeptical even though some of the topics involved "none-of-your-business" type questions. All industry participants in both workshops said that, if asked, they would cooperate further. Most industry people had never been asked to provide information or offer opinions on their fisheries by scientists or administrators. They sincerely appreciated the opportunity afforded by the workshop. Industry people think most fishery research is not relevant to them or is inefficient and sometimes erroneously conceived or incorrect because researchers do not

have information that would be provided by industry people if they were asked.

Most workshop participants concluded the major shortcoming was that the background papers were not distributed to participants several weeks in advance of the workshop. This should definitely be done if such workshops are conducted in the future.

Bottom Line

Participants were quick to refute faulty information in the background papers but not as quick or able to provide new information. This situation could have been improved if the background papers would have been distributed earlier so that participants would have had a better idea about what type of information (e.g., business records) they might have brought with them to the workshop.

In general, the workshop staff was somewhat disappointed in the amount of new information generated as a result of the workshop (compare background papers and final reports). This was not due to a lack of cooperation by participants. In this regard, industry people were more cooperative than anticipated. It is believed this was a result of a thorough job on the pre-workshop background papers and a lack of experience in obtaining the desired type of socio-economic information in such a workshop setting.

The cost of conducting the workshops was relatively small compared to the costs of assimilating and organizing the pre-workshop background material. This suggests that if socio-economic profiles are being prepared, it could be cost effective to conduct such an "industry people workshop" during the preparation of a profile. Such a "workshop" should

not be confused with public hearings or other forums where interest groups can present their views of management plans or other policies that are presumably based on biological, economic, and social information. These workshops should be viewed as methods of obtaining specific information that is not otherwise available and review of the factual content of information to be utilized in formulating socio-economic profiles that become the basis for management plans.

SEA GRANT SPECIAL REPORT NO. 12

THE FISHERY ACT OF 1976

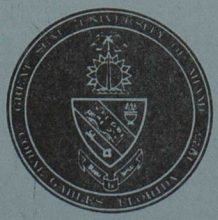
A SUMMARY

THE MANAGEMENT COUNCILS

A DESCRIPTION

BY JOAN A. BROWDER

PREPARED FOR
THE FISHERY SYSTEMS WORKSHOPS
ON
MACKEREL AND CROAKER
SPONSORED BY
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SOUTHEAST FISHERIES CENTER
MIAMI, FLORIDA



FISHERY ACT OF 1976 AND THE MANAGEMENT COUNCILS

Joan A. Browder[1]

PREFACE

This report was prepared in response to numerous questions received by the University of Miami staff developing the background information for the fishery systems workshops on mackerel and croaker, sponsored by the National Marine Fisheries Service[2]. Questions were in regard to the composition and responsibilities of the Fishery Management Councils. The questions were asked by fishermen, whose main concern was how they could have impact on management decisions.

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[2]Supported by NOAA Contract No. 03-6-042-35137

INTRODUCTION

The U.S. Fishery Conservation and Management Act of 1976 (P.L. 94-265) was designed to perpetuate our nation's fishery resources and to promote their efficient utilization. The Act includes the following:

1. Set forth "national standards" for the management of fisheries;

2. Established the 200 mile "fishery conservation zone," which extends from the boundary of state sovereignty out to a distance 200 nautical miles from the baseline from which territorial sea is measured; and declared exclusive national jurisdiction over all fishery resources in that zone, including oceanic species that move into estuaries or rivers to spawn and fishery resources of the Continental shelf. Excluded are the highly migratory tunas: skipjack, yellowfin, bigeye, and bluefin tunas and albacore.

3. Created regional fishery management councils to develop fishery management plans for each fishery in the conservation management zone of their regions; and

4. Declared that fishing by foreign vessels within the U.S. fishery conservation zone would no longer be allowed, except under an international fishery agreement and with permits specific to each fishery and conforming with a fishery management plan.

Regional Fishery Management Councils

The Regional Fishery Management Councils have the authority and funding to set up their own staffs and also to draw upon the services and facilities of the National Marine Fisheries Service and other federal agencies to organize, develop, and evaluate information relevant to the development of the management plans. These councils are required to conduct public hearings in appropriate areas to allow interested persons to be heard in the development of each management plan.

Scientific and statistical committees

Councils are required to establish and maintain an interdisciplinary scientific and statistical committee made up of biological and social

scientists. The scientific and statistical committee will assist the Council in developing and evaluating statistical, biological, economic, and social information relevant to a fishery management plan.

Advisory panels

Councils may also establish advisory panels "described as being composed of persons actually engaged in the harvest of, or knowledgeable and interested in the conservation and management of a given fishery." The panels will aid the Council in establishing both the goals and objectives of plans as well as the criteria for judging plan effectiveness, and will serve as a communication link with those who operate under the management regime. Members of the panel serve for one year but can be reappointed.

Management plans

The management plan for each fishery must include:

A) an estimate of "optimum yield," which is essentially the biologically-derived "maximum sustainable yield," modified by the economic and social constraints of the fishery (an explanation of the concept of optimum yield is given in the Proceedings of the Symposium on the subject, available as Special Publication No. 9 from the American Fisheries Society, 5410 Grosvenor Lane, Bethesda, Md. 20014, Price: $3.00).

B) an estimate of the percent of optimum yield that will be harvested by the U.S. fishery.

C) recommendations for conservation and management measures applicable to both foreign and domestic vessels.

D) a description of the fishery, including vessels, gear, stock, recreational interests, and current foreign fishing.

E) specification of data needs and recommendations for data reporting and collecting. Statistics submitted by any person in compliance with this requirement shall be confidential, by law.

A fishery management plan developed by a regional council can also include:

A) requirements for permits by U.S. vessels;

B) the designation of protective zones where fishing is prohibited or where gear types are limited;

C) the setting of catch limits, based on area, species, size, number, weight, sex, incidental catch, or other factors;

D) prohibitions or limits of specific types of fishing gear, vessels, or equipment;

E) incorporation of pertinent management and conservation practices of the coastal states of the fishery area;

F) a system of limiting access to the fishery to achieve optimum yield. In devising a system of limited access, the council must take into account:

   a) present participation in the fishery;

   b) historical fishing practices;

   c) the economics of the fishery;

   d) capability of fishing vessels engaged in the fishery to be used in other fisheries;

   e) the cultural and social framework relevant to the fishery.

Each management plan must be approved by the Secretary of Commerce in order to be implemented. To be accepted by the Secretary each plan must conform to national standards. The National Standards require that fishery management plans:

1) be based upon the best scientific information available;

2) be nondiscriminatory between residents of different States;

3) be designed to achieve the optimum yield of a stock of fish on a continuing basis;

4) promote efficiency in harvesting techniques or strategies;

5) result in reasonable administration and enforcement costs;

6) be designed to prevent overfishing of fishery resources while achieving, on a continuous basis, the optimum yield; and

7) take into account the variability of fish resources, the individuality of fishermen, and the needs of consumers and the general public.

Publication and public hearings on the plan

The Secretary is required to publish each management plan in the Federal Register immediately following approval. Individuals will have at least 45 days after such publication to submit in writing; data, views, or comments on the plan. The Secretary may schedule an additional hearing on the plan, and, based on its outcome, may postpone or revise the plan.

Federal and state jurisdiction

Councils may develop plans for fisheries predominantly within State jurisdiction but such plans may not be implemented under federal authority alone, except in the fishery conservation zone. The State (or States) in whose boundaries the fishery is conducted may manage on the basis of the council plan but is not obligated to do so. The following statement from the Regional Fisheries Management Council Operations Manual of the National Marine Fisheries Service defines the conditions under which state authority can be preempted:

> "When the Secretary of Commerce finds after a hearing is held that the fishing in a fishery, which is covered by a fishery management plan implemented under the Act, is engaged in predominantly within the fishery conservation zone and beyond such zone, and a State has taken some action, or omitted to take some action, the results of which will substantially and adversely affect the carrying out of such fishery management plan, the Secretary of Commerce may regulate that fishery (i.e., stocks of fish treated as a management unit, or any fishing for such stocks) within the boundaries of the State (other than internal waters). The State involved may apply to the Secretary of Commerce at any time for reinstatement of its authority over such fishery. If the Secretary finds that the reasons for which Federal regulation was assumed no longer prevail he shall promptly terminate such regulation. It is noted that the fishing in such a fishery must be predominantly located in waters outside a State's boundaries."

Enforcement

Enforcement of the Fishery Conservation and Management Act, including approved fishery management plans, is the responsibility of the Secretary of Commerce and the U.S. Coast Guard. Enforcement within the area of state jurisdiction is the prerogative of the state except in cases where state authority is preempted.

Foreign fishing

Fishing permits to foreign vessels will be made only with regard to those species for which a surplus has been declared in the fishery management plan or in a preliminary management plan. If a management plan for a given species is not yet available, the Department of Commerce will prepare a preliminary plan upon submission of a permit request by a qualified foreign vessel. The preliminary plan is superceded by the plan completed by the Council, once the latter is prepared and approved by the Secretary of Commerce. Permits, which are specific to vessel, will be granted only to vessels from countries who have signed a governing international fishery agreement (GIFA), by which the country formally recognizes total U.S. authority regarding the fishery. A foreign vessel must have a permit specific to a species in order to fish for that species in U.S. waters.

International fishery agreements are made by the Secretary of State in concert with the Secretary of Commerce. Each international fishery agreement will become operative only after approval by Congress. The committee with major responsibility in the House of Representatives is the Committee on Merchant Marine and Fisheries (John Murphy, Dem., NY, Chairman). In the Senate the Committee on Commerce, Science, and Transportation (Senator Warren Magnuson, Dem., WA, Chairman) and the Committee on Foreign Relations (Senator

John Sparkman, Dem., AL, Chairman) are primarily responsible.

Gulf and South Atlantic Councils

The councils that will develop management plans affecting the croaker and mackerel fisheries are the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council. The croaker will be covered under the groundfish management plan, and mackerel will be considered in the management plan for coastal pelagic species. The states represented on the Gulf Council are Florida, Alabama, Mississippi, Louisiana, and Texas. Those represented on the South Atlantic Council are Florida, Georgia, South Carolina, and North Carolina.

Council members

Each Council has as voting members:

a) The principal state official (or his designee) with marine fishery management responsibility and expertise, as designated by the governor.

b) The regional director of NMFS for the geographic area concerned, or his designee.

c) Others appointed by Secretary of Commerce from a list of qualified individuals submitted by each governor. At least three names must be submitted for each vacancy. Each state must be represented by at least one council member in this category. "Qualified individual" means someone who is knowledgeable or experienced with regard to the management, conservation, or recreational or commercial harvest of the fishery resources of the particular geographic area. The Secretary of Commerce is required to attempt to maintain a reasonable balance of interests on each Council in making appointments.

The Gulf Council has 17 voting members. The South Atlantic Council has 13 voting members. William H. Stevenson, regional director of the National Marine Fisheries Service in St. Petersburg, Florida, is a voting member on both councils. Voting members of each council are listed according to their affiliations in Tables 1 and 2.

Council members serve for three years, with terms staggered so that some

TABLE 1. VOTING MEMBERS OF GULF OF MEXICO FISHERY MANAGEMENT COUNCIL

Administrator	Consumer	Processor	Commercial Fisherman	Sport Fishing Interest	Conservationist
(TX) James P. Johnson[2] Chairman of Parks and Widlife Comm. Austin		(AL) Charles W. Kraver[2] Seafood Haven Inc. Bayou La Batre	**	(TX) John M. Green[1] Pres. E.H. Green Lumber Co., Beaumont	
(LA) James B. Angelle Director of Wildife & Fisheries Commission New Orleans		(FL) Robert P. Jones[1]* Southeastern Fisheries Assn., Tallahassee		(AL) Thomas H. Clark[1] Sportfish guide Orange Beach	
(MS) Richard L. Leard Director of Marine Conservation Comm. Biloxi		(MS) George A. Brumfield Zapata-Haynie Corp. Moss Point		(FL) Billy J. Putnam (Charterboat-tackle-Marina) Point Marina Panama City	
(AL) John Hodnett (Hugh Swingle) Dept. Conservation & Natural Resources Montgomery & (Dolphin Island)		(TX) Robert G. Mauermann Exec. Director Texas Shrimp Assn. Brownsville		*	
(FL) Harmon W. Shields[1][2] Exec. Dir. Dept. Natural Resources Tallahassee		(TX) John A. Mehos, C Vice President Liberty Fish & Oyster Co. Galveston			
(US) William H. Stevenson Regional Director of National Marine Fishery Service St. Petersburg		(LA) Edward W. Swindell, Jr. Wallace Menhaden Products New Orleans			
(LA) Theodore B. Ford III, VC[2] Office of Sea Grant ISU, Baton Rouge		(MS) Nicholas A. Mavar, Jr.[2] Sec./Counsel Mavar Shrimp & Oyster Co. Biloxi			

(1) serving on the subcommittee concentrating on coastal migratory and pelagic species.

(2) serving on the subcommittee concentrating on groundfish

*Recently charterboat captains (sport fishing interests) have joined the Southeastern Fisheries Association and so may be represented by Mr. Jones.

**Some fishermen are members of the Southeastern Fisheries Association and are represented by Mr. Jones.

TABLE 2. VOTING MEMBERS OF SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Administrator	Consumer	Processor	Commercial	Sport Fishing Interests	Conservationist
(FL) Harmon W. Shields Exec. Director Dept. Natural Resources Tallahassee	(FL) George B. Gross Red Lobster Inns of America Orlando	(GA) J. Roy Duggan, VC King Shrimp Co. Brunswick	*	(SC) Benjamin T. Hardesty Vice President Shakespeare Co. (fishing rod Manuf.) Columbia	(FL) Gertrude W. Bernhard Jupiter - Tequesta
(GA) David H. Gould Superintendent Coastal Fisheries Dept. Natural Resources Brunswick	(NC) Margaret "Peggy" Stamey Raleigh	(NC) Norman B. Angel Exec. Secretary N.C. Fisheries Association New Bern		(GA) Allen F. Branch Midway	
(SC) Edwin B. Joseph, C Director Marine resources Division Charleston				(SC) Edgar C. Glenn, Jr. Beaufort	
(NC) Edward G. McCoy Director, Division of Marine Fisheries Morehead City					
(US) William H. Stevenson Regional Director National Marine Fishery Service St. Petersburg					

*Some commercial fishermen are members of the N.C. Fisheries Association and are represented by Mr. Angel.

new appointments are made each year. In order to facilitate this type of turnover, the first appointments to the councils have been made for designated one, two, and three year terms.

The councils elect a chairman and a vice-chairman, who serve for one year. The chairman of the Gulf Council is John A. Mehos of Galveston, Texas and the vice-chairman is Theodore Ford III, of Baton Rouge, Louisiana. The South Atlantic Council chairman is Edwin Joseph of Charleston, South Carolina, and the vice-chairman is J. Roy Duggans of Brunswick, Georgia.

Each council also has nonvoting members, who are designated as follows:

1) the regional or area director of the U.S. Fish and Wildlife Service, or his designee;

2) the commander of the Coast Guard district for the geographic area concerned, or his designee;

3) the executive director of the Marine Fisheries Commission; for the geographic area concerned, or his designeee; and

4) one representative of the Department of State.

Scientific and statistical committee members

Members of the Scientific and Statistical Committees of the two Councils have been selected. Members of the Committee for the Gulf Council are listed in Table 3. Those serving on the South Atlantic Scientific and Statistical Committee are listed in Table 4.

Scientific Subcommittee members

Subcommittees of scientific experts on each fishery have been appointed by the Gulf Council. Members of the subcommittees for coastal migratory and pelagic fishes are listed in Table 5 and groundfish are given in Table 6.

Advisory panel members

The Gulf Council has an advisory sub-panel for each fishery of current

TABLE 3. MEMBERS OF GULF COUNCIL'S STANDING SCIENTIFIC AND STATISTICAL COMMITTEE

Standing Committee

Mr. Gary Knight (Chairman)	Louisiana State University (marine law)	Baton Rouge, LA
Dr. James Cato (Vice Chairman)	University of Florida (fishery economics)	Gainesville, FL
Dr. Sammy Ray	Texas A & M (shallow water oceanography)	College Station, TX
Mr. Harry Shafer	Louisiana Wildlife and Fisheries Comm. (marine resource management)	New Orleans,LA
Dr. Richard Noble	Texas A & M (fisheries statistics)	College Station, TX
Dr. Edward Houde	University of Miami (population dynamics)	Miami, FL
Dr. Al Bertrand	Louisiana State University (rural sociology)	Baton Rouge, LA
Mr. Bob Ingle	Environmental Consultant (fisheries biologist)	Apalachicola, FL Apalachicola, FL

TABLE 4. GULF COUNCIL'S SCIENTIFIC SUBCOMMITTEE ON COASTAL MIGRATORY AND PELAGIC SPECIES

Mr. Dale Beaumariage	Florida Department Natural Resources	Tallahassee, FL
Dr. Connie Arnold	NMFS Laboratory	Port Aransas, TX
Dr. John D. McEachran	Texas A & M	College Station, TX
Mr. E. L. Nakamura	NMFS Laboratory	Panama City, TX

TABLE 5. GULF COUNCIL'S SCIENTIFIC SUBCOMMITTEE ON GROUNDFISH

Mr. Shelby Drummond	NMFS	Pascagoula, MS
Mr. Elmer Gutherz	NMFS	Pascagoula, MS
Mr. C. E. Bryan	Texas Park and Wildlife	Rockport, TX
Ms. Harriet Perry	Gulf Coast Research Lab	Ocean Springs, MS

TABLE 6. MEMBERS OF THE SCIENTIFIC AND STATISTICAL COMMITTEE OF THE SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Mr. Dale Beaumariage	Florida Department of Natural Resources	Tallahassee, FL.
Dr. James Cato	University of Florida Sea Grant	Gainesville, FL.
Dr. A. F. Chestnut (Chairman)	Inst. of Marine Sciences	Moorehead City, NC.
Dr. Thomas A. Clingan	Prof. of Law, Univ. of Miami (former negotiator of Law of the Sea)	Miami, FL.
Dr. Peter Eldridge (Vice Chairman)	SC Marine Resources Institute	Charleston, SC.
Dr. Donald W. Hayne	NC State University	Raleigh, NC.
Dr. Harold L. Mix	University of Georgia	Athens, GA.
Dr. Kenneth J. Roberts	Sea Grant National Headquarters	Washington, D.C.
Mr. Richard H. Stroud	Exec. Vice President, Sport Fishing Inst.	Washington, D.C.

interest. Members of the advisory panel for coastal migratory and pelagic species are given in Table 7. Members of the advisory panel for groundfish are in Table 8. Members of the advisory panel of the South Atlantic Council are listed in Table 9.

Executive directors

An executive director is appointed by each council. The names and addresses of executive directors of the Gulf and South Atlantic councils are as follows:

Mr. Wayne E. Swingle
Gulf of Mexico Fishery Management Council
Suite 881
5401 W. Kennedy Blvd.
Tampa, Fla. 33609
Phone: 813-228-2815 (FTS 826-2815)

Mr. Ernest D. Premetz
South Atlantic Fishery Management Council
Southpark Bldg.
No. 1 Southpark Circle
Charleston, S.C. 29407
Phone: 803-571-4366

Council meetings

The councils generally meet once a month. The meeting of the South Atlantic council is normally on the 4th Tuesday-Thursday of the month. The meeting of the Gulf council is usually on the 1st Wednesday-Friday of the month. Notice of meetings must be published in the Federal Register. They may also be announced in local papers in the area in which the meeting is held. The councils make an effort to hold meetings in different locations of their region. Meetings are open to the public.

The Caribbean Fishery Management Council may also be involved in developing management plans for the king mackerel fishery. The executive

TABLE 7. GULF COUNCIL'S ADVISORY PANEL ON COASTAL MIGRATORY AND PELAGIC SPECIES

Mr. Leon Kenney	Pinnelas Seafood Processor	St. Petersburg, FL
Cap. Roland Walker	charterboat captain	Orange Beach, AL
Mr. David McKeithrum	Pres, Salt Water Sportsman's Assoc.	Mobile, AL
Mr. C. W. Wade	sportsfisherman-biologist Alabama Dept. of Conservation and Natural Resources	Dauphin Island, AL
Mr. Bobby O'Barr	sportsfisherman and attorney	Biloxi, MS
Dr. Wilson Couch	sportsfisherman	Baradis, LA
Capt. B. O. Niquet	charterboat captain	Lynn Haven, FL
Mr. Marvin D. Burnett	marina operator and boat dealer	Houston, TX
Mr. Raymond Muchowich	retired partyboat operator	Freeport, TX
Mr. John W. Blackwell	sportfisherman	Beaumont, TX
Mr. Jimmy Pace	processor	Brownsville, TX
Mr. Gene Raffield	processor	Port St. Joe, FL
Mr. Harland Franklin	sports writer	Tallahassee, FL
Mr. Charles Carter	commercial fisherman	Key West, FL

TABLE 8. GULF COUNCIL'S ADVISORY PANEL ON GROUNDFISH

Mr. John E. Christianson (Chairman)	Quaker Oats Co. (industrial processor)	Pascagoula, MS
Mr. Hilliard A. Le Bretton (Vice Chairman)	recreational fisherman	New Orleans, LA
Mr. Fred K. Williams	Williams Seafood & Poultry (food fish distributor)	Birmingham, AL
Mr. Joe Moore	Joe's Seafood Co., Inc. (food fish processor)	Bayou La Batre, LA
Mr. Grady Seaman	food fisherman	Bayou La Batre, LA
Mr. John S. Mavar	industrial fisherman	Ocean Springs, MS
Mr. David J. Summersgill	Summersgill Interprises (minced fish processor)	Golden Meadow, LA
Mr. Jimmie B. Martin	industrial fisherman	Pascagoula, MS
Mr. Newton Verrett	industrial fisherman	Moss Point, LA
Mr. Edward M. Holder	recreational fisherman	Grover, TX
Ms. Karen Smith	Northwest Fla. Fisherman's Assoc. (commercial fisherman)	Pensacola, FL

TABLE 9. ATLANTIC COUNCIL'S ADVISORY PANEL

Blue Fulford	Executive Director Organization of Florida Fishermen	Bradenton, FL
Clyde Kitchel	Indian River Seafood Co.	Sebastian, FL
Laurence Jacobs	Georgia Fishermen's Cooperative	Valona, GA
James W. Morgan	Fisherman and packer	Midway, GA
Madison Howell	Commercial fisherman packer, shrimp fishery	Mount Pleasant, SC
Wally L. Shaffer, Jr.	commercial fisherman	Isle of Palms, SC
William E. Smith	trawler owner, operator, packer, shipper, Luther Smith & Sons Seafood	Atlantic, NC
Ron Tillet	Chief Wanchese Packing Co.	Wanchese, NC
Jesse L. Webb	Pfluger Taxidermy	Hallandale, FL
William R. Dewers	Le Fills Oak Hill Fishing Camp	Oakhill, FL
Dean J. Poucher	outdoor writer and and sportsfisherman	Bluffton, SC
Dr. Frank Carlton	President, National Coalition for Marine Conservation and sports fishermen	Savannah, GA
Robert Simpson	outdoor writer and President of North Carolina Salt Water Fishing Club.	Moorehead City, NC

director is Mr. Omar Munoz-Roure, P.O. Box 1001, Hato Rey, Puerto Rico 00919. Figure 1 is a decision making diagram showing where you can have input to the decision-making process.

SELECTED REFERENCES

Allen, H.B., 1977. United States - Mexican negotiations in context with United States extended jurisdiction policy. Proc. of the 29th Annual Gulf and Caribbean Fisheries Institute. Brownsville, TX, 1976. Available from Executive Director, Gulf and Caribbean Fisheries Institute, 4600 Rickenbacker Causeway, Miami, FL 33149.

Larkin, P.A., 1977. An epitaph for the concept of maximum sustained yield. Trans. Amer. Fish. Soc. 106: 1-11.

National Marine Fisheries Service, 1976. Regional Fisheries Management Council Operations Manual. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. Washington, D.C. 20235.

Ninety-fourth Congress., 1976 (April 13). Fishery Conservation and Management Act of 1976. Public Law 94-265. H.R. 200. Available from U.S. Government Printing Office. Washington, D.C.

Roedel, P.M. (Ed.) 1975. Proc. of symposium on optimum sustainable yield as a concept in fisheries management, 1974. Spec. Publ. No. 9, American Fisheries Society, 5410 Grosvenor Lane, Bethesda, MD 20014. Price: $3.00 per copy, postpaid.

ECONOMIC ANALYSES OF PRODUCTION AND MARKETING OF FLORIDA EAST COAST KING AND SPANISH MACKEREL

Fred J. Prochaska
James C. Cato

ECONOMIC ANALYSES OF PRODUCTION AND MARKETING OF FLORIDA EAST COAST KING AND SPANISH MACKEREL

by

Fred J. Prochaska and James C. Cato

INTRODUCTION

King and Spanish mackerel accounted for 17 percent of Florida landings and 18 percent of value of landings in 1975 [9]. King mackerel landings for the 1973-75 period averaged 7.5 million pounds valued at $2.6 million (Table 1). For the same time period Spanish mackerel landings averaged 10.3 million pounds valued at $1.8 million. Both species experienced relatively large rates of increased landings during the past two decades. Comparing the 1956-60 period with the most recent period, 1971-75, shows a 96 percent increase in landings of king mackerel and a 23 percent increase for Spanish mackerel. Differences in these fisheries exist between the East Coast and West Coast of Florida (Table 2). Landings of king mackerel generally are larger on the East Coast. Dockside prices on the East Coast are considerably higher than West Coast king mackerel prices in spite of the larger landings. The price differential is probably due to differences

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Prepared for use in the University of Miami Fishery Systems Workshop on king and Spanish mackerel, April 28-29, 1977.

Table 1. Landings, values and prices of Florida king and Spanish mackerel, 1956-1975

Year	King mackerel			Spanish mackerel		
	Pounds	Dollars	Price	Pounds	Dollars	Price
1956	3,425,698	380,762	.11	7,445,010	595,098	.08
1957	3,347,391	384,834	.11	7,815,898	617,005	.08
1958	3,205,920	340,558	.11	11,137,072	837,038	.08
1959	3,434,343	362,746	.11	7,021,653	613,270	.09
1960	3,591,902	407,944	.11	7,717,326	734,557	.10
1961	3,759,269	444,942	.12	7,146,375	708,159	.10
1962	4,096,425	520,276	.13	9,447,116	915,418	.10
1963	4,990,063	544,325	.11	7,528,299	683,635	.09
1964	3,333,893	383,617	.12	5,881,591	538,891	.09
1965	4,447,335	606,432	.14	7,784,279	875,309	.11
1966	4,414,661	642,566	.15	9,185,524	1,045,062	.11
1967	6,072,184	847,948	.14	7,669,076	763,864	.10
1968	6,189,412	966,791	.16	11,472,712	1,179,620	.10
1969	6,185,119	1,013,872	.16	10,533,448	1,199,163	.11
1970	6,709,694	1,334,449	.20	11,674,479	1,397,275	.12
1971	5,644,148	1,292,381	.23	9,964,946	1,138,082	.11
1972	4,867,623	1,306,528	.27	9,901,267	1,241,211	.13
1973	5,928,846	2,134,712	.36	9,397,233	1,536,601	.16
1974	10,401,155	3,271,879	.31	10,612,023	1,902,842	.18
1975	6,319,230	2,354,849	.37	10,765,947	1,862,599	.17

Table 2. Landings, values and prices of East and West Coast king and Spanish mackerel, 1971-75

Species and Year	East Coast			West Coast		
	Pounds	Value		Pounds	Value	
		-Dollars-	Dollars per pound		-Dollars-	Dollars per pound
King mackerel:						
1971	2,906,527	820,168	.28	2,737.472	472,213	.17
1972	3,489,482	1,051,201	.30	1,378.141	255,327	.19
1973	3,711,939	1,537,308	.41	2,216,907	597,404	.27
1974	4,267,520	1,677,730	.39	6,133,635	1,594,149	.26
1975	3,696,806	1,715,130	.46	2,622,424	639,719	.24
Spanish mackerel:						
1971	2,581,713	308,401	.12	7,383,233	829,681	.11
1972	3,368,967	425,314	.13	6,532,300	815,897	.12
1973	3,202,001	537,681	.17	6,194,232	998,920	.16
1974	2,346,277	459,015	.20	8,265,746	1,443,827	.17
1975	5,144,779	901,497	.18	5,621,168	961,102	.17

in fishing practices and marketing difficulties. More nets are used for king mackerel fishing on the West Coast which results in greater landings per day. Transportation difficulties associated with bridge conditions in the Florida Keys place some limitations on value of shipments. Both reasons probably cause lower prices on the West Coast. Prices for Spanish mackerel are slightly lower on the West Coast which is consistant with the larger volume of landings on the West Coast.

The relative economic importance of these two species, the increased fishing pressure and industry opinion all suggest king and Spanish mackerel should recieve priority in the development of fishery management plans. The purpose of this paper is to present economic analyses of production costs and returns and of the marketing system which provide necessary data useful in the consideration of a management plan which defines optimum yield. Cost and returns are presented seperately for each species because of different production characteristics in each fishery. In addition, Spanish mackerel net boats are analyzed in two size classes which represent distinctly different fisheries. A discussion of Florida East Coast marketing margins and an analysis of market and dockside prices follows the production analyses. Personal interviews with king and Spanish mackerel fishermen and fishhouse managers and owners provided the primary data base necessary for the analyses.

COST AND RETURNS

Ten hook-and-line king mackerel fishermen and 13 net-boat Spanish mackerel fishermen on the Florida East Coast were interviewed during February, 1977 to obtain production and cost and returns data for 1976. Averages, ranges, and analyses of reported data are given for each fishery in the following sections.

King Mackerel

Production characteristics. Average age of the captain was 49 years. Fishing experience averaged nearly 21 years (Table 3). The average boat was 29.9 feet in length and 10.5 feet in width with a fish carrying capacity of approximately 4,000 pounds. Eighty percent of these boats were of fiberglass construction. Horsepower rating ranged from 210 to 365 with an average of 264.

Number of fishing trips per year ranged from 100 to 270 for an average of approximately 182 per boat (Table 3). The average one-way distance traveled was 17.5 miles with a range of 7 to 25 miles. The normal or average fishing trip was 11.1 hours.

Average catch and dollar returns. King mackerel fishermen landed an average of 36,113 pounds of king mackerel per boat in 1976. King mackerel accounted for 70 percent of total landings (Table 4). Sales of king mackerel were $17,460 per boat which accounted for over 71 percent of total sales. Other principle species landed included Spanish mackerel and bluefish (Table 4).

Costs. Fuel was the most important cost item averaging $2,713 per boat in 1976 (Table 4). Average fuel consumption was 5,094 gallons (Table 3). Fishing gear consisting of paravanes, wire, hooks and spoons, swivels and snaps and other gear totaled $629 per boat annually. Repairs and maintenance on hull, engine and electronic equipment averaged over $1,500 annually. Total cost of all variable input items was $6,293 per firm.

Total annual fixed costs consisted of depreciation, boat registration, insurance and other overhead items and averaged $3,354 per

Table 3. Production and financial characteristics of Florida East Coast king mackerel hook-and-line fishing boats, 1976[a]

Item	Average	Range in data	
		Low	High
Boat:			
Length (feet)	29.9	24	36
Width (feet)	10.5	8	14
Hull fabrication:			
Fiberglass (percent)	80.0		
Wood (percent)	20.0		
Carrying capacity (lbs. of fish)	4,070.0	1,400	9,000
Age (years)	8.3	.5	20
Engine:			
Horsepower	264.0	210	365
Fuel type:			
Diesel (percent)	50.0		
Gasoline (percent)	50.0		
Age (years)	3.7	.5	8
Captain:			
Age (years)	49.0	33	70
Experience (years fishing)	20.9	7	35
Income from fishing (percent)	67.7	10	100
Fishing characteristics:			
Number of trips	181.5	100	270
Average one-way distance (miles)	17.5	7	25
Average hours per trip	11.1	8	14
Production inputs:			
Fuel (gallons)	5,093.7	1,062	12,000
Oil (quarts)	126.0	24	600
Ice (pounds)	49,246.7	10,000	100,000
Electric reels (number)	2.9	1	4
Jerk lines (number)	2.6	1	3
Investments (present value):			
Engine (dollars)	5,710.0	800	12,500
Hull (dollars)	9,650.0	1,500	36,000
Electronic equipment (dollars)	2,010.0	450	2,550
Electric reels (dollars)	494.0	100	1,200
Other equipment and gear (dollars)	75.0	0	3,000
Percent with loans	30		
Percent with insurance	40		

[a]Based on a survey of 10 hook-and-line king mackerel boat captains taken on the Florida East Coast during February, 1977.

Table 4. Cost and returns for Florida East Coast king mackerel hook-and-line boats, 1976[a]

Item	Average	Range in data[b] Low	High
RETURNS:			
King mackerel			
Pounds	36,112.70	16,000	70,000
Dollars	$17,459.84	$ 7,680.00	$35,000.00
Spanish mackerel			
Pounds	502.6	0	5,026
Dollars	$ 90.4	0	$ 904.00
Bluefish			
Pounds	376.7	0	3,767
Dollars	$ 45.2	0	$ 452.00
Other fish			
Pounds	14,337	2,000	50,000
Dollars	$ 6,919.73	$ 900.00	$20,000.00
Total			
Pounds	51,329		
Dollars	$24,515.17		
	----------dollars----------		
COSTS:			
Variable costs:			
Ice	$ 517.55	$ 100.00	$ 1,000.00
Bait	460.55	100.00	1,000.00
Fuel	2,713.45	1,500.00	5,280.00
Oil	104.92	18.50	375.00
Fishing gear:			
Paravanes	$ 48.80	0	100.00
Wire	151.80	50.00	375.00
Hooks and spoons	98.20	36.00	250.00
Swivels and snaps	30.10	2.00	50.00
Other gear	300.00	0	1,625.00
Raincoats and boots	40.10	0	78.00
Gloves	206.60	30.00	504.00
Repairs and maintenance:			
Hull and propeller	645.80	317.00	1,400.00
Engine (and oil change)	588.20	82.00	1,500.00
Electronic equipment	277.10	0	907.00
Electric reels	99.60	10.00	400.00
Other gear	10.00	--	100.00
Total variable costs	$ 6,292.77		

Continued

Table 4. Continued

Item	Average	Range in data	
		Low	High
Fixed costs:			
Depreciation:			
Engine	931.75	466.67	1,472.00
Hull	1,015.04	400.00	3,600.00
Electronic equipment	542.75	187.50	884.00
Electric reels	117.24	24.00	240.00
Boat registration	28.65	11.50	38.00
Insurance	215.00	0	650.00
Interest on loans	188.25	0	1,200.00
Bookkeeping costs	44.50	0	150.00
Dockage fee	270.80	0	540.00
Total fixed costs	$ 3,353.98		
Total costs	$ 9,646.75		
Net returns	$14,868.42		

[a]Based on surveys taken from 10 hook-and-line boat operators on the Florida East Coast during February, 1977.

[b]Range data do not total individual species reports in this table because highs and lows were recorded for individual operations which were not necessarily the same for species on all cost items.

firm in 1976 (Table 4). Depreciation on engine and hull accounted for approximately two thirds of total fixed costs.

Total cost per boat was $9,647. Comparing this to total revenue of $24,515 gives a net return of $14,868 per boat (Table 4). The management, labor and capital inputs provided by the captain must be considered to fully evaluate net returns (or profits). Hours of labor provided by the captain is conservatively estimated at 2,014 hours when only actual fishing time is considered. At $5.00 per hour (currently earned in other fisheries) labor income should be at least $10,070. Present value of investment averaged $17,939 per firm (Table 3). At a 7.5 percent market rate of interest, returns to capital investment are estimated to be $1,345. Total returns to the captain's labor on board and capital investments are estimated at $11,415. This leaves $3,453 as returns to the captains management functions and other labor activities while on shore.

Spanish Mackerel

Small Boats

Production characteristics. Average age of Spanish mackerel net-boat captains on small boats was 45.6 years which is slightly less than king mackerel boat captains (Table 5). These captains had an average of 27.3 years of fishing experience. Small net boats averaged 21.1 feet in length and 7.4 feet in width. The range in length was 20 to 22 feet. The carrying capacity for the average small boat was 4,857 pounds. Nearly 86 percent were of fiberglass construction. Average horsepower rating was 164.

Fishing trips on small boats averaged 183 per boat in 1976 with a range of 150 to 200 for individual boats (Table 5). Average one-way dis-

Table 5. Production and financial characteristics of small Florida East Coast Spanish mackerel net boat fishing operations, 1976[a]

Item	Average	Range[b] Low	Range[b] High
Boat:			
Length (feet)	21.1	20	22
Width (feet)	7.4	6.6	8
Hull fabrication:			
Fiberglass (percent)	85.7		
Steel (percent)	14.3		
Carrying capacity (lbs. of fish)	4,857.1	2,500	6,000
Age (years)	5.5	.5	10.0
Engine:			
Horsepower	164.3	105	250
Fuel type:			
Diesel (percent)	0.0		
Gasoline (percent)	100.0		
Age (years)	1.3	.5	3.5
Captain:			
Age (years)	45.6	30	60
Experience (years)	27.3	6	45
Income from fishing (percent)	71.2	15	100
Fishing characteristics:			
Number of trips	182.7	150	200
Distance (miles one way)	15.4	8	20
Average hours per trip	9.3	5	12
Production inputs:			
Fuel (gallons)	2,825.0	800	6,000
Oil (quarts)	298.3	20	500
Percent with spotter plane	14.5		
Ice (pounds)	56,112.9	23,300	120,000
Nets:			
Number	8.7	4	19
Yards (average per net)	4,683.3	2,000	7,600
Yards replaced	2,594.2	1,600	3,750
Crewmen[c]	.6	0	2
Investments (present value):			
Engine	2,982.1	2,000	5,000
Hull	2,742.9	1,000	4,000
Electronics	435.0	100	500
Nets	12,500.0	5,000	20,000
Other gear	21.4	0	150
Percent with loans	0		
Percent with insurance	28.6		

[a]Based on interviews with seven boat captains during February, 1977.

[b]Range data do not total individual species reports in this table because highs and lows were recorded for individual operations which were not necessarily the same for each species.

[c]These boats have crewmen on board for some trips during the year. The result is an average of 0.6 crewmen per boat.

tance traveled was 15.4 miles with an average fishing day consisting of 9.3 hours. Each net boat had an average of 8.7 nets each averaging 4,683 yards in length (Table 5).

Average catch and dollar returns. An average of 58,360 pounds of Spanish mackerel were landed per boat (Table 6) which accounted for 40 percent of total landings by these boats. Bluefish was the other species of principle importance landed by these fishermen. Sales of Spanish mackerel averaged $10,548 per boat while total sales of all species landed was $26,698 (Table 6). Total sales per boat ranged from $16,200 to $49,00 in the sample of fishermen interviewed.

Costs. Fuel cost averaged $1,711 during 1976 (Table 6). Hull costs consisting of repair, maintenance and depreciation averaged approximately $1,026 annually. Engine costs were $1,756. Repair, maintenance and depreciation on nets were the most substantial cost items, averaging approximately $4,278 in 1976.

Total cost per boat was $10,754 in 1976 (Table 6). Average investment per small boat was $18,681. At the assumed rate of 7.5 percent, returns to investment were estimated to be $1,401. Annual fishing time per boat averaged 1,699 hours. Crewmen on large Spanish mackerel net boats spent 1,880 hours at sea and earned $11,484 in 1976 (see analysis later in this report). Captains of small boats could earn at least this much working on a large boats, so the valve of their labor would be $11,464. Some boats also employ one crewman during a portion of the year (average 0.6 crewman per boat, see Table 6, footnote d). The average labor paid for crew could not be determined, but after returns to captain's own labor and investment are subtracted from net revenue, $3,078 remain for the crewmember's labor and the captain's management functions. Labor and management together amount to $14,543; but labor returns are not to the captain alone, but also include returns to a crewman during the times (0.6) when a crewman is required.

Table 6. Cost and returns by small Florida East Coast Spanish mackerel net boats, 1976[a]

Item	Average per boat	Range[b]	
		Low	High
Spanish mackerel:			
Pounds	58,360.00	20,000	100,000
Dollars	10,547.86	3,600	18,000
Bluefish:			
Pounds	27,354.86	4,000	50,000
Dollars	3,565.36	480	7,000
Other:			
Pounds	58,829,57	1,200	250,000
Dollars	12,584.32	600	25,000
Total[b]:			
Pounds	144,544.43	105,000	400,000
Dollars	$ 26,697.54	16,200	49,000
Fuel	1,711.16	480	3,714
Oil	243.91	10	690
Spotter plane	302.92	0	2,116.
Rain gear & gloves	273.68		
Overhead	294.64	0	900
Ice	562.57	244	1,200
Hull:			
Repairs and maintenance	608.19	144	1,300
Depreciation	418.89	200	667
Engine[c]	1,756.09	1,450	2,500
Electronic equipment:			
Repair and maintenance	134.56	0	350
Depreciation	169.72	50	233
Nets:			
Repair and maintenance	1,040.67	600	2,000
Depreciation	3,237.68	1,600	5,000
Total cost	$ 10,753.97		
Net returns[d]	$ 15,943.57		

[a]Averages based on records from 7 boats ranging in size from 20 to 22 feet in length.

[b]Range data do not total individual species reports in this table because highs and lows were recorded for individual operations which were not necessarily the same for each species.

[c]Since engines for boats were generally replaced each year total engine expenses are included as one item rather than in two items for repair and depreciation.

[d]These boats have crewmen on board for some trips during the year. The result is an average of 0.6 crewmen per boat. Data on the exact percentage of each crewman's share per boat were not available, because the catch could not be separated into trips during which crewmen were on board. In addition, crewmen on small boats are sometimes family members. Net returns to the boat include both the captain's share and that of the crewman during the trips in which a crewman was required.

Large Boats

Production characteristics. Spanish net boat captains on large boats had an average age of 45.5 years (Table 7) with an average of 33.7 years fishing experience. Large boats average 42.3 feet in length and 13.9 feet in width with a net fish carrying capacity of 29,167 pounds. Two-thirds of the boats were constructed from fiberglass. One-half of the engines were gasoline powered with the remaining being diesel powered.

Number of fishing trips averaged 159.3 per large boat (Table 7). Average one way distance was 21.8 miles with a range of 12 to 30 miles for individual boats. The average fishing day was 11.8 hours which was 2.5 hours longer than the average for small net boats. Each boat averaged 8.8 nets with an average length of 4,200 yards.

Average catch and dollar returns. Large Spanish mackerel net boats landed an average of 425,000 pounds of Spanish mackerel in 1976 valued at $76,000 (Table 8). Spanish mackerel accounted for 82 percent of total volume landed and 79 of total value of landings per boat. Total sales range from $34,660 to $147,250 for individual boats.

Costs. Crew share was the most important item at $34,392 per boat (Table 8). Average number of crewmen per boat was three with the average crewman earning $11,464 in 1976. Spotter plane costs were the second most important variable cost item averaging $8,646 per firm. Fuel cost averaged $6,727 in 1976. Total variable and fixed cost of the hull and engine were $2,528 and $4,361, respectively. Cost of electronic equipment and nets were $559, and $7,856, respectively.

Total cost per boat was $74,536 in 1976 (Table 8). Net revenue per boat was $21,828.68. The captains labor input would receive $11,464 assuming his labor was rewarded at the same level as the average crewman. Average investment per large boat was $71,031. Returns to investment at a 7.5 percent rate of interest would be $5,327. This leaves a residual to management and the captain's onshore labor of $5,037.

Table 7. Production and financial characteristics of large Spanish mackerel net boat fishing operations, Florida East Coast, 1976[a]

Item	Average	Range in data	
		Low	High
Boat:			
Length (feet)	42.3	30	55
Width (feet)	13.9	11	16
Hull fabrication:			
Fiberglass (percent)	66.7		
Wood (percent)	33.3		
Carrying capacity (lbs. of fish)	29,166.7	15,000	50,000
Age (years)	4.3	.5	10
Engine:			
Horsepower	552.2	282	871
Fuel type:			
Diesel (percent)	50.0		
Gasoline (percent)	50.0		
Age (years)	1.8	.5	4.5
Captain:			
Age (years)	45.5	25	61
Experience (years)	33.7	10	50
Income from fishing (percent)	91.7	50	100
Fishing characteristics:			
Number of trips	159.3	100	220
Distance (miles one way)	21.8	12	30
Average hours per trip	11.8	8	20
Production inputs:			
Fuel (gallons)	13,483.3	5,000	30,000
Oil (quarts)	323.8	100	800
Percent with spotter plane	83.3		
Ice (pounds)	169,091.7	60,000	239,400
Nets:			
Number	8.8	5	15
Yards	4,200.0	3,000	6,000
Crewmen	3.0	1	5
Nets replaced (yards)	840.0	600	1,200
Investments (percent value):			
Engines	16,000.0	3,000	30,000
Hull	31,000.0	6,000	63,000
Electronic equipment	778.1	270	4,850
Nets	22,125	12,000	50,000
Other	1,128	270	4,650
Percent with loans	83		
Percent with insurance	83		

[a]Based on a survey of six Spanish mackerel boat captains taken on the Florida East Coast during February, 1977.

Table 8. Cost and returns for Florida East Coast large Spanish mackerel net boats, 1976[a]

Item	Average	Range[b] Low	Range[b] High
RETURNS:			
Spanish mackerel:			
Pounds	425,000.00	100,000	700,000
Dollars	$ 76,000.00	$ 18,000	$126,000
Bluefish:			
Pounds	52,500.00	25,000	100,000
Dollars	$ 6,766.67	$ 1,000	$ 15,000
Other:			
Pounds	38,583.33	10,000	100,000
Dollars	$ 13,598.33	$ 1,200	$ 37,500
Total:			
Pounds	516,083.33	197,000	798,100
Dollars	$ 96,365.00	$ 34,660	$147,250
	----------dollars----------		
Fuel	$ 6,726.50	$ 2,400	$ 15,600
Oil	174.98	46	400
Crew share[c]	34,391.66	9,339	50,513
Other labor	3,346.67	0	13,500
Spotter plane	8,645.77	0	14,725
Rain gear & gloves	1,172.98	250	3,410
Ice	1,907.39	900	2,594
Insurance	917.50	0	1,625
Interest	1,725.00	0	5,525
Overhead	187.50	0	680
Boat registration	35.42	15	51
Hull:			
Repair & maintenance	800.00	358	1,302
Depreciation	1,727.78	200	3,000
Engine:			
Repair & maintenance	2,082.37	94	5,000
Depreciation	2,279.17	750	6,000
Electronic equipment:			
Repair & maintenance	243.00	40	750
Depreciation	315.63	112	838
Nets:			
Repair & maintenance	1,579.17	75	5,000
Depreciation	$ 6,277.83	$ 2,500	$ 8,000
Total Cost	$ 74,536.32		
Net Returns	$ 21,828.68		

[a]Based on surveys taken from 6 large boat (30 to 55 feet in length) operators during February, 1977.

[b]Range data do not total individual species reports in this table beacuse highs and lows were recorded for individual operations which were not necessarily the same for each species.

[c]Crew share includes groceries provided for the crew.

MARKETING CONSIDERATIONS

Data and analysis of marketing information have been developed only for the king mackerel industry. The objectives of this section are to (1) review trends in producer and wholesale market prices, (2) identify the margin and shares in the king mackerel industry, (3) determine the functional relationship between the marketing margin, market prices, and marketing input cost and volume marketed, and (4) analyze the costs of marketing services which make up the marketing margins (cost of marketing also applies for Spanish mackerel). Accomplishment of these objectives will answer questions concerning price stability, changing market shares and margins and factors determining the size and variability of marketing margins.

King mackerel production on Florida's East Coast is concentrated in Central Florida off Palm Beach, Saint Lucie, Indian River, and Brevard Counties. Fishermen sell king mackerel to coastal wholesalers in gutted form. Wholesalers box and ice the fish which are trucked primarily by independent truckers to buyers. A 1975 survey conducted by the authors indicated that 65 percent of the Florida East Coast king mackerel was shipped to the New York Fulton market in 1974[1]. The survey represented approximately 85 percent of the East Coast production. Secondary wholesalers buy from Florida wholesalers and then resell on the New York market or sell on the market for a commission. Thus king mackerel actually do not change form from the time they are unloaded from the fishing boats until they pass through the New York market.

Price Analysis

A complete examination of prices, shares and margins requires knowledge of prices in each level of the marketing system. Unfortunately, prices at

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[1]The same survey indicated that 17 percent of Florida East Coast Spanish mackerel went out of state on the first sale. The actual amount going out is probably higher after moving through freezing plants.

each marketing level in the marketing system are not available. Prices are available at the producer level (sometimes referred to as either fisherman price, dockside price or the ex-vessel price) and at the New York Fulton Terminal fish market [9, 10]. The New York price level represents the price level received by secondary wholesalers as they sell to other wholesalers and retailers.

Both New York prices and Florida dockside prices trended upward with considerable month-to-month variation during the 48 month period from 1971 through 1974 (Figure 1). New York prices increased $.0085 per pound per month while dockside prices increased approximately $.0052 cents per pound per month (Table 9). A comparison of coefficients of variation show the New York price to be relatively less variable from month-to-month.[2] Month-to-month price variation was 27 percent at dockside and 23 percent at the New York market level.

The relatively larger monthly price increase at the New York market than at dockside suggests an increasing price spread or marketing margin. Marketing margins calculated as the difference between New York and dockside prices show considerable month-to-month variation (Figure 2) and a significant upward trend over the period (Table 9). The margin increased a a little over one-third of a cent per pound per month. The coefficient of variation for margins was 29.7 percent which is higher than variation for either the New York price or the Florida dockside price.

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[2]Coefficient of variation was calculated as:

$$CV = \left[\frac{\Sigma(P_i - \bar{P}_i)^2}{(n-1)}\right]^{1/2} \Big/ \bar{P}$$

where P_i represents price in month i and $\bar{P}$ represents the average price for the 48 month period.

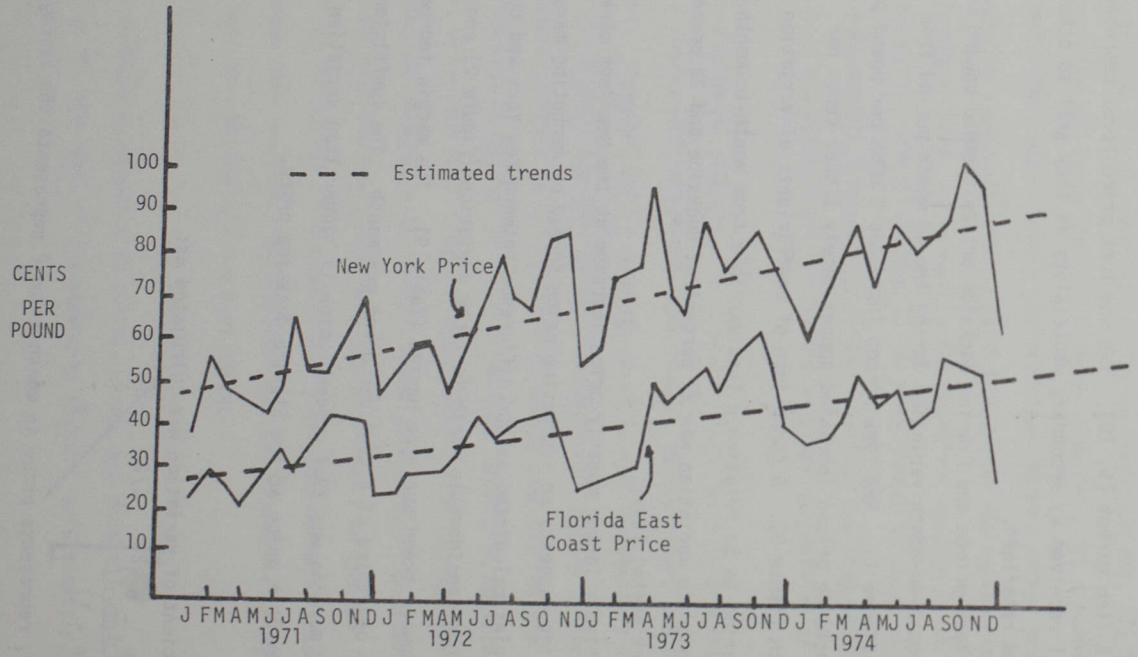

Figure 1. New York and Florida East Coast king mackerel prices and estimated trends by month, 1971-1974.

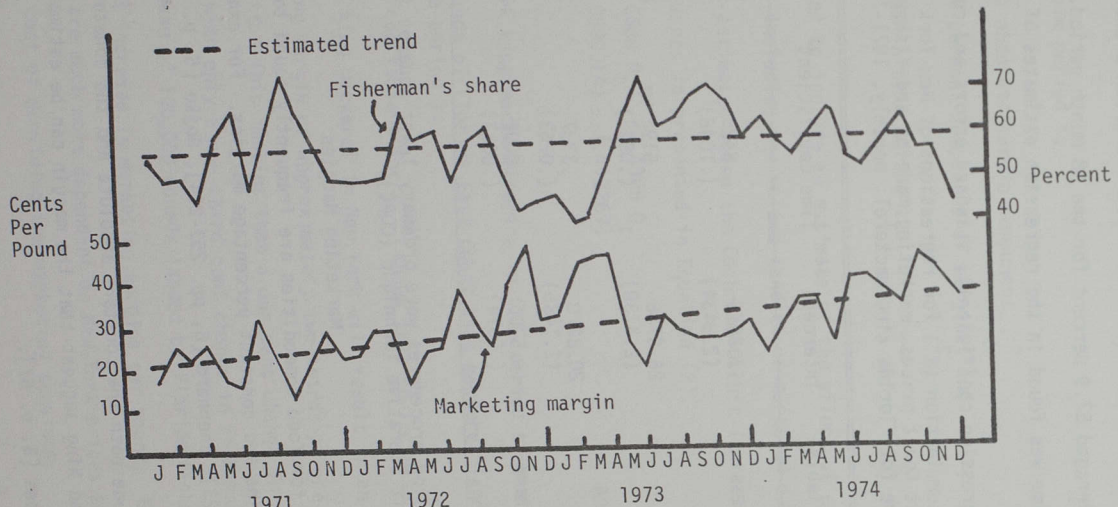

Figure 2. Fisherman's share, marketing margins, and estimated trends, Florida East Coast king mackerel, 1971-1974.

Market shares were computed to compare the relative increase in prices and margins (Figure 2 and Table 9). The fisherman's share of the New York price averaged 57.9 percent for the 48 month period. No significant trend over time was found in the regression estimates of market shares.[3]

Table 9. Regression coefficients, standard errors and coefficients of determination (R^2) for regressions of New York prices, Florida East Coast prices, marketing margins and fishermen shares over time for Florida king mackerel, monthly, 1971-74

Dependent variable	Intercept	Time coefficient	R^2	Procedure[a]
New York prices	47.8056 (2.9434)	.8528 (.1046)	.59	OLSQ
Florida East Coast price	26.9786 (2.3730)	.5192 (.0843)	.45	OLSQ
Gross marketing margins	20.8270 (2.1485)	.3337 (.0763)	.29	OLSQ
Fishermen's share	.5796 (.0514)	-.0002 (.0017)	.29	CORC

[a]Regression procedures were ordinary least squares (OLSQ) and the Cochrane-Orcutt Iterative Technique (CORC).

Marketing Margins

Margins for food commodities are frequently found to be a combination of absolute margins and constant percentage margins. For example see Thomsen [7, pp. 221-223]; Shepherd [6, pp. 253-254]; Rojko [5, p. 157]; and Waugh [11, p. 20].

To include both the constant absolute and the constant percentage margin, George and King suggest that the margin can be estimated as a function of retail prices [3, p. 57]:

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[3]Tomek and Robinson state that before any conclusions with respect to the well-being of any group can be made, changes in input coefficients and prices must be considered [8, p. 117].

$$M_t = a + b_1 P_t^R \qquad (1)$$

where:

M_t = margin in time period t,

a = the constant absolute margin component,

b_1 = the constant percent component of margins, and

P_t^R = retail prices in time period t_1.

Equation (1) was expanded to include an estimate of the effect of economies or diseconomies of size by including the volume handled or marketed during time period t. The equation estimated using the Cochrane-Orcutt Iterative Technique[4] of generalized least squares is presented in Equation (2).

$$M_t = \underset{(7.48761)}{-18.2241} + \underset{(.0899014)}{.6688}\, P_t^{NY} + \underset{(.412269)}{.4325}\, Q_t \qquad (2)$$

where:

P^{NY} = the New York king mackerel price in time period t, and

Q_t = 100,000 pounds of Florida East Coast king mackerel landings during time period t.

The highly significant coefficient for P_t^{NY} shows that an increase (decrease) of one cent per pound for king mackerel in New York will result in an increase (decrease) in the marketing margin of approximately two-thirds of one cent, holding volume marketed constant. This implies that a one cent change in New York prices are associated with only a one-third cent change in fisherman or dockside prices. An increase of 100,000 pounds landed by Florida fishermen is associated with a $.0043 increase in marketing margins per pound. Equation (2) suggests that margins are much more dependent on New York prices than volume marketed and thus the cost of providing the marketing services.

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[4]Ordinary least squares estimates resulted in an unacceptable Durbin-Watson (DW) statistic of .92. Using generalized least squares the DW statistic is 1.63 and R^2 = .72.

Margin Variations and Marketing Costs

Costs of marketing Florida king mackerel were determined from the survey of fish dealers (initial wholesalers) mentioned earlier on the Florida East Coast. Cost estimates are presented in Table 10. Variable cost items include transportation, electricity, labor, telephone and boxes. Transportation is the largest cost item, amounting to $7.68 per 100 pound box. Labor is second in importance in variable cost at $3.45 per box. Boxes used for shipping king mackerel average $1.40 each. Electricity charges are associated principally with icing activities. The relatively large marketing cost associated with telephone usage is because of constant communication with the terminal market. Variable costs total $13.95 per box.

Table 10. Weighted average marketing cost per box of Florida East Coast king mackerel during 1974

Item	Dollars per box[a]
Transportation to New York	7.68
Electricity	.95
Labor	3.45
Telephone	.47
Boxes	1.40
Total variable cost	13.95
Overhead[b]	3.86
Grand total	17.81

[a]A box is equivalent to 100 pounds.

[b]Overhead does not include return for equipment investment or depreciation.

Overhead cost includes costs of the plant based on rental rates and office expenses. No estimates for equipment costs were possible. Overhead or fixed cost plus variable cost totals to $17.81 per box. This cost does not include a return to the owners management function but does include his labor input.

The marketing margin between Florida dockside prices and the New York price represents two levels in the marketing system. These are the Florida wholesaler and the New York agent in the terminal market. Marketing charges by the New York agent were determined from the survey to be approximately 15 percent of the terminal price for king mackerel. Margins for Florida wholesalers were estimated by adjusting the total margin to represent the adjusted New York price. Both margins for 1973 are presented in Figure 3.

A comparison of monthly margins and cost is presented in Figure 3 using average marketing cost of $17.81 as shown in Table 10. During six months in 1973 and two months in 1974 margins to Florida fish dealers were not sufficient to cover average cost. Wholesalers continue to operate in months when costs exceed the total margins to hold their market share.

SUMMARY

King and Spanish mackerel landings are both of considerable importance in the state and landings of each increased considerably in recent years. Gross sales by king mackerel hook-and-line boats averaged $24,515 in 1976. Total cost incurred averaged $9,647 leaving net returns to the captain-owner of the boat at $14,868 annually in 1976. Net returns to captains of small Spanish mackerel net boats were comparable. Gross sales for Spanish mackerel, bluefish and other fish averaged $26,697 per small boat in 1976. Total costs incurred were $10,754 leaving net returns of $15,943 for the

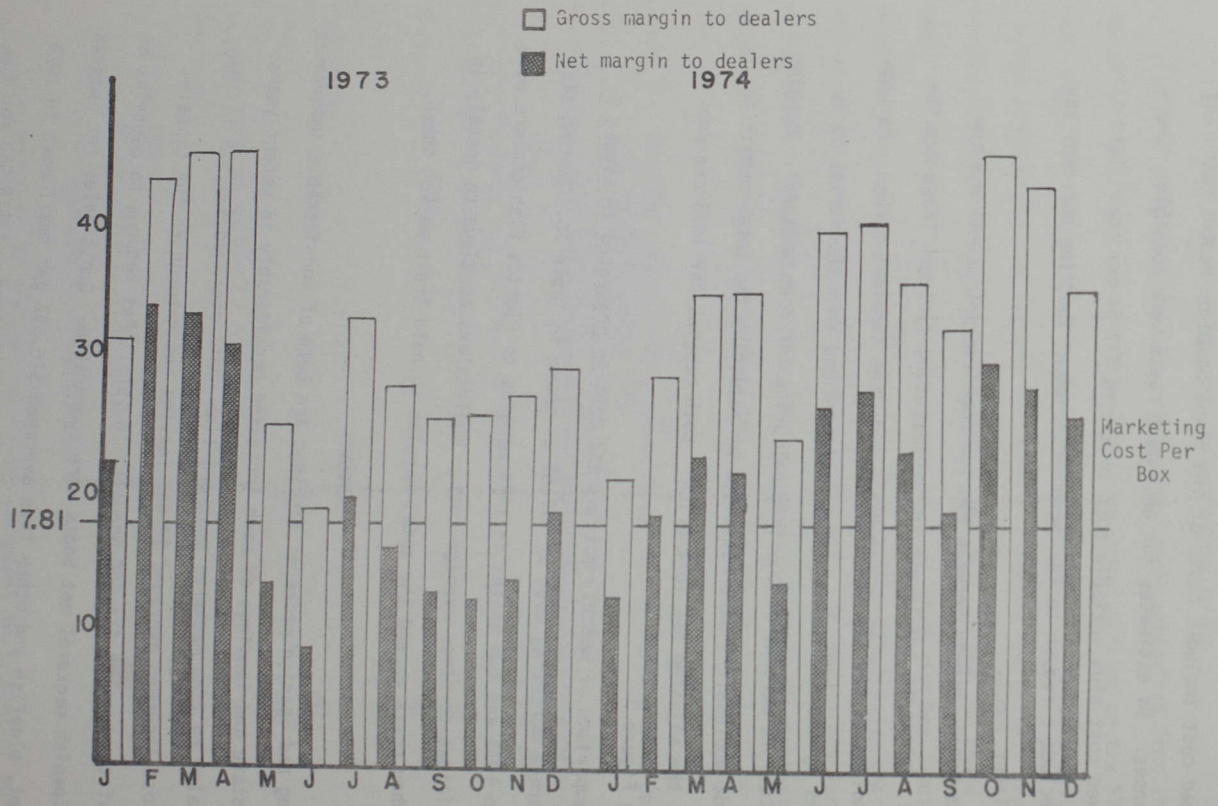

Figure 3. Gross margins to dealers (New York price minus Florida East Coast price), net margins to dealers (gross margin adjusted for selling commission) and marketing cost per box for Florida East Coast king mackerel by month, 1973-74.

year. Gross sales for Spanish mackerel, bluefish and other fish by large Spanish mackerel net boats averaged $96,365 per boat in 1976. Total costs incurred were $74,536 leaving net returns per large boat equal to $21,829 for 1976.

Prices at both the New York terminal market and Florida dockside trended upward for the 48 months shown from 1971 to 1974 with the greater increases occurring at the terminal market. Month-to-month variations in prices are considerable at both levels but relatively more unstable at the dockside level.

The marketing margin increased significantly while fishermen's gross share remained constant. Month-to-month variation was considerable. The margin received by Florida fish dealers was found to be a function of both the terminal market price and the volume landed by fishermen. However, variation in New York prices essentially explained all of the monthly variation in marketing margins.

Costs of performing marketing services for king mackerel were found to be approximately $17.81 per 100 pound box in 1974. For six of the twelve months during 1973 and two of the months during 1974 the price spread was not sufficient to cover marketing costs. However, because of large volumes marketed during months with positive net margins the average net margin was $3.01 per box.

References

[1] Breimyer, Harold F. "On Price Determination and Aggregate Price Theory," Journal of Farm Economics, 39: 678-694, 1957.

[2] Buse, Rueben C., and G. E. Brandow. "The Relationship of Volume, Prices and Costs to Marketing Margins for Farm Foods," Journal of Farm Economics, 42: 362-370, 1960.

[3] George, P. S. and G. A. King. Consumer Demand for Food Commodities in the United States with Projections for 1980. Berkeley: Giannini Foundation Monograph Number 26, March, 1971.

[4] Ladd, George W. Agricultural Bargaining Power, Ames: Iowa State University Press, 1964.

[5] Rojko, A. S. The Demand and Price Structure for Dairy Products, USDA, Technical Bulletin 1168, 1957.

[6] Shepherd, G. S. Marketing Farm Products, Economic Analysis, Third Ed., Ames: Iowa State University Press, 1955.

[7] Thomsen, F. L. Agricultural Marketing, New York: McGraw-Hill Book Company, Inc., 1951.

[8] Tomek, William G. and Kenneth L. Robinson. Agricultural Product Prices. Ithaca, New York: Cornell University Press, 1972.

[9] U. S. National Oceanic and Atmospheric Administration. Florida Landings, January 1971-December 1975.

[10] U. S. National Oceanic and Atmospheric Administration. Fishery Market News Reports (New York), January 1971-December 1974.

[11] Waugh, Frederick W. Demand and Price Analysis; Some Examples from Agriculture, ERS, USDA, Technical Bulletin 1316, 1964.

RECREATIONAL FISHING FOR KING MACKEREL IN BAY COUNTY, FLORIDA, DURING 1975

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PREFACE

The following report was written for our constituents, many of which helped make this study possible. The report was not re-written for publication in a scientific journal for the following reasons:

1. A large and important stratum (privately owned boats registered outside of Bay County) of the desired sample frame was not sampled for catch and effort. Before initiating the survey we assumed that this stratum would represent about 20% of the private boats that fish for king mackerel from Bay County; ratio sampling indicated that this stratum represented about 73% of the private boats.

2. Response rates were low for two strata of private boats.

3. Non-response bias was checked only superficially within certain strata, but these checks indicated that serious bias existed. We could not define the degree of bias and thereby correct our estimates with any degree of statistical reliability. We were unable, therefore, to compute statistically valid confidence limits about our estimates.

INTRODUCTION

A study of recreational fishing for king mackerel in Bay County, Florida, was undertaken from April 1 through November 31, 1975, by biologists of the Panama City Laboratory of the Gulf Fisheries Center, National Marine Fisheries Service. Information on catch and effort was obtained using questionnaires and log sheets provided to owners of private boats and captains of charter boats and party boats. Analyses of the data returned by these recreational fishermen permitted us to estimate the amount of effort expended in catching king mackerel and the total number and pounds of king mackerel.

Catch and effort data are extremely valuable to biologists, because the data indicate to biologists what is being caught, how much is being caught, where catches are being made, and when catches are being made. These bits of information obtained over a sustained period of time are then used by biologists to determine abundance and distribution of stocks of fish and whether or not the stocks are being over or under fished. Economists can also use these data in determining the value of recreational fishing and related activities.

Ultimately, we wish to obtain data from all recreational fisheries in the Gulf of Mexico. Because methods and techniques of getting these data must be developed and tested, we decided to restrict our initial study to the recreational boat fishery for king mackerel in Bay County. The methods that were developed and the results of our study are presented in this report.

In the following sections, we first present a review of the available statistics on both commercial and recreational catches of king mackerel in the U.S. Then we describe briefly the offshore recreational fisheries of

Bay County, Florida. Next we state our objectives in the 1975 study and follow this with a description of the methods used in the study. After discussing our evaluation of these methods, we present the results of our analyses on effort, catch per effort, and catches.

STATISTICS ON KING MACKEREL CATCHES

The U.S. commercial fishery for king mackerel exists mainly along the Atlantic coast of Florida. Landings and the value of landings have increased from 4.16 million pounds valued at 0.53 million dollars in 1962, to 4.88 million pounds valued at 1.31 million dollars in 1972. During 1972, the total pounds of king mackerel landed by all U.S. commercial fishermen, in relation to area or state, were: Chesapeake Bay, 1,800; North Carolina, 9,000; South Carolina, 1,000; east coast of Florida, 3,489,000; and west coast of Florida, 1,378,000. Note that 4.87 million pounds (3,489,000 plus 1,378,000), or 99.8% of the entire U.S. catch, were landed in Florida. Only 28.2% of the 4.87 million pounds were landed on Florida's west caost, and only 7.4% (102,237 pounds) were landed in the six northwestern coastal counties of Florida (Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf Counties).

A summary of the commercial landings of king mackerel in Florida from 1950 to 1973 is shown in Figure 1. A generally increasing trend in landings and value is evident.

Much less information is available on U.S. recreational fishery landings. Total numbers and pounds of king mackerel caught by recreational fishermen in 1970 by region were: Middle Atlantic, 45,000 and 225,000 lbs.; South Atlantic, 4,165,000 and 34,942,000 lbs.; Eastern Gulf, 2,813,000 and 24,481,000 lbs.; and Western Gulf, 259,000 and 2,978,000 lbs.

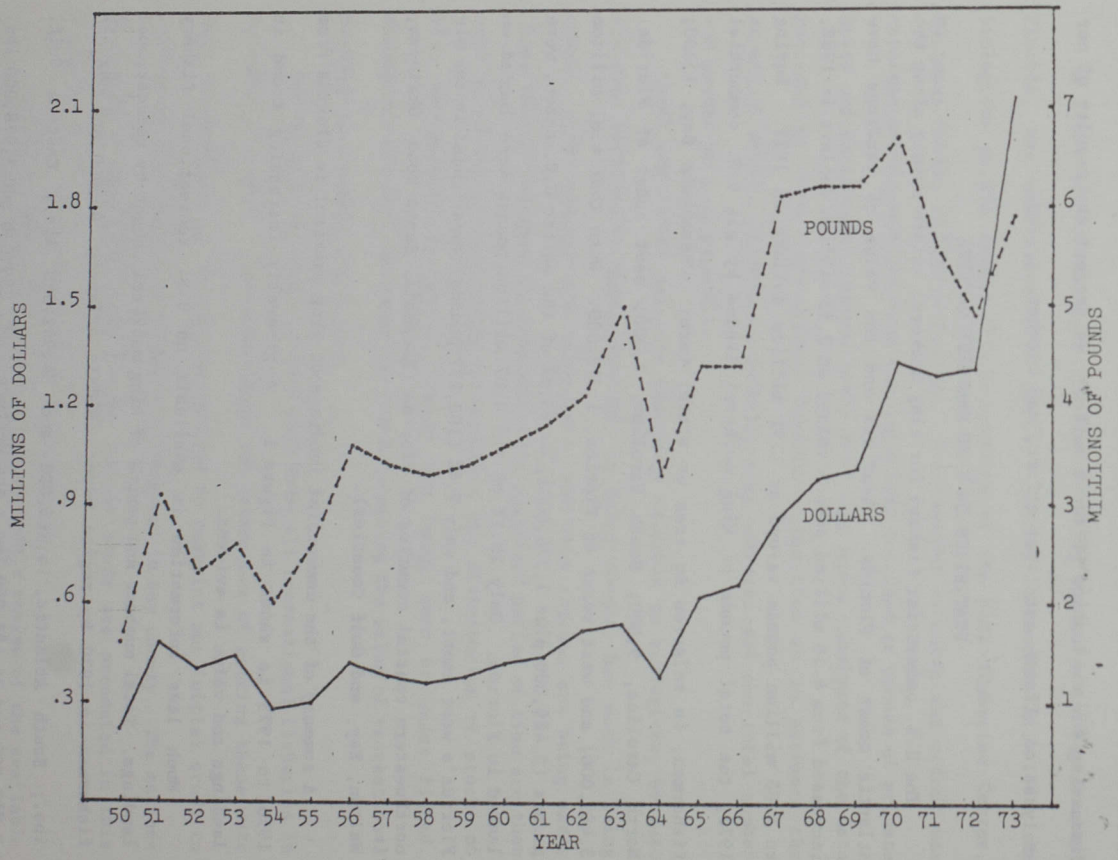

Figure 1. Values and landings of king mackerel in the Florida commercial fishery, 1950-1973.

Interestingly, the estimated average weights of king mackerel caught for each region were: Middle Atlantic, 5.0 lb.; South Atlantic, 8.4 lb.; Eastern Gulf, 8.7 lb.; and Western Gulf, 11.5 lb.

Attempts have been made to compare the commercial with the recreational catches of king mackerel in Florida. In 1965, the Florida Department of Natural Resources estimated that 61.6 million pounds of king mackerel were caught by Florida recreational fishermen, while only 4.4 million pounds were taken commercially. This means that the recreational catch was at least 14 times as great as the commercial catch. For 1970, the total landings of king mackerel in the South Atlantic and Eastern Gulf of Mexico were an estimated 62.6 million pounds for the recreational fishery and 6.7 million pounds for the commercial fishery. Thus, the catch of king mackerel by the recreational fishery was estimated as 9.3 times that of the commercial fishery.

Clearly then it is evident that as accelerating fishing pressures are placed on king mackerel populations, both recreational and commercial catch data must be obtained. Both types of data are necessary for rational biological, economic and sociological decisions if conflicts arise in future years regarding the harvesting of this resource.

TYPES OF RECREATIONAL BOAT FISHERIES IN BAY COUNTY

Offshore fishing adjacent to Bay County, Florida, is done from charter boats, party boats, and privately owned inboard and outboard boats. In March 1975, over 99% of the charter and party boats fished from four docking sites in St. Andrew Bay and one in Mexico Beach (Fig. 2), whereas the private boats fished from dockage and landing sites scattered throughout the county. In April, when the study began, 50 charter and 13

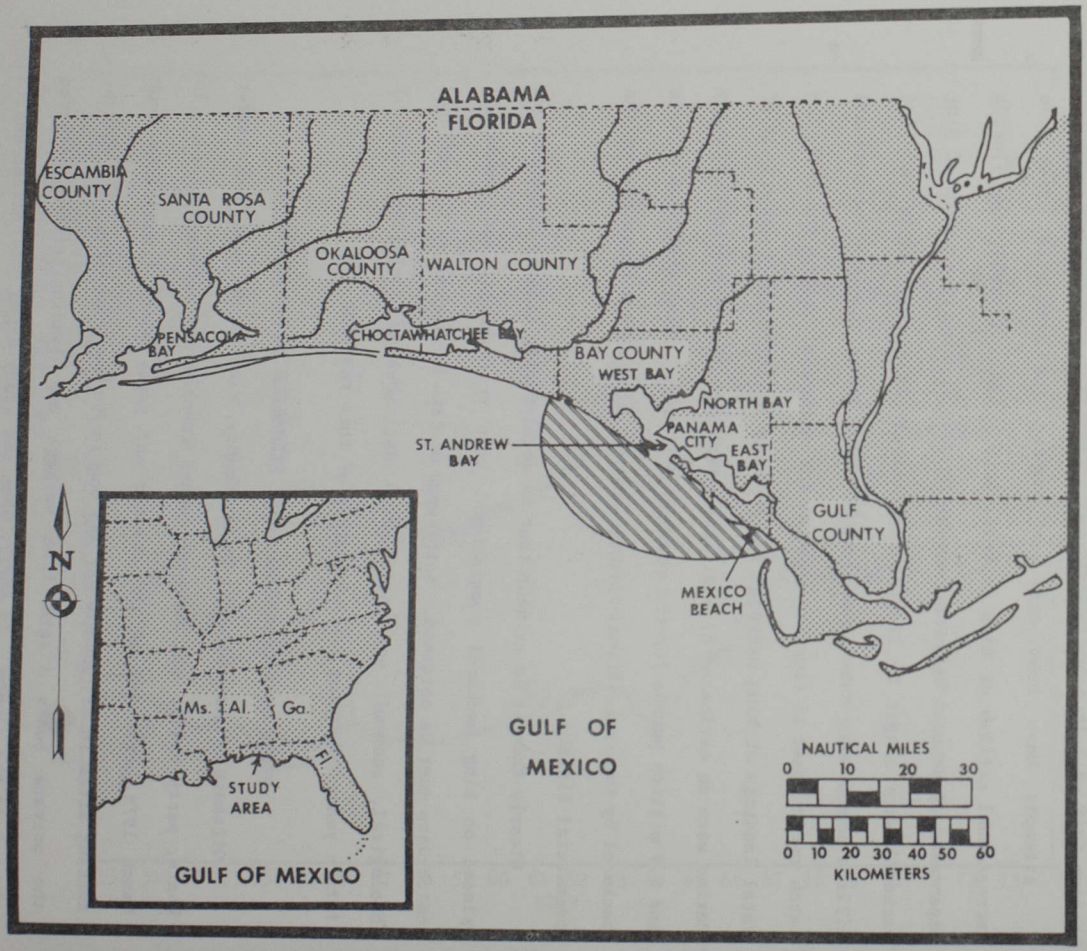

Figure 2. Chart of northwest Florida showing area where most king mackerel are caught by Bay County recreational fishermen.

party boats were available for charter and fee fishing, and according to the Florida Motorboat Registration Division, 5,581 privately owned outboard and inboard boats were registered in Bay County (Table 1). In addition, more charter and party boats entered the fishery during the survey and a large number of privately owned boats registered outside Bay County were stored in or trailered to Bay County and used for salt-water fishing. In July, the numbers of charter and party boats available for hire had increased to 60 and 15, respectively.

Cost of fishing from charter or party boats varies in relation to the length and type of fishing trip. Costs of salt-water fishing from charter boats ranges from about $90 for a 4 hour trip (nearshore) to about $300 for a 12 hour trip (offshore). These boats range in length from 28 to 65 feet and accommodate from 4 to 25 people. Prices of the chartered vessel usually include tackle, ice, and services of a deckhand. Fees per fisherman for party boat fishing range from $8 for a 5 hour trip (nearshore) to $25 for a 15 hour trip (offshore). The party boats range in length from 65 to 85 feet and accommodate from 15 to 60 people per trip. Fees include tackle, ice, and the services of at least one deckhand per 10 fishermen. All fees charged by charter and party boat fishermen include "running times" to and from fishing grounds.

Most of the privately owned boats that fish nearshore or offshore range in length from 15 to 25 feet. The number of fishermen on a private boat varies from 1 to 10.

The charter and privately owned boats generally use one of three fishing techniques. Trolling is the most commonly used technique. Charter boats normally use four lines, two fished at the surface (unweighted) and two fished at some depth below the surface (weighted). Private boats

Figure 1. Bay County recreational fishermen.

Table 1. Summary of charter boats, party boats, and registered private boats in Bay County with retail value of prizes awarded to captains or owners of each type of boat during 1975.

Boat type	Length of boat in feet	Number available on 1 April	Prizes*		
			Value of those available (dollars)	Number awarded	Value of those awarded (dollars)
Charter	28 to 65	50	1,710	64	1,308
Party	65 to 85	13	375	24	375
Private					
Small	Less than 15	3,150	966	15	231
Medium	15 to 20	1,982	608	9	175
Large	Greater than 20	449	138	8	130

*Penn reels, Andé monofilament line, Sampo fighting belts, Pompanette gaffs, Dexter stainless steel knives, Sportmate cutters, Low-Boy coolers, Plano tackle boxes, rainsuits, and True-Temper boat rods. (Use of trade names does not imply endorsement by the National Marine Fisheries Service.)

usually troll less than four lines and remain closer to shore. Trolling usually is conducted in a straight line until fish are hooked, and then the vessel trolls in tight circles until fish are no longer being caught. Circular trolling also occurs around structures (buoys and surface platforms) and over underwater outcrops or structures (artificial reefs). Round scad, locally called "cigar minnow" is the most frequently used bait (common, local, and scientific names used in this report are listed in Table 2).

A second technique is often called jigging; the vessel remains close to surface or underwater structures while the fisherman casts a lure toward or over the structure and retrieves the lure by jerking it through the water.

The third technique is to anchor or drift near surface or subsurface structures and fish with bait in some part of the water column. Occasionally a charter or private boat fisherman will use live round scad, pinfish, pigfish, or blue runner as bait.

The fishes caught most abundantly by charter and private boat fishermen are king mackerel, little tunny, dolphin, Spanish mackerel, jack crevalle, blue runner, ladyfish, bluefish, barracuda, greater amberjack, cobia, gray triggerfish, snappers, and groupers.

The party boats almost always use one fishing technique claled bottomfishing. These boats usually fish over bottom outcroppings (natural or artificial) and travel farther offshore than do the charter and private boats. Usually one rod with an electric reel and a line of 80-100 pound break strength is used per fishrman. Baits frequenlty used include dead round scad, Spanish mackerel, ladyfish, mullet, squid, and live pinfish, pigfish, or blue runner.

Table 2. Common names, local names, and scientific names of fishes or groups of fishes mentioned in this report.

Common name	Local name	Scientific name
Round scad	Cigar minnow	Decapterus punctatus
Pinfish	Chofer	Lagodon rhomboides
Pigfish	Chofer	Orthopristis chrysopterus
Blue runner	Hardtail	Caranx crysos
Spanish mackerel	Spanish	Scomberomorus maculatus
Ladyfish	Skipjack	Elops saurus
Mullet	Mullet	Mugil sp.
King mackerel	Kingfish	Scomberomorus cavalla
Little tunny	Bonito	Euthynnus alletteratus
Dolphin	Dolphin	Coryphaena hippurus
Crevalle jack	Crevalle jack	Caranx hippos
Bluefish	Bluefish	Pomatomus saltatrix
Great barracuda	Barracuda	Sphyraena barracuda
Greater amberjack	Amberjack	Seriola dumerili
Cobia	Ling	Rachycentron canadum
Sea bass	Squirrel fish	Centropristis sp.
Sand perch	Squirrel fish	Diplectrum sp.
Gray triggerfish	Triggerfish	Balistes capriscus
Gag grouper	Black grouper	Mycteroperca microlepis
Red grouper	Red grouper	Epinephelus morio
Red hind	Kitty Mitchell	Epinephelus guttatus
Scamp	Scamp	Mycteroperca phenax
Warsaw grouper	Warsaw	Epinephelus nigritus
Porgies	White snapper	Calamus sp.
Vermillion snapper	Beeliner	Rhomboplites Aurorubens
Red snapper	Red snapper	Lutjanus campechanus
Gray snapper	Black snapper	Lutjanus griseus

Fishes caught in greatest abundance by party boat fishermen include greater amberjack, black or gag grouper, red hind, scamp, warsaw grouper, porgies, vermillion snapper, red snapper, black snapper, dolphin, and gray triggerfish.

OBJECTIVES

The objectives of our study in Bay County during 1975 were:

1. To develop an acceptable method for obtaining catch and effort information;
2. To estimate the total amount of fishing effort expended to catch king mackerel;
3. To determine the average number of king mackerel caught per hour of fishing from each kind of boat; and
4. To estimate the total number of king mackerel caught by all boats during the king mackerel season.

METHODS

Before beginning the survey we had to do several things. First, we had to specifically define the units that we were interested in, or the units that were to be sampled. The unit that we used was an individual boat. To sample properly, and to make our final estimates, we had to know how many boats of each type would be included in our total population of boats, and how to reach by mail, personal interview, or telephone each boat owner or operator.

Our population of boats was defined as all charter boats and party boats that were planning to fish from Bay County during 1975, and all privately owned boats, by size class (Table 1), registered in Bay County in early 1975. We obtained this information, along with names and addresses,

by interviewing charter and party boat captains and from the Florida Motorboat Registration Division. This population did not include, however, all private boats that would fish, but were not registered, in Bay County. Since there was no feasible way to obtain a listing of the private boats registered outside of Bay County that planned to fish in Bay County, we were forced to use two sampling techniques which will be discussed later. The number of boats of each type and size class are given in Table 1.

The second step was to define the types of information we would obtain from each boat captain or boat owner. We decided that we needed to know, from a sampled boat on a particular day, whether the boat was involved in fishing for king mackerel and, if so, how many king mackerel were caught, and how many hours the boat was involved in fishing for king mackerel.

The third step was to decide how to obtain the desired information. Three commonly used methods--personal interview, telephone interview, and postal questionnaire--were considered. We decided to use postal questionnaires for most of our sampling because personal interview was too expensive in terms of manpower, and we assuemd that telephone interviews would be too much of an inconvenience to the boat captains and fishermen. The other two methods (personal and telephone interview) were used in special cases, however, as discussed later.

Postal questionnaires have been used in several fishery surveys, but serious problems have occurred in almost all of these because of poor response rates, and because of non-response bias in certain situations. In an attempt to prevent the problem of poor response we did the following: (1) designed our questionnaire (Figs. 3 and 4) so that only a minimum amount of information was requested, and it would be easy to fill out and

CARD NO._____

OMB NO. 41-S-75037
expires 12/77

Your help in answering this questionnaire will be greatly appreciated.

1. On_____, _____, was **your boat** engaged in fishing for King Mackerel? YES NO (circle one)

2. If your answer was "YES":
   a. How many hours was your boat engaged in fishing for King Mackerel? _____.
   b. How many King Mackerel were caught?_____ (enter zero if none were caught)

Thank you very much!

Figure 3. Return part of the questionnaire used to obtain information from charter boat captains.

CARD NO._____

OMB #41-S-75037
expires 12/77

Your help in answering this questionnaire will be greatly appreciated.

During the week of_____, did any fishing for **KING MACKEREL** occur **from your boat?** YES NO (circle one)

If your answer was "YES" please indicate in the boxes below the **hours fished** for **King Mackerel** and the **number caught** for each day that fishing occurred:

DAY	SUN	MON	TUES	WEDS	THURS	FRI	SAT
HOURS FISHED							
KING MACKEREL CAUGHT							

Thank you very much!

Figure 4. Return part of the questionnaire used to obtain information from private boat owners.

return; (2) incorporated a reward system so that each respondent had a chance of winning a valuable prize (we awarded $2,219 worth of prizes--see Table 1); and (3) promoted our survey by newspaper articles (6 June, 15 July, 17 August, and 15 October), a television appearance (12 September), discussions with local organizations (15 April and 1 July), and personal contact with the boat captains and fishermen. To evaluate non-response bias, we also conducted a one-week telephone survey of private boat owners. This helped us to determine whether or not the pecent of boat owners that go fishing as estimated with postal questionnaires was similar to that estimated by telephone interviews.

The fourth step was to design the statistical methods for sampling and analyzing the data. Each boat type (charter, party, and private) and each size class of private boat (Table 1) were sampled as independent units. The required sample sizes were determined for each boat type or size using appropriate statistical procedures, and for each day or week, names were selected at random from the lists of charter boat captains and private boat owners. The names were selected by computer and printed with the corresponding addresses on labels which were fixed to the questionnaires. These questionnaires were mailed to charter boat captains 1 day prior to the end of the weekly period in question. Data from the party boat captains were obtained each week by picking up forms that had been left with them. Information on the percent of private boats fishing for king mackerel in Bay County but registered outside the county were obtained by personally recording the registration numbers of boats going through West Pass (Fig. 2) or on the fishing grounds.

EVALUATION OF SAMPLING METHODS

In general, we were pleased with the response rates (number of questionnaires returned vs. number of questionnaires mailed) obtained in this survey and are extremely grateful to the charter boat captains, party boat captains, and private boat owners that cooperated with us in conducting this survey. Of a total of 28,097 questionnaires mailed, the following percentages were returned: charter boats, 58.2%; private boats--large, 40.6%, medium, 23.5%, and small, 18.5% (Table 3). A total of 2,684 log sheets were given to the party boat captains, and 83.9% of these were properly filled out and returned.

The big differences in response rates in relation to boat type or size of private boat are possibly explained as follows. Charter boat captains are dependent upon king mackerel for a major part of their livelihood and are very much interested and concerned about king mackerel resources. Further, we were able to personally contact most charter boat captains at least one time to discuss our survey and saw several of them frequently during the survey. During these discussions they indicated that the prizes provided an important incentive to return the cards. Their response rate of 58.2% was much higher than that reported in any similar study that we are aqare of. The response rates from private boat owners were expected to be lower than those from charter boat captains, because the boat owners were not as dependent upon king mackerel resources and, except for an extremely small number, they were contacted only through the questionnaires and by newspaper and T.V. We were unable to evaluate the effects of awarding prizes to private boat owners.

Due to the low response rates and our inability to discuss personally our program with each private boat owner, we questioned whether the people

that returned cards were representative of all those who owned boats. Our telephone survey indicated that our questionnaire survey was overestimating the percent of private boat owners that were fishing on a prticular day. During the week of September 14-20, the number of questionnaires mailed to small boat owners was 269 (38 returned) and to large boat owners 13 (4 returned); telephone calls were completed to 90 small boat owners and to 8 large boat owners. Both questionnaires and telephone calls obtained information for a 7-day period. For small boats, the estimated percents of the days that boats fished were 3.0% by questionnaire and 0.2% by telephone. For large boats these percents were 14.3% from questionnaires and 5.4% by telephone. Based on one week's data, we tentatively concluded that a serious response bias occurred in using mailed questionnaires to determine the percent of private boat owners that fish for king mackerel. We adjusted our estimates accordingly. The explanation for this bias is probably that boat owners who fish for king mackerel are more likely to return questionnaires than boat owners who do not fish for king mackerel. Another indicator of this bias is that the response rate by boat owners increased with an increase in boat size (Table 3). For private boat owners the likelihood of the boat being used to fish for king mackerel probably increases with boat size.

We think our results from charter and party boat captains were representative of the respective boat types because of the high response rates and because of our personal involvement with the captains.

We detected a general decrease in response rate within each boat type or size of boat as the season progressed (Fig. 5). Possible explanations for these trends are that the novelty of the survey diminished or that general enthusiasm for the survey by boat captains and fishermen declined as the season progressed.

Table 3. Summary of response to questionnaires in the king mackerel survey in Bay County in 1975.

Boat type	Number sent out	Number returned	Percent returned
Charter	3,242	1,887	58.2
Party	*	*	*
Private			
Large	2,276	925	40.6
Medium	8,002	1,877	23.5
Small	14,577	2,691	18.5

*Data not applicable.

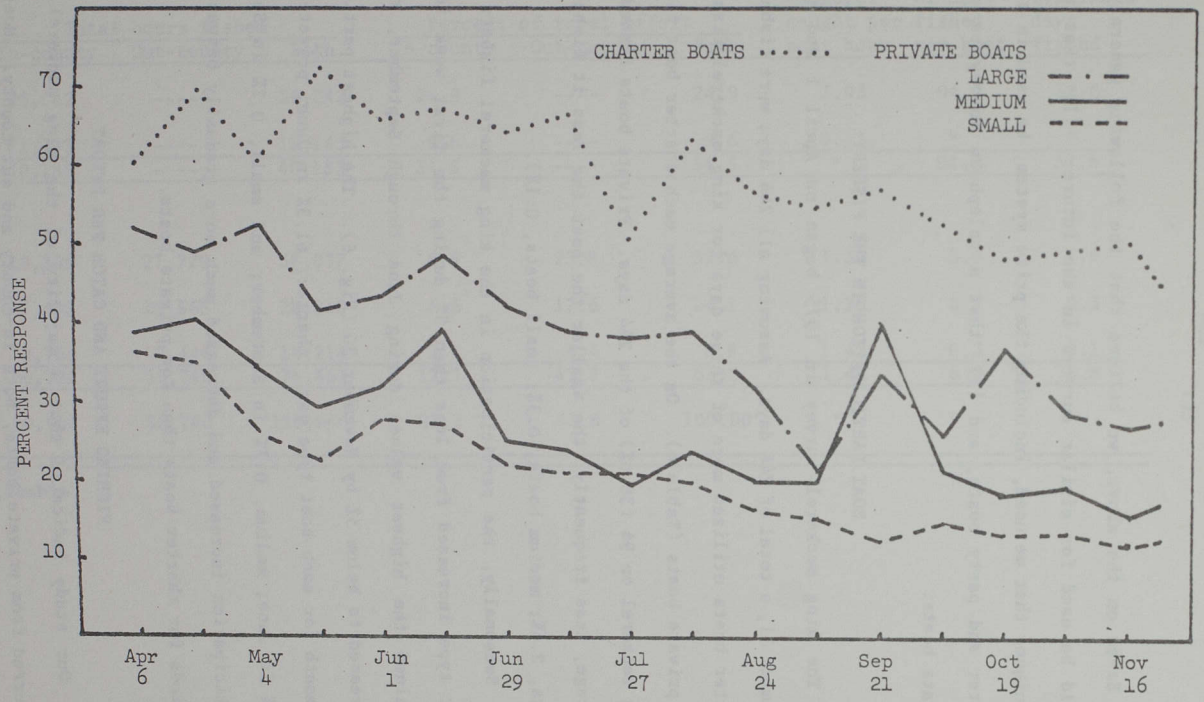

Figure 5. Percent of questionnaires returned per two-week period in 1975 for charter boats, and for private boats by size class.

Based on the above, we believe that the following general methods should be used for similar surveys in the future: (1) that the same techniques that we used, including the prize system, be used in surveying charter and party boats, and (2) that a telephone survey be used for private boats.

BOAT PARTICIPATION IN THE FISHERY

The king mackerel survey in 1975 began on April 1 and ended on November 31, a total of 244 days. Assuming all 244 days were fishable, the charter boats utilized more of these days for king mackerel fishing than did private boats (Table 4). On the average each charter boat fished for king mackerel on 94 (38.6%) of the 244 days. Private boats fished, on the average, less frequently, the smaller the boat the less it fished (large boats, 2.4%; medium boats, 0.3%; small boats, 0.1%).

Seasonally, the participation in the king mackerel fishery by each boat type increased from less than 5% during the first week in April, attained the highest values during June through September, and then decreased to below 5% by November 30 (Fig. 6). The highest participation by month for each boat type was: charter, 61.3% in June; private--large, 3.8% in June; medium, 0.7% in September; and small, 0.2% in September. Participation increased and decreased much more gradually between 2-week periods for charter boats than for private boats.

FISHING EFFORT AND CATCH PER EFFORT

Our study indicated that a majority of the king mackerel fishing occurred from private boats, both in-county and out-county. Most of the private boat effort was expended from out-county boats (72.9% of all private boats were out-county; Table 5). The total private boat (in-county

Table 4. Summary of estimated effort on king mackerel landed in Bay County between April 1 and November 31, 1975.

Boat type	Total hours fished			Percent of total effort			Number of king mackerel caught per boat hour	Average number of days fished per boat	Percent of total available days fished
	In-county	Out-county	Both	In-county	Out-county	Both			
Charter	29,042	----	29,042	24.9	----	24.9	3.93	94.2	38.6
Party	11,143	----	11,143	9.6	----	9.6	0.13	*	*
Subtotal	40,185	----	40,185	34.5	----	34.5	*	94.2	38.6
Private									
Large	10,308	27,729	38,037	8.8	23.8	32.6	1.39	5.9	2.4
Medium	7,645	20,565	28,210	6.5	17.6	24.1	1.36	0.7	0.3
Small	2,768	7,446	10,214	2.4	6.4	8.8	1.49	0.2	0.1
Subtotal	20,721	55,740	76,461	17.7	47.8	65.5	1.44	6.8	2.8
Total	60,906	55,740	116,646	52.2	47.8	100.00	*	*	*

*Data not applicable.

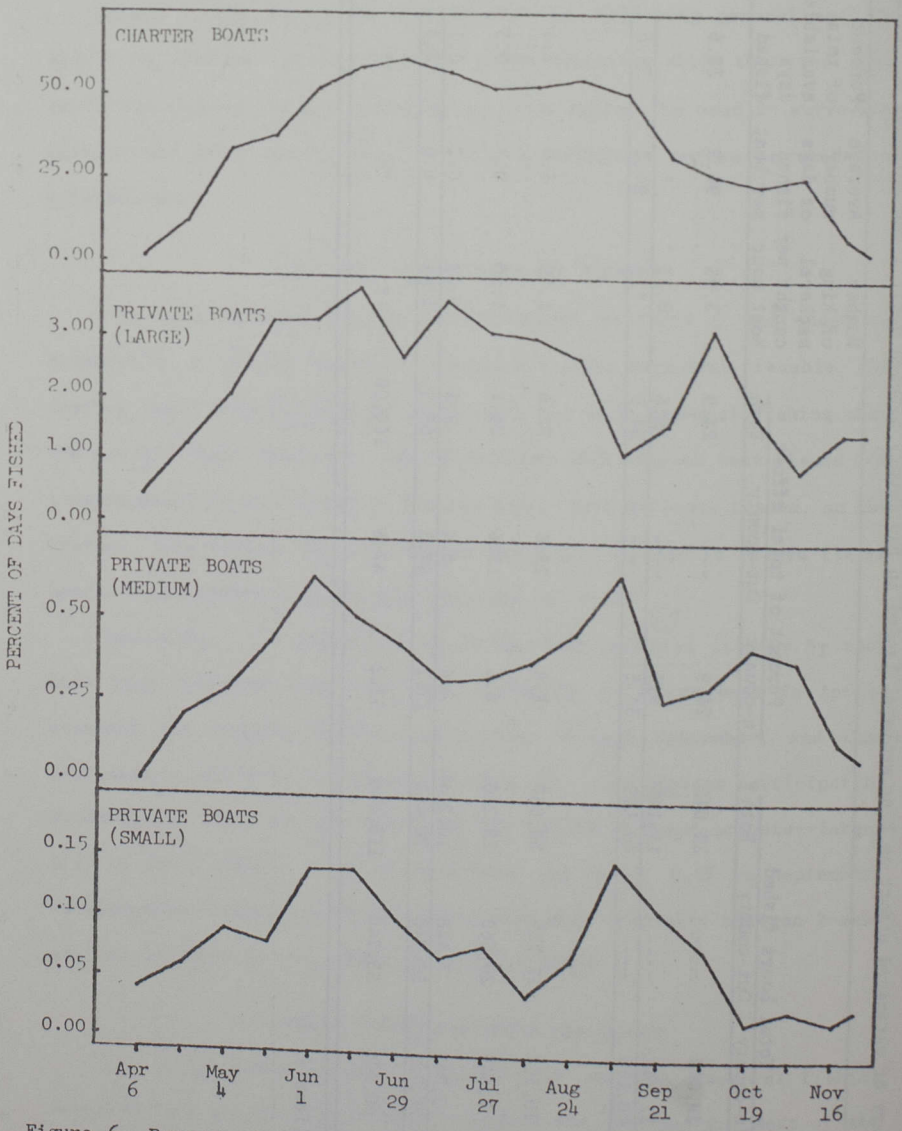

Figure 6. Percent of the total number (244) of days that boats fished for king mackerel by two-week periods in 1975 for charter boats, and for private boats.

Table 5. Summary of counts made at West Pass in 1975 of private boats assumed to have gone fishing for king mackerel.

Month	Number days boats counted	Number Bay County boats	Number out-county boats			Total number boats	Percent out-county boats
			Florida	Non-Florida*	All		
May	5	23	20	41	61	84	72.6
Jun	7	87	86	116	202	289	69.9
Jul	3	22	28	56	84	106	79.2
Aug	3	7	9	25	34	41	82.9
Sep	2	6	6	11	17	23	73.9
Oct	1	27	31	33	64	91	70.3
Total	21	172	180	282	462	634	72.9

*Includes Alabama, Georgia, Illinois, Kentucky, Louisiana, Mississippi, North Carolina, Ohio, South Carolina, Tennessee, and Texas.

and out-county) effort (76,461 hours) was nearly twice that of the total charter and party boat effort (40,185 hours). Private boat owners in Bay County expended only about one-half the total effort of the local charter and party boats (Table 4). Thus, our analysis showed 17.7% of the effort to have been expended by in-county private boats, 47.8% expended by out-county private boats, and 34.5% expended by local charter and party boats.

The amounts of fishing effort increased gradually from the first of April to early June for the charter boats and for private boats (Fig. 7). For charter boats, effort was highest from June through August and then declined to almost zero by late November. On the other hand, effort by private boats fluctuated during June and July but in September reached seasonal highs for medium and small boats. Large private boats exhibited a pattern similar to that of the charter boats, with the exception of a sudden drop in effort in mid-August.

The value of a fishery is often estimated from the amount of effort expended and the origin (residents or tourists) of this effort. If we assume that 98% (as estimated by local charter and party boat captains) of the fishermen that fished on charter and party boats were non-resident of Bay County, then 33.8% (98% of 34.5%) of the total effort was attributable to non-residents on charter and party boats. We may conclude that 81.6% (47.8% + 33.8%) of all fishing effort for king mackerel by all boats resulted from non-residents. These estimates indicate that aside from the charter and party business, this fishery probably produces a sizeable cash flow into Bay County motels, restaurants, fishing tackle and other tourist-related businesses.

Our yearly averages show that charter boats caught 3.9 king mackerel per hour vs. 1.5 fish per hour for small private boats and 1.4 fish per hour

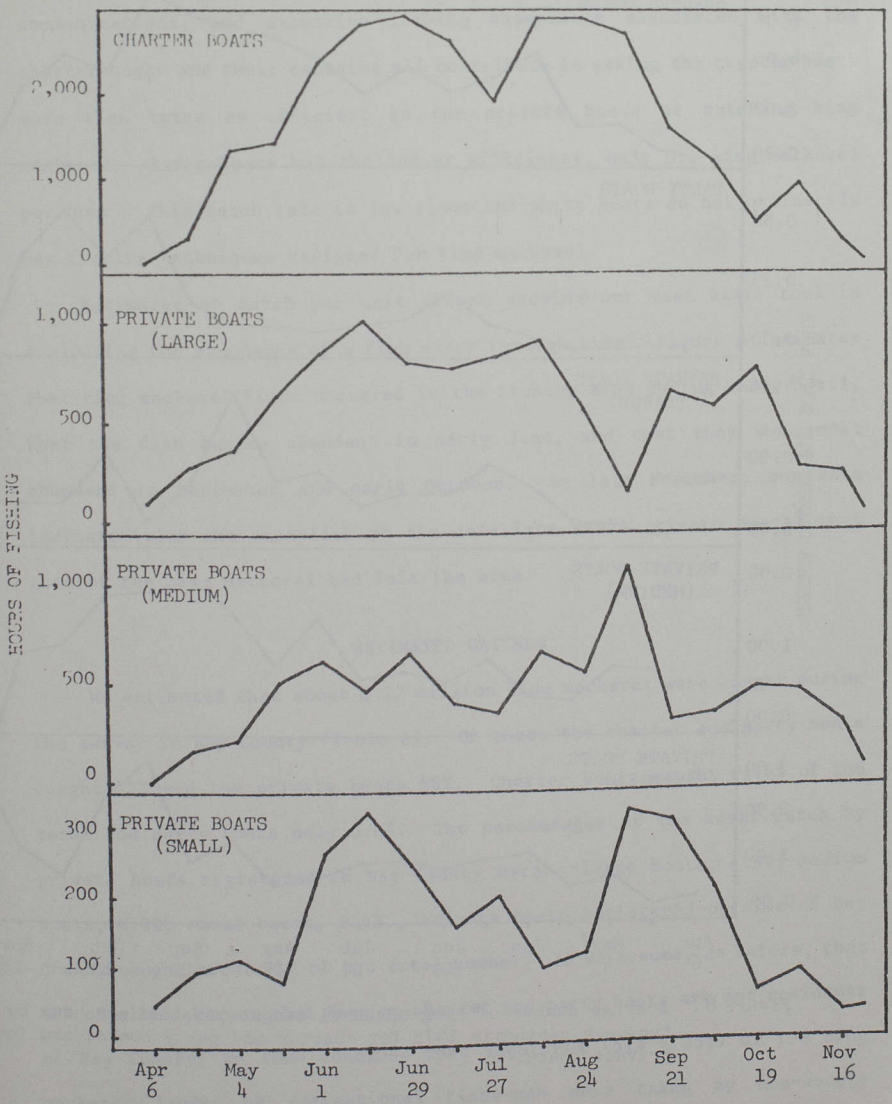

Figure 7. Estimated number of boat hours of fishing for king mackerel by two-week periods in 1975 for charter boats, and for private boats.

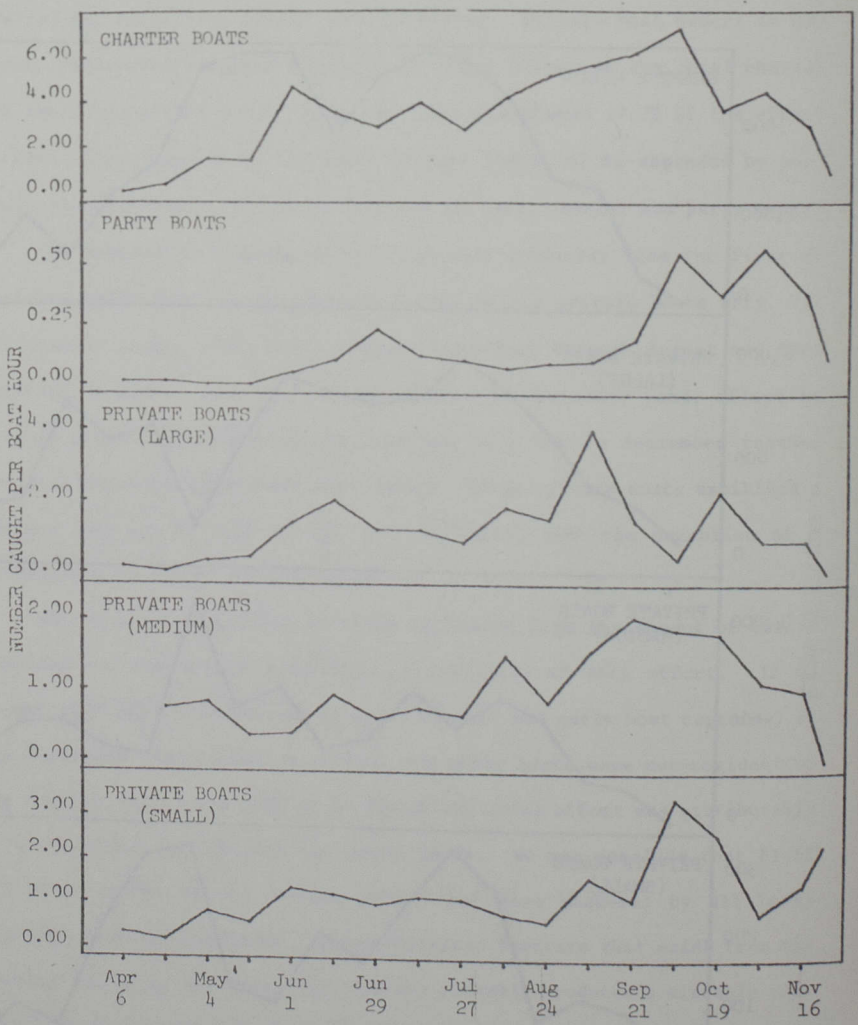

Figure 8. Average number of king mackerel caught per boat per hour by two-week periods in 1975 for charter and party boats, and for private boats.

for medium and large private boats (Table 4). Expert rigging, boat-to-boat communications, and extensive fishing experience associated with the charter boats and their captains all contribute to making the charter boats more than twice as efficient as the private boats at catching king mackerel. Party boats had the lowest efficiency, only 0.1 king mackerel per hour. This catch rate is low since the party boats do not ordinarily use fishing techniques designed for king mackerel.

Estimates of catch per unit effort provide our most basic tool in evaluating the abundance of a fish stock through time. Figure 8 indicates that king mackerel first occurred in the fishing area during early April, that the fish became abundant in early June, and that they were most abundant in September and early October. By late November, our data indicate (with the exception of the data from small private boats) that most of the king mackerel had left the area.

ESTIMATED CATCHES

We estimated that about 0.22 million king mackerel were caught during the survey in Bay County (Table 6). Of these the charter and party boats caught 52% and the private boats 48%. Charter boats caught 51.4% of the total and party boats only 0.6%. The percentages of the total catch by private boats registered in Bay County were: large boats, 1.9%; medium boats, 4.7%; small boats, 6.4%. Private boats registered outside of Bay County caught about 35% of the total number. If we assume, as before, that 98% of all fishermen that fish on charter and party boats are not residents of Bay County, we then conclude that about 86% (51% + 35%) of the king mackerel landed by recreational fishermen were taken by non-county residents.

Table 6. Estimated numbers of king mackerel landed in Bay County between April 1 and November 31, 1975.

Boat type	Catch			Percent of Total Catch		
	In County	Out County	Both	In County	Out County	Both
Charter	114,136	-----	114,136	51.4	-----	51.4
Party	1,419	-----	1,419	0.6	-----	0.6
Subtotal	115,555	-----	115,555	52.0	-----	52.0
Private*						
Large	14,279	38,411	52,690	6.4	17.3	23.7
Medium	10,435	28,071	38,506	4.7	12.6	17.3
Small	4,138	11,131	15,269	1.9	5.0	6.9
Subtotal	28,852	77,613	106,465	13.0	34.9	47.9
Total	144,407	77,613	222,020	65.0	34.9	99.9

*For Private Boats, the estimates were expanded by 100/27.1(3.69) to account for 72.9% of the boats that were not sampled (see Table 5).

The largest catches were made at different times of the year from the charter and party boats and from each size class of private boat (Fig. 9). Largest catches were made from late July to early September from the charter and medium size private boats. Largest catches from party and small private boats were made from late September to early October. Largest catches from large private boats were made in mid-June.

Although the local charter boat captains stated that the abundance of king mackerel in 1975 was the best in recent years, the fish were small. The king mackerel averaged about 5 pounds, with weights ranging from 2 to about 50 pounds. Using our estimates of the total number caught (0.22 million) and the average weight (5 pounds), we estimated that 1.10 million pounds of king mackerel were caught during the season (1 April-30 November). The magnitude of these estimates indicates that the king mackerel is an important recreational resource of Bay County.

CONCLUSIONS

1. Response rate using mailed questionnaires were 58.2% for charter boats and 40.6%, 23.5%, and 18.5% for large, medium, and small private boats.
2. Response rate, using log sheets, was 83.9% for party boats.
3. We detected probable non-resonse bias in our questionnaire survey of private boat owners when this survey technique was checked with a telephone survey.
4. For similar surveys in the future, we recommend methods similar to the ones we used for charter and party boat fisheries, but we recommend telephone interviews for surveying private boats.
5. The estimated percentages (after adjustment for non-response bias for

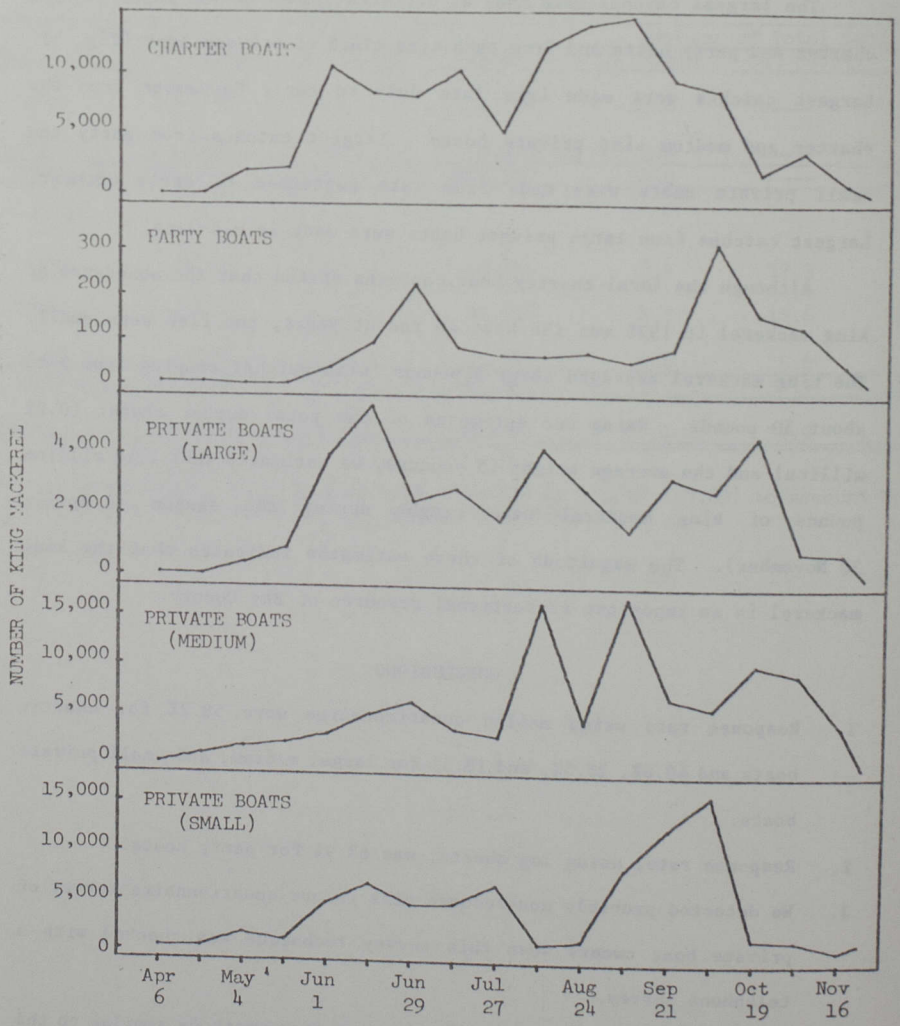

Figure 9. Estimated number of king mackerel caught by two-week periods in 1975 for charter and party boats, and for private boats.

private boats) of the total number of fishing days (244) that were spent fishing for king mackerel by boats were: charter, 38.6%; private--large, 2.4%; medium, 0.3%; and small, 0.1%.

6. The highest percentage participation in the Bay County king mackerel fishery occurred from June through September for all recreational boat types.

7. Estimates of the total boat hours of fishing for king mackerel were: charter and party boats, 40,190; private boats registered in-county, 20,721; and private boats registered out-county, 55,740.

8. We estimated that 81.5% of the boat hours fishing for king mackerel were expended by non-county residents.

9. Fishing effort began in early April, was high from June through mid-October depending on boat type, and then declined to almost zero by late November.

10. The average numbers of king mackerel caught per boat per hour were: charter, 3.9; party, 0.1; private boats--large, 1.4; medium, 1.4; and small, 1.5.

11. Based on biweekly estimates of catch per boat per hour, king mackerel first occurred in the fishing area during early April, became abundant in early June, were most abundant in September and October, and except for a few stragglers, had left the area by late November.

12. We estimated that about 0.22 million king mackerel were caught in the study area from 1 April through 31 November and that charter and party boats accounted for about half this total. Further, we estimated that 85% of the total catch was made by non-county residents.

13. According to the local charter boat captains, the 1975 season was the best for catching king mackerel in recent years but the fish were

small and averaged about 5 pounds each. Nonetheless, over 1 million pounds of king mackerel were caught in the Bay County area.

ACKNOWLEDGMENTS

We are indebted to many people for helping us obtain the information on which this report is based. We very much appreciate the help given to us by the Panama City Charter Boat Association (B.J. Putnam, President), local party boat owners, and private boat enthusiasts. We are especially indebted to Captain Putnam who spent much time and effort in helping us get our program underway. Others who were helpful were Tom Guinn, Sandy Ware, Joe Ed David, E.G. Hobbs, L. Nelson May, Sonja L. Hedley, and Kathleen D. Nolan.

MACKEREL FISHING IN NORTHWEST FLORIDA

Jeffery A. Fisher*

A Report to the Mackerel Workshop

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In Northwest Florida, the primary harvest pressure placed on the King Mackerel resource comes from recreational fisning. "Recreational fishing" includes private boats and commercial charter boats.

The commercial King Mackerel fishery exists principally on the East Coast of Florida. On the Gulf Coast the main catch seems to occur in Southwest Florida. A huge percentage - over 90% - of the U. S. commercial King Mackerel catch is landed in Florida. Of the total commercial catch, Northwest Florida (Wakulla through Escambia counties) accounts for less than 10% of the landings. Florida commercial landings have shown a gradual increase in the past 25 years (from approximately 2 million pounds in 1950 to almost 6 million in 1973. Landings in 1975 were 8.7 million lbs. Over the same time period the value of landings has perhaps increased five-fold.

King Mackerel are taken on relatively small commercial boats (20' to less than 40') using handlines with hooks or large gill nets. There are fewer than 10 commercial vessels in Northwest Florida which actively harvest King Mackerel at some time in their fishing activity.

The recreational landings are evidence of the fishing pressure. In 1970, from the Mid-Atlantic, to Florida, through the Western Gulf, an estimated 62.6 million pounds were landed - perhaps 10 times more than the commercial catch. The average weight of the fish increases as one moves from the Chesapeake, Southeast, around Florida into the Western Gulf. The Mid-Atlantic Kings averaged 5.0 lbs. while those of the Western Gulf averaged 11.5 lbs.

Kings in the recreational fishery are taken by commercial charter boats and privately owned boats. Charter boats in Northwest Florida range from 28 - 65 feet while private boats that fish for King Mackerel generally range from 15 - 25 feet in length. A few exceed 25 feet and are as large as charter boats. Private boats carry from 1 to 10 people while charter boats carry from 4 to 15. Some charter boats are licensed for up to 25 passengers but fishing trips with such large numbers rarely fish for Kings. Head boats (party boats) fish almost exclusively for bottom fish and therefore are not considered important as King Mackerel harvesters. They range from 65 - 85 feet, carry up to 60 people and charge about $25 per person.

Cost of fishing on charter boats varies with the length and type of fishing, number of people, popularity and reputation of the vessel, etc. Local charter boat associations fix minimum fees. On this coast, a half day (4 hr.) trip for Kings cost at least $100 and a full day trip costs $200, at a minimum. Bait, tackle, ice and deckhand services are included in the fee. Food, drinks and tips are extra.

Numbers of recreational boats fishing King Mackerel is almost impossible to estimate. In Bay County alone, 1975 boat registrations were approximately 5500. Of these, I would guess one-third fished at least once for Kings. The estimate of charter boat numbers is more exact:

Port	Number
Wakulla	3
Mexico Beach	5
Panama City	65
Ft. Walton	3
Destin	80
Pensacola	9
Total	165

in Northwest Florida

There are also approximately 30 in Alabama and 35 in Mississippi. Along the remaining Gulf Coast of Florida (not including Key West and Marathon) there are about 120 charter boats. Key West has approximately 35 and Marathon 40. It is important to note that the King Mackerel is the "bread and butter" fish of the charter boats although, more and more charter trips are being taken for billfish and bottomfish (snappers, groupers, etc.).

There are three fishing techniques used by the recreational King Mackerel fishermen:

Trolling

Charter boats generally fish four lines while private boats fish fewer than four (usually two). The baits are trolled deep (weighted) or on the surface. Trolling is done in straight lines until fish are caught, then a circling pattern results until the "rally"is over. The principal bait is the round scad, locally called "cigar minnow" (Decapterus punctatus), and retails for about $.75 per pound (usually in 5 lb. boxes at $3 - 5). Charter boat captains acquire their bait at lower prices.

Jigging

This technique involves casting an artificial bait near a submerged structure, buoy, reef, wreck, etc. The lure is retrieved with a jerking motion. The lures cost up to several dollars.

Drift or anchor

In this method the boat is not under power. Live bait or a baited lure is fished somewhere in the water column (from surface to bottom). The cut or live bait includes scad, pinfish, mullet, blue runner or pigfish.

Spanish Mackerel

I have much less information on this subject although some is available from published sources such as the "Angler's Survey of 1970 and the "DNR - NOAA Commercial Landings Reports".

In the recreational fishery, Spanish Mackerel are not very important in Northwest Florida. The Spanish "run" on this coast is short lived, i.e. rarely more than 1 month. Last year (spring, 1976) there never was a run! The fish are caught by trolling or casting with light rods from small boats close to the beaches and jetties on the Gulf side. Charter and head boats rarely fish for or catch them.

The commercial fishery is more extensive. The fish are generally caught inshore (Gulf) at night with gill nets. The boat range from 20 - 30 feet. The product is sold fresh for retail market consumers or salted or frozen for bait. Bait Spanish go principally to the commercial snapper - grouper boats, longliners (for swordfish and tuna) and trap fishing (crabs).

My estimate for numbers of boats that commercially fish Spanisn Mackerel in Northwest Florida is seventy-five (75), however only about one-third (25) fish the resource seriously.

A good trip five years ago was considered to be 2000 lbs. landed in one night. In the past three years, it is not uncommon to land no Spanish Mackerel. Along the northwest Florida coast, the Spanish fishing seems to be better in the western section (Santa Rosa and Escambia counties). Prices "usually" vary around 22¢ per pound drawn (gutted) and 20¢ in the round, paid to the producer.

There are two "general" seasons: April - May and September - October. The spring season is generally the best.