SURVEY OF THE UNITED STATES SHRIMP INDUSTRY

VOLUME I

SPECIAL SCIENTIFIC REPORT–FISHERIES No. 277

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

EXPLANATORY NOTE

The series embodies results of investigations, usually of restricted scope, intended to aid or direct management or utilization practices and as guides for administrative or legislative action. It is issued in limited quantities for official use of Federal, State or cooperating agencies and in processed form for economy and to avoid delay in publication.

United States Department of the Interior, Fred A. Seaton, Secretary
Fish and Wildlife Service, Arnie J. Suomela, Commissioner

SURVEY OF THE UNITED STATES SHRIMP INDUSTRY

VOLUME I

Prepared in

Branch of Economics

Bureau of Commercial Fisheries

United States Fish and Wildlife Service
Special Scientific Report--Fisheries No. 277

Washington, D. C. : November 1958

The Library of Congress has cataloged this publication as follows:

U. S. *Bureau of Commercial Fisheries.*
Survey of the United States shrimp industry. Prepared in Branch of Economics, Bureau of Commercial Fisheries. Washington, 1958–

v. illus. 27 cm. (U. S. Fish and Wildlife Service. Special scientific report: fisheries, no. 277,

Includes bibliography.

1. Shrimps. (Series)

SH11.A335 no. 277, etc. 639.5 59–60018

Library of Congress

The Fish and Wildlife Service series, Special Scientific Report--Fisheries, is cataloged as follows:

U. S. *Fish and Wildlife Service.*
Special scientific report: fisheries. no. 1–
[Washington] 1949–

no. illus., maps, diagrs. 27 cm.

Supersedes in part the Service's Special scientific report.

1. Fisheries—Research.

SH11.A335 639.2072 59–60217

Library of Congress

ABSTRACT

This report published in two volumes provides a comprehensive examination of the shrimping grounds, vessel construction, fishing operations, fishing costs, processing plant efficiency, processing costs, trends in distribution, packaging, storing, shipping, per capita consumption, prices, wholesaling, retailing, merchandising, and consumer preferences.

A chapter on conclusions and recommendations finds that the shrimp industry's welfare can be safeguarded best (1) by increasing the efficiency of operations at all levels and thus effecting cost savings in shrimp production, processing and distribution and (2) by stabilizing markets. Specific suggestions to improve current practices are made throughout. For example, the chapter on processing contains the results of engineering surveys which provide plans for model layouts for freezing and breading plants and canneries. An economic analysis is made of the problems of marketing and price stability.

The project was financed with funds made available by the Saltonstall-Kennedy Act, approved July 1, 1954 (68 Stat. 376).

ACKNOWLEDGEMENTS

Survey of the United States Shrimp Industry was compiled by staff members of the Branch of Economics, Bureau of Commercial Fisheries from sources of information and technical advice available, for the most part, from within the Bureau. The results of special research projects undertaken under contract arrangements with private firms, universities, and other government agencies to supplement these sources of information are incorporated in this report.

The survey originated under the direction and supervision of the late Dr. Richard A. Kahn, Chief, Economics and Cooperative Marketing Section, Walter H. Stolting, Assistant Chief, and Otto Rauchschwalbe, Economist.

The economic analysis and the text are largely the work of Robert Hamlisch, Economist. The report was prepared for publication under the direction of Alton T. Murray, Economist. Charles A. Carter, Commodity Analyst, provided the references to the historical development of shrimp fishing and processing industries. Donald S. FitzGibbon prepared the graphs and charts; Evelyn H. Kramer and Saralyn V. Wolff assisted in the preparation of statistical tables.

Stewart Springer, Chief, Branch of Exploratory Fishing and Gear Research, and James B. Higman of that Branch gave technical advice for the development of the chapters on fishing vessel construction and fishing operations. Charles Butler, Chief, Branch of Technology; William H. Dumont, Assistant Chief, Branch of Statistics; and Stacey C. Denham, Fishery Marketing Specialist, were consulted on technical subjects.

The A. C. Nielsen Company contracted for a sub-project on distribution, merchandising and consumer preference; the University of Miami, at Coral Gables, Florida, for primary marketing; Harwell, Knowles and Associates, for vessel efficiency; the Federal Trade Commission, for fishing vessel and processing plant costs; First Research Corporation of Florida, for processing plant efficiency and for time and motion studies of fishing operations. Lawrence W. Strasburger, Consultant, reviewed the manuscript, particularly the chapters concerned with processing.

All figures were prepared by United States Fish and Wildlife Service personnel, except those specifically credited.

PREFACE

Discovery of new fishing grounds, expanding markets, and the increase in the size of the fleet have contributed to the dramatic growth of the shrimp industry within the past decade. Currently, the shrimp fishery is the most important in the United States measured by the value of landings. Moreover, the shrimp processing industries and distributive channels have also greatly expanded their facilities and the volume and variety of shrimp products reaching the national market during the past decade.

The period of growth and expansion of the shrimp industry was marked by occasional setbacks and periods of marketing doldrums. It was during these periods that some of the basic problems of this industry were revealed as pitfalls to be avoided in the future. Fortunately, none of these basic problems appear insoluble. Rather the shrimp industry's general welfare is related mainly to the solutions of a lot of little problems--all of them concerned with increasing the efficiency of operations at all levels and thus effecting cost savings in shrimp production, processing, and distribution.

Survey of the United States Shrimp Industry examines all phases of the fishery, vessel construction, operation, and gear used in fishing, production costs, the physical layout and efficiency of processing plants, packaging, distribution, and marketing. Every effort has been made throughout the survey to provide specific suggestions and recommendations for improving current practices. Volume I of this report contains the first five chapters which deal with production and processing. Volume II contains the last four chapters, three of which deal with marketing and the last chapter contains a summary of conclusions and recommendations.

Survey of the Shrimp Fisheries of Central and South America and Foreign Shrimp Fisheries other than Central and South America referred to in the text have been published as Special Scientific Report--Fisheries No. 235 and No. 254, respectively.

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CHAPTER I

THE DOMESTIC SUPPLY

ABSTRACT

ONLY THREE OF THE MANY SPECIES OF SHRIMP FOUND IN WATERS ADJACENT TO THE COASTLINE OF THE UNITED STATES ARE CURRENTLY OF SUBSTANTIAL COMMERCIAL IMPORTANCE, WHITE SHRIMP PENAEUS SETIFERUS, BROWN SHRIMP PENAEUS AZTECUS, AND PINK SHRIMP PENAEUS DUORARUM. ALL THREE ARE TAKEN IN ABUNDANCE IN THE SOUTH ATLANTIC AND GULF AREA, EACH OF THEM HAVING ITS OWN HABITAT PREFERENCE WITHIN THIS AREA. THERE IS, HOWEVER, SOME OVERLAP OF GEOGRAPHIC RANGES. IN THE FUTURE, THE SUPPLY ACCESSIBLE TO THE DOMESTIC FLEET WILL BE INCREASED BY THE ROYAL RED SHRIMP HYMENOPENAEUS ROBUSTUS RESOURCES RECENTLY DISCOVERED IN THE DEEP WATERS OF THE SOUTH ATLANTIC AND GULF. COMMERCIAL FISHING FOR ROYAL RED SHRIMP ON A MODEST SCALE WAS INITIATED IN SOUTH ATLANTIC WATERS IN THE FALL OF 1956.

OUTSIDE THE SOUTH ATLANTIC AND GULF AREA, SHRIMP FISHERIES EXIST IN THE MIDDLE AND NORTH ATLANTIC COAST , THE PACIFIC COAST, AND SOUTHEASTERN ALASKA AREAS. THESE FISHERIES ARE NOT OF SUBSTANTIAL SIZE. THE ATLANTIC COAST SHRIMP ARE UTILIZED MAINLY FOR BAIT PURPOSES. THE WEST COAST FISHERIES, FOR THE MOST PART, SUPPLY SPECIAL MARKETS FOR DRIED AND FROZEN COOKED SHRIMP BUT MAY IN THE FUTURE BECOME IMPORTANT IN THE CANNING INDUSTRY.

THE EXPANSION OF THE GULF COAST FISHERY IN RECENT YEARS, AS THE RESULT OF THE DISCOVERY OF THE GROOVED (BROWN AND PINK) SHRIMP GROUNDS IN THE GULF OF CAMPECHE AND OFF THE DRY TORTUGAS, HAS WROUGHT MANY CHANGES IN SHRIMP PRODUCTION AND MARKETING. ONE CONSEQUENCE OF THE EXPLOITATION OF THE NEW GROUNDS HAS BEEN A SMOOTHING OUT OF THE SEASONAL DISTRIBUTION OF CATCH. THE INCREASE IN FREEZINGS, IN SIMILAR FASHION, HAS CONTRIBUTED TO STABILIZING SUPPLY ON THE MARKETING SIDE.

AMONG OTHER CONSEQUENCES OF THE OPENING UP OF NEW FISHING GROUNDS HAS BEEN A SHIFT IN THE CENTER OF GRAVITY OF THE FISHERY TO THE WEST AND TO WATERS FARTHER OFFSHORE. THE CHANGING GEOGRAPHY OF THE FISHERY HAS AFFECTED THE SCALE OF OPERATIONS. THE GREATER DISTANCE FROM SHORE OF SOME OF THE NEW SHRIMP GROUNDS HAS BROUGHT ABOUT THE ADDITION OF LARGER AND STURDIER VESSELS TO THE FLEET. THIS IN TURN HAS INFLUENCED COSTS OF OPERATION.

SINCE THE EXPLOITATION OF THE DOMESTIC SUPPLIES OF SHRIMP HAS REACHED A LEVEL CLOSE TO ITS ESTIMATED MAXIMUM POTENTIAL, SATISFACTION OF DEMAND IN THE FUTURE WILL LARGELY DEPEND ON THE SUCCESS IN (A) THE MANAGEMENT OF DOMESTIC SUPPLIES, (B) DISCOVERY OF NEW GROUNDS ACCESSIBLE TO THE DOMESTIC FLEET, AND (C) MEETING DOMESTIC SUPPLY DEFICITS BY IMPORTS.

THE GEOGRAPHIC LOCATION OF THE INDUSTRY - GENERAL CHARACTERISTICS

Geographic factors have had a large part in shaping the shrimp fishery. In all probability, they will play an important role, too, in the future development of the industry.

The form and geologic structure of the coast line have determined the sites of ports. Distances from newly discovered shrimp beds have influenced the location and, in many cases, the relocation of fishing activities. Weather conditions prevailing in specific areas are responsible for the peculiar seasonal pattern of the fishery. Commercial, industrial, and to some extent agricultural conditions, too, have affected the growth and character of the fishing segment, its organization, and its labor force.

In general, the location of the shrimp industry is closely tied in with the geography of fishing grounds. This is true not only of the fishery but also of the processing segment of the industry. In recent years only, a number of processors have located at some distance from shrimp ports as the result of the growing importance of such considerations as nearness to markets, strategic distance to several home ports, and availability of marine and transport facilities.

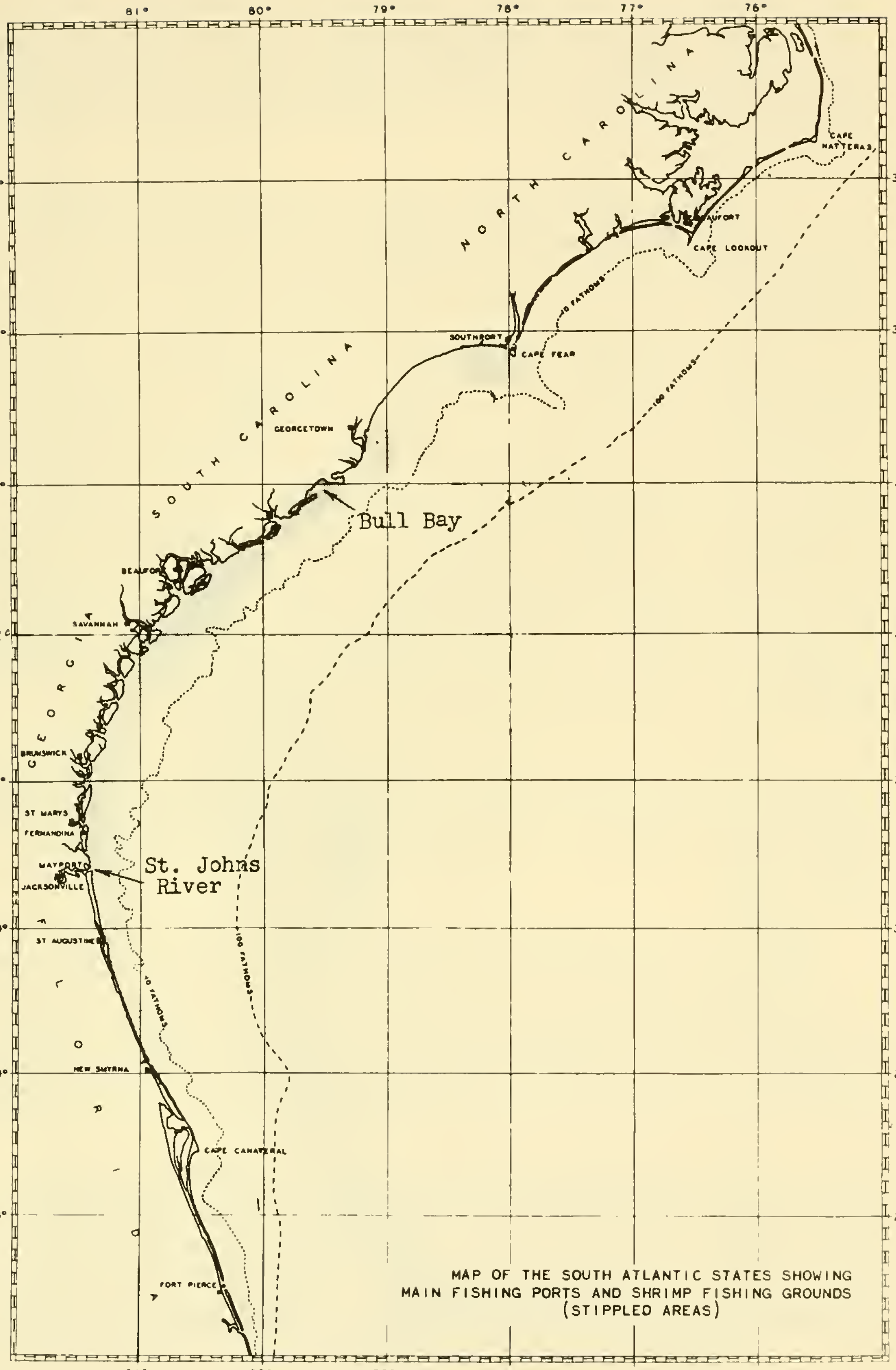
The coastal waters off the South Atlantic States and the Gulf of Mexico coast contain the bulk of the domestic shrimp resources. The industry, therefore, is concentrated in the eight states bordering on these waters starting with North Carolina on the Atlantic and ending with Texas on the western side of the Gulf.

The Shrimp Fishery in the South Atlantic and Gulf of Mexico Areas

The shrimp fishery of the South Atlantic States extends approximately from Beaufort, North Carolina, to Fort Pierce, Florida. Fishing is conducted within ten miles of the shore and in the sounds and estuaries. Most of the ocean fishery, however, is conducted between the shoreline and about six miles offshore. The fishery is almost continuous from about Bull Bay, South Carolina, to the St. Johns River, Florida, while in the northern and southern extremes of the range, the fishing grounds are scattered. (see figure I - 1)

In an attempt to extend the area of operations of the south Atlantic shrimp fishery, the Bureau of Commercial Fisheries of the United States Fish and Wildlife Service initiated exploratory fishing operations in offshore waters from Cape Hatteras, North Carolina to Cape Canaveral, Florida, in March 1956.

Until about 1950, the domestic shrimp fishery in the Gulf of Mexico embraced an area from Apalachicola, Florida, to the Mexican border in Texas, and included sounds, bay, bayous, and coastal waters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GEORGIA
FLORIDA
CAPE HATTERAS
BEAUFORT
CAPE LOOKOUT
10 FATHOMS
SOUTHPORT
CAPE FEAR
100 FATHOMS
GEORGETOWN
Bull Bay
BEAUFORT
SAVANNAH
BRUNSWICK
ST MARYS
FERNANDINA
MAYPORT
JACKSONVILLE
St. Johns River
ST AUGUSTINE
NEW SMYRNA
CAPE CANAVERAL
FORT PIERCE
MAP OF THE SOUTH ATLANTIC STATES SHOWING
MAIN FISHING PORTS AND SHRIMP FISHING GROUNDS
(STIPPLED AREAS)

FIGURE I - 1

out to a distance in a few areas of approximately 50 miles. In every state, except Louisiana, the coastal fishery did not extend much beyond ten miles from shore. The grounds were not continuous over this entire section, but tended to be scattered at the two extremes and more concentrated in the central area, with Louisiana the center of production. (see figure I - 2)

The year 1950 represents a milestone in the history of the Gulf coast shrimp fishery. In that year the Dry Tortugas fishery to the west of the Florida Keys was intensively worked for the first time, and newly-developed shrimp fishing grounds in the Gulf of Campeche were beginning to contribute heavily to the landings at Gulf fishing ports.

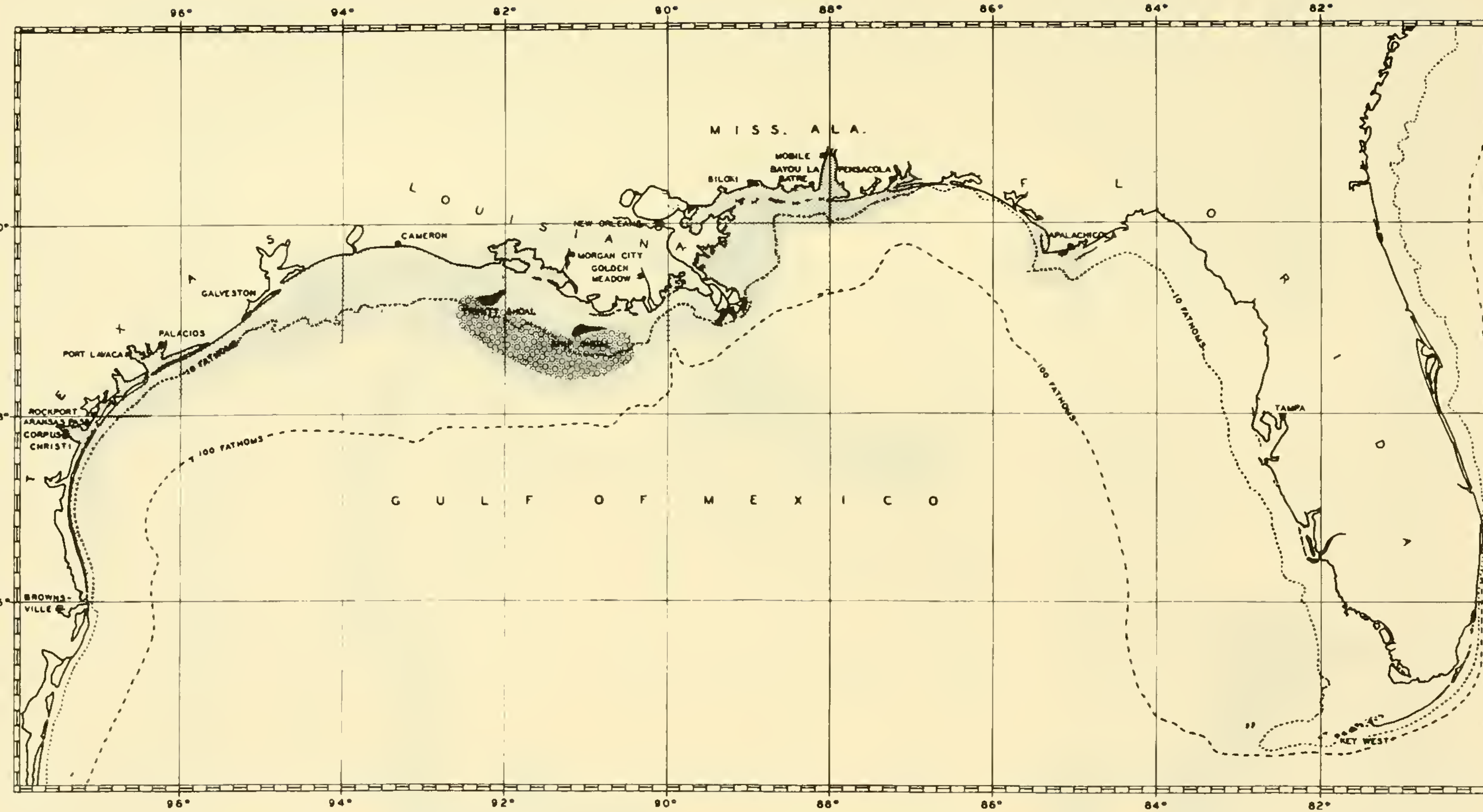
The conveniently accessible Dry Tortugas grounds, which were discovered by fishermen at a time when a strong market for shrimp prevailed, were exploited at once. Exploratory information roughly outlining the fishing grounds for pink shrimp in the Gulf of Campeche, on the other hand, had been obtained as early as 1936 and 1937 by Japanese fishing vessels working under the auspices of the Mexican Government. No attempt to fish these grounds was made until after the termination of World War II hostilities. Prior to that time there was no market for the pink species of shrimp; neither were there vessels capable of undertaking fishing operations in this area. At the same time, and partly because of exploratory fishing operations undertaken by the Bureau of Commercial Fisheries of the United States Fish and Wildlife Service, extensive new fishing areas for brown shrimp in the Gulf were discovered. Figure I - 3 shows the Gulf area shrimp grounds that had been charted by 1950 with the predominating species.

Additional exploratory activities by the Bureau of Commercial Fisheries conducted in the years from 1950 through 1954 have revealed new shrimp resources in the Gulf of Mexico. The most important discoveries during that period are the deep-water resources of Royal Red shrimp. This species was also found in the Atlantic off Florida during 1956 and 1957.

Domestic Shrimp Fisheries Outside the South Atlantic and Gulf Areas

Shrimp fisheries of comparatively modest proportions exist in the Middle and North Atlantic Areas as well as in southeastern Alaska, Washington, Oregon, and California. The shrimp taken off the coasts of the States of Maine, New York, and New Jersey are used chiefly for bait purposes. The Pacific coast catch, for the most part, is marketed primarily on the west coast as frozen cooked shrimp.

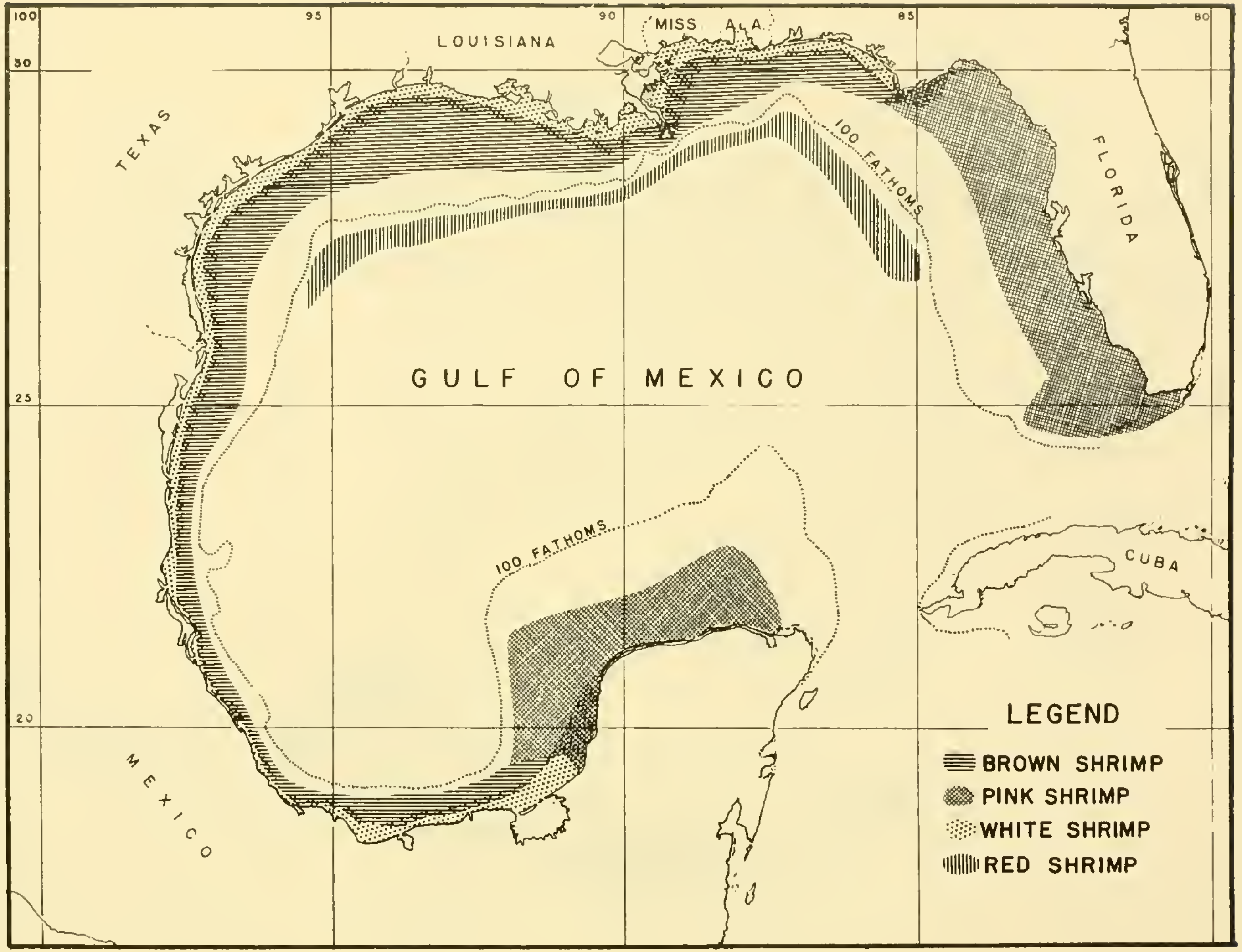
In the three West Coast states of California, Oregon, and Washington, shrimping has been of importance in some localities since shortly after the Civil War. In the San Francisco area three species of small shrimp, the best known of which is *Crago franciscorum*, commonly known as "San Francisco Bay shrimp", taken in the Bay were dried and exported to the Orient for many years. The inside waters of Puget Sound have in the past also yielded considerable quantities of shrimp.



MAP OF THE NORTHERN GULF OF MEXICO SHOWING MAIN FISHING PORTS AND SHRIMP FISHING GROUNDS (STIPPLED AREAS); DOUBLE STIPPLING INDICATES THE AREA MOST HEAVILY FISHED BY THE LOUISIANA OFFSHORE FLEET

(PRE 1950)

FIGURE I - 2



COMPOSITE CHART SHOWING KINDS OF MARKETABLE-SIZE SHRIMP MOST COMMON TO EACH GULF AREA. THE RANGES OF SOME SPECIES OVERLAP, AND COMMERCIALLY-IMPORTANT QUANTITIES DO NOT OCCUR THROUGHOUT THE RANGE OF ANY OF THESE SPECIES. (BASED ON DATA FROM ALL AVAILABLE SOURCES.)

FIGURE I - 3

It was not until 1952, however, that offshore fishing for shrimp on a commercial scale was first undertaken on the Pacific coast. Exploratory operations conducted by State and Federal government agencies in the years since 1950 have laid the groundwork for the development of the ocean fishery. Figure I - 4 shows the areas where the principal concentrations of shrimp discovered in the course of these explorations are located. The dates refer to the time the explorations in the specific area were conducted.

The State of Washington accounted for the greatest part of the production of deep-water shrimp taken off the Pacific Coast States in 1958. The Grays Harbor area is the principal place where these shrimp are landed in that State. The potential of the shrimp fishery off the coast of Alaska, where considerable exploratory work has been done, appears to be even greater than the shrimp fisheries off the Pacific Coast States.

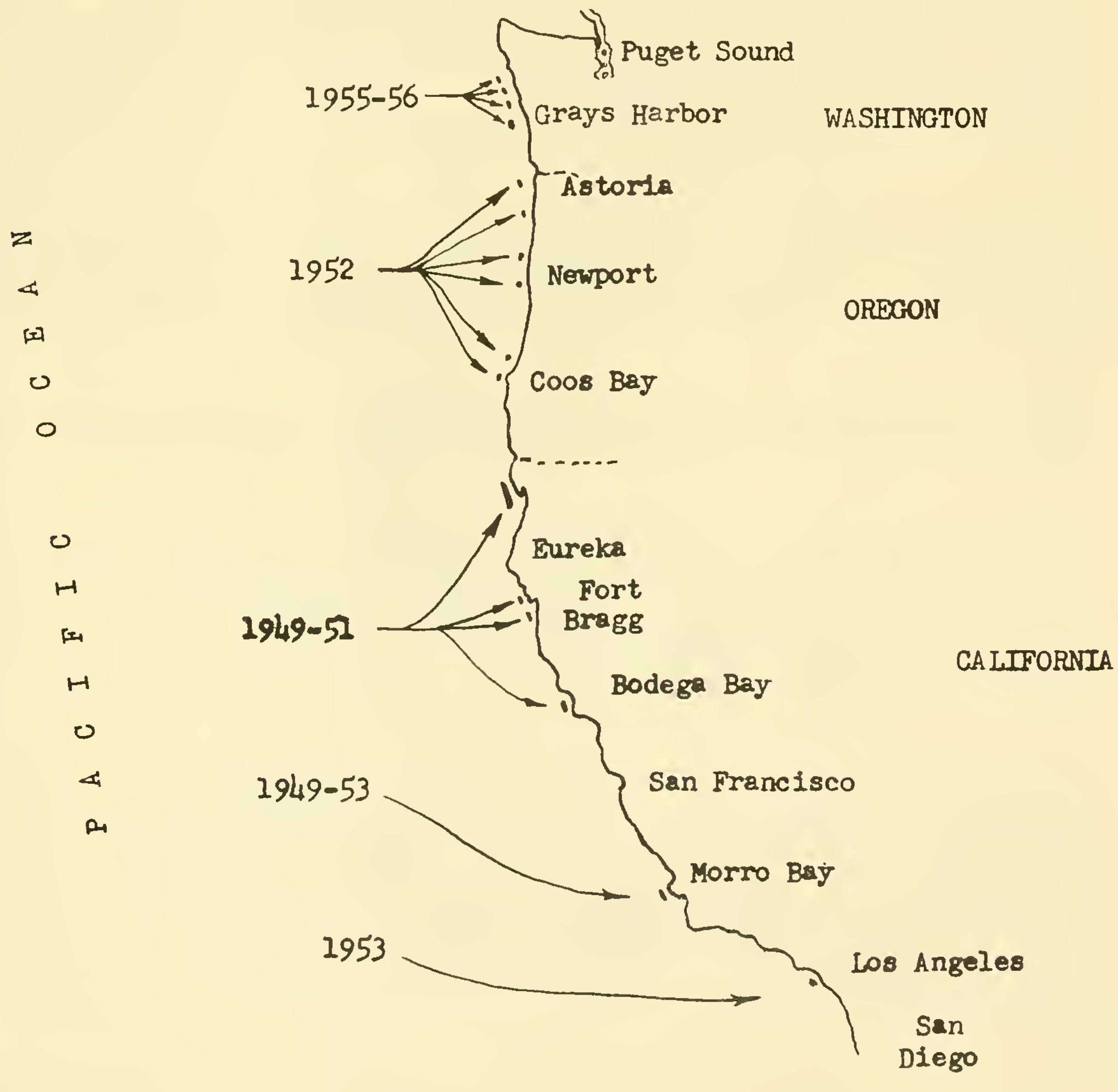


FIGURE I - 4.--Map of Exploratory Fishing Results - Pacific Coast Area.

SPECIES REPRESENTING THE COMMERCIAL CATCH

The number of species of shrimp identified in waters fished by the domestic fishing fleet runs into dozens, but the species taken by commercial fishermen probably do not exceed 20. At least 90 percent of the total catch consists of only three species. These are white shrimp Penaeus setiferus, pink shrimp Penaeus duorarum, and brown shrimp Penaeus aztecus. (see figuresI - 5a, 5b and 5c) The last two are sometimes referred to as grooved shrimp. Of lesser importance is the sea bob Xiphopeneus kroyeri.

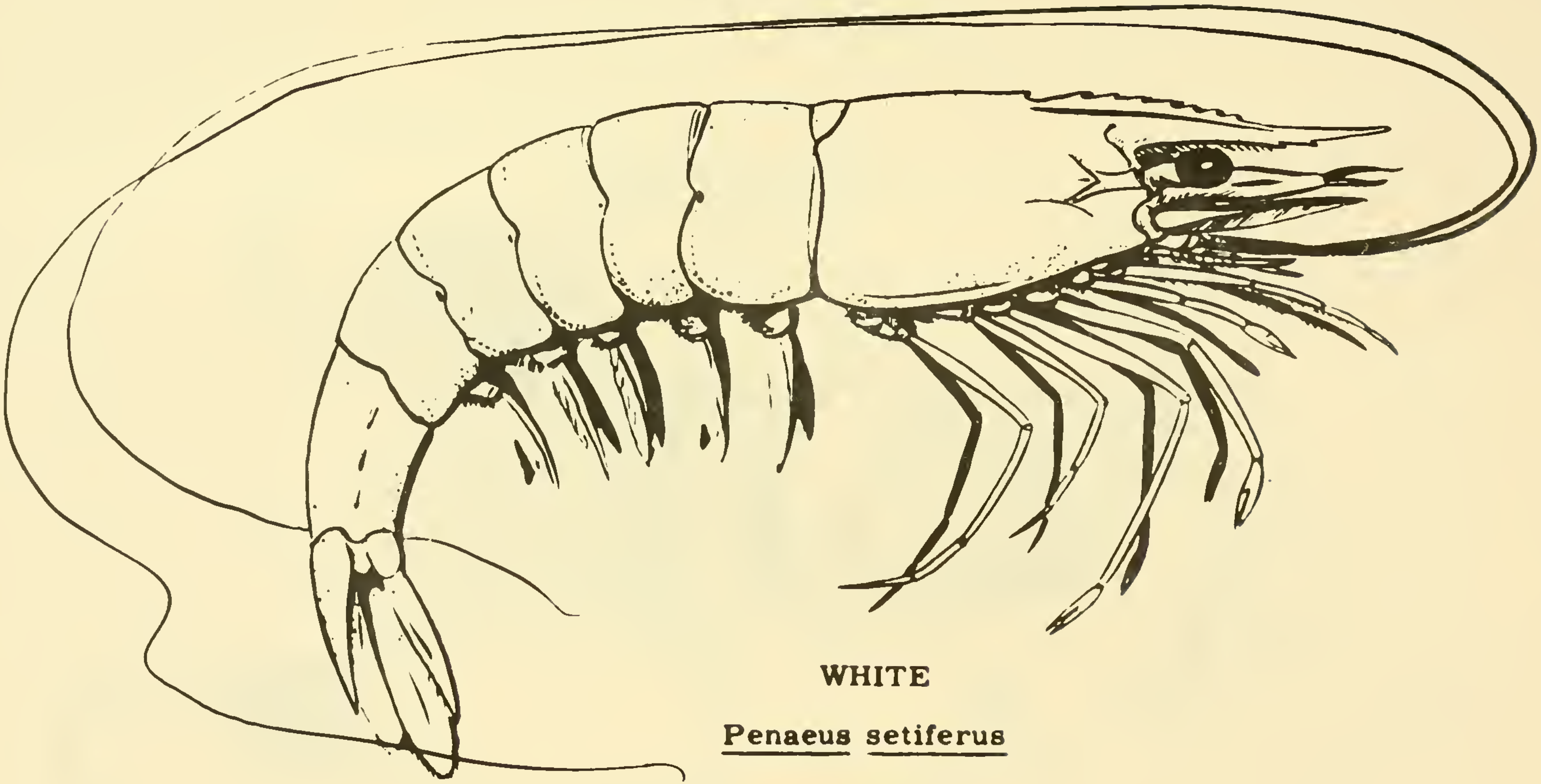
Among the species contributing to the commercial catch, there are distinct differences in size, variations in color, and anatomical structure. The species of sea shrimp listed above have the first three pairs of thoracic (walking) legs of which there are five pairs in all, fitted with chelae (pincers). The white shrimp and the grooved shrimp have teeth above and below on the rostrum (head spine), whereas the sea bob has rostral teeth only on the upper surface. The grooved shrimp can be distinguished from the white shrimp (which it closely resembles at first glance) by the presence on the former of grooves on either side of the rostrum which extend to the back margin of the carapace (head shell) and grooves on the last segment of the tail.

In the sea bob the last two pairs of walking legs are slender and much elongated. It was from these four elongated legs and the two antennae or feelers that the designation sea bob was derived. The name is a corruption of the French "sis barbes" which means six beards - the name given to this shrimp by Louisiana fishermen of French extraction.

Broadly speaking, the larger shrimp come from the warmer waters of the south Atlantic and Gulf area. In Alaska and in the Pacific Coast States large shrimp constitute relatively small proportions of the catch.

In the North Atlantic Coast States pink shrimp Pandalus borealis was the only species taken in Maine and Massachusetts, when these States had a commercial shrimp fishery. In New York and New Jersey, where the fishery is almost entirely for bait shrimp, sand shrimp Crangon vulgaris and grass shrimp Palaemonetes vulgaris and Palaemonetes carolinus constitute the entire catch.

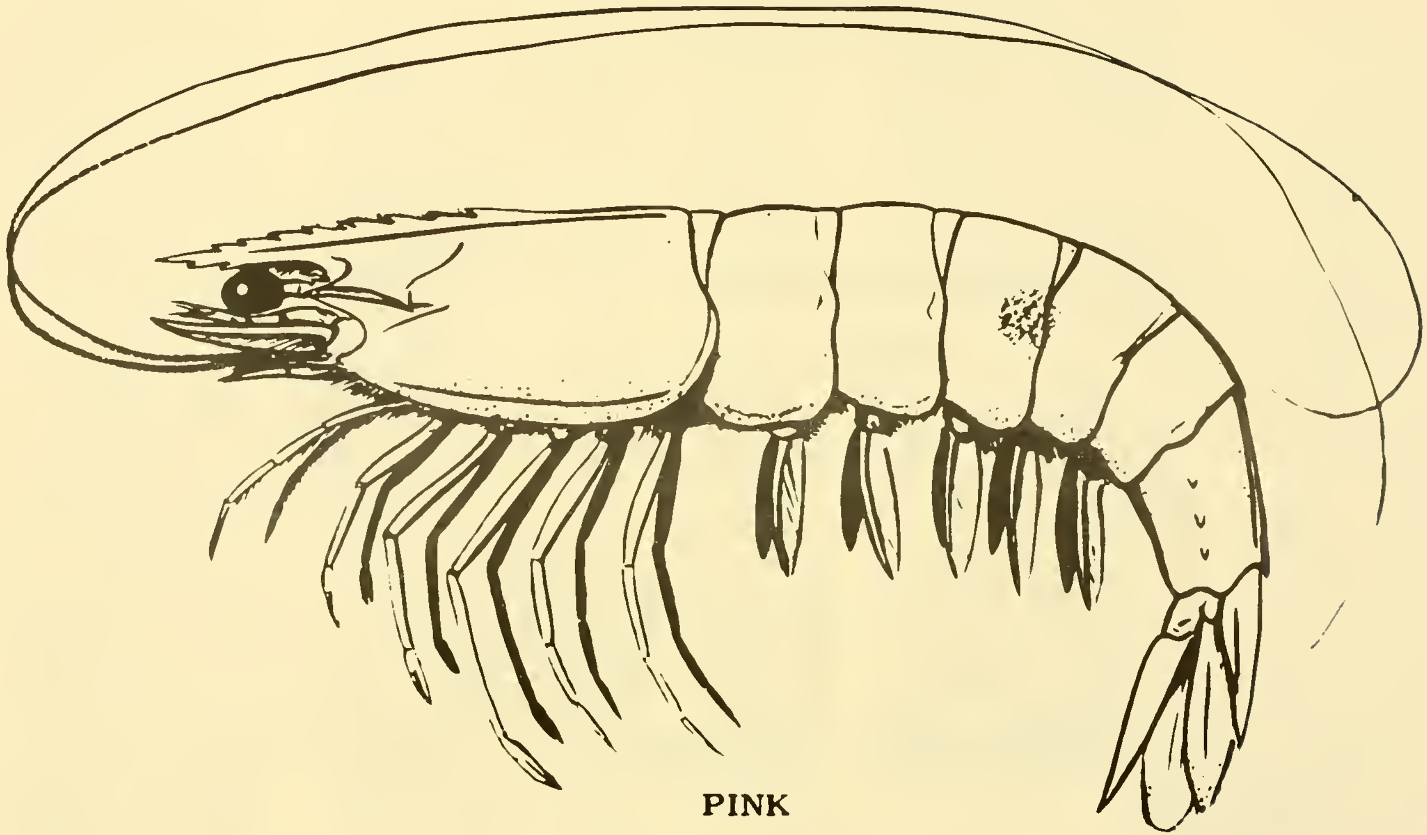
The commercial catch of shrimp in Alaska and in the Pacific Coast States consists of the genera, Crago and Pandalus. The former, commonly called Bay shrimp, are taken only in San Francisco Bay. The species landed there are for the most part Crago franciscorum, Crago nigricauda, and Crago nigromaculata, the first named being the most important. Up to 1954, Bay shrimp account for about 75 percent of the total California catch of shrimp. In 1956, however, the catch from the new shrimping grounds off the northern coast of California exceeded the Bay shrimp catch.



WHITE

Penaeus setiferus

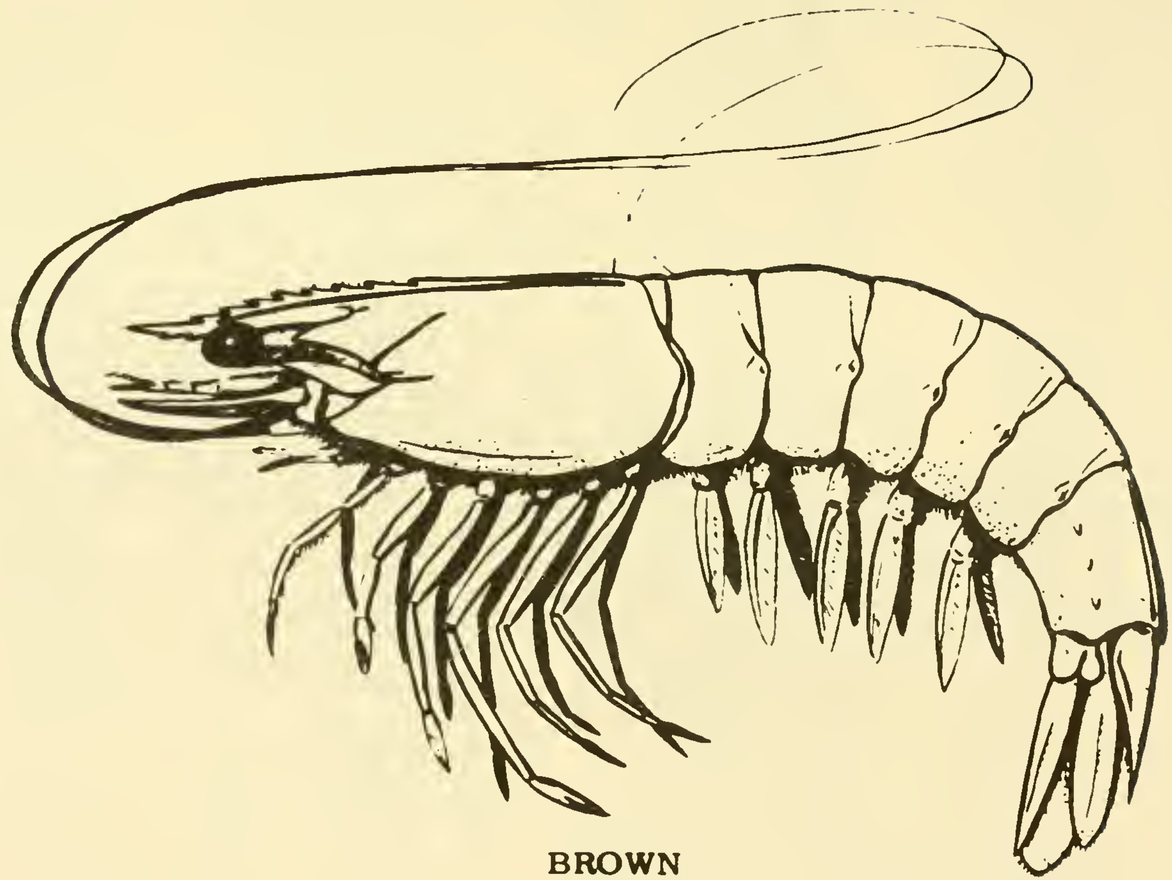
FIGURE I - 5a



PINK

Penaeus duorarum

FIGURE I - 5b



BROWN

Penaeus aztecus

FIGURE I - 5c

Among the species belonging to the genus Pandalus taken on the Pacific coast, pink shrimp Pandalus borealis are landed in all three Pacific Coast States and in Alaska. Alaska appears to be the only area where side-stripe shrimp Pandalus dispar, coon-stripe shrimp Pandalus hypsinotus, and humpy shrimp Pandalus goniurus are included in the commercial catch.

Until the late 1940's, the bulk of the catch of shrimp in the South Atlantic and Gulf Coast States consisted of white shrimp Penaeus setiferus with sea bobs Xiphopeneous kroyeri making up the remainder. With the extension of the fishery in 1950, two species of Peneidea were added to the commercial catch. These species were pink shrimp Penaeus duorarum, and brown shrimp Penaeus aztecus.

Catches landed on the south Atlantic coast (including the Florida east coast) consist predominantly of white shrimp Penaeus setiferus and brown shrimp Penaeus aztecus. Pink shrimp Penaeus duorarum and brown shrimp in recent years have accounted for well over half of the landings in the Gulf Coast States (including the Florida west coast), most of the remainder consisting of white shrimp. Sea bobs Xiphopeneus kroyeri which account for not more than two percent of the total catch are caught exclusively in inshore waters. The sea bob which does not attain the size of either the white or grooved shrimp, deteriorates rapidly after landing. It is used for drying and canning.

Table I - 1 lists the common and scientific names of the different species of shrimp contributing to the commercial catch, and the areas where the different species are caught or landed. Another species recently discovered in deeper and hitherto unfished waters of the the Gulf and south Atlantic is Royal Red shrimp Hymenopenaeus robustus. (see figure I - 6) Commercial production on a limited scale of this species was started in August 1956.

TABLE I - 1.--COMMON AND SCIENTIFIC NAMES OF SHRIMP CONSTITUTING THE UNITED STATES COMMERCIAL CATCH, AND AREAS, STATES, OR TERRITORIES WHERE THE VARIOUS SPECIES ARE LANDED

Common names	Scientific names	Where landed
White	Penaeus setiferus	South Atlantic and Gulf States
Pink, grooved, or brown-spotted	Penaeus duorarum	South Atlantic and Gulf States
Brown, grooved, or brown-grooved	Penaeus aztecus	South Atlantic and Gulf States

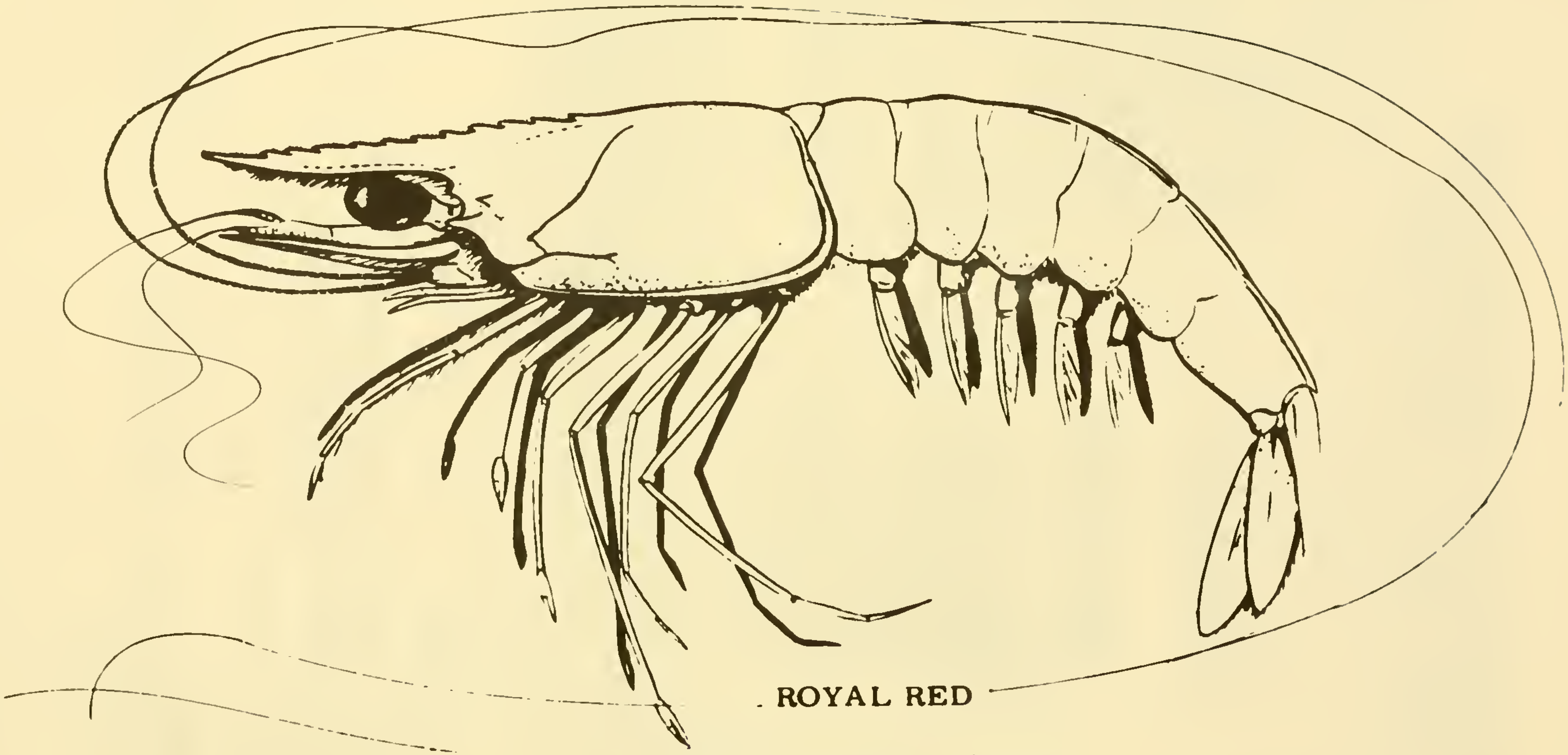
TABLE I -1.--COMMON AND SCIENTIFIC NAMES OF SHRIMP CONSTITUTING THE UNITED STATES COMMERCIAL CATCH, AND AREAS, STATES, OR TERRITORIES WHERE THE VARIOUS SPECIES ARE LANDED - Continued

Common names	Scientific names	Where landed
Brazilian or brown	Penaeus brasiliensis	South Atlantic and Gulf States
Sea bob	Xiphopeneus kroyeri	Gulf States
Pink	Pandalus borealis	Maine, Massachusetts, Alaska and Pacific Coast States
Pink	Pandalopsis jordani	Pacific Coast States
Spot	Pandalus platyceros	Pacific Coast States and Alaska
Side-stripe	Pandalus dispar	Alaska
Coon-stripe	Pandalus hypsinotus	Alaska
Humpy	Pandalus goniurus	Alaska
Bay	Crago franciscorum, Crago nigricauda and Crago nigromaculata	California
Sand	Crangon vulgaris	New York and New Jersey
Grass	Palaeomonetes vulgaris and Palaeomonetes carolinus	New York and New Jersey

Many different names are applied to shrimp in different localities. In order to avoid confusion in identifying the various species of shrimp standardization of these names appears desirable. The common names currently encountered, and the localities in which these names are used, are shown below together with the scientific names of the species which they represent.

Penaeus setiferus:
- White shrimp
- Green shrimp (Southport, North Carolina)
- Green-tailed shrimp (Pamlico Sound)
- Blue-tailed shrimp (Ocracoke, North Carolina)
- Common shrimp
- Lake shrimp (Louisiana)

Penaeus aztecus:
- Brown shrimp (Southport, North Carolina)
- Grooved shrimp
- Brazilian shrimp



ROYAL RED

Hymenopenaeus robustus

FIGURE I - 6

Penaeus aztecus:
  Golden shrimp (Texas)
  "Brownies"
  Red shrimp (Texas)

Penaeus duorarum:
  Pink shrimp (Key West, Florida)
  Brown-spotted shrimp
  Grooved shrimp
  Blue-tailed shrimp (Carteret County, North Carolina)
  Channel shrimp (Carteret County, North Carolina)

"Red-legged shrimp" may belong to any species of shrimp if its legs are red. Any species of shrimp may turn bluish and its meat may become soft and white. It is then known as a "blue shrimp", "cotton shrimp" or "king shrimp". These names may be said to describe a physiological condition rather than a species.

DISTRIBUTION OF THE COMMERCIALLY IMPORTANT SPECIES OF SHRIMP IN THE COASTAL WATERS OF THE SOUTH ATLANTIC STATES AND THE GULF

Since the bulk of the resources of the domestic fishery is located in the waters of the South Atlantic States and the Gulf of Mexico, more attention has been devoted to the study of this area than to any other.

The ranges of the three species of shrimp of primary commercial importance overlap to some extent, but each has its own habitat preference. In the Gulf of Mexico there are areas where one species exclusively is taken, others where more than one species may be fished. The two species of grooved shrimp, the brown and the pink, rarely are taken in large numbers at the same time and place. Royal Red shrimp, still of limited commercial importance, does not, as far as is known, ever appear within the range of the other species taken in the south Atlantic and Gulf waters.

Species Taken on South Atlantic Fishing Grounds

Commercial production of shrimp in the south Atlantic until recently was confined to shallow waters along a relatively narrow strip of the coast. The latest development in the fishery is the start of deep-water operations for Royal Red shrimp *Hymenopenaeus robustus*.

The shrimp fishery in some states along the south Atlantic coast, e.g., North Carolina and Florida, is centered in the waters around the mouths of inlets.

Elsewhere, as in Georgia, production is fairly uniform along the entire coastline of the State.

White Shrimp

Johnson and Lindner make the following summary comments on the geographic concentration of the south Atlantic coast white shrimp fishery in 1934 1/:

North Carolina - The principal fishing areas are at the mouths of the Neuse and Newport Rivers, Core Sound; the coastal waters approximately 10 miles offshore from Cape Lookout north to a point about opposite Atlantic, North Carolina; coastal waters a similar distance offshore from about Little River Inlet to Fort Caswell; and coastal waters on the eastern side of South Island.

South Carolina - In South Carolina there is a small fishery in the vicinity of Georgetown, but the major portion of the fishing is done in the southern half of the State from Bull Island to Tybee Roads. The areas most productive are off Johns, St. Helena, and Hilton Head Islands and in St. Helena, Port Royal, and Calibogue Sounds.

Georgia - The Georgia shrimp fishery is carried on throughout the entire extent of the inside and littoral offshore waters of the State from the Savannah River in the north to the St. Marys River in the south. This coast is fairly uniform in its production of shrimp.

Florida - On the east coast of Florida the fishery is more scattered than in Georgia and with the exception of the Cape Canaveral fishery is centered around the mouths of the various inlets of the central and northern coast. Other than a few shrimp taken near the mouth of the St. Johns River, practically the entire catch of shrimp on this coast of Florida is from the Atlantic Ocean within 10 miles of shore. The principal Florida east coast shrimping grounds are in the vicinity of Fernandina, the mouth of the St. Johns River, St. Augustine, New Smyrna, and Cape Canaveral. South of the Cape Canaveral grounds, which extend to Melbourne, there is no fishery of major importance although shrimp are occasionally taken off Vero Beach and Fort Pierce. From Fort Pierce south there is no fishery as the coral bottoms make it impossible to operate the otter trawl successfully.

1/ Fred F. Johnson and Milton J. Lindner, Shrimp Industry of the South Atlantic and Gulf States, United States Department of Commerce, Bureau of Fisheries, Investigational Report 21.

Royal Red Shrimp

The discovery of Royal Red shrimp in the deep waters of the Gulf in the course of its explorations prompted the United States Fish and Wildlife Service to extend its investigations to South Atlantic waters. The following paragraphs contain excerpts from the reports on the results of the first four cruises made by the Service's exploratory vessels.

In a series of 15 deepwater trawling stations off Fort Pierce and Cape Canaveral, Florida, using 40-foot flat shrimp trawls and a 10-foot beam trawl, large deepwater Royal Red shrimp Hymenopenaeus robustus were caught in all drags between 180 and 235 fathoms. Catches of shrimp ran from 5 to 20 pounds per 2-hour drag. A 4-1/2-hour drag off Cape Canaveral using an 80-foot balloon trawl caught 125 pounds of Royal Red shrimp of mixed sizes averaging 26-30 count, heads-off. Excellent trawling bottom was found between Fort Pierce and Cape Canaveral.

Between Cape Canaveral and St. Augustine seven 4-hour drags in depths of 150 to 212 fathoms caught 20/30-count red shrimp at rates of about 40 pounds per drag. The largest catch (70 pounds) was made in 150 to 156 fathoms off False Cape, Florida.

Twenty-five 4- to 5-hour drags between Cape Canaveral and St. Augustine produced 2,700 pounds of Royal Red shrimp during the period. The most productive drags were made in the 175-212 fathom range southeast of St. Augustine using a 40-foot trawl. Three tows in this area produced 1,020 pounds at a rate of 85 pounds per hour.

Round-the-clock trawling by the M/V Combat off St. Augustine in depths of 175 to 210 fathoms yielded excellent catches of deep-water Royal Red shrimp. A total of 4,200 pounds of heads-on shrimp (21 boxes, headed) were caught in 16 drags, using a 40-foot flat trawl.

In view of the encouraging results of the Service's explorations commercial production of Royal Red shrimp in south Atlantic waters was initiated in August 1956. Relatively high costs of production caused a discontinuance of this fishing.

Species Taken on Gulf of Mexico Fishing Grounds

Bottom Conditions of Fishing Grounds

Because of the growing importance of the Gulf of Mexico fishing grounds in recent years, and the characteristic distribution of the various species of commercial shrimp in this area, the ecology of the fishery will be discussed in some detail.

The Gulf of Mexico is approximately a thousand miles wide from east to west. From north to south, between the Delta of the Mississippi and the north coast of Yucatan, it is approximately 500 miles. The western Gulf is defined as the area west of the meridian between the Delta of the Mississippi and the north coast of Yucatan (longitude 90°W.). It is a convenient geographical boundary and has some biological significance at least in the northern part of the Gulf, as the influence of the Mississippi River is greater to the west than to the east of the Delta.

Economically there is little reason to divide the Gulf into eastern and western areas. One of the oldest fisheries on the Gulf coast is located in Pensacola, Florida, and snapper fishermen have for years traveled to and from Campeche Bank. Recently more shrimp from Campeche Bank have been landed at southern Florida ports than in Texas. The migratory character of the shrimp fleet makes it possible for the fishermen to fish extensively both in the eastern and western Gulf during the course of a single year.

Structurally, the continental shelf should be considered a part of the bordering coastal plain. The continental shelf varies greatly in width. It is approximately 120 miles wide off Cameron, Louisiana. In Texas it has an average width of sixty miles and is much wider off Sabine than off Port Isabel. The slope of the Texas coastal plain is about five feet to the mile and the slope of the continental shelf is about twelve feet to the mile. The average width of the shelf off Tamaulipas, Mexico, is considerably less than off Texas. Off Punta Roca Partida in the State of Vera Cruz, Mexico, where the Eastern Sierra Madre Mountains almost reach the coast, the continental shelf is correspondingly narrow and steep, being approximately eight miles wide. In the vicinity of Campeche, Mexico, the shelf is ninety miles wide, and the abrupt seaward escarpment of Campeche Bank is probably due to down-faulting.

The bottoms of the continental shelf are described as follows: beyond the 10-fathom curve the bottom is primarily terrigenous mud or silt, but with mixtures of sand extending out to thirty or more fathoms in some areas. Mud lumps and large coral-rock structures are common beyond the 50-fathom curve out to the edge of the shelf. If the continental shelf were a smooth area, everywhere suitable for the operation of the otter trawl, it would be much simpler to map the concentrations of shrimp. The abundance of shrimp in areas not suitable to trawling can only be surmised.

All four species of shrimp now commercially exploited in the Gulf of Mexico are caught on the continental shelf. The brown-grooved shrimp, *Penaeus aztecus*, is the principal species found in catches from the extensive mud bottoms of the continental shelf of Alabama, Mississippi, Louisiana, and Texas. White shrimp, *Penaeus setiferus*, are also present in the same region. In the Gulf of Campeche important commercial fishing grounds for the above-named two species and for pink shrimp, *Penaeus duorarum*, exist in contiguous areas. Pink shrimp are taken in abundance off Key West and the Dry Tortugas. Sea bob, *Xiphopeneus kroyeri*, is found primarily in the estuarial waters of Louisiana.

History of Explorations and Development of Fishing Grounds

The history of the explorations and development of new shrimping grounds in the Gulf of Mexico in recent years is described by Hildebrand. The following paragraphs have been excerpted from Mr. Hildebrand's account.

The shrimp fishery on the Gulf coast first developed in the bays and the lagoons. On the Gulf coast of the United States, except for peninsular Florida, shrimp were caught in large drag seines and cast nets, while on the coast of Mexico shrimp were caught in fixed traps.

The introduction of the otter trawl (between 1912 and 1915) in Louisiana freed the fishermen from dependence on the seasonal abundance of shrimp in shallow water. For a number of years the demand for shrimp was entirely supplied by shrimp from the bays and shallow water of the open Gulf. In 1938, the large scale production of jumbo white shrimp on the Ship Shoal grounds off Morgan City, Louisiana, began. The resultant national publicity helped create new outlets for the shrimp catch. The size of the Gulf shrimp fleet increased greatly, and a number of large offshore trawlers were built. Although the addition of new boats to the fleet was stopped during World War II, it can be stated that all shrimping grounds for white shrimp in the northern Gulf of Mexico were known and were being exploited shortly after the end of the war.

In 1946, the crew of the "Sovereign", an 84-foot boat owned by Major J. A. Pullen, discovered an enormous concentration of white shrimp off Carmen in the Gulf of Campeche. These fishing grounds had been previously explored by the Japanese in 1936 and 1937; but their location was unknown to the Louisiana boat owners.

The decline of the white shrimp production, discussed by Gunter and Hildebrand (1953), occurred shortly after the end of the war, when the demand for shrimp was high and previous high earnings of the fleet had attracted many new fishermen.

Although brown shrimp had been sold for many years, most of them were dried, canned or peeled. Because of the color, the quantity of brown shrimp that could be sold on the fresh market was at first very small.

During the first half of 1947, the production of shrimp was very low along the Texas coast and often the boats would bring in mixed catches of white and brown shrimp. The proportion of whites and browns (50 percent browns or more) was such that it was impossible to market them in one package. A producer-dealer of Aransas Pass was approached by a group of fishermen who wanted to set up a cooperative marketing agency for their shrimp. He acted as a broker for these vessel owners, who were anxious to push the sale of brown shrimp, until the cooperative was officially established during February 1948. The first carload of brown shrimp was shipped to San Francisco during August 1947. They were carefully graded to uniform size and shipped at cost to develop the market. Most of the brown shrimp that were sold the first year were handled through this brokerage arrangement and the cooperative. After the first six months the market was strong enough to handle all the brown shrimp produced by members of the cooperative.

Almost ninety percent of the production of brown shrimp during 1947 and 1948 was caught along the Texas coast with the greatest production at Aransas Pass. The rich shrimp beds which Hildebrand calls the "24-10" grounds, although discovered during 1947, did not figure prominently in the brown shrimp catch until 1949 when they dominated the catch.

Brown shrimp production developed somewhat later off Mississippi, Alabama, and Louisiana because the owners of the large trawlers did not find brown shrimp as abundant as on the "24-10" grounds. However, the shrimping grounds offshore were well-known to many of the fishermen. The offshore fishery developed during June 1950, when large trawlers from the Texas fleet brought the first sizable landings into Alabama ports.

The last major discovery of a commercial brown shrimp ground was the Obregon grounds. Commercially valuable concentrations were apparently exploited for the first time during the full moon of April 1951. For several months afterwards the boats would leave Campeche for Obregon to fish for brown shrimp during the full moon. However, fishing pressure became so great in the Gulf of Campeche that fishermen informed Mr. Hildebrand that it soon became difficult to prove that fishing was any better during one phase of the moon than another.

After the discovery of the Obregon (brown shrimp) grounds, the development of small "pockets" in the area between Punta Jerez and Alvarado, Mexico, began. The largest area of trawlable bottom was found in the region around Lobos Island. Still later the fishermen actively explored and exploited fishing grounds off Galveston and Freeport. During the winter of 1954-55 many fishermen were operating in depths of 30 to 50 fathoms off Freeport and Galveston.

Pink shrimp <u>Penaeus duorarum</u> were first described by Burkenroad (1939). He gave the range as extending from Cape Hatteras, North Carolina to Key Largo, Florida on the Atlantic coast. Nearly all his records from the Gulf of Mexico were from the west coast of Florida. He lists only Vera Cruz in the western Gulf. Although the details of its distribution in the Gulf of Mexico are not yet known, pink shrimp have not been reported authoritatively between the mouth of the Mississippi and the meridian of Galveston, and very little was known about their distribution along the east coast of Mexico.

Burkenroad (1949) described a 10-year old fishery between Core Sound and Beaufort Inlet in North Carolina. Here seventy channel nets were fished on the night ebb tide in May, June, and July. The annual production of these nets was around 100 tons, and although a portion of brown shrimp Penaeus aztecus was present, the catch was chiefly immature pink shrimp Penaeus duorarum.

Undoubtedly small pink shrimp have supported small fisheries in other bays along the Gulf coast, particularly a bait fishery along the west coast of Florida, but the landings have never been great.

In the northern Gulf the fishery for pink shrimp has been insignificant, and although few data are available, it is probable that it is less than one percent of the catch (Hildebrand 1954). Springer (1952) stated that at times the Mississippi fleet landed as much as 30 percent pink shrimp. However, he stated that in 1953 and 1954 the fauna had changed and less than one percent pink shrimp were landed (Springer and Bullis, 1954).

The most highly publicized and the first really major development of a pink shrimp fishery occurred in 1950 with the exploitation of the Tortugas shrimp grounds. Idyll (1950) gives an account of the discovery of these grounds off Key West and Tortugas from which the following summary was abstracted.

Exploratory fishing in the Tortugas area was begun during September 1949 following accounts of successful night fishing for grooved shrimp in Texas. Results were encouraging and commercial operations began in January 1950. When the discovery became generally known, rapid expansion followed and during February 1950 an estimated 2,117,000 pounds (whole shrimp) were landed. Two hundred and fifty to three hundred boats were fishing there by March 1, 1950. The fishing grounds are located north of a line drawn from Key West to Loggerhead Key in the Dry Tortugas group. They are approximately 70 miles long by 10 to 15 miles wide. The bottom is covered by fine calcareous sediments ("coral mud") with some coral obstructions.

However, the large fleet dispersed by the end of March 1950 and there has been a steady though not spectacular production since that time.

Although the pink shrimp grounds off Campeche were prospected by the Japanese in 1936-37, they were unknown to Texas fishermen. A man closely associated with shrimp developments in the Gulf of Campeche, informed Hildebrand that probably the first shipment from the banks was made in 1947 when 1,500 pounds were sent to Brownsville. However, the shrimp buyer in Brownsville requested that no more be sent because of marketing difficulties. Exploitation of the Campeche Bank shrimp fishery started when the trawler, "Oro Lobo", brought a load of pink shrimp into Brownsville on May 23, 1950. Because of a shortage of ice the catch was only 30 barrels, but the boat captain knew that he had located extensive new beds of shrimp. On the next trip the "Oro Zorro" and "Oro Lobo" had cargoes of 120 barrels each. The secret of the new grounds became common knowledge, and a large number of fishermen started making the trip across the Gulf to new fishing grounds.

The discovery and development of the Campeche fishery was at first entirely a Texas operation. The first Florida-based fishermen apparently arrived on the grounds during January 1951 but by April 1951 the majority of the boats were based in Florida. However, some of the boats fishing the grounds were transients from New England. A record breaking run of brown shrimp during the fall of 1951 kept most Texas fishermen away from Campeche Bank, and the Florida fishermen have produced over 90 percent of the shrimp from the banks since that time.

Campeche catches fell off sharply in 1954. It is not known, whether this decline is an indication of decreased abundance of pink shrimp since brown and white shrimp are included in the catches of the Florida boats fishing the Campeche waters.

Recent information on the status of explorations in the Gulf of Mexico is available from the publications of Hildebrand previously cited as well as from the cruise reports of the "Oregon", the exploratory vessel of the Bureau of Commercial Fisheries of the United States Fish and Wildlife Service. From the above sources the following observations have been excerpted.

White Shrimp 2/

Although white shrimp have been recorded in water as deep as 43 fathoms off Louisiana, commercial trawling is concentrated inside 20 fathoms; the bulk of the catch is made inside 14 fathoms. There are seasonal variations in the depths where white shrimp occur and the tagging of shrimp has shown that in Louisiana they move offshore in the winter. There are indications that the species is restricted to a narrower vertical range on the south Texas coast and off Tamaulipas than in Louisiana.

Production varies greatly from year to year and seasonally; often most of the shrimp are caught in very small areas. There are indications that the catch of this species shows a long-term tendency to decline in some areas. The 1951 State of Texas landings of white shrimp, for instance, were only about 30 percent of the 1943 landings.

The largest single fishing ground for white shrimp is the territory from the mouth of the Mississippi River to Freeport, Texas.

2/ Source: Hildebrand, H. H., Fauna of the Brown Shrimp Grounds in the Western Gulf, Institute of Marine Science, The University of Texas, Port Aransas, Texas, November 1954, v. III, No. 2, p. 240.

Almost all the bottom inside 14 fathoms is clear and suitable for trawling except for Sabine and Heald Bank and the vicinity of wrecks and snapper banks. There are also regions of soft mud, such as off Timbalier Pass and the Atchafalaya River, and extensive amounts of shell in 8 to 14 fathoms off Sabine, but either these hazards are not extensive, or they do not hinder fishing with modern gear. Between nine fathoms and the shore there are numerous obstacles to trawling in the region from Freeport to the Colorado River. Numerous snags and large amounts of soft mud ("suck sand") make fishing virtually impossible except in small prescribed areas. These small pockets are very productive at times, but even the most experienced local fishermen sometimes lose gear. Presumably the Colorado and the Brazos Rivers deposit logs and mud which make this locality unsuitable for trawling.

Paralleling the coast from the Colorado River to about 27°N. is a belt of bottom inside 14 fathoms that is suitable for trawling. There are very few hazards to trawling in this region.

From about 27°N. to ten miles south of the Rio Grande there is an area that is unsuitable for trawling because of soft mud, coral, shell and topographic irregularities. At 26° 48' N. are found the small fingerlike ridges and valleys discussed by Mattison (1948). Some of these ridges are reputedly topped by dead coral. Much of the ground off Port Isabel, according to the fishermen, is covered with prickly conch, *Murex fulvescens*, and other shell. Shell bottom can be trawled, but net damage is much greater than on mud or sand bottoms. A few patches of clear bottom are present, such as around the whistling buoy and a small tract along the beach about 15 miles north of Port Isabel. Fishermen with small boats and small nets fished much more of the inshore area in former years than is now fished by the large trawlers.

The grounds along the east coast of Mexico suitable for white shrimp trawling are equal to about one-tenth of the white shrimp grounds in the Louisiana-Texas area. In part this is due to the much narrower continental shelf, but there are also large areas of coral, volcanic rocks and soft mud.

Generally the production of white shrimp along the northern coast of Tamaulipas is very small, although fishermen in the Port Isabel area report that a run of white shrimp occurs about once every ten years. Presumably these fluctuations are caused by changes in the hydrographic condition of Laguna Madre del San Antonio, the only extensive nursery ground along the coast. There is a small stretch of trawlable bottom that begins about ten miles south of the Rio Grande and extends about 70 miles down the coast. From this ground to Tampico the bottom is marked as hard on the hydrographic charts. According to Texas fishermen it is rough and covered with prickly conchs. Presumably "pockets" could be trawled, and indeed an extensive area near the Tampico Light produces shrimp. From Tampico to Tuxpan there is very little trawling ground. Near Cabo Rojo a few white shrimp are caught.

In the State of Vera Cruz there is a small area of good bottom known to the Texas fishermen as the Nautla grounds. As far as is known only the immediate surroundings of the estuaries of the Tuxpan, Tecolutla and Nautla Rivers are suitable for trawling. A little trawling is done off Alvarado, Vera Cruz.

No other offshore white shrimp fishery has been developed along the Mexican coast this side of Obregon although a small area can be trawled near Laguna Carmen. The most important white shrimp fishing ground in Mexico lies off the coast of the States of Tabasco and Campeche. Only the area of highest production is delineated in figure I - 7. Additional ground is trawlable, but production is usually low, although occasionally large concentrations of white shrimp are encountered on the pink shrimp grounds to the east. Production is reported to be very slight in the area west of Punta Buey, where the hydrographic charts show a shell bottom.

EXPLANATION OF FIGURE I - 7

This map is based on data supplied to Hildebrand by Mr. John Wiech, an experienced navigator and shrimp fisherman in the Gulf of Campeche. It shows the fishing grounds and principal areas of production of shrimp in the Gulf of Campeche from August, 1950 to August, 1951.

Area 1. Pink shrimp; size 21/25 count; abundant during hurricane season (August to November, 1950).
Area 2. Pink shrimp; size 15/20; total fishing area small and consisting of small holes among the big logger-head sponges; areas buoyed when fishing.
Area 3. Pink shrimp; big producing area from November 1, 1950, to January 1, 1951; bottom with occasional flat rocks, washboard topography but with fewer conchs than Area 4.
Area 4. Pink shrimp abundant; also the area with the greatest concentration of conchs.
Area 5. "Quick sand" and mud lumps; not fished.
Area 6. Pink shrimp; size mostly 25/30 count; most of pink shrimp produced here from January to June, 1951.
Area 7. White shrimp; during February and March, 1951 enormous quantities of white shrimp were encountered here; some boats produced 60 to 70 barrels a day and production was slowed by inability to handle the shrimp faster.
Area 8. White shrimp; a few scattered boats found large concentrations of white shrimp during February and March, 1951.
Area 9. Brown shrimp; heavy concentration of large brown shrimp.
Area 10. Brown shrimp; smaller than Area 9; most shrimp 20/30 count.
Area 11. White shrimp; mixed sizes but mostly 20/25 count during August, 1951.
Area 12. Pinks merge with brown shrimp, but production so slight during 1950-51 that no boats fished the ground. Bottom very good.
Area 13-14. Pear and New Bank. 18 fathoms; rough bottom but plenty of shrimp. Some fishing by a few boats.

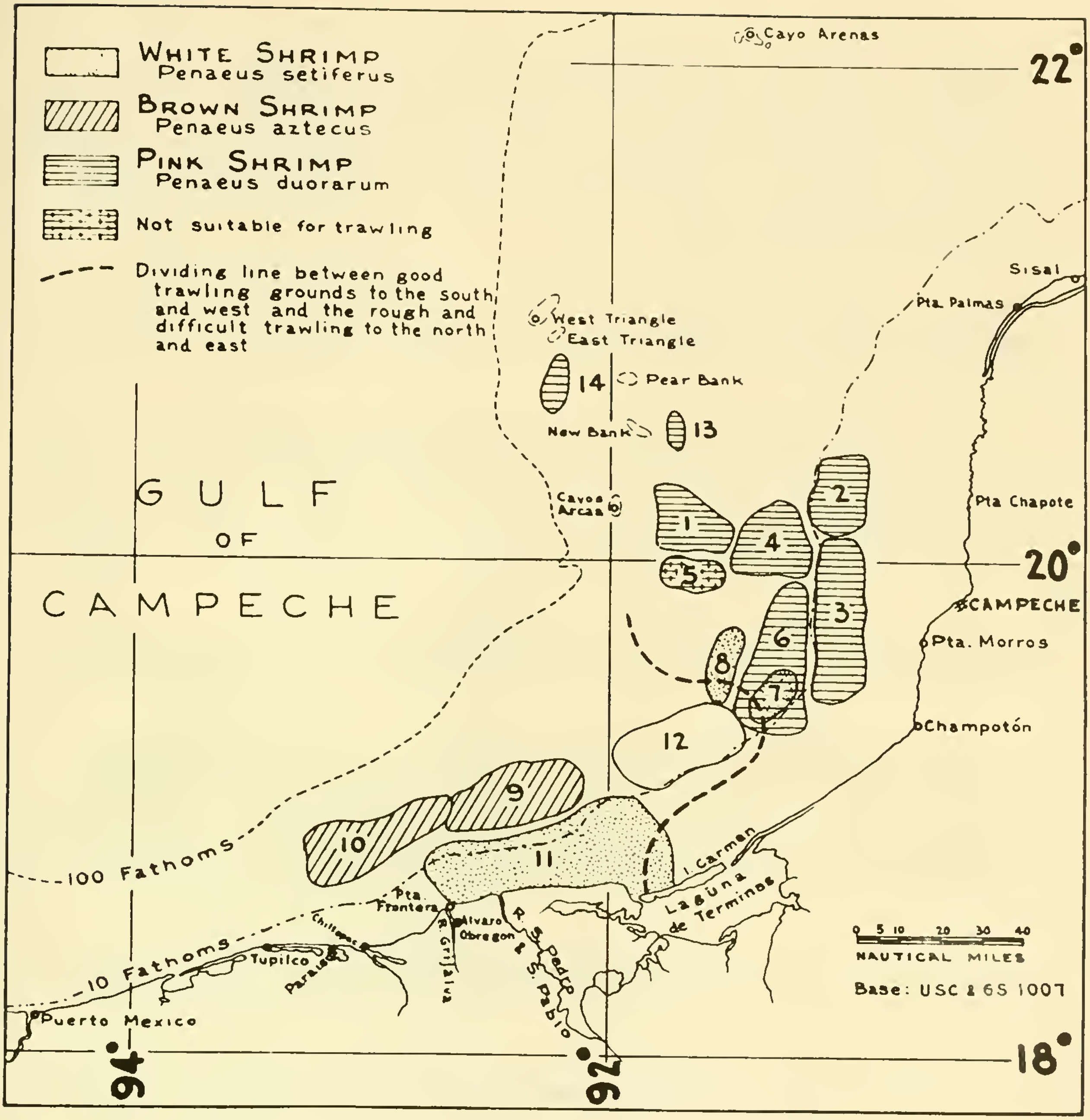


FIGURE I - 7.--Major shrimping grounds in the Gulf of Campeche. (August, 1950 to August, 1951)
Institute of Marine Science, Volume IV, No. 1.

Brown Shrimp[3/]

Mr. Springer and Mr. Bullis, in charge of the exploratory expeditions of the "Oregon", the vessel of the United States Fish and Wildlife Service, conclude that the brown shrimp have a wider depth range than white shrimp. Although there are many instances, particularly at

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3/ Source: Hildebrand, H. H., Fauna of the Brown Shrimp Grounds in the Western Gulf, Institute of Marine Science, the University of Texas, Port Aransas, Texas, November 1954, v. III, No. 2, p. 240

dawn and at dusk, or in muddy water, when both species may be taken in a single drag, brown shrimp are usually caught in night drags while white shrimp are taken in the daytime. A few pink shrimp are found in the western Gulf of Mexico, and the range of the brown shrimp may extend into the eastern Gulf, but the commercial importance of these out-of-range shrimp is not known, perhaps because of the limited observations of fluctuating availability.

Brown shrimp have been taken in 85 percent of all exploratory drags made by the "Oregon" in depths of 10 to 70 fathoms between Cape San Blas, Florida, westward and southward on the continental shelf to Carmen, Mexico.

The area that has repeatedly yielded the highest catch rate of brown shrimp lies in the 30-to 45-fathom depth range between 88° and 90° west longitude on both sides of the Mississippi Delta. Until 1952 some sections in this area were only partly fished because the soft mud bottom bogged trawling gear. After the introduction of the "mud rope", however, the entire area was being fished.

Eastward from 88° west longitude (east of Mobile) catch rates diminish rapidly. No catches of brown shrimp were made east of Cape San Blas, Florida.

Westward from the Delta, all grounds that seasonally have commercially valuable stocks are being worked by the Texas and Louisiana fleets. Beyond the present depth range of this fishery, in 35 to 50 fathoms, there are extensive areas of good trawling bottom. Catches of the "Oregon" in this area averaged only 20 to 50 pounds per hour, a quantity which is considered below the present minimum catch rate for offshore shrimp vessels.

Off the Alabama, Mississippi, Louisiana, and Texas coasts the steep slope of the continental shelf between 70 and 100 fathoms makes trawling difficult or impractical.

Beyond 50 fathoms out to the edge of the continental shelf poor trawling bottom was encountered by the "Oregon" in its latest trips.

Hildebrand goes into considerable detail in outlining the expanse of the fishing grounds for brown shrimp in the Gulf. His description of the fishing grounds is based on the results of his own explorations and on information supplied to him by commercial fishermen in the area. The maps prepared by him do not show the fishery for small brown shrimp in the protected waters of the bays and in depths of less than twelve fathoms since no separate statistics on this part of the fishery exist. He emphasizes, though, that at times large landings of small, 40-65 count, shrimp are made in Louisiana and East Texas ports. (see figure I - 8)

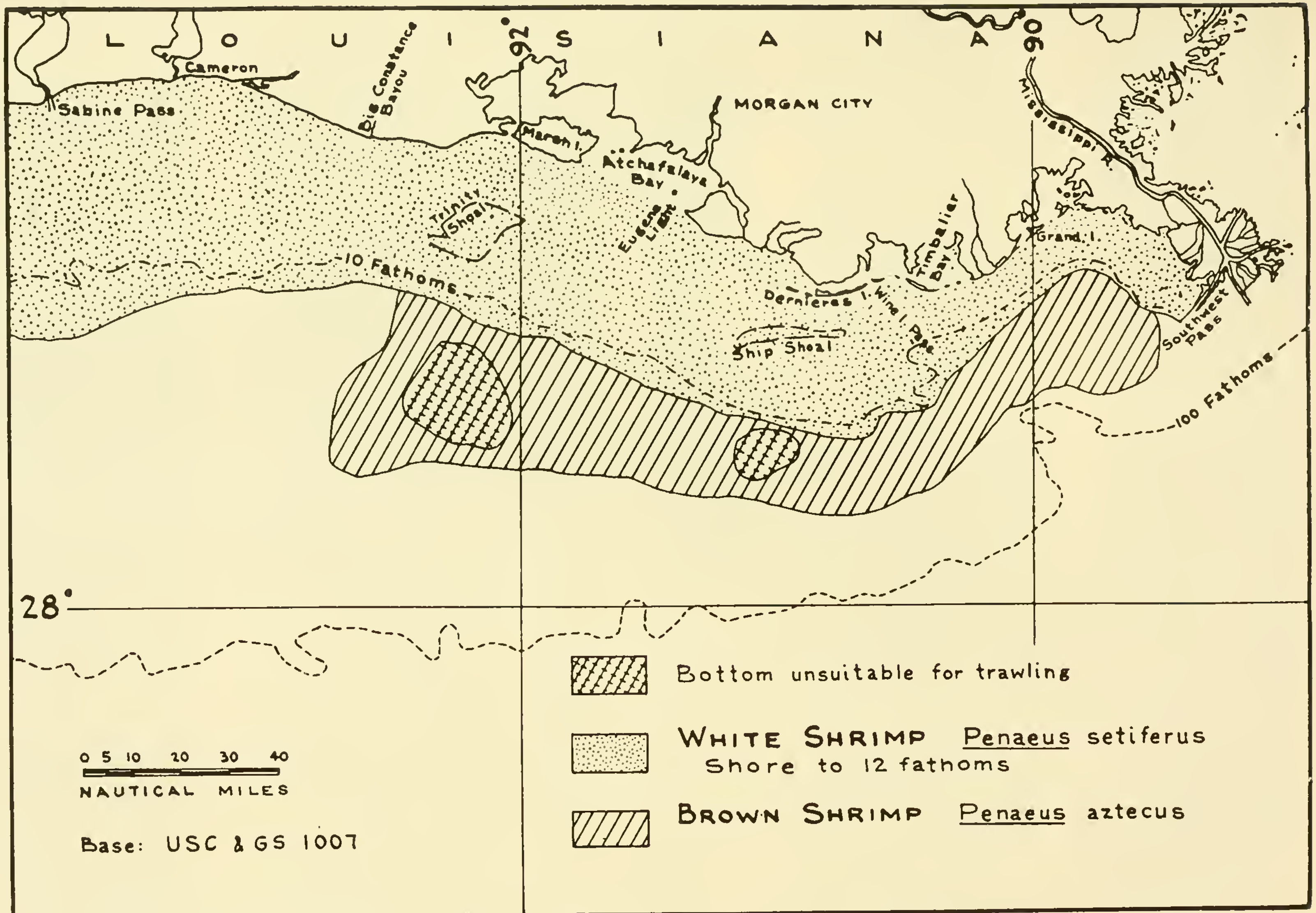

FIGURE I - 8.--Southwest Pass shrimping grounds and shrimping grounds in Western Louisiana. Institute of Marine Science, Volume IV, No. 1.

There is an important ground for brown shrimp, in Hildebrand's words, off Southwest Pass at the mouth of the Mississippi River. However, trawling conditions are for the most part difficult and the returns are small compared with the rich "24-10" beds so that many fishermen have emigrated with their large trawlers to Port Isabel. New interest was shown in the Southwest Pass ground when the fleet became so large in Port Isabel that the catch per boat became less than catches off Southwest Pass. However, not all this bottom is trawlable and much gear has been lost in soft mud and "mud lumps".

Shaw (1914) described mud lumps as domes of fine, tough, structureless clay rising two to ten feet in height usually within a mile or two of the end of the passes of the Mississippi River. Fenneman (1938) favored the theory that thin layers of highly mobile clay under the pressure of accumulating sediments on the delta are caused to flow laterally and break through to the surface at favorable points. Whether the mud lumps, as used in the Gulf fishermen's vocabulary, are the same type as the ones studied by Shaw, is not known. Fishermen have used this term to describe trawling conditions 60 to 70 miles from land. Springer (1952) identifies "mud lumps" as soft mud bottom.

Another bottom type is the very soft mud of the Delta region and offshore in east Texas. Possibly this condition is synonymous with the so-called "suck sand" found off the Colorado River and on Campeche Bank. Often an entire rig is lost when such trawling conditions are encountered.

From Southwest Pass to the submarine canyon, a distance of approximately 20 nautical miles, there is considerable trawling in depths of 40 to 55 fathoms. All other major brown shrimp grounds in the western Gulf of Mexico are in shallower water. The Southwest Pass grounds continue westward from the submarine canyon in depths of 12 to 29 fathoms to the shell ridge off Big Constance Bayou. In this part of the Southwest Pass grounds there are obstacles to trawling such as dynamited wrecks south of Ship Shoal and the extensive area of soft mud south of Trinity Shoal. Some of the soft mud bottom off Trinity Shoal is fished by wrapping the footrope of the trawl until it is a foot or more in diameter. Many places on the Southwest Pass grounds in former years were seasonally fished for large white shrimp, and it is probably on these grounds that there is the greatest interspecific competition between the adult white and brown shrimp.

Prior to the summer of 1953 the vast area from Big Constance Bayou to the Colorado River was not fished for brown shrimp. It was deemed that there was very little bottom suitable for trawling because of an extensive shell ridge, snapper banks and soft mud. A few brown shrimp were caught off Freeport in 14 to 17 fathoms, and small brown shrimp were caught inshore of the 12-fathom contour. Most of the landings of brown shrimp at Freeport, Texas, were caught off Pass Cavallo or off Obregon, Mexico. Active exploration in the area east of the Colorado River was carried out by the shrimping fleet during the summer of 1953, and the largest catches per unit of effort were made in that area. Most of the fishing was done in depths of 14 to 17 fathoms from Freeport to Sabine. Some fishing was done in 19 fathoms southeast of Freeport, and some bottom was reported in deeper water. One of the big disadvantages of this area is the great distance from shore; consequently, there is very little winter fishing in the area.

The bottom types off Sabine are described as follows:

1. Beach to 8 fathoms. Sand, mud and some shell, but the bottom is clear and suitable for trawling except for Sabine Bank, a rocky area.
2. Eight to 18 fathoms. Shell, mostly prickly conchs, *Murex fulvescens* and *Strombus alatus*.
3. Eighteen to 20 fathoms. Mud bottom (some trawling can be done here but it is 8 to 9 hours running time from Sabine).
4. Twenty fathoms and beyond. Too many mud lumps for trawling. Fishermen have lost nets in 27 fathoms off Sabine, where bottom looked clear on the depth recorder but the nets sank into the soft mud.

Hildebrand calls the largest single area of trawlable bottom for brown shrimp the "Texas" ground. This fishing ground extends from the Colorado River to Sebree Bank about 30 miles north of Port Isabel. Although the entire region from 12 to 50 fathoms is suitable for trawling, it has been divided into two parts with the 28 fathom contour as the dividing line because this contour marks the seaward limit of the most profitable fishing. (see figure I - 9)

Between 12 and 25 fathoms on the Texas grounds there is an estimated 2,700,000 acres suitable for trawling. The bottom type is predominantly mud, and only a few snapper banks and wrecks hinder trawling. Possibly the most extensive area of bad bottom is in the 17-1/2-to 20-fathom zone off Pass Cavallo. At its northeastern edge the mud bottom is replaced by shell and the fishery is relatively unproductive in this region. The southern edge is highly irregular and narrow belts of trawlable bottom link it with the "24-10" grounds to the south. Snapper banks and shell occur along the south edge of the Texas grounds.

As previously mentioned, the present seaward limit is prescribed by the productivity of the grounds, i.e., the trawlable bottom beyond 29 fathoms produces less shrimp per hour of trawling than the inshore grounds. Nevertheless, there is some trawling in 29 to 50 fathoms, but the area is not well known to most Texas fishermen, and gear is lost because of the ignorance of trawling hazards. There are a number of snapper banks in this district, notably the ones in 41 fathoms off Aransas Pass. Although the extent of trawlable bottom is undoubtedly large, no estimates of the area involved were made because little is known about the bottom.

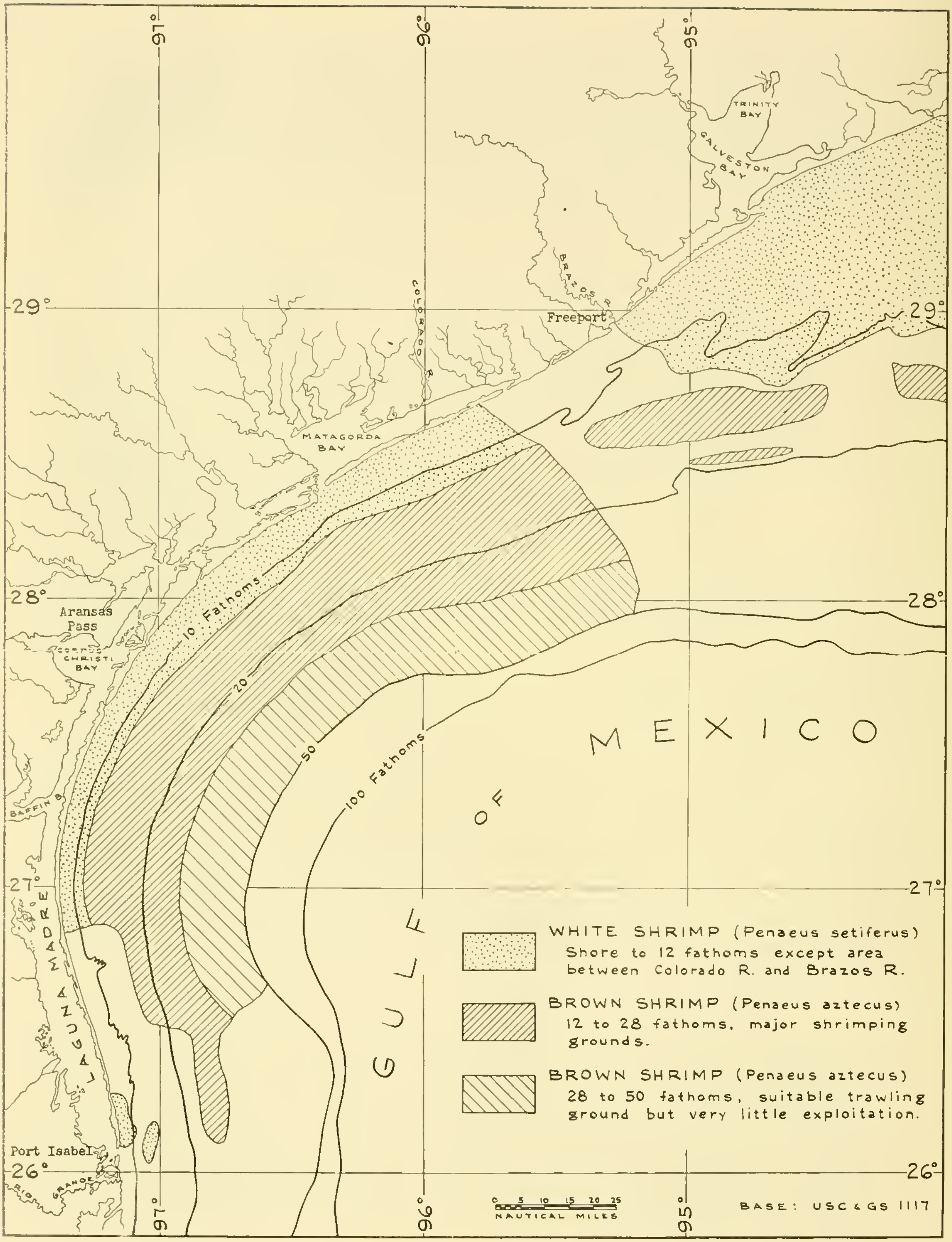

FIGURE I - 9.--Texas shrimping grounds.
Institute of Marine Science, Volume IV, No. 1.

From Sebree Bank to about 20 miles below the Rio Grande, there is an area that is not fished regularly. The bottom is rough and there are locally large concentrations of shell and sand dollars. These obstacles plus the snapper banks discourage most fishermen from trawling here. Some trawling is done at depths of 24, 32-33, and 35 fathoms.

The next important ground, called by Hildebrand the "24-10" ground after its most productive portion, extends southward from about 20 miles below the Rio Grande to northeast of Sugarloaf Mountain at approximately 23° 15' N. From Sugarloaf Mountain southward to Punta Jerez, there are small "pockets" of trawlable ground that should be included. There are an estimated 2,300,000 acres of trawlable bottom in the "24-10" ground. The fishery is concentrated between 12 and 40 fathoms, except in the region of 24° 10' N. where rocks (probably igneous in origin) extend out to 27 fathoms. The depth of the fishery varies seasonally, and the bulk of the winter and spring catches are made in depths of 30 to 40 fathoms. A number of trawling conditions are encountered in the area. Most of the bottom is mud, some of it is soft mud and a small part is shell. (see figure I - 10)

Between Punta Jerez and Lobos Island the bottom is rocky. Coral and volcanic necks hinder trawling. The known shrimp grounds consist of "pockets" of trawlable bottom. Occasionally, a few large catches from this area are unloaded in Port Isabel.

The next locality of importance is the Lobos Island ground, where a small fishery has been developed about 10 miles south of the island. The chief pockets of trawlable bottom are in 16-17, 25-26 and 34-36 fathoms, and most of the trawlable bottom, according to the fishermen, is reddish mud. Although this fishing ground has been known to Texas fishermen since the days of extensive exploration along the Mexican coast during 1947-50, it was not intensively fished until the spring of 1953. Perhaps the heavy run during 1953 was, indeed, greater than in previous years as some fishermen think, and it may well have been related to the decreased run-off and rainfall on the nursery grounds in Laguna Tamiahua.

Between the Lobos Island ground and Obregon, no important brown shrimp grounds exist, although there are pockets of trawlable bottom at least as far as Alvarado. One of the largest of these pockets is in 22-35 fathoms east of Alvarado.

The Obregon ground is delineated in figure I - 7. It consists of about 800,000 acres of productive bottom. Mud is the predominant type of bottom and the grounds were found to be surprisingly free of shell during the investigations conducted by Hildebrand in 1951. The limits of this fishery are prescribed by small populations of shrimp on the neighboring grounds rather than trawlable bottoms. Some brown shrimp are caught as far east as Champoton, the west boundary of the pink shrimp grounds, but this fishery developed after catches fell on neighboring pink and brown shrimp grounds. The west boundary is a shell ridge that runs offshore from Chiltepec. At times, a few shrimp are caught in 23-26 fathoms in the area between the Chiltepec shell ridge and Laguna Carmen.

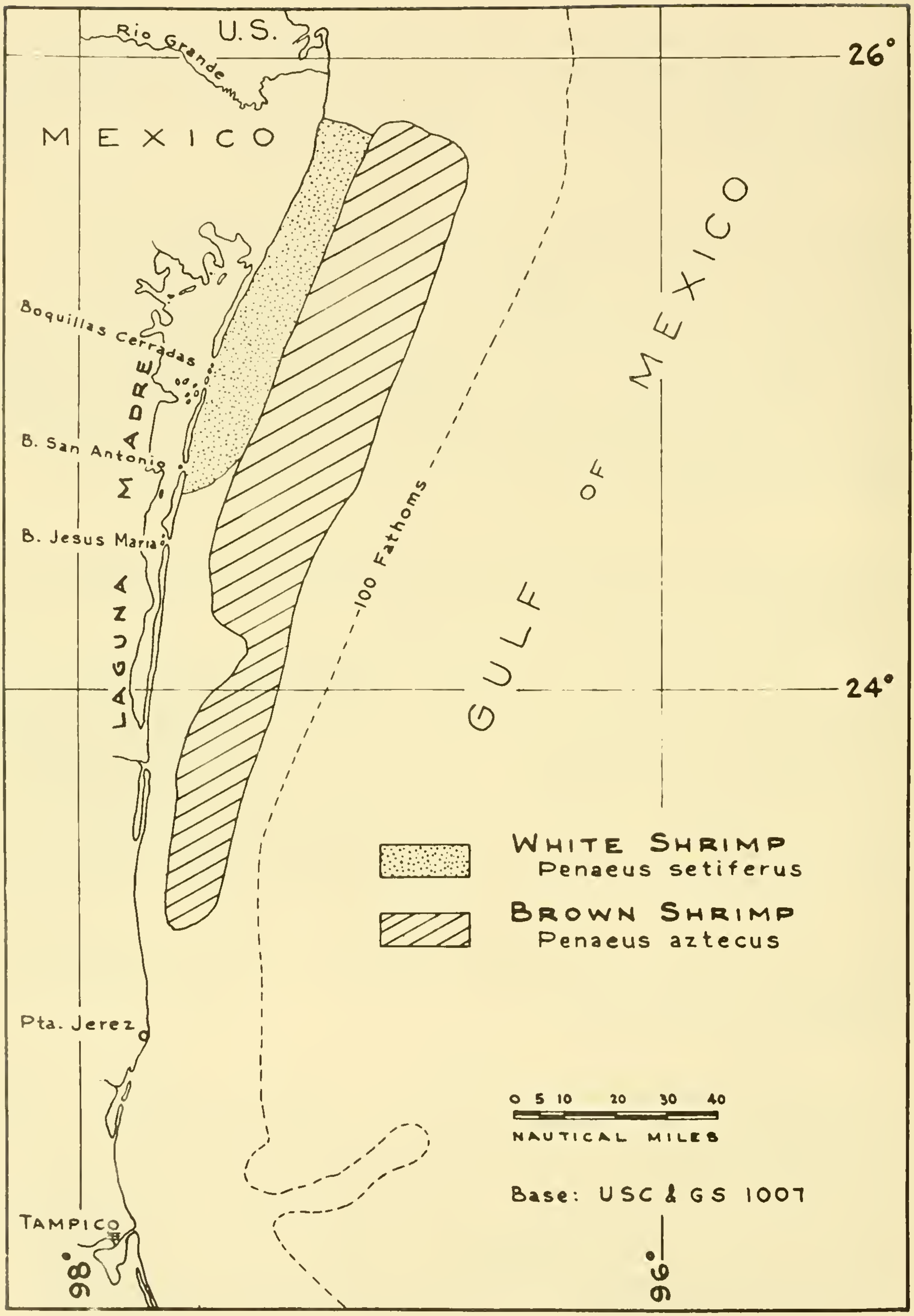

FIGURE I - 10.--"24-10" Shrimping grounds.
Institute of Marine Science, Volume IV, No. 1.

The main brown shrimp grounds as described in the preceding paragraphs are as follows:

Grounds	Estimated Trawlable Area
	Acres
Southwest Pass Ground	1,800,000
Texas Ground (main region)	2,700,000
"24-10" Ground	2,300,000
Lobos Island Ground	25,000
Obregon Ground	800,000

Pink Shrimp

Pink shrimp in the Gulf are taken primarily in the eastern part of the continental shelf.

The eastern Gulf continental shelf zone extends from Pensacola south along the Florida coast and includes the Campeche Bank down to Carmen, Mexico. These two sections are characterized by sand, shell, and coral gravel; and by live coral overlying white, gritty, calcareous mud.

In the western Gulf pink shrimp occur as juveniles in the bays of Texas and a few adults, less than one percent of the total catch, are captured along the coast. Hildebrand (1955) says that sometimes in the spring of the year a large number of small spotted (pink) shrimp are captured, according to fishermen's reports, in depths of less than 20 fathoms along the Texas coast. This was especially true during the spring of 1954.

The only pink shrimp ground of importance in the western Gulf is off the coast of Campeche. Numerous conchs, large loggerhead sponges, coral and rough bottom plague the shrimp fishermen in this region, but much of the area outlined in figure I - 7 can be trawled. The pink shrimp has an ecological preference for shell sand rather than the mud bottom on which the brown shrimp thrive. Most of the pink shrimp fishery is concentrated in depths of 4 to 25 fathoms.

Springer reporting on his explorations states that commercial concentrations of pink-grooved shrimp were found to extend beyond the heavily worked areas on both the Dry Tortugas and Gulf of Campeche grounds. In August 1951 the "Oregon" ran a series of drags away from the relatively confined 14-fathom fishing area off Campeche and demonstrated that equally high catches could be maintained out to 25 fathoms at distances of 20 to 25 miles away from the area of intensive fishing.

In June 1950, January and February 1951, July and December 1952, and in June 1953, exploratory soundings were made in 10 to 25 fathoms between Apalachee Bay and the Dry Tortugas grounds in search of level bottom sufficiently clear of coral and loggerhead sponge to permit trawling with conventional type trawling gear. The few drags made in less hazardous-appearing areas off Cedar Keys, Tampa, and Boca Grande generally resulted in severe gear damage.

Owing to the time-consuming nature of developing trawling gear suited to this type of bottom, experiments were limited in favor of explorations in areas suitable to existing gear. However, some progress has been made in combating certain trawling hazards. Several types of bottomless trawls were used successfully in loggerhead-sponge areas. They were designed to break the sponge away from the bottom and permit it to pass between stringers running from the tickler chain back to the unweighted lead line. Subsequent comparison drags with standard commercial trawls showed an average reduction of 75 percent of trash and scrap fish and a reduction of the shrimp catch by about 30 percent.

Extensive areas along the west coast of Florida and on the Campeche Bank within the depth range of pink-grooved shrimp *Penaeus duorarum* received scanty exploratory trawling prior to 1954. The possible development of confined limited production areas was indicated by the occasional good catches in small isolated gulleys of clear mud bottom; the presence of pink shrimp in Boca Grande Harbor, Tampa Bay, Cedar Keys, and off Apalachicola; and scattered pink shrimp caught in exploratory drags throughout the 10-to 25-fathom depth range on bad bottom. However, either clear bottom should be located or gear developed to overcome the natural trawling hazards.

Royal Red Shrimp

Beyond the edges of the continental shelf there has been no commercial shrimp fishing in the Gulf of Mexico. Snapper fishermen have extended the range of their fishing from about 80 fathoms to about 150 fathoms within the past few years. This has been possible because of new developments in fishing gear, such as power reels, stainless steel wire lines, and electronic aids for finding position, depth, and good fishing places. Deep-water fishing for snappers has not been better than fishing in shallower water, but it has made it possible for snapper fishermen to move offshore during periods of temporary poor fishing on the shallow banks. The net result has not been larger daily catches but better trips and greater seasonal earnings for well-equipped and well-managed vessels.

In the opinion of the exploratory fishing and gear research specialists of the United States Fish and Wildlife Service, the development of a deep-water fishery for Royal Red shrimp *Hymenopenaeus robustus* may eventually create a supplement to the inshore fishery in the Gulf of Mexico. Preliminary explorations of the "Oregon" indicate that the prospects for commercial exploitation of Royal Red shrimp are good.

Bullis (1956) described the results of these explorations as follows:

> "The first catches of Royal Red shrimp in the Gulf were made while the "Oregon" was primarily engaged in explorations for brown-grooved shrimp, Penaeus aztecus. In July 1950, a series of trawling stations was made off the Mississippi Delta, in increasing depth intervals beyond the limits of the continental shelf. At that time, small numbers of Royal Red shrimp were taken in depths of 195 to 232 fathoms. During the following four years, which were primarily devoted to exploration for shallower-water shrimp and for tuna, a short period of each trawling cruise was spent on additional deep-water dragging. By the end of 1954, exploratory coverage of the 100-to 300-fathom range in the eastern Gulf between the Mississippi Delta and Key West, and along the Texas Coast was extensive, with limited work carried out to depths of 500 fathoms. Only scattered drags were made off Louisiana, the Campeche Banks, and in the Gulf of Campeche.
>
> "In 1955...a series of cruises were programmed for the "Oregon" to provide a more comprehensive picture of the commercial potentialities of Royal Red shrimp.... In March 1955, a series of 34 trawling stations were made in depths of 160 to 270 fathoms between the Mississippi Delta and Cape San Blas, Florida. In July, round-the-clock trawling was attempted in depths of 190 to 300 fathoms south and southeast of Dry Tortugas.... Following this work, some exploration of the 200-fathom depth range was carried out on the eastern end of Nicolas Channel along the north coast of Cuba, and in the Straits of Florida off Key Largo. In September, exploratory coverage was extended along the Louisiana Coast....During the last half of the cruise, the Delta to Cape San Blas area was reworked using 80-foot balloon trawls....
>
> "The distributional picture that emerged from this work showed Royal Red shrimp to be present throughout the Gulf of Mexico on all types of bottom in a depth range of 190 to 270 fathoms, with a maximum range of 150 to 400 fathoms."

Commercial operations for Royal Red shrimp in the Gulf of Mexico on an experimental basis were conducted in September 1952 and throughout most of 1956. Royal Red shrimp catches of commercial significance, according to Bullis (1956), were restricted, for the most part, to two well-defined areas: off Dry Tortugas and east of the Mississippi Delta (see figures I - 11 and I - 12).

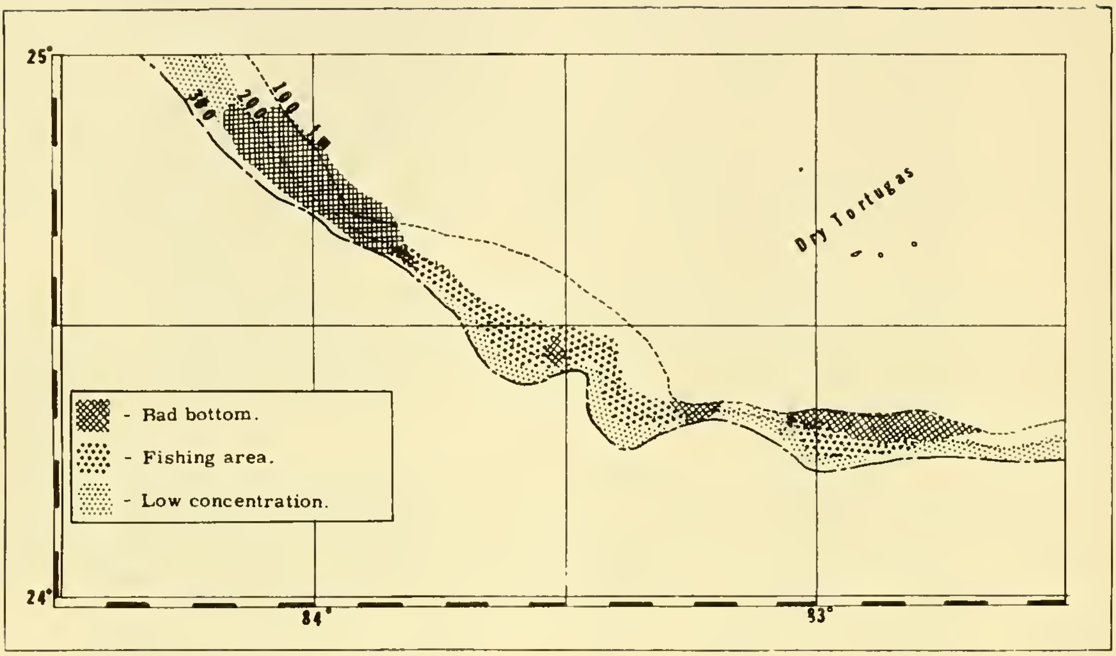

FIGURE I - 11.--Dry Tortugas Royal Red shrimp grounds showing areas of fishing concentrations and bad trawling bottom.

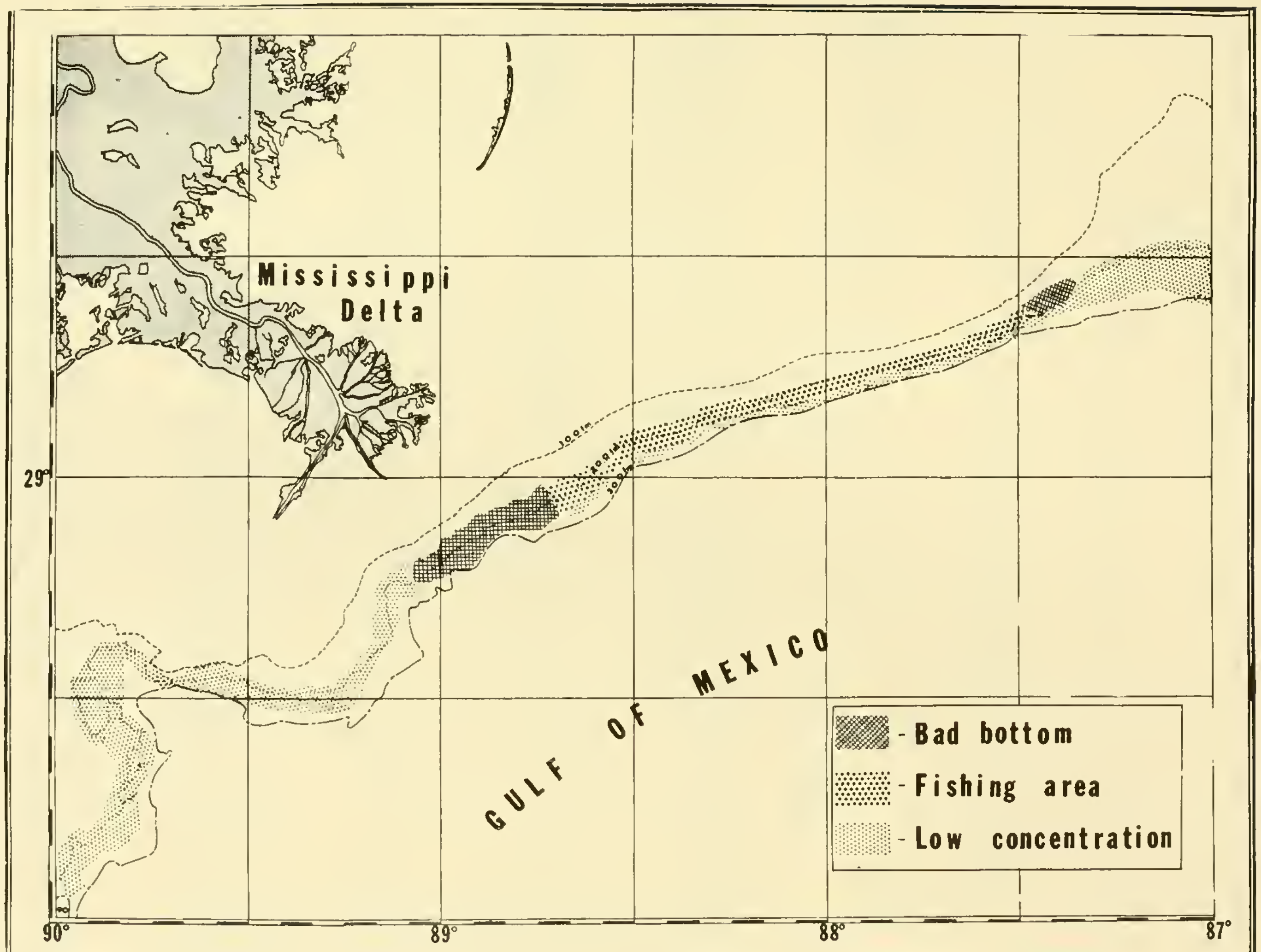

FIGURE I - 12.--Mississippi Delta Royal Red shrimp grounds showing areas of fishing concentrations and bad trawling bottom.

Among Bullis' general observations regarding the distribution of the species were the following:

> "Royal Red shrimp have shown no apparent seasonal variation in average size. In areas of maximum fishing concentrations, the heads-off count consistently averaged 26-30, in both the Tortugas and Delta areas. A larger average size is noted in greater depths, but the concentrations are much smaller. No uniform size dominates the catch, which contains individuals ranging from 12 to 50 count heads-off shrimp.
>
> "There is some color variation in Royal Red shrimp. Nighttime catches are typically bright red, while catches landed during daylight hours are a light pink."

In 1957, however, the best catches of Royal Red shrimp were all made off the east coast of Florida between Cape Canaveral and Saint Augustine.

FACTORS DETERMINING THE AVAILABILITY OF SUPPLY

Production planning and budget preparation are a lot more difficult for the fishermen than for the average enterpreneur. Success in fishing operations depends largely on fisherman's luck and the skill of captain and crew. Yet, the fisherman cannot afford to ignore biological considerations relating to the nature of the fish supply nor conditions attendant to the marketing of his product. His study of these factors is complicated by the fact that changes in fishing grounds from year to year are not uncommon. Not only does the volume of catch change but also the types of species taken. Nevertheless, some generalizations about supply can safely be made.

The variety and size, as well as the quantity of shrimp landed during a given period, will depend basically upon the availability of the species and fishing intensity or effort. The availability of shrimp in turn, is governed by (1) the inherent life cycle of shrimp and (2) the influence of environmental factors on reproduction, growth, and migration while the fishing effort is dependent principally upon (1) prices and market conditions, (2) weather conditions, (3) conservation laws and the extent of their enforcement, and (4) the economic status of the fishermen. The composition of shrimp landings during any given time is the result of the inter relationship of all of these factors with certain factors predominating at different times.

The life cycle of shrimp is primarily responsible for the seasonal character of the fishery. It accounts for the presence or absence of the shrimp in certain waters at a given time and has an influence on the conservation laws of the various states. Inclement weather will hamper fishing operations regionally at certain times and thus further reinforce the seasonal characteristics of the fishery.

As an example of the life cycle of shrimp, and the seasonality of the fishery, the biological development of white shrimp Penaeus setiferus taken in the shallow waters of the south Atlantic and Gulf is described below.

The shrimp spawn during the spring and summer in the open waters of the ocean. In the larval stage the shrimp float freely in the water and are more or less at the mercy of the currents. The young shrimp then move to the inside waters where they can be taken in great abundance in the sounds, bays, rivers, and bayous throughout the spring and summer. The inside waters apparently serve as nursery grounds for the young shrimp.

As the shrimp grow they tend to seek larger bodies of water and by June, July or August, depending upon the locality, some of them attain sufficient size (about 4 inches) to enter the commercial fishery. By September practically the entire fishery is composed of young shrimp derived from the spawning of the preceding spring and summer. With the oncoming of winter and the resultant cooling of the waters the larger shrimp move to deeper and more stabilized bodies of water such as the sounds and the open waters of the Atlantic and the Gulf of Mexico. During the winter, at times of extremely cold weather, the shallow inside waters which are readily affected by changes in temperature are frequently entirely depopulated of shrimp. Throughout the winter the growth rate of the shrimp is lessened but with the coming of spring and the warmer waters they again start growing rapidly. At this time their sex products begin to mature and spawning follows. The disappearance of the mature shrimp is associated with spawning. From the evidence gathered, the common shrimp apparently dies after spawning and must, therefore, be considered an annual. (Lindner and Anderson 1956)

In conformity with this biological pattern, the fishing season starts along the Atlantic coast in spring and moves steadily southward, ending in December or later in the Mexican grounds. Shrimping in the Carolinas and Georgia begins in May, reaches a peak in midsummer, and drops off until the close of the season in November. On the Florida east coast the season starts in June and continues through December. In the northern Gulf coast area, white shrimp is landed from August through January and periodically through the remaining months. There are two seasons for white shrimp in Texas--one in the spring and one in the fall. The spring season is of minor importance.

Brown shrimp follows a similar seasonal pattern in that heaviest runs begin in northern areas and progress steadily southward as the season grows older. Heavy brown shrimp runs start in July and last through January. Pink shrimp, found principally in the Dry Tortugas, has few seasonal limitations.

To protect the growing shrimp the various states have enacted statutes establishing or authorizing regulations prohibiting or restricting activities seasonally.

The pink shrimp fishery on the Dry Tortugas and Campeche grounds is seasonally affected by the hurricanes which greatly increase the hazards to boats during the months from July to September.

Owing to the seasonal characteristics of supply the extension of the fishing areas in the Gulf in recent years has had a marked influence on the marketing pattern of shrimp.

At one time, heavy landings of shrimp were normally made only in the late summer and fall months, except for a winter fishery off Cape Canaveral in Florida. As other fishing grounds were opened up the availability of fresh shrimp has spread throughout the year. When the Morgan City, Louisiana, fishery began, fishing in that area was more evenly distributed during the entire year. The percentage of the total catch taken in these waters, however, was not large enough to even out the total supply. As other new grounds were opened, the trend toward stabilization of monthly catches increased. The fishery in the Dry Tortugas augmented the supply during the winter and early spring months, while that of Pascagoula and Bayou La Batre brought in larger supplies during the late spring and early summer months.

The leveling out of supply will tend to reduce the fluctuations in price. Price, in turn, and market conditions will influence fishing effort, other things remaining equal. A higher price, and more attractive profit-making opportunities, normally will spur the fishermen on to greater exertion. Declining profit-making opportunities may produce the same result when under generally depressed conditions a greater effort on the fisherman's part may be required to assure him at least of a subsistence standard of living.

In the Alaska fishery, the only restriction on fishing operations is a closed season in specified areas which extends from February 15 to April 30. The number of fishermen participating in the shrimp fishery during the open season, varies from year to year depending upon the profitability of the shrimp fishery as compared with other fisheries of the territory. Most of the vessels used in the shrimp fishery are designed primarily for other fisheries.

In the North Atlantic States, the fisheries of Maine and Massachusetts are seasonal due to the summer migrations of the shrimp. Most of the catch is made in the late winter months and the season usually ends early in April. Most of the vessels used in the shrimp fishery are designed as draggers and trawlers, and normally trawl for bottom fish, principally ocean perch. These vessels seldom go after shrimp unless that fishery appears to offer greater financial returns for their fishing efforts than the fisheries they are normally engaged in.

In the New York and New Jersey fishery, shrimp may be taken the year - round, but the peak fishing period is during the summer months. Substantially the entire catch of these two States is used as bait for sport fishing, and the greatest demand for bait shrimp is during the late spring, summer, and early fall months.

The California fishery in San Francisco Bay is a year-round operation, but there is a closed season in the ocean fishery, which usually extends from October 16 to April 30. The fishing craft and gear used in the ocean fishery are easily adapted to other fisheries. Therefore, the intensity with which the shrimp fishery is pursued during the open season often hinges on the profitability of fishing for shrimp as against fishing for other species.

In the Washington fishery, the open season in certain areas extends from April 1 to November 30 for the trap fishery and from July 1 to November 30 for the trawl fishery. But even during the open season the number of craft and fishermen engaged in the shrimp fishery is contingent upon the profitability of such ventures as compared with other fisheries. As is true of many of the other areas discussed, the vessels employed in the shrimp fishery were primarily designed for other fisheries. The fishermen are equally as proficient in the one as in the other; and whether or not they engage in the shrimp fishery or in some other fishery is dependent upon which pursuit appears to offer the greater financial return.

In the eight States comprising the South Atlantic and Gulf Area, the inshore or coastal fisheries are seasonal due to the migrations of the shrimp; and these vary slightly from one State to the other. In the South Atlantic States the migrations are along the coast, but in the Gulf States they are seaward-shoreward. Some of the States have closed seasons which coincide more or less with these migrations.

In the offshore fisheries, particularly in the Gulf Area, the shrimp fishery is a year-round operation, and many fishermen and vessels are engaged exclusively in this fishery. This is particularly true of the larger vessels, most of the newer ones having been designed and built solely for operation in the shrimp fishery. The smaller vessels and boats, whose shrimping operations are confined almost entirely to the inshore or coastal fishery, frequently change to other fisheries during the closed seasons for shrimp and when other seasonal fisheries (crabs, oysters, etc.) appear to offer greater financial return.

THE IMPACT OF THE EXTENSION OF THE FISHING AREA IN RECENT YEARS

The discovery of new fishing grounds in the Gulf Area has wrought important changes in the shrimp industry. The greater distance from shore of the new shrimp beds has necessitated the building of larger, more sturdily constructed vessels. To prevent deterioration, better methods of handling, storing and transporting shrimp had to be developed.

The rich beds of the Dry Tortugas and of the Gulf of Campeche, at the same time, produced a shift in the center of production in the fishery to the west. Lured by the success of fishing the new grounds, some fishermen transferred their activities from the Atlantic coast to southwest Florida. Simultaneously, the operations out of ports located in the southern portion of Texas mushroomed. Other fishermen, reluctant to abandon the Atlantic fishery altogether, started to fish part-time in the newly discovered grounds while continuing to take advantage of the fishing season for white shrimp on the Atlantic coast. Since a fishing craft is highly mobile, boat owners are in a position to "follow the crop". Domicile for these fishermen, consequently, has become a mere formality of registration.

The migratory character of a section of the industry has left its imprint on shrimping as an occupation. Shrimping was at one time very seasonal and often was combined with agricultural pursuits. While in the northern extremity of the south Atlantic coast shrimping and farming may still be combined by some seasonal fishermen, shrimping more recently has become for most a full-time occupation. To be able to work the year around the fishermen has to change residence with changing employment opportunities. The readiness of the shrimp fisherman to follow the job, in turn, has solved many problems of labor recruitment and has made possible the establishment of new shrimp bases without regard to existence of a local labor supply. Aside from a relocation of existing shrimping activities the discovery of the new grounds led to an influx of fishermen who traditionally fished for other fish; and of even more significance, the influx of people formerly not connected with the fishing industry.

The changing geography of the fishery has affected the size of enterprise. The need to obtain financing for the larger boats required for the Dry Tortugas and Campeche fisheries has forced the fisherman to turn to processors, and interests outside the industry, for funds. There also has been a tendency on the part of boat owners to associate with fleets operated by processors; in some instances, resulting in vertical integration of fishing with processing operations.

The geographic distribution of shrimping activities influence the economic life of various areas of the country to different degrees. Outside the Atlantic and Gulf coast regions shrimping is of relatively small economic significance. Even in the two principal regions of production, however, the industry is of varying importance locally. Shrimp fishing and processing, thus, may be a major economic factor in smaller communities in this area while in the larger cities it may be of minor significance as a source of income. There are a few cities such as Brownsville, Texas, and Tampa, Florida, which may be called specialized shrimp ports. In most ports in the area, however, other marine pursuits are carried on in addition to shrimping.

Due to differences in its geographic complexion, the shrimp industry in the South may be classified into four major sub-areas; the Atlantic Coast Area comprising the States of North and South Carolina, Georgia, and northeastern Florida; southwestern Florida with the principal ports of Key West, Tampa, and Fort Myers; the north Gulf region which includes the coastal areas of Alabama, Mississippi, and Louisiana; and, finally, Texas with its more than 400 miles of coastline.

Each region has developed individually and has adapted itself to meet its own particular needs, to maximize the advantages and to minimize the disadvantages of its location. All of the areas are affected, however, by geographical forces that stem from the distributional pattern of the national market for shrimp and the distributional channels which this market has developed.

The Atlantic coastal area is favorably situated in relation to the nation's most concentrated consumer market--the industrial northeast. On the other hand, the discovery of more productive grounds elsewhere has placed it at a comparative disadvantage in respect to supply.

The Florida Gulf coast is in close proximity to valuable shrimp resources off the Dry Tortugas and Sanibel Island. The industry here also draws a large portion of its resources from the waters of the Gulf of Campeche. Although farther away from the New York market than are the Carolinas and Georgia, Florida is still close enough to be able to ship fresh shrimp there in refrigerated trucks.

The north Gulf coastline is crowded with many small inlets, bayous, and canals that provide suitable conditions for shrimp propagation. Shrimp caught here are generally small and lend themselves to the needs of the canning industry; and historically Louisiana, Mississippi and Alabama have been important producers of the canned product.

The discovery and development of important shrimping grounds in Gulf waters off the Texas and northern Mexican coasts have prompted the remarkable expansion of the industry in Texas. Production has increased rapidly in recent years and several Texas ports have risen to dominance. Because of the relatively great distances from Texas to large consumer markets, the freezing and breading processes are of paramount importance, and Texas leads the industry in these lines.

Figure I - 13 shows the principal shrimp landing and processing areas of the South Atlantic and Gulf regions. Since shrimping is of such relatively small importance elsewhere, this map, for all practical purposes, presents a panorama of the domestic industry.

SUPPLY OUTLOOK

Speculation about the future of the shrimp industry revolves around the possibilities of expanding supply.

On the demand side, a principal problem is the maintenance of prices at levels which will not frighten potential consumers out of the market. With the notable exception of a period of high prices in 1953 which acted as a temporary deterrent to sales, consumers have shown generally a willingness to absorb whatever quantities of shrimp are channeled to them. Consumption, in a period of two decades, has increased three-fold. It is reasonable to assume, therefore, that demand may continue to respond favorably provided prices of shrimp remain competitive with other protein foods.

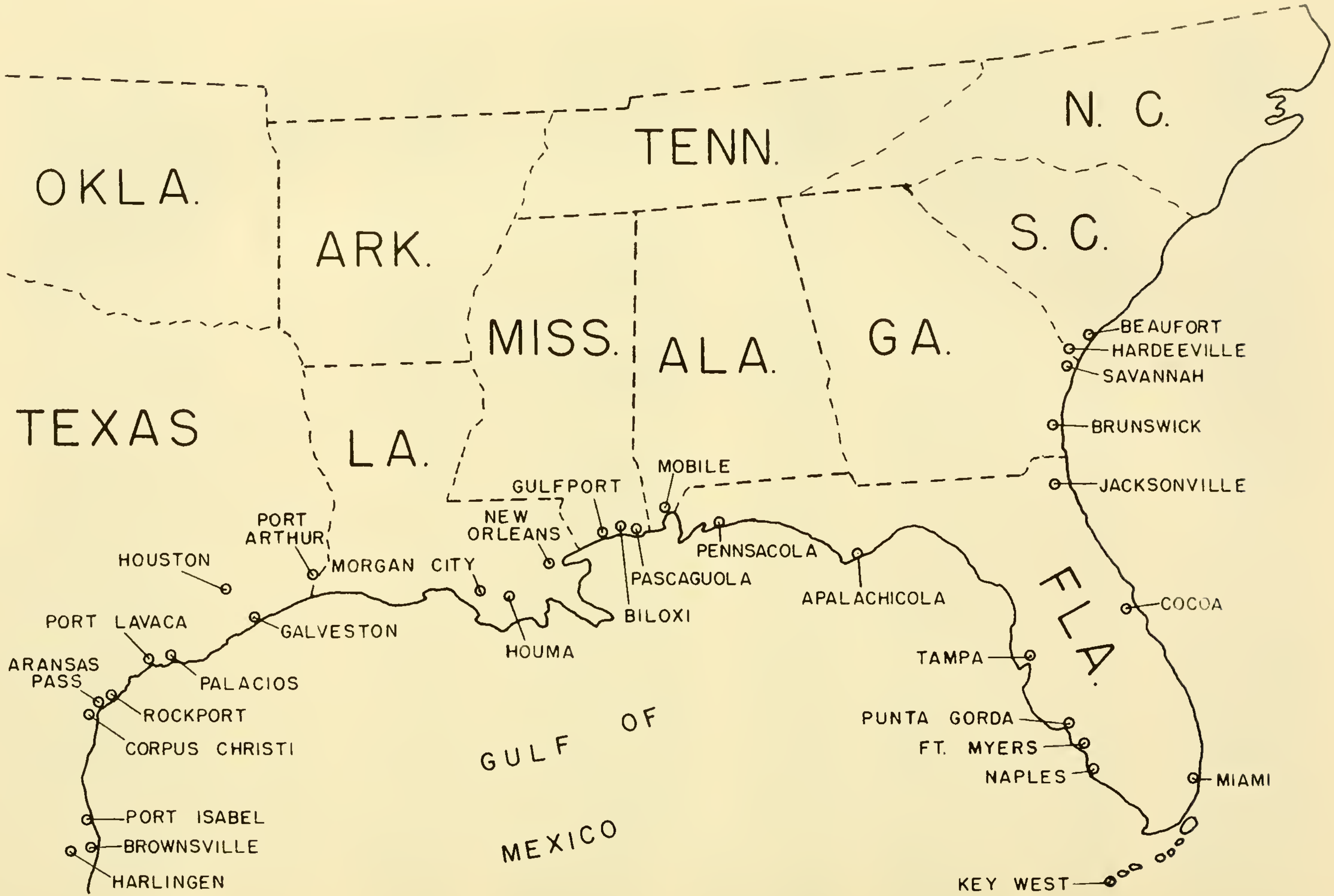

FIGURE I - 13.--Principal United States shrimp landing and processing areas.

Flexibility of supply in the shrimp industry is largely controlled by nature. When demand increases, supply cannot be adjusted easily. The increased demand can only be met by intensified, and sometimes more costly, efforts.

When shrimping was on a small scale, and the industry was more local in character, the fisherman adapted his operations to the run of the shrimp on the grounds he customarily fished. More recently, the fisherman has striven to overcome limitations of supply by following the shrimp runs. Thus, by shifting from one base to another, he has tried to evade the lows of seasonal fluctuations. Similarly, he has taken advantage of the newly discovered beds in the Gulf of Mexico to extend his operations to off-shore waters.

In some ways, the attempts to overcome shortages of supply have added to, rather than subtracted from, the problems of the fisherman. The introduction of larger boats has increased the cost of production as well as the investment in vessel and gear. Specialized equipment of trawler boats has enhanced the efficiency of the vessels. On the other hand, it has also decreased the potential use of the vessels for other operations and thus added to the risks the boat owner has to assume. More labor is needed to man the boats which sometimes operates to reduce the share of earnings to the individual fisherman. The shift from a fixed domicile to a migratory existence has frequently disrupted the ties of the fisherman with his local environment and thus reduced his economic and social stability. On the whole, however, the fisherman has profited from the expansion of supply.

A distinction must be made between an extension of fishing to newly discovered areas and increased operations due to accentuated competition for already exploited resources. The later may result in "over-shrimping" which more often is an economic, rather than a biological, phenomenon. Characteristically, in over-shrimping, more boats are added to the fishing fleets, the number of trips is increased, and idle time in the harbors is shortened. Thus, more boats, fishing with increased intensity, compete for the available supply at any given point. The stepped-up fishing activities may not lead to a permanent reduction in the total stock of shrimp in the sea; but the productivity of individual vessels is adversely affected.

The tendency to overfish frequently is characteristic of periods of adverse market conditions. It then becomes evident that the shrimper has little command over the marketable supply. Instead of adjusting their catches to the shrinking demand, the fishermen as a group tend to intensify their fishing effort and increase their catches to compensate for the lower prices and declining revenue, thus adding to the surplus and aggravating the market depression. In recent years this tendency has been reinforced by the change in the scale of operations in the shrimp fishery. Production on a larger scale has increased fixed costs of operation and is encouraging a pattern under which the operator is forced to continue fishing as long as out-of-pocket expenses are recovered. With the inception of year-round operations, secondary pursuits during off-seasons have been abandoned; the fishermen now continue fishing regardless of the vagaries of the market.

A vicious circle is set in motion where a high demand and high prices encourage an influx of newcomers into the industry which because of the natural limitations of supply leads to over-shrimping. A weakening of the market at such times, rather than rectifying the situation, may only serve to accentuate the tendency to overshrimp. Ultimately, large losses suffered by the fishermen over a period of time lead to the withdrawal of some operating units from the fishery. This process of attrition in accordance with the principle of the survival of the fittest, or in this instance, of the best-financed, generates instability and benefits neither fisherman nor consumer. The answer to these problems lies in the intelligent management and control of the fishery with the twin goals of giving the full-time shrimp fisherman an opportunity to remain in the industry and of attempting to expand the fishery through addition of heretofore untapped resources.

Overfishing of a different sort which may have serious consequences of a biological nature, in addition to detrimental effects on the fisherman's welfare, may be connected indirectly with technological developments in the processing of shrimp. The introduction of mechanical peeling and deveining devices in canning operations permits the use of smaller shrimp. If, as the result of this innovation, a larger proportion of small shrimp is taken, the species may sustain some damage.

Evidence of rising demand is furnished in table I - 2, which shows imports as a percentage of total annual market supply for selected years from 1931 to 1955. Imports jumped from 6.5 percent of total supply in 1945 to 26.1 percent in 1950; preliminary data for 1957 indicate imports were 36.0 percent of the total supply.

TABLE I - 2.--SHRIMP IMPORTS AS PERCENT OF TOTAL UNITED STATES SHRIMP SUPPLY, SPECIFIED YEARS
(Heads-off weight)

Year	Total supply	Imports	Imports as percentage of supply
	Thousand pounds	Thousand pounds	
1931	60,240	1,078	1.8
1936	73,138	809	1.1
1940	95,951	5,024	5.2
1945	121,726	7,876	6.5
1950	154,125	40,198	26.1
1951	175,292	41,824	23.9
1952	173,667	38,471	22.2
1953	198,006	43,094	21.8
1954	201,178	41,519	20.6
1955	199,151	53,772	27.0
1956	202,001	68,618	34.0
1957	191,350	69,732	36.0

As long ago as 1931, concern was expressed over the possibility of depletion of shrimp supplies. In response to requests from the industry and State conservation agencies, the United States Bureau of Fisheries established the Shrimp Investigations (later on called Gulf Investigations) whose principal task was the analysis of the shrimp supply. Several times since the start of these investigations people familiar with the industry have expressed fears that production was at or past its peak. Each time these pessimists have been wrong. Only three years before the opening up of the Dry Tortugas and Campeche grounds one authority in the field questioned the probability of the discovery of new grounds accessible to the domestic fleet. The experiences of recent years tend to discourage the making of any categoric predictions regarding the likelihood of discovering new grounds. The consensus of the people in the fishery is that it would be impractical to increase production of the fishery on grounds now fished.

From the standpoint of the domestic fisherman the best solution to the supply problem consists in adding to currently utilized resources through discovery of new grounds accessible to the fleet or through exploitation of already discovered grounds which heretofore have not yet been fished. The discovery of new grounds within the operating range of the domestic fleet is still within the realm of possibility as the success of the recent explorations for Royal Red shrimp indicates. Future exploitation of the Royal Red shrimp resources may not only supplement existing supplies of shrimp but give the fishing fleet employment during the off-season. Potentially, however, the largest increase in the supply available for domestic consumption may come from foreign sources.

Some of the fishing grounds off the Central and South American shores may become accessible to the new big, long-range trawlers of the domestic fleet. The major part of the supply from these grounds, however, will come into this country in the form of imports. Shrimp production in some of the countries south of the border has increased considerably in recent years. In the last fifteen years, the Mexican shrimp industry has risen from modest proportions to a thriving multi-million dollar business. In the same period, there has been a more than tenfold increase in United States imports of fresh and frozen shrimp from Mexico. As pointed out by Lindner (1957), the Mexican shrimp fishery may currently be operating close to the limits of its potential. Other countries south of the border may be able in the future to increase their shrimp production, and exports to this country.

The countries of Latin America are not the only sources of shrimp imports. Recently, shipments of modest size have been received from Greenland, Argentina, and India. It is significant that foreign countries exporting shrimp to this country increased from ten in 1940 to over thirty in 1957.

There is some question of what will be the attitude of the fisherman and primary wholesaler concerning the rising tide of imports. As long as demand remains high, the fisherman has little reason to be alarmed over the trend in imports. To the extent that imports contribute to a stabilization of prices and prevent the precipitous influx of casual fishermen into the industry during market booms, he has reason to welcome the trend. In a declining market, the fisherman's attitude can be expected to be substantially different, as foreign producers favored by lower costs may offer a serious threat to his market. More than likely efforts will be made at such times to combat imports and complaints against dumping will be raised in the industry.

The attitude of processors and secondary wholesalers with respect to imports may differ from that of the people at the producing level. Imports arriving in a form requiring additional processing and marketing operations do not constitute a threat to the business of the processor. If foreign supplies can be obtained for less than prices asked by the domestic fisherman, the processor, may shift part of his purchases to foreign sources. The distributor who has no direct interest in producing or processing operations may be totally unconcerned about any potential danger to his business stemming from rising imports. He can be expected to argue vigorously for free imports, since he is primarily concerned in supplementing any gaps between supply and demand caused by the domestic fleet's inability to meet domestic requirements.

The fact that demand for shrimp has held up so well favors amicable relations between United States and Mexican shrimp processors. That a large part of the domestic industry favors Latin American participation in the United States market is demonstrated by the existence of the Shrimp Association of the Americas which is composed of United States and Mexican shrimp interests. The Association was formed as a joint enterprise to promote the industry and its products.

A theoretical alternative to the possibilities of expanding supply is that additional resources in some fisheries may be created through cultivation. Unfortunately, the prospect of cultivating shrimp on a commercial basis does not appear promising.

Some fishery biologists consider it improbable that successful cultivation could be achieved since the larval stages of shrimp float freely in the ocean water. When confined in aquaria the shrimp tend to absorb their eggs instead of laying them. This situation would have to be overcome before successful cultivation could be achieved.

MANAGEMENT OF SUPPLY

No discussion of shrimp supply should fail to stress the importance of proper management and protection of resources. These are tasks entrusted to state conservation agencies. The primary objective of these agencies is the elimination of hazards to natural resources resulting from overfishing, pollution of fishing grounds, or other causes. Poor management has frequently been blamed for otherwise unaccountable decreases in annual catch. Ideally, intelligent management will see to it that resources are exploited at their most profitable level. When small shrimp are permitted to grow, through the enforcement of closed seasons and other protective measures, fishing results are better, handling costs lower, and financial returns more favorable. At the same time the consumer is assured of a more abundant supply at a lower cost.

Where signs of danger appear, the State conservation agency has the authority, and the obligation, to step in to protect not only the fishery but also the economic interest of the fishermen as a group against the acts of unwise individuals.

State conservation agencies commonly impose closed seasons and regulations with respect to minimum mesh sizes of fishing nets and minimum size of species that can be taken, for the purpose of protecting fishery resources.

Limitation of catch is the most direct, precise, flexible, and effective method of control available to stabilize fishing intensity. It is founded on a share-the-work policy and is therefore basically inefficient. Moreover, direct catch controls are costly to operate because of enforcement difficulties.

An alternative way of achieving control over supply has been suggested through limitation of operating units. This method greatly eases the enforcement burden. Proponents of licensing limitations claim that the end result attained is the same as under direct catch limitation but with the advantages of savings in time and effort.

State Regulatory Powers

Regulation of the fisheries of the continental United States is under the jurisdiction of the individual States, except as otherwise provided in treaties, conventions, and other international agreements, and except in matters relating to interstate commerce, navigable streams, etc. The Federal Government has jurisdiction of the Alaska fisheries, but the only regulation directly relating to the shrimp fishery is a closed season in specified fishing areas. The laws, rules, and regulations applicable to the shrimp fishery generally are briefly outlined below.

Each of the shrimp-producing States issue licenses for, or impose taxes on, shrimp fishing and processing operations. Some of these are applicable to the fisheries of the State as a whole; others apply only to shrimp. In some States standard license fees are applicable to fishermen, processors, dealers, and vessels without regard to citizenship or nationality; in other States a distinction is made between resident-citizens, nonresidents, and aliens.

Every shrimp-producing State requires vessels to obtain licenses before engaging in the fisheries; however, not all of them require commercial fishermen and fishing gear to be licensed. All of the States license dealers and processors, and a few of them levy severance taxes, shipping taxes, etc., on shrimp.

There are no restrictions or regulations with respect to the type of vessel or boat that may be used in the shrimp fishery, but some of the States have restrictions on the size and type of gear that may be used, subject to certain exceptions in the case of shrimp taken for use as fish bait. For example, laws of the State of California stipulate that only beam trawls may be used in the ocean shrimp fishery, limit the length of the beam, the circumference of the net, the mesh size of the net, and specify how the trawl may be towed. In some States the only restriction relates to the mesh size of the net.

For the ostensible purpose of conserving the fishery by protecting small, young shrimp, most States have established periods during which shrimp fishing is prohibited in inside waters; and for the same reason some waters of a State may be permanently closed to shrimp fishing. The temporarily closed periods usually vary from one State to another, and even within a given State they may vary from one area to another.

There are no restrictions on the species of shrimp which may be taken during the open seasons for shrimp fishing. The only restrictions applicable here relate to the size of the shrimp permitted to be taken and landed. The standard method for determining minimum sizes is by weight, with a specified number of shrimp to the pound. Shrimp taken for use as fish bait are generally excepted from the minimum size limitations. The State of Louisiana exempts grooved shrimp and sea bobs from this limitation.

Effect of State Regulations

Changes in fishing regulations often have an important bearing upon shrimp landings. In addition to seasonal distribution of catch, regulations may influence the division of the market between residents and non-residents or between fishermen regularly engaged in the fishery and casual fishermen. The landings at particular ports, and the extent of foreign trade in shrimp may be affected by statutory provisions. As an illustration of the impact of regulatory measures on the shrimp fishery the following paragraphs from a review of the Gulf States fisheries in 1947 (Denham 1947) are quoted:

> Changes in the fishing regulations of certain Gulf States had an important bearing upon shrimp landings at a number of fishing ports. The Louisiana legislature, in the summer of 1946, revised the closed seasons for commercial shrimping operations. The inside and outside waters of Louisiana were closed for fishing from June 10 to the second Monday in August. Inside waters were closed from December 15 to March 15. As Mississippi adopted the same closed seasons, no shrimp were taken commercially in Mississippi and Louisiana from June 10 to August 11, 1947. Previous to the enactment of the present closed season in Louisiana, only the inside waters were affected by closed season regulations.

These applied to commercial shrimp fishing from March 15 to May 16 and from June 25 to August 16. The high non-resident license fee for fishing craft and fishermen sharply limited operation of out-of-state boats in Louisiana waters with the exception of those from Mississippi. The latter State has a reciprocal agreement with Loui s iana for operation of Mississippi craft in certain designated Louisiana waters. Previous to the passage of the legislation in 1946, Alabama fishermen enjoyed the right to operate in Louisiana waters without payment of the non-resident license fee. A number of Louisiana shrimp trawlers operated out of Texas ports during the early months of 1947. This resulted in controversies between the resident and non-resident shrimp producers. The Texas legislature in 1947 enacted additional laws and fees restricting non-resident fishermen and fishing craft.

The United States Supreme Court in a decision rendered since 1947 (Toomer v. Witsell) has taken a significant step toward elimination of discriminating state legislation. The underlying facts in this case, and the substance of the Court's opinion, are digested as follows (92 L ed 1460):

> South Carolina statutes impose a poundage tax on shrimp taken in the 3-mile belt of its coast requiring a license fee for each shrimp boat owned by a non-resident one hundred times the fee for boats owned by residents; condition the issuance of licenses to non-residents on submission of proof that the applicants have paid South Carolina income taxes on all profits from operations in that State during the preceding year; and that all boats are licensed to trawl for shrimp in the State's waters, dock at a South Carolina port, and unload, pack, and stamp their catch with a tax stamp before shipping or transporting it to another state....
>
> The Supreme Court majority held:
>
> ...(3) that the imposition of a discriminatory license fee for boats owned by non-residents was without reasonable basis and, therefore, in violation of the privileges and immunities clause, and (4) that the requirement that shrimp fishing boats dock at a South Carolina port and unload, pack, and stamp their catch for tax purposes before shipping or transporting it to another State, unconstitutionally burdened interstate commerce and could not be sustained as a proper means of insuring collection of the poundage tax.

The international aspects of regulations in the shrimp fishery are brought out by Denham (1947) as follows:

> Shrimp operation in Gulf waters off the Mexican coast by a few United States shrimp trawlers began in 1946. During the year, it became known generally that only craft of Mexican registry operating under a permit from a Mexican cooperative could legally catch shrimp in the waters of the Gulf of Mexico under the jurisdiction of that nation. At least 48 fishing vessels were transferred from United States to Mexican registry and the majority operated from Carmen in the Bay of Campeche. As a result of this, an increased quantity of shrimp was imported into the Gulf States from Mexico during the latter part of 1947.

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CHAPTER II

AGENTS OF PRODUCTION

ABSTRACT

DURING 1956 THERE WERE ABOUT 3,715 VESSELS AND 3,818 MOTOR BOATS ENGAGED IN TRAWLING FOR SHRIMP IN THE SOUTH ATLANTIC AND GULF AREA. THE AVERAGE CAPACITY OF CRAFT IN THE VESSEL CATEGORY IS APPROXIMATELY 18 NET TONS. A MODERN AND WELL-EQUIPPED SHRIMP VESSEL COSTS IN THE NEIGHBORHOOD OF $70,000, IF OF STEEL CONSTRUCTION, AND IN THE NEIGHBORHOOD OF $45,000 - $50,000, IF OF WOODEN CONSTRUCTION.

AMONG THE LARGER CRAFT IN THE SHRIMP FISHERY, THE FLORIDA-TYPE AND THE BILOXI-TYPE SHRIMPERS PREDOMINATE. THE MAJORITY OF CRAFT TODAY ARE OF WOODEN CONSTRUCTION; STEEL VESSELS, HOWEVER, HAVE GAINED IN POPULARITY IN RECENT YEARS.

DESIGN AND CONSTRUCTION OF THE AVERAGE VESSEL AS WELL AS LAY-OUT ON BOARD HAVE SUBSTANTIAL SHORTCOMINGS. THE LARGER VESSELS, IN PARTICULAR THOSE FISHING THE CAMPECHE GROUNDS, SHOULD BE OF STURDY CONSTRUCTION. FORETIMBERS, KEELS, KEELSONS, DECK-BEAMS AND FRAMES SHOULD BE STRENGTHENED AND TREATED WITH COPPER PRESERVATIVE. FASTENINGS SHOULD BE IMPROVED AND HIGH QUALITY STAINLESS STEEL BOLTS USED IN THE KEEL. SCREW-TYPE GALVANIZED NAILS SHOULD BE USED IN PLACE OF WEDGE-TYPE NAILS.

HULL DETERIORATION CAN BE COMBATTED WITH COPPER AND CHROMATE PAINTS WHICH RETARD SHIPWORM PENETRATION AND THE EFFECTS OF DRY ROT. DRYDOCKING AT THREE- OR FOUR-MONTH INTERVALS IS RECOMMENDED.

THE SHRIMP TRAWL, WHICH IS THE PRINCIPAL GEAR IN THE FISHERY CORRESPONDS TO THE OTTER TRAWL. OTHER TYPES OF TRAWLS, SUCH AS THE BEAM TRAWL, AS WELL AS DIP AND CAST NETS AND HAUL SEINES, ARE USED PRIMARILY IN THE SMALLER FISHERIES OUTSIDE THE SOUTH ATLANTIC AND GULF AREA. THE USE OF SYNTHETIC MATERIAL MAY EXTEND THE SERVICE LIFE OF NETTING IN SOME FISHERIES. HYDRAULICALLY DRIVEN WINCHES ARE CONSIDERED SUPERIOR TO WINCHES ACTIVATED BY THE MAIN ENGINE.

IN THE OFFSHORE FISHERY, AND TO AN INCREASING MEASURE IN THE INSHORE FISHERY ALSO, DIESEL MOTORS ARE USED. SINCE THE OUTLAY FOR AN ENGINE MAY REPRESENT A CONSIDERABLE PORTION OF THE BOAT OWNER'S INVESTMENT, CARE SHOULD BE EXERCISED IN THE SELECTION OF THE MOST EFFICIENT TYPE OF EQUIPMENT. IN PARTICULAR, THE TEMPTATION TO OVERPOWER FISHING CRAFT SHOULD BE AVOIDED.

FREEZING AT SEA IS GAINING IN POPULARITY IN THE SHRIMP FISHERY. BOTH BLAST- AND THE HYDRO-FREEZE INSTALLATIONS ARE ENCOUNTERED. THE HIGH INITIAL INVESTMENT IS THE ONLY DETERRENT TO EVEN MORE WIDESPREAD USE OF THIS EQUIPMENT.

THE PRINCIPAL ITEMS OF ELECTRONIC EQUIPMENT FOUND ON SHRIMP VESSELS ARE AUTOMATIC PILOTS, DEPTH RECORDERS, AND RADIO TELEPHONES. OF THESE, DEPTH RECORDERS ARE CONSIDERED AS POSSIBLY THE MOST VALUABLE FISHING AND NAVIGATING AIDS, PROVIDED CREWS ARE INSTRUCTED IN THE PROPER USE AND MAINTENANCE OF THIS EQUIPMENT.

OWNERSHIP OF SHRIMP VESSELS IS DIVIDED BETWEEN INDEPENDENT FISHERMEN, PROCESSORS AND DISTRIBUTORS CONNECTED WITH THE FISHING INDUSTRY, AND OUTSIDE INTERESTS. THE PRODUCTIVITY OF OWNER-OPERATED VESSELS, AS INDICATED BY DATA FOR A SAMPLE OF VESSEL OPERATIONS, IS GREATER THAN THAT OF VESSELS SKIPPERED BY HIRED CAPTAINS FISHING THE SAME WATERS.

A SHORTAGE OF QUALIFIED PERSONNEL IN THE FISHERY HAS INSPIRED PROPOSALS FOR THE LAUNCHING OF A COMPREHENSIVE EDUCATIONAL PROGRAM WITH INDUSTRY AND GOVERNMENT SUPPORT. A RESERVE OF TRAINED AND SKILLED FISHERMEN IS OF VITAL IMPORTANCE TO THE INDUSTRY.

THE INTERESTS OF THE FISHERMEN ARE REPRESENTED BY TRADE ASSOCIATIONS, FISHERMEN'S COOPERATIVES, AND FISHERMEN'S UNIONS. THE FUNCTIONS OF THESE ORGANIZATIONS VARY TO A GREAT EXTENT. IN THEIR EFFORTS TO PARE DOWN COSTS OF DISTRIBUTION, COOPERATIVES, IN SOME INSTANCES, HAVE EFFECTED INTEGRATION OF FUNCTIONS FROM FISHING THROUGH PROCESSING AND WHOLESALE DISTRIBUTION. UNIONS ARE OF IMPORTANCE LOCALLY IN THE WESTERN GULF AREA WHERE THEY PARTICIPATE IN NEGOTIATING MINIMUM EX-VESSEL SHARING PRICES. THESE PRICES FORM THE BASIS FOR THE DISTRIBUTION OF THE LAY. THE LAY SYSTEM IS THE PREDOMINANT METHOD OF SHARING PROCEEDS FROM THE CATCH.

THE WHEREWITHAL OF PRODUCING

Management of shrimp boat operations is vested either in the hands of the boat owner himself or else is delegated by the latter to a boat management firm which operates his boats on a fee basis. By principal occupational activity the owner may either be a fisherman who captains his own vessel, a processor, wholesaler, or 'absentee owner' who engages in fishing operations only on a sideline basis.

Efficiency of production in the shrimp fishery, as in any other industry, depends on the successful assembly of the agents of production. To survive, the businessman has to bring together the best organization with the most economical type of equipment at the most favorable location.

Depending on the scale of operations and the location of the fishing grounds the fixed investment for fishing will include some, or all, of the following: hull, engine, special equipment (e.g. a freezer installation), spars and rigging, fishing gear, and navigational aids. In addition, the fisherman must be assured of access to adequate docking and repair facilities. The questions which have to be considered in connection with the utilization of equipment are design and construction, layout, maintenance, repairs, cost, and service life.

The complement of the vessels should be both good seamen and good fishermen. The captain, in addition, must have initiative, be familiar with the location of the best shrimp grounds, know something about the seasonal characteristics of the fishery, the weather and topographical conditions likely to be encountered, and finally, he must be a leader of men.

Ultimately, a lot depends upon the nature of the resource and the access to it. The fisherman must accept as immutable facts linked to the task of gaining a livelihood from the sea, the uncertainties of the weather, oceanographic conditions, and the risks of fishing itself. Yet, he must make an effort to cope with these hazards. Migration may be the answer to seasonality, the use of special gear to rough bottoms, and the heeding of weather warnings to reducing storm losses.

Shrimping, as conducted today, is predominantly a trawling operation. This applies regardless of the size of boat or type of shrimp landed. The boats are equipped with nets the size of which is dependent upon the size of the boat.

The operating characteristics of boats currently employed in the fishery are geared to the trawling process. This makes shrimp boats mainly one-purpose boats which cannot be easily converted for other fishing processes. The risk connected with an investment in a shrimp trawler, as a result, is considerably heightened.

The same does not necessarily hold true of the smaller motorboat operations (craft with a capacity of less than five tons) where the investment specifically required for shrimping is not large enough to impede conversion to other activities. Because of the relatively greater significance of vessel operations, the subsequent discussion will deal, except where otherwise specified, with vessel rather than boat operations.

EQUIPMENT

Fishing Craft

Types of Craft Employed

For a great many years in the shrimp fishery sailing vessels and small non-powered boats, principally row boats, were used for fishing operations. Substantially all shrimp fishing was carried on in shallow water from 6 inches to 6 feet deep. Some of the fishermen even operated without floating equipment, using cast nets or dip nets and haul seines.

The original inshore and offshore shrimpers were not designed, in the true sense of the word, but were developed from types already in use along the Florida and Gulf coasts. Their hull forms were developed by rule of thumb and fishing experience. The basic design was derived from the forms of Mediterranean work-boat types adapted to the conditions peculiar to Atlantic and Gulf coast operation. The vast majority of vessels are still built with crude plans, without the aid of scientific knowledge, and without much regard for their specialized use.

There are two types of vessels which can be said to have been developed especially for the shrimp industry. The type most commonly employed in the Atlantic and Gulf coast offshore fishery is the so-called Florida-type vessel, named for the state where the design originally was developed. The other type of boat widely used in the shrimp fishery is the bow dragger or Biloxi-type vessel.

The most important difference in design between the two vessel types is the location of the wheel house, which on the Florida-type vessel is forward and on the bow dragger, aft. While the Florida-type vessel is distinguished by greater maneuverability and makes it possible for the fisherman to haul the nets more quickly, the bow dragger is considered to be more seaworthy and is capable of towing under greater strain. The proximity of the engine to the propeller in the latter type reduces shaft troubles.

The Florida-type hull usually has a round bottom, flared bow, and a broad square transom stern. The deckhouse is forward and the clear fishing deck, aft. Nets are towed from booms. The engine room is under the deckhouse and fish holds are aft. The majority of the vessels range from 55 to 70 feet in length, with a few as long as 75 to 80 feet or more. Typically, the vessels are diesel powered and use cable rigs with drum hoists powered from the main engine. A good many of the vessels are equipped with electronic navigational aids and possess mechanical refrigeration equipment or insulated holds for stowing the catch in ice. They are capable of a wide range of activity, and commonly make trips of long duration.

Motherships operate occasionally in the offshore fishery. The motherships are vessels of 100 to 150 feet in length, equipped with the necessary machinery and crew for heading and freezing the catch. The large vessel may do some trawling on her own but, in general, depends on the catch of the smaller feeder-boats. A major problem in the operation of motherships is the retention of crews willing to accept long voyages on a regular basis.

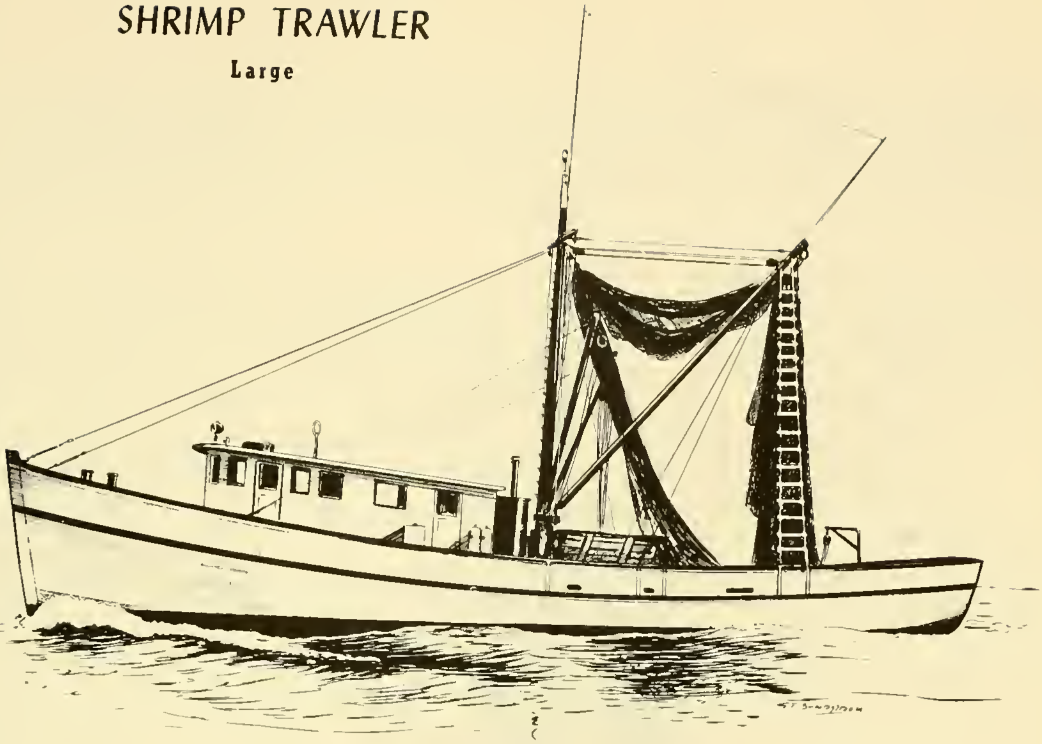
The Biloxi-type vessels usually have a V-type bottom and there is less freeboard than on the Florida-type. The deckhouse and engine room are aft, the fishing deck is amidships, and the fish hold forward. Nets are towed from a gallows arrangement on the outboard side near the deckhouse. The bow draggers are popular in much of the Louisiana area, in Biloxi, Mississippi, and in the vicinity of Morehead City, North Carolina.

In the inshore fishery of the south Atlantic and Gulf coasts vessels not exceeding 30 to 45 feet in length are used. Depending on fishing capacity these craft are referred to as shrimp vessels or shrimp motor boats, the latter having a capacity of less than five net tons. In general, the group of smaller vessels presents a varied array of designs since local tendencies and individual ideas enter into their construction. They are powered, as a rule, with gasoline or distillate burning engines, although there has been a tendency for some time to use more diesel engines. The boats usually are equipped with power winches and rope towlines.

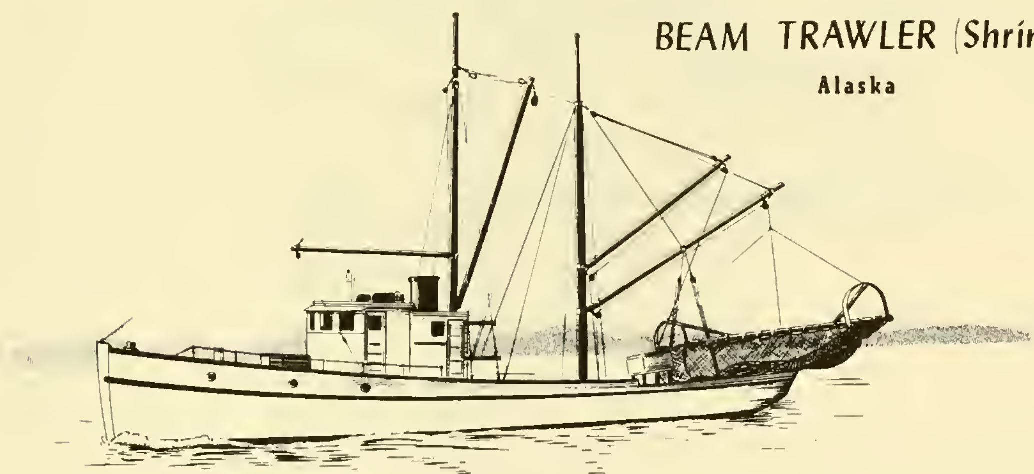
When the Gulf coast fishery was still primarily an inshore operation the type of vessel in general use in the area was the lugger. Today, the lugger has been replaced to a large extent by the Florida-type trawler, its use being confined more or less to the Louisiana inshore fishery.

The vessel, which may range from 25 to 50 feet in length, is of shallow draft and is designed for the shallow inside waters. Consequently, it is not well suited for the open Gulf, particularly when the weather is bad. In contrast to the vessels of the south Atlantic coast and Texas, in which the engines are forward and the fish hold is in the stern, the lugger has the engine in the stern and the fish hold forward. The early luggers were adapted for trawling by the simple expedient of adding a set of towlines and a trawl. Sometimes, a platform was extended off the stern to provide room for

SHRIMP TRAWLER
Large



BEAM TRAWLER (Shrimp)
Alaska



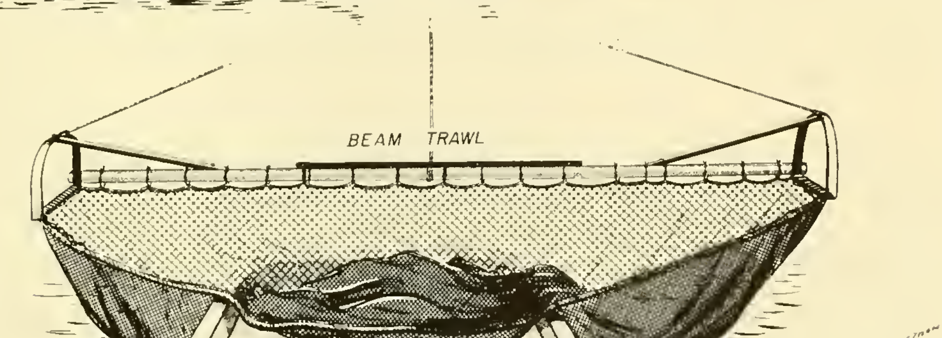


FIGURE II - 14

SHRIMP TRAWLER

Medium

FIGURE II - 15

pulling in the net. Up until the late 1930's, few of these vessels carried power-driven machinery for taking in the trawls. At present, many of the better equipped and more recently built luggers employ a hoist, but on a number of the older boats, the gear is still operated entirely by hand.

Ice or freight boats formerly were used in conjunction with small luggers in the Louisiana, Mississippi, and Alabama fisheries. These ice boats were large luggers used for picking up shrimp on the the fishing grounds, icing, and transporting them to the cannery or other unloading station. The small vessels, as a rule, did not carry ice, but when they caught shrimp pulled alongside the ice boat, unloaded and returned to the fishing grounds. When a fleet of luggers was operating some distance from port, the ice boat would also supply the fleet with fuel, water and provisions. There were advantages to the ice boat system in the circumstances under which it was employed. Quite often the luggers operated at considerable distances from the port where their shrimp would be landed, and for each vessel to obtain ice and bring in its catch would have forced it to spend much of its time in traveling to and from the fishing grounds. Today freight or ice boats have almost disappeared from the scene and are used only to a nominal extent in Louisiana.

The use of skiff-type vessels operated by one man is a relatively recent development in the Louisiana and Mississippi inshore fisheries. The skiffs are about 30 feet in length or less, have a 6-foot beam and are powered by gasoline marine motors. They work primarily out of the Louisiana ports of Grand Isle, Barataria, and Lafitte, and certain Mississippi ports. They make short trips of six or seven hours' duration and normally land about two barrels of shrimp. They carry no ice and the only protection for the shrimp is an awning which is stretched across the forward deck. The canneries utilize a large proportion of the catch from this type of vessel.

In Alaska and on the Pacific coast the beam trawler is common.

Wood Versus Steel Construction

In recent years steel has been gaining popularity in the industry as building material. It is estimated that until recently not more than one percent of all the shrimp vessels in the South Atlantic and Gulf Areas were constructed of steel.

Because of the general rusty appearance of the hull and the superstructure of the steel vessels on returning from fishing, many vessel owners and captains harbor a prejudice against steel. Steel is stronger than wood and problems of hogging and sagging are reduced. Fuel storage is between the double bottoms of the hull, which greatly increases the below decks space. Watertight bulkheads add to the safety of the vessel. The fish holds require careful insulation because of heat conductivity of the metal. Greater power is required because of the added weight of the vessel. Some of the steel hull vessels have been overcoming this problem with the installation of twin diesels, usually mounted in line on the same shaft. This adds to fuel and overhaul bills, although costs are not doubled owing to the lighter load per engine in this type of arrangement. The electrolysis problem, common to both steel and wooden vessels, is accentuated in the case of steel. Few provisions are made by the builders to reduce this menace. Some owners, in addition, have expressed concern that repair services for the steel vessels are not as accessible as for wooden vessels.

Wood has several advantages over steel. It is nonmagnetic and has a high modulus of elasticity. On the other hand, timbers which remain damp over long periods of time are subject to decay. Modern wood preservatives can be chemically fixed in the wood and cannot be washed out. Fire retardants in combination with preservatives are also available and used.

In general, to avoid shrinkage in wooden construction, timber used in shipbuilding should be well seasoned. Boat planking below the water line should be dried so that when put into the water there is a slight swelling and the joints become tighter. Decking timber should contain at all times 15-18 percent moisture in order to prevent shrinkage and consequent opening of the seams.

Shortcomings in Design and Construction of Craft Currently Employed

Design and construction of shrimp vessels frequently are subjected to serious criticism. Two studies on vessel efficiency conducted by Florida research consultants under contract with the United States Fish and Wildlife Service commented as follows on vessel design and construction: 4/

Until the start of the utilization of the grooved shrimp grounds off the Dry Tortugas and in the Gulf of Campeche, construction of shrimp vessels was carried on by various shipwrights scattered along the coast line. Construction was slow but apparently quite thorough. The sudden demand for more and larger vessels, requiring increased financing, developed a new trend in the industry. The attempts to meet this demand as rapidly as possible had their effect

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4/ The comments were combined from the following studies: Harwell, Knowles and Associates, Survey of Domestic Shrimp Vessel Efficiency, 1955; and First Research Corporation of Florida, Work Practices on Shrimp Fishing Craft, 1955.

on the quality of design and construction. The yards simply took the smaller vessels which they were producing at the time and "blew them up", increasing both length and beam. In general, the same scantlings were used as in the smaller vessels and the same method of framing and construction prevailed. The result was a 70-foot vessel built to the specifications of the 50-footer which was lacking in the necessary heavy lateral and longitudinal framing.

In ordering a vessel the fishermen gave foremost consideration to the delivery date, finance, and price of vessel. To meet the problem of rapid delivery and low construction cost a number of yards started to mass-produce vessels. The number of skilled shipwrights was limited and some builders were forced to recruit inadequately trained labor. The attempt by the builders to cut construction costs and the increasing shortage of the proper kinds and grades of lumber soon resulted in the use of undersized, substandard, and improperly cured materials.

General observations with respect to shortcomings of design and construction in the shrimp vessel fleet were made in the course of the vessel efficiency studies.

The midship sections of the vessels have very slack bilges resembling the barrel-like midship sections of the smaller and older vessels and results in excessive rolling. The forward sections are full and there is little flair or reserve buoyance to be found in the bow. The run aft is steep, leading to a transom form and stern sections which are inefficient.

The high sheer forward of the Florida-type vessel, which owes its origin to efforts to make planking easier, does not produce an efficient or dry hull form and actually hampers visibility.

The Biloxi-type bow dragger is superior for fish-dragging because of its more rugged towing arrangement, but it is less desirable for shrimp dragging because of poorer maneuverability. Conversion to deep-water shrimping appears feasible for the larger, lighter-powered vessels if the catch per day warrants the additional expense. The materials used in construction quite frequently are those which gain easy acceptance with the operators. Although keels, deadwood and stern posts are commonly constructed of pine or fir, stems are constructed of oak, a wood which is notably perishable in tropical climate. The use of long-leaf yellow pine, in this instance, might well result in substantial savings for the operator.

Another example of tradition and habit in the use of materials is the use of bent oak frames by most of the builders along the Florida Gulf coast. The builders have had little, or no, experience with sawn frame construction. Consequently all the wooden shrimp vessels are framed with steam bent oak which not only limits the size of the frames themselves but affects the actual form of the hull as well. In addition, it is customary to ceil the vessels throughout, and the fish holds are not only ceiled but insulated. The framing of the vessels, consequently, is very poorly ventilated, causing the oak frames to deteriorate very quickly. As a consequence, a shrimp vessel is frequently considered old in five years.

Design and construction are of minor importance as far as motor boats are concerned since motor boats are operated on a "make-do" basis in protected waters where almost any small work boat is able to live up to requirements.

Among specific shortcomings of vessel construction encountered were the following:

(1) Frames were frequently not steamed long enough, and they sometimes cracked upon bending.

(2) Planking was nailed in many cases directly to the frames without counter-sinking and plugging of holes, or the nails used were too long and nail ends, consequently, protruded and rusted on the inside of the vessel; in both instances the nails gradually worked loose under normal stress and planking pulled away from the ribs.

(3) Caulking of the planking was not always done, and the planking usually butted on the frames.

(4) Fastenings were often inadequate.

(5) The keel and keelson were drifted together rather than bolted.

(6) Green lumber was frequently used for engine beds. On drying, these beds shrink and twist, thus causing alignment problems between the engine and the shaft.

(7) Short engine beds were installed, giving improper weight distribution in the vessel and little flexibility in the positioning and type of engine used. (Good practice requires the placing of an L-shaped steel shoe on the engine beds to reduce alignment problems.)

(8) The deckhouse was seldom adequately secured to the cross timbers, and nails were again substituted for the more secure bolts.

(9) Masts were fastened inadequately. In lieu of the mast being stepped down into the vessel, as good practice requires, it is frequently secured to the deck.

Specific Recommendations on Vessel Design and Construction

Officials of the major boat building and repair yards interviewed seem to be agreed that the larger vessels now being launched are constructed too lightly and have inadequate fastenings.

Many builders produce two versions, a standard and de luxe, of the same hull. The latter usually costs considerably more but the stress is mainly on additional aesthetic features, such as the superstructure. Only a small portion of the extra cost is applied to devices designed to strengthen the hull structure.

The larger (67-to 70-foot) vessels designed for the distant Campeche grounds should be built of sturdier material than the 55-foot vessels. In actuality, the structural differences between the two in the past have been few which has accounted for the smaller boat being as rigid as the larger one. The foretimbers, keels, keelsons, deckbeams, and frames should be strengthened and treated with cuprinol. All fastenings should be improved and Monel bolts used in the keel. Screw-type galvanized nails should be used in place of the wedge-type nails. All of these improvements in construction, of course, would add to the initial cost of the vessel, but would undoubtedly pay off in the long run.

Builders, owners, and repair personnel have suggested that the following features be stressed.

Timbering.--All timbers used should be free of knots and properly cured. The keel should be about 12" x 12"; keelson 10" x 12"; frames 3" x 4" or 4" x 4", dressed and on 12" or 13" centers; planking 1-3/4" to 2", dressed; deck beams 4" x 4", on 13" centers.

Fastenings.--The keel must be bolted with high quality stainless steel or galvanized bolts to the frames. All knees and foretimbers must be securely bolted. Hull planking should be fastened with screw-type nails and the holes plugged with wood. Nails should not protrude through the ribs. Butt blocks are preferable and should be staggered and bolted through to the planks.

Seaming.--All seams in the planking should be properly caulked. The weather decks should have adequate camber and should be caulked and pitched.

Frame.--Sawed or steamed rib construction is satisfactory, but bending of the steamed ribs should not be hurried and those ribs that crack during the bending process should be discarded.

Engine Bed.--The engine bed should be made of dried timber and of a length not less than two-thirds of the boat length. A metal shoe over the engine bed will reduce shaft aligning problems.

Layout and Arrangement Aboard Ship

Improper layout may be responsible for hazardous operations when it results in overloading, disregard of proper trim, and inadequate means of communication fore and aft.

The layout and arrangement of the typical Florida shrimper is standardized. All work is done on the afterdeck. The deckhouse varies from 15 to 30 feet in length, depending upon the size of the vessel, and is placed well forward. It generally contains the pilot house, a captain's stateroom, and a galley. On the larger vessels it may also include the crew's quarters and toilet facilities. Water tanks and auxiliary gasoline tanks are frequently mounted along the cabin side on the main deck. The mast is stepped on the centerline as close to the deckhouse as possible, with a winch either alongside of it or just aft. This arrangement leaves a large working deck aft to the transom. Below is a large forepeak used for crew's quarters and toilet facilities on the smaller vessels, and for additional tank capacity on the larger vessels. This is generally followed by the engine room which extends aft of the center section. The fish hold is located aft of the engine room and extends as far towards the stern as is practical. The remainder of the space to the transom is used either as a lazarette or for additional tank space. The main fuel tanks are located in the engine room alongside the engine. Engine rooms are generally cramped for space and poorly ventilated.

As fishing trips became more extended, additional fuel and water tanks were installed in new vessels without regard to the vessel's design. The hold capacity, too, was increased and the vessels were iced to the limit, sometimes far beyond originally intended capacity. Equipment was added and installed where there was room without regard to the effect on trim and stability.

The pilot house is of minimum size and crammed with whatever navigational and electronic equipment may be on board. Only on a few of the newer vessels is a separate room provided for the radio and other electronic gear.

Facilities for the crew are kept to a minimum. Little or no comfort is provided for living in tropical weather. The captain's stateroom is usually large enough to be comfortable and is located on the main deck. On most vessels the crew's quarters are below in the forecastle and consist of 2 to 4 berths and small hanging lockers. For the most part, they are very cramped and the only ventilation is afforded by the forecastle hatch.

Lavatory and toilet facilities are not provided on some vessels and the only fresh water in these instances is found in the galley.

As a rule, galley and messing facilities are good. Most vessels are equipped with either bottled gas or oil stoves and with running water. A refrigerator is a necessity on freezer vessels as the hold temperatures are too low to permit the stowage of many items such as fresh vegetables, eggs, and other perishables.

The deck layout of some vessels disregards safety during the fishing operation. The long deckhouse, with the pilot house forward prohibits adequate communications between the pilot house and the winch aft. Electronic public-address systems which may be found now and then are not always in operating condition. The exhausts from the engines are dry with a minimum of muffling, adding to communication difficulties. The fact that communication between fore and aft, except by shouting, is often impossible coupled with the fact that only open winches are used on the vessels, creates a dangerous situation which makes the layout of the Florida-type vessel unsafe and impractical.

Hull Maintenance

Rapid hull depreciation, in addition to basic weaknesses in vessel design and construction, can be traced also in many instances to improper and inadequate maintenance practices.

To protect the hull against deterioration, measures must be taken against the two principal enemies of wooden construction exposed to sea water, i.e. shipworm (Teredo) and dry rot. Shipworm penetration can be retarded by the use of good copper paints when properly applied. The keel and the shoe should be separated for this purpose by two layers of good quality asphalt paper.

Dry rot can be controlled through the use of chromate paints. This treatment, if carefully applied, will extend the life of the shrimp vessel considerably.

Many vessels are put into drydock at intervals of six to eight months instead of the recommended three or four months. Sometimes the application of copper paint is neglected.

The maintenance problem is increased by the shortage of conscientious crews. The standard of maintenance of the vessels owned by independent owner-skippers and small fishing companies, furthermore, is influenced by the size of the shrimp catch and the price range during the year. During the 1953-54 market decline, for instance, hauling of shrimp vessels and general maintenance was noticeably reduced. Construction practices appear to have a definite bearing on the amount of maintenance work required during the life of a vessel. Most owners interviewed reported that well-constructed vessels required less maintenance than poorly built vessels, particularly after the first season or so of fishing.

Vessel Accidents

Sins of omission and commission in the construction and maintenance of vessels are reflected not only in the rapid depreciation of the fixed investment but also, to a relatively high degree, in the frequency of occurrence of accidents aboard ship. This is borne out by a sample study of damage and claim records for shrimp vessels included in the report of Harwell, Knowles and Associates on the efficiency of domestic shrimp vessels from insurance company files for the years from 1952 to 1955.

On the basis of these records the accidents for which particulars were made available were classed into two general categories:

(1) Those due to the negligence and error in judgment of the captain or crew.

(2) Those due to mechanical failure of the vessel equipment. (Some of the latter type of accidents may be attributable to poor maintenance of the equipment by the crew or by shore personnel.)

TABLE II-3.--FREQUENCY OF OCCURRENCE OF VARIOUS TYPES OF SHRIMP VESSEL ACCIDENTS, VESSEL SAMPLE FOR PERIOD 1952 - 1955 (SELECTED FROM REPORTS OF MARINE SURVEYORS)

Human error	Frequency	Mechanical failure	Frequency
Poor vessel handling	6	Clutch and gears	7
General negligence	4	Rudder or steering	6
Gear entanglement	3	Improper anchorage	4
		Fire, exhaust	3
		Fire, wiring	2
		Vibration	2
		Water in fuel and oil	2
		Engine overheating	3
		Shaft breakage	2
		Propeller loss	1
		Other	2
Total	13		34

About 28 percent of the accidents reported in the files made available were the direct result of human error. Many of the mechanical failures might have been avoided if proper preventive maintenance had been observed. About 13 percent of all the above-listed accidents resulted from careless or inexperienced vessel handling and were avoidable. A proper crew training program probably could have reduced the incidence of this type of accident.

Vessel ownership is an important factor to be considered in this connection. Captain ownership plays an important part in the amount of attention paid to measures designed to forestall accidents. A disproportionate number of the insurance claims analyzed were filed for company-owned vessels.

Of the 34 mechanical failures, 7 were attributed to reduction gear and clutch mechanism failures. Hydraulic clutches appeared to be less vulnerable. The weakening of rudder fastenings, perhaps by electrolysis and the disablement of the steering mechanism, resulted in 6 other accidents. Of the 5 fires, 3 were caused by inadequately protected exhausts and 2 by faulty wiring. Four accidents were associated with inadequate anchorage. Two breakdowns were caused by water in the fuel.

Systematic inspection and maintenance of equipment might have prevented many of the accidents included in the sample which was analyzed. It has been suggested that a check list for captains and shore mechanics be established as an aid in accident prevention.

Statistics on Fishing Craft

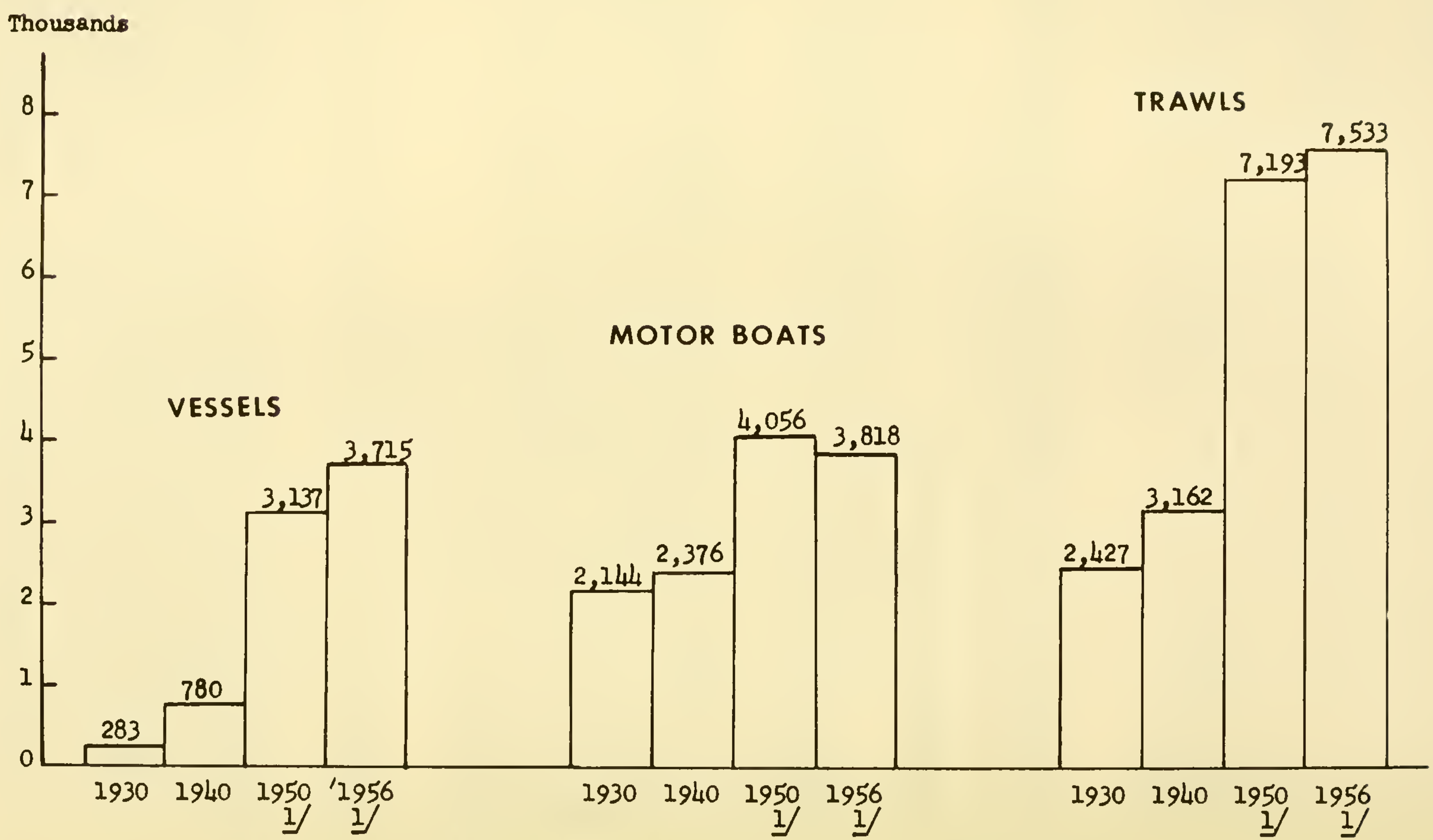
Shrimp fishing as a full-time occupation is of importance only in the South Atlantic and Gulf Area. The statistics on fishing craft cited in the following paragraphs, therefore, relate to operations in this area only.

The growth in the number of vessels, motor boats, and shrimp trawls engaged in the shrimp fishery in the south Atlantic and Gulf Area over the quarter century from 1930 to 1956 is illustrated by figure II - 16. In 1930 the fleet consisted of 283 vessels and 2,144 motor boats. Estimates for 1956 indicate that the number of vessels and boats by that year had grown to 3,715 and 3,818, respectively. The total number of shrimp trawls in the shrimp fishery in the area in both years corresponded roughly to the combined number of vessels and motor boats. Some vessels have recently started operating with two trawls at a time.

In the decade 1945-1955 the number of shrimp vessels fishing in south Atlantic and Gulf waters has more than doubled, whereas the number of motor boats has increased by approximately 30 percent.

In 1930, of the total number of motor vessels five net tons and over in the United States fishing fleet, 6.5 percent engaged in shrimping. Twenty-five years later three out of every ten vessels were so engaged. In spite of the absence of complete statistics on the distribution of the United States motor vessel fishing fleet over the individual fisheries, it appears that today more vessels are engaged in shrimping than in fishing for any other variety of fish or shellfish. The isolated statistics that are available reveal that in 1951 some 1,510 vessels, or about 15 percent of the total number of vessels in the domestic fleet, were fishing for tuna and/or other species on the

FIGURE II - 16.--NUMBER OF VESSELS, MOTOR BOATS AND TRAWLS OPERATING IN THE SOUTH ATLANTIC AND GULF STATES, SPECIFIED YEARS



1/ Data adjusted to eliminate duplication.

west coast. 5/ The inland fisheries accounted for approximately 6 percent, and the Pacific coast halibut fishery for somewhat less than 4 percent of all motor vessels in 1953. 6/

The full growth of the shrimp fleet in the last twenty-five years is not shown by a comparison between the number of vessels, motor boats, and shrimp trawls engaged in the fishery in 1930 and in 1956. To gain proper perspective of the increase in fishing activity a comparison of vessel and boat capacity in net tons is needed.

Figure II-17 shows that the increase in vessel tonnage from less than 2,500 net tons in 1930 to about 80,000 net tons in 1956 has been the most significant development in the period studied in the South Atlantic and Gulf Area shrimp fleet. Since the average motor boat tonnage is small, the contribution of this type of craft to total tonnage is relatively modest. Total fishing capacity increased from 6,714 net tons in 1930 to 88,370 net tons in 1956. Average capacity of shrimp vessels, figure II-18 reveals, went up from 8.6 to 21.7 net tons over the period.

The fishing capacity of a shrimp vessel is considerably smaller than the average tuna vessel. The survey of the tuna industry completed by the United States Fish and Wildlife Service in 1953 indicates that in 1951 the average capacity of a vessel fishing exclusively for tuna on the west coast approximated 50 net tons. Pacific coast vessels fishing for tuna and other species in that year averaged about 35 net tons.

Typical Vessel Prices

Recent vessel price quotations ranged from a few thousand dollars for small inshore trawlers to as much as $70,000 or $80,000 for fully equipped Florida-type vessels. Steel hulls are appreciably more expensive than wooden hulls; the cost of a 70-foot steel vessel is approximately $70,000 compared with $45,000 to $50,000 for a similar size vessel of wooden construction. Steel vessel builders claim that vessels constructed with the two materials would differ little in price if the same standard were adhered to by all shipbuilders.

Data were gathered on the cost of the boatowner's fixed investment at the time of acquisition in connection with a study of

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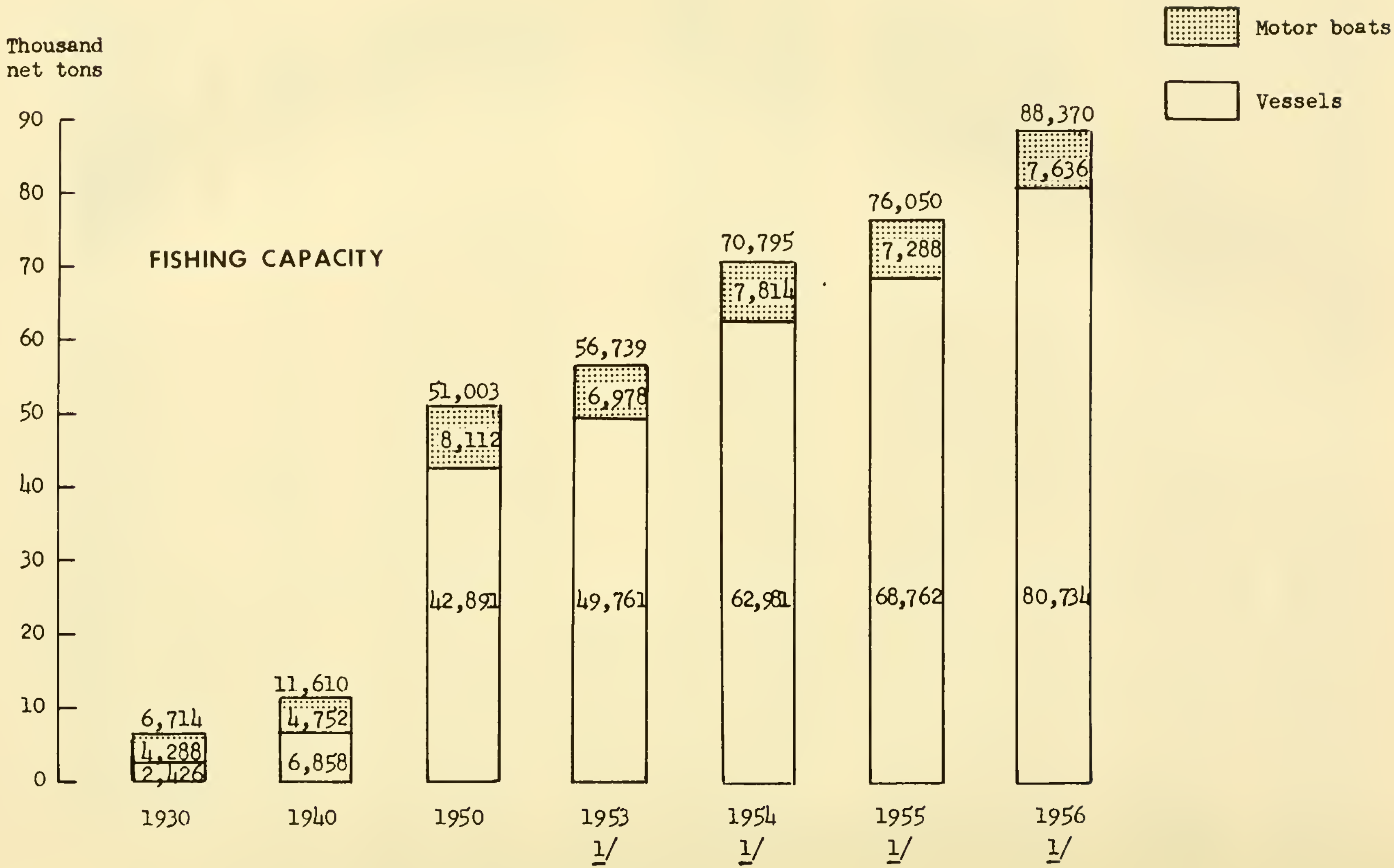
5/ See A. W. Anderson, W. H. Stolting, et. al., Survey of the Domestic Tuna Industry, 1953.

6/ The data on the inland fisheries are taken from Fisheries of the United States and Alaska, 1953, a Preliminary Review; the data on the halibut fishery are taken from Fishery Statistics of the United States, 1953, Statistical Digest No. 35.

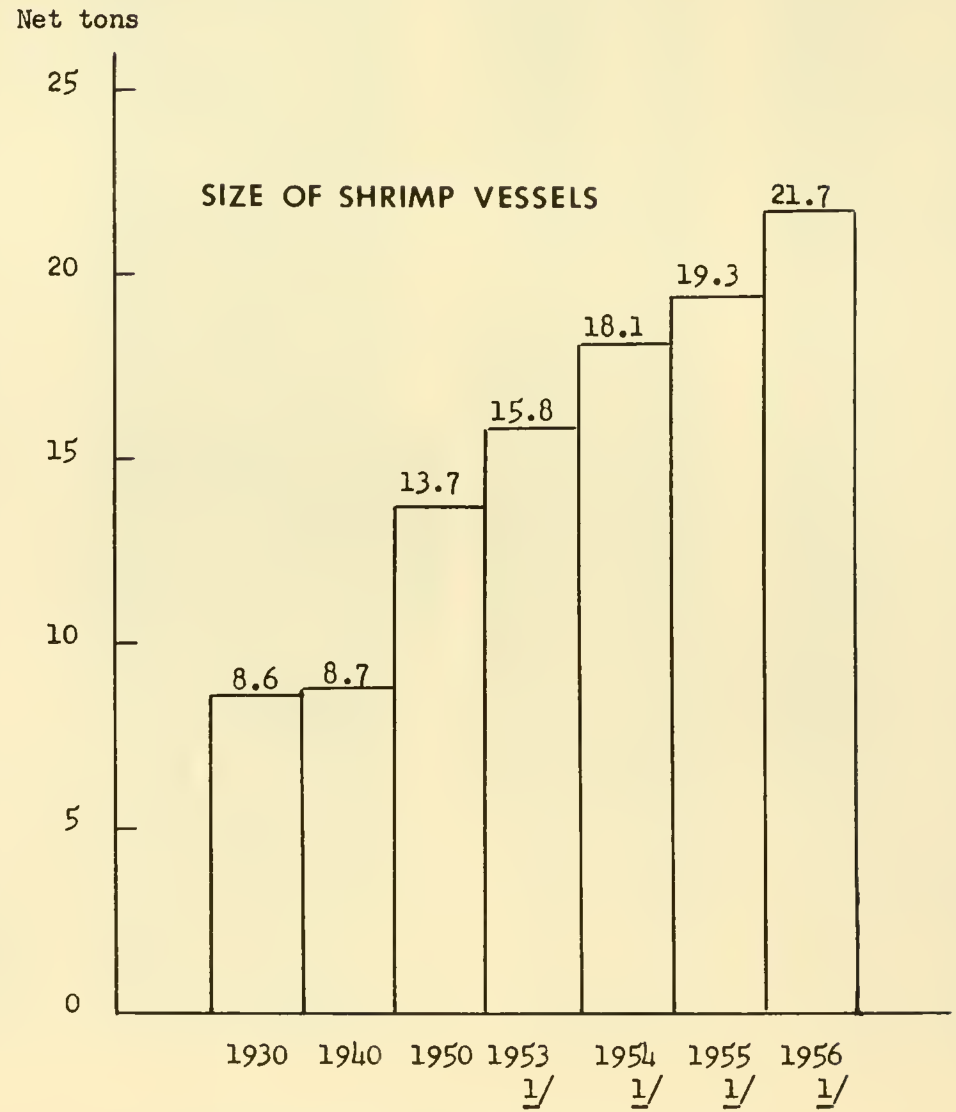
FIGURE II - 17.--SHRIMP FISHING CAPACITY (NET TONS) SOUTH ATLANTIC AND GULF STATES

SPECIFIED YEARS



1/ Data adjusted to eliminate duplication.

FIGURE II - 18.--AVERAGE NET TONNAGE OF SHRIMP VESSELS OPERATING IN THE SOUTH ATLANTIC AND GULF STATES, SPECIFIED YEARS



1/ Data adjusted to eliminate duplication.

operational costs of shrimp vessels undertaken by the Federal Trade Commission. Where vessels had changed hands since launching these cost figures did not represent cost of construction. The data collected reveal (1) substantial differences in cost between different-size vessels, (2) marked variations in costs between vessels of similar length and capacity acquired in the same year, and (3) the high percentage, in some instances more than 50 percent, of total investment represented by cost of engine and electronic and freezing equipment. The following examples illustrating these points may be cited:

(a) Cost of acquisition in 1954 of a fully equipped 31-foot vessel with a 6-ton capacity was $11,000 compared to a 62-foot vessel with a 25-ton capacity which was acquired equipped with engine and special apparatus for $35,330.

(b) Fully equipped vessels of like capacity and length, i.e., 40-foot, 38-foot and 43-foot, acquired in 1953 varied in cost from $3,000 up to $13,000.

(c) Cost of hull acquisition in 1954 in the case of one vessel was $16,000; with $10,000 spent for the engine and $9,330 for special equipment.

Fishing Gear

The types of gear described below relate to the equipment used in the South Atlantic and Gulf Area. Although several types of gear have been used in the commercial shrimp fishery of this area since 1880, only two may be regarded as standard equipment. These are haul seines, introduced about 1872, and shrimp trawls (otter trawls), introduced about 1912. Haul seines had become standard gear by 1880, but were almost completely replaced by shrimp trawls by 1930. Other types of gear used on a minor scale were skim nets, cast nets, push nets, and dip nets. Cast nets, push nets, and dip nets are used almost entirely to catch shrimp for bait purposes.

Cast Nets

There is considerable variation in the size of cast nets. They are circular, usually from 10 to 15 feet in diameter and have a lead line running around the outside edge. A cord line extends through a metal ring in the center of the net, and from this end there radiate numerous smaller cords which are fastened at regular intervals to the lead line; the other end of the cord is held by the fisherman. The net is cast in such manner that it falls flat on the water in the shape of a disk. When the weighted edges of the net have settled to the bottom, the fisherman draws in the cord attached to the net which pulls the edges to the center, thus forming a circular bag to hold the captured shrimp. The net is then hauled up and emptied and another cast made.

When haul seines were standard gear fishermen frequently "tested" shallow water areas with cast nets to determine if shrimp were present in sufficient abundance to justify setting and hauling the seine.

Haul Seines

Haul seines were introduced about 1872 and by 1880 had become the most important type of gear in the commercial shrimp fishery. Basically, a haul seine consists of netting with a stretched mesh of 1/2 to 1-1/2 inches rectangular in shape; it varies in length and depth, with a lead line running along the bottom, and a cork or float line running along the top. During the years haul seines were used there was little change in the overall design. As the fishery progressed and as power boats came into general use, larger seines were used in the fishery.

Originally the seines were made of half-inch stretched mesh netting and were up to 120 feet long and 10 feet deep. The smaller seines could be handled by two men in a row boat. Gradually, however, the net mesh was made larger and the seines increased in size, some of them reaching 1,800 feet in length with 14 feet depth at the center, graduated to about 7 feet at each end. With seines of this size powered boats were necessary and crews of as many as 20 men were required to handle them.

As long as shrimping was confined to shallow waters the boat was run close to shore where one end of the net was dropped and held by about half of the crew. The boat then laid out the net in a large circle surrounding the shrimp and returned to shore with the remainder of the crew and the other end of the seine. The seine was then pulled in . After the net had been hauled in sufficiently for the catch to be enclosed in a small area, the boat was brought alongside and the shrimp brailed into it. During the heyday of seining operations various seines were designed for use in water as deep as 20 feet. As haul seines gradually gave way to shrimp trawls, the seines remaining in operation were rarely used in water more than 6 feet deep.

Shrimp Trawls

The shrimp trawl basically corresponds to the otter trawl which was first introduced in the New England fisheries in the early 1900's. Constructed along the same lines, differences are confined almost entirely to size, weight, and mesh size of the netting. It is today the most important gear in the shrimp fishery. (see figure II - 19)

The shrimp trawl consists of a cone-shaped bag in which the catch is gathered in the tail or cod end, a wing on either side of the bag for "herding" the shrimp into it, a trawl door or otter board at the extreme end of each wing for holding the wings apart and holding

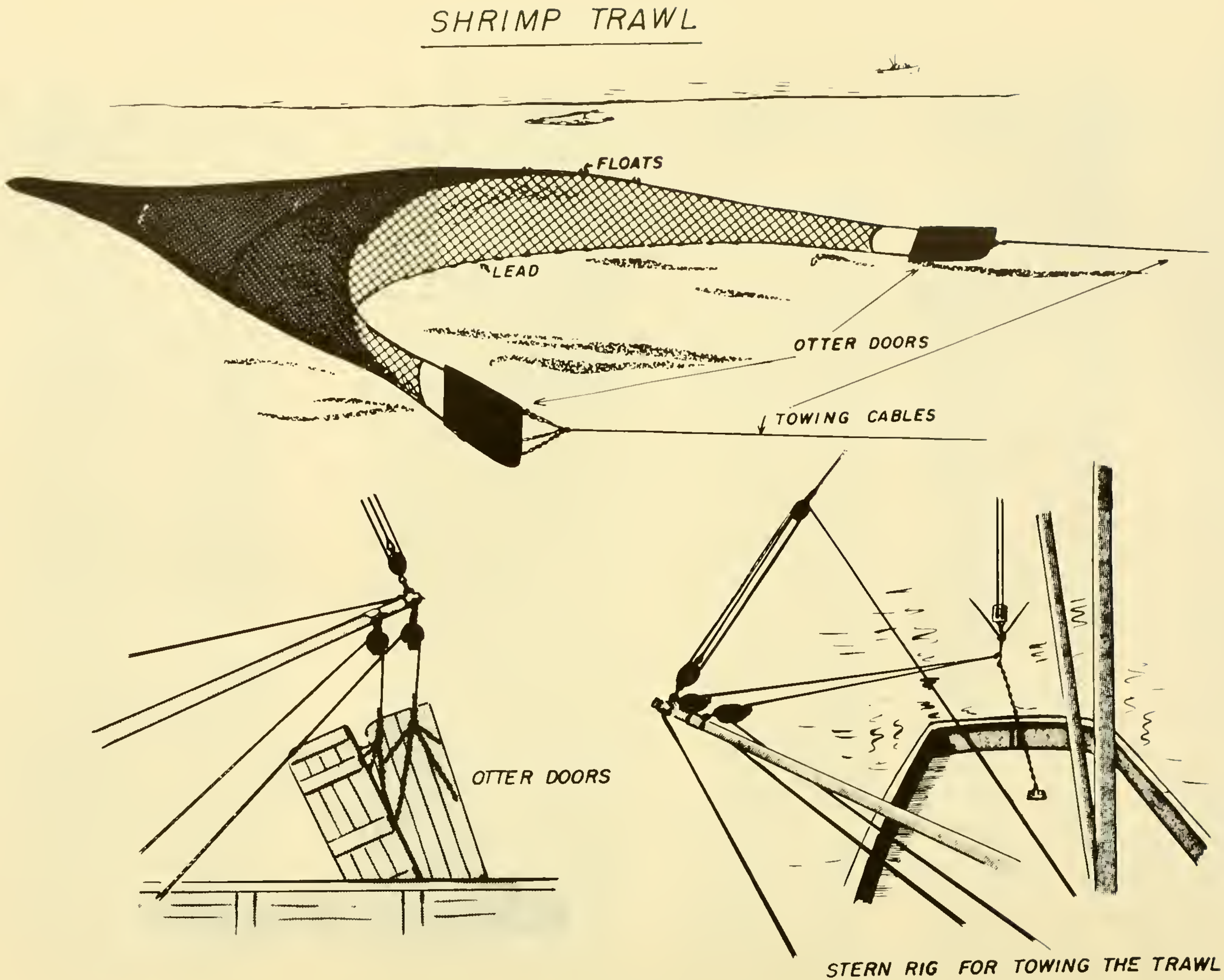

SHRIMP TRAWL
FLOATS
LEAD
OTTER DOORS
TOWING CABLES
OTTER DOORS
STERN RIG FOR TOWING THE TRAWL

FIGURE II - 19

the mouth of the net open in a somewhat rectangular shape when in operation, and two lines attached to the trawl doors are made fast to the vessel. A lead or ground line extends from door to door on the bottom of the wings and mouth of the net; and a float or cork line is similarly extended at the top of the wings and mouth of the net. The size of the net is measured by the width of the mouth. 7/

The steel trawling or towing cable extending from the vessel to the trawl door varies in size from a quarter to a half inch, depending upon the size of the vessel, the size of the trawl, and the depths fished. The ratio commonly used for determining the required length of cable is 5 or 6 fathoms of line to 1 fathom of water, although occasionally in deeper water the ratio may be reduced to 3 to 1 or less. In the earlier days of the trawl fishery the towing cable consisted of 1/2-to 1-inch manila rope, and the line was seldom extended more than 40 fathoms, which was sufficient for the depths then being fished.

The towlines are secured to the two trawl doors by means of bridles (consisting of four chains) fastened to the doors somewhat like the bridle of a kite. The chains fastened to the net end of the trawl door are somewhat longer than the front chains and the top chains are somewhat longer than the bottom chains. Set thus, the doors have an outward, downward thrust while being towed through the water.

The wings are the sides of the net and are tapered along the top seam but straight along the bottom seam. They are attached directly to the trawl doors and extend to the mouth of the net, which varies in width. Most trawls are shaped so that the lead line of the mouth rides behind the float or cork line. This is referred to as the overhang, setback, undercut, or cutback. A good many trawls use a tickler chain of adequate length between the trawl doors to drag behind the float line and scare the shrimp off the bottom in advance of the lead line.

The net is tapered from the mouth to the throat, which is about 6 feet in diameter. Attached to the throat is the tail, bag, or cod end, an untapered cylinder of heavy webbing which holds the catch. The end of the tail is closed with a slip-knotted tie rope. To prevent chafing while being dragged on rough bottoms, various types of gear are used, the most common being unraveled manila strands. In addition to the chafing gear, and when fishing in shark and porpoise infested waters, some trawls use covers of heavier, large-stretched mesh that completely encircle the tail to protect the net from sharks and porpoises which bite at fish gilled by the net. The shark covers are also used for attaching the chafing gear to the bottom of the tail.

7/ For a detailed description see Fishery Leaflet 394, entitled Gulf of Mexico Shrimp Trawl Design, and Fishery Leaflet 470, entitled Double-Rig Shrimp Trawling in the Gulf of Mexico, copies of which may be obtained on request to the Fish and Wildlife Service, United States Department of the Interior, Washington 25, D. C.

Until comparatively recent years the mouths of all shrimp trawls were rectangular, the lead or bottom line and the float or cork line being more or less straight horizontally. A new design, however, has the float line forming a pronounced arc when the trawl is in operation. The former is known as a flat trawl and the latter as a balloon trawl. The United States Fish and Wildlife Service has made experiments designed to compare the efficiency of the two trawls. The results of these experiments indicated that under similar conditions the catches per hour of the 74-foot balloon and the 100-foot flat trawl were about the same. The balloon net contained less bottom trash (shells and sponges) and the catch was landed in a better condition.

The length of the drag and the speed of the tow vary with depths, bottom conditions, and the speed with which the tail of the net is filled. Generally speaking, drags in deep waters usually take from 1-1/2 to 3 hours. In the inshore and shallow water fishery, however, drags are sometimes of much shorter duration.

Gear Preferences

Preferences for types of gear in the south Atlantic and Gulf shrimp fishery ascertained by Harwell, Knowles and Associates in 1955 in connection with a study of vessel efficiency are stated below.

Balloon and Flat Nets on Shrimp Trawls.--The number of nets fishermen find necessary to keep aboard ship is a function primarily of length of trip and type of bottoms encountered. In North Carolina, South Carolina and Georgia 1 or 2 trawls are carried; in Florida, Louisiana and Texas, 2 or 3; and in Mississippi, 2 to 5 nets.

In the Carolinas and Mississippi, 2-inch stretch mesh is used, while in Florida, Louisiana and Texas the 2-1/4-inch stretch mesh is most common. The nets are made of 15-to 18-thread cotton twine and are usually tarred. The cod end or bag is made up of heavier, 1-to 1-1/2-inch netting.

Every fisherman has his own preference for net size. The sizes most commonly encountered ranged from 90 feet to 110 feet in flat nets and from 65 feet to 85 feet in balloon nets. In Louisiana the 30-foot to 42-foot vessels are equipped with 45-foot to 55-foot flat trawls. The nets used in the Carolinas are also small and are usually about 55 feet to 60 feet. In addition to vessel length, vessel power has a bearing on the choice of net size.

In considering the efficiency of a fishing net an investigation cannot be limited to operational efficiency but must include a study of "net use-life". Inquiries have been made to determine the causes of net losses in various areas. In North Carolina, South Carolina, Georgia, Florida and Texas, the general opinion of fishermen, net dealers, and

FIGURE II - 20.--Shrimp entangled by their numerous spines in the improved tail bag net invented by Guthrie. Ordinarily the meshes are not open when the net is in operation as shown here, but are in a stretched position.

Aycook Brown, Assignment Photographer, New Bern, North Carolina.

vessel owners was that nets in these fisheries were lost primarily due to regular wear and tear and secondarily as a result of entanglement with obstructions. The wear and tear is mainly due to the chafing of the gear on the shell and gravel seabeds. The other factor is the reduction of tensile strength caused by microbiological deterioration of the twine. An average of three to four nets are worn out annually by vessels fishing in these regions.

From two to five nets are used annually by vessels fishing in Mississippi and Louisiana. Boat owners there claim that nets seldom wear out when their vessels fish in the delta area. Nets are lost mainly as a result of bogging. A secondary factor is the sharks which tear great portions of the cod end section.

Tests by Robas (1954) have shown that in southern waters menhaden nets treated with copper napthenate and seine tar retained as much as 82 percent of their tensile strength after three months' exposure. After a similar period of exposure untreated twine or pine tar-treated nets retained no tensile strength. It is believed that considerable savings in net costs in the shrimp fishery, especially on the Atlantic coast, can be made by treating nets in copper based solutions.

Nylon trawls which have a reputation for being more durable than cotton have been tried in various areas. In South Carolina one experienced fisherman reported that the net spread well if the size of the doors was reduced. A difficulty apparently arose whenever the nylon net had to be mended which prompted this particular fisherman to abandon its use.

In Texas, a net maker reported that cod ends made of nylon lasted three times as long as those made of cotton. The cost is about 35 percent higher than regular twine. Thirty-thread nylon or combination nylon netting was recommended.

One shrimp vessel captain from Brownsville reported excellent results with nylon netting. He stated that despite the higher initial cost, net expenses for a year's operation were reduced from $3,000 in 1953 to $1,500 in 1954 by the switch-over from cotton to nylon webbing. This vessel operator also used nylon in place of manila rope in the rigging. He reported that if a net became hung during trawling, he usually managed to save the nylon net whereas the cotton net often ripped and portions of it were lost. Perhaps this was due to the greater strength of the nylon webbing. He reported no problems as a result of webbing being cut on rough surfaces.

Louisiana vessel owners felt that, since in their particular area the nets and cod ends were being destroyed usually early in the use-life of the gear, there was no real economy in equipping boats with the more expensive nylon nets which were vulnerable to bogging.

An increase in the use-life of the gear in the Mississippi delta area depends on reducing the losses caused by bogging down in the mud. One solution was offered by a captain-owner who claimed considerable success with his 85-foot flat net in which the lead and head lines were similar. One float was attached to the center of the lead line. The lead lines were attached to the trawl door bracket which was raised about 9 inches above the shoe. United States Fish and Wildlife Service specialists have described curved doors and more recently doors with wider runners which reduce the hazards of bogging down.

The efficiency of shrimp trawls depends on the extent to which the net is spread. The spreading of the net is controlled largely by the attachment of the various lines to the trawl doors. Carlson (1952) using a 100-foot flat net with doors 9 feet long by 40 inches high reported that the attachment of these lines to pad eyes on the back side of the board, opposite the after or long pair of chains, was found to increase the spread of the boards from 45 feet 3 inches to 53 feet 6 inches or by more than 18 percent. To obtain maximum vertical spread of the net and its tending bottom, the pad eyes should be as near the top and bottom of the trawl boards as possible.

Further increases in the spread of the net up to 30 percent over the conventional method of operating a shrimp trawl were made possible by the use of stern davits and an experimental winch (Carlson). The latter are not standard equipment aboard shrimp boats and may require further developments.

More recently a new type of a flat trawl known as the "Western Jib" has been developed in Freeport, Texas. Experiments have shown that this new net in a 95-to 98-foot model will pull easier than the conventional 90-foot flat net and will give more spread.

The key to the design is in the jibs, i.e. the forward topside pieces which are hung so that, in use, the strain is with the webbing and the jibs do not pull out of shape.

Midwater Trawls.-- White shrimp are usually available only in the daytime, while pink shrimp are restricted to the hours of darkness. Research has not been able to show the pattern of the vertical migration of the shrimp. However, it has been established that other marine crustacea are sensitive to sunlight. Some respond to light by moving up; others move away from the sunlight. The pink *P. duorarum* and white shrimp *P. setiferus* move at times upward from the sea bed. So-called midwater trawls have been developed for other fisheries where the species migrate vertically. Such gear may be of great value in the shrimp fishery.8/

8/ A detailed report on this gear is available from the Fisheries Research Board of Canada, Pacific Experimental Station.

A standard model of a midwater trawl--sometimes called "Phantom" trawl--with vertical and horizontal spreads of 48 to 52 feet, and a smaller net with a 36-to 38-foot opening were tested by the United States Fish and Wildlife Service M/V Oregon (Springer and Bullis, 1952). The standard size net was too large to maneuver properly with the power available. Better results, because of higher trawling speeds and better maneuverability, were attained with a smaller model. During these tests no indication of the effectiveness of the midwater trawl fishing for shrimp was obtained.

Trawl Doors.--The trawling doors are constructed of wood, usually hard pine, with iron fittings. The bottom of the doors are equipped with iron runners. Their size varies in accordance with the towing power of the vessel, the depth of the water and the size of the net. The doors serve to hold the mouth of the net open when towing and are fastened to the four corners of the mouth with manila-clad cable. The proper rigging of the doors and net leads involves careful adjustment, and the success of the fishing operation is largely dependent upon the experience of the captain in making these settings. A mistake in rigging the doors can result in collapsing the spread of the net and in towing it too low or too high.

Trawling doors of 4 to 5 feet in length are used on trawls up to 50 feet in width, 6-to 8-foot doors on trawls up to 80 feet, and 9-to 14-foot doors on nets up to 120 feet wide. The doors are set according to individual preference. They can be purchased completely rigged.

When in deep water, the doors are weighted with iron bars bolted just above the runner. In this manner 5-foot trawl doors, each weighted with a 100 pound bar, have been used successfully while fishing in over 450 fathoms. (Bullis, 1951)

Trawling Cables.-- Trawling cables are usually 7/16-to 1/2-inch steel stranded wire. From 125 to 150 fathoms of cables are usually wound on each spool. The cable length-depth ratio should be 5-6 fathoms of line to 1 fathom of water depth to assure full spread of the trawl. In deeper waters a 2:1 ratio has been employed successfully. (Bullis, 1951)

Cables must be replaced about twice a year. Springer (1955) recommends the use of galvanized preformed cable, which experience aboard the M/V Oregon has shown to be superior.

Hanging Line.--An experienced net maker in Texas recommends the use of a stainless steel manila-clad line for the hanging of the net. Such a line apparently lasts twice as long and costs only 50 percent more than regular manila-clad steel cable. An additional advantage is that the stainless steel cable can be spliced if a break occurs in the leadline section. This, reportedly, cannot be easily done with the regular manila-clad steel cable, which corrodes.

Tickler Chain.--Some boats customarily tow a tickler chain. Formerly, the chain was secured to the bottom of the net and on many vessels this procedure is followed today. However, greater success with the tickler chain has resulted from towing it ahead of the net and separate from it. The chain is towed along the bottom to stir up the shrimp so that the net, which is carried 1 foot to 18 inches above the bottom, will pick up the shrimp after they have been stirred up. The chain serves a dual purpose inasmuch as it tends to level off the irregularities on the bottom and destroy growths which otherwise might be caught in the net. By towing the tickler chain ahead of the net, it is possible to tow the net without touching the bottom. This results in cleaner catches as far as mud and debris are concerned, and in many instances this practice is believed to minimize the amount of trash fish caught. In addition to the tickler chain, short lengths of chain are secured to the bottom of the net and allowed to hang down towards the bottom. The latter are from 12 to 24 inches in length and are used to measure the distance between the bottom of the net and the ocean floor. The depth is ascertained by the length of chain which becomes shiny as the result of being dragged on the bottom.

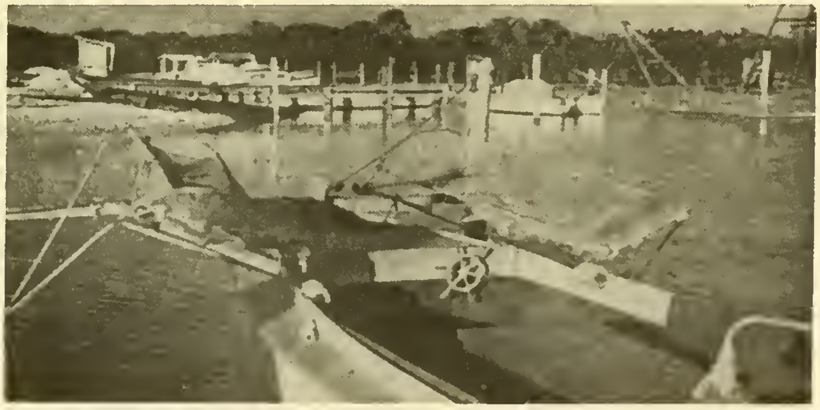


FIGURE II - 21.--Florida shrimp boats with nets and outriggers at bow for sports fishermen. Fishing Gazette.

Gear Used in the Bait Fishery

Several types of gear are used by bait shrimp fishermen throughout the United States, but the bulk of the catch is taken by trawl nets. In certain areas other types of gear may account for the total catch or may be predominant in the fishery. These types of gear are push nets, cast nets, channel or lift nets, dip nets, and bridge nets.

Trawls.--The bait shrimp fishermen use both a small and modified version of the standard otter trawl and a beam trawl. The latter is the predominant trawl gear. The beam trawls encountered in the bait fishery are variously referred to as frame trawls and pipe trawls because, instead of the traditional beam, the mouth of the net is held open by a rectangular pipe frame of varying width and depth. Various devices are attached to the lower part of the frame in order to prevent the trawl from bogging in soft mud and to prevent clogging by vegetation and debris. Among such devices are sled runners made of galvanized pipe; iron wheels, and a cylindrical roller made of wood laths. The iron wheels work well only on relatively clean, firm bottoms but perform less satisfactorily when bottom conditions are muddy or grassy. The roller works satisfactorily on soft muddy bottoms, but becomes entangled on grassy bottoms which stop its forward rolling action. The sled runners work well on muddy bottoms and also slide through grass patches without picking up large quantities of grass; however, considerable quantities of brown algae are sometimes caught in the net when they are used.

The trawls are towed by small power boats in comparatively shallow water. The length of the tow varies depending on the quantity of shrimp available, the depths fished, and the amount of vegetation, debris, etc., taken in the tow.

Channel or Lift Nets.--Channel or lift nets are shaped somewhat like a trawl net and are hung on rectangular pipe frames of various widths and depths. They are used only in a running tide or current with each boat fishing with one or two nets. When put into operation, the boat is anchored heading upstream and the nets are lowered at right angles from the sides of the boat so that the current sweeps into the mouth of the net. The nets are lifted from the water at intervals and the catch emptied. The net may be lifted without removing the frame from the water by having a line attached a few feet from the end of the bag for the purpose of hauling the bag to the boat. To dump the catch a trip line on the end of the bag is loosened.

Push Nets.--A push net consists of a rectangular frame up to 10 feet wide and 4 feet long covered with fabric netting to form a bag. A handle which has a cross brace at the other end to rest against the fisherman as he wades through the water pushing the net is attached to the frame. Push nets are used over grass and mud flats in water 6 inches to 3 feet deep. A fisherman may work by himself, pushing the net with one hand and towing his boat with the other hand, or he may have assistants to row the boat and sort the catch as the contents of the net are emptied into the boat.

Dip Nets.--A dip net consists of a large hoop, up to 3-1/2 feet in diameter, to which a cone-shaped net is attached. A handle 6 to 8 feet long extends from the hoop. Fishing with dip nets is usually done at night from a small boat anchored in water up to 20 feet deep. A lighted lantern is fastened to the prow of the boat to attract the shrimp. As the shrimp swim to the light, they are scooped up in the net.

Some dip net fishing is carried on from bridges and piers where there is a current.

Bridge Nets.--Bridge nets are used almost exclusively on bridges connecting the numerous Florida Keys. They consist of cotton webbing hung on a lozenge-shaped frame. The frame is attached by a bridle to a long line tied to the bridge railing. The net is held in the outgoing tide with up to 6 inches of the frame above the water surface. Fishing with bridge nets is confined to the outgoing night tides.

Bait Fishing Methods

When shrimp are fished for bait purposes in small quantity, it is recommended that the shrimp be attracted to a chosen fishing spot by means of minced clams or, as is sometimes done in New Orleans, Louisiana, by paste-like dog food which is packed in empty clam shells. After allowing the shrimp time to congregate, a cast net is used for fishing.

An excellent method of catching live shrimp in larger quantities is to drag slowly a small otter trawl of about 10-foot spread at the mouth, or a small beam trawl of about 6-foot spread, behind a powered boat or skiff for about 15 minutes.

Spars and Rigging

Spars and rigging on a sample of shrimp vessels in the south Atlantic and Gulf area were studied by First Research Corporation of Florida. The following practices were observed:

Aside from minor variations, the rigging on all of the fishing vessels included in the survey was standardized. Innovations were encountered here and there; no single improvement, however, had been accepted by a majority of the vessels.

The mast was generally stepped on the centerline close to amidship or slightly aft. Until recently wooden masts were used but at present all of the newer vessels are equipped with masts constructed of steel pipe.

The boom was secured to the mast by a goose neck at a point about 5 feet above deck. It was of sufficient length to bring its outboard end over the afterdeck several feet forward of the transom and was steadied in position by fixed or adjustable topping lifts and preventers leading to the port and starboard bulwark. On recently built vessels, the booms were made of iron pipe.

Outriggers, port and starboard, extended athwartship from the mast and were of sufficient length to make sure that their outboard ends were well clear of the side of the ship. They were equipped with adjustable topping lifts so that they could be raised and lowered. The inboard end was secured at the mast at about the same height as the boom. The large net and doors were handled on the starboard outrigger and the trynet was handled on the port outrigger. Some of the new vessels studied had no port outrigger, the trynet being handled by a fixture secured to the overhang of the cabin top. When in port, the outriggers were raised so that their ends were inboard. Outriggers were constructed of steel pipe.

A davit, constructed of steel pipe, was set outside of the port bulwark aft, within about 10 feet of the transom. The towing line for the trynet was led through a block at the end of this davit.

Standing rigging was constructed either of cable or steel rod. As a rule, there were two forestays leading to the stem. There were shrouds to port and to starboard athwartship of the mast with pin rails between them. Preventers for the outriggers led forward and were secured to chain plates located opposite the pilot house. The size of the standing rigging varied but slightly and appeared to have little connection with the size of the vessel.

With the exception of the towing lines for the nets, manila rope was used for the running rigging. Wire cable was used for the two towing lines, for the main net and the single bridled towline for the trynet. A four-purchase block and fall was fixed to the end of the boom and used for heavy hauling, such as bringing the loaded neck of the bag on board. The lower block was equipped with a hook and a manila gripe. A fixed single-purchase whip ran through a fixed block near the top of the boom. Another whip was led through a running snatch-block which was free to slide up and down a starboard boom preventer. Both whip lines were equipped with hooks. The fixed whip was used for general hauling and the running whip was used to haul in the lazy line which was secured around the mouth of the net bag. This lazy line was loosely secured around the mouth of the bag while towing, the bitter end being usually secured to the inboard door. When the net is hauled, the lazy line is led through the snatch-block of the running whip which is then hoisted to the end of the boom. As it is heaved in by the winch, it closes the mouth of the bag preventing the escape of any fish. Frequently, there were additional halyards leading from the crosstrees which were used for hoisting the net for drying.

The majority of the winches encountered in the survey were open with two or three drums, depending on the model. As a rule, they are driven from a power take-off on the main engine through a chain and sprocket drive, with a clutch control convenient to the winch-man. The main drums handle the wire towing cable, the manila lines being handled by a built-in "niggerhead" or gipsey. On one vessel the winches were driven by a diesel engine located on deck next to the winch and the trynet was operated by a separate winch, also driven from this small engine. The winches are located in the open, just aft or alongside the mast.

The current power take-off arrangement aboard shrimp boats often includes various undesirable mechanical features and safety hazards.

Mechanical transmission from the main engine is undesirable for winch motivation since the speed of the winch can be controlled only by regulating the speed of the main engine. Since the speed of the engine in turn affects the propeller speed, it is impossible to reduce the speed of the boat and accelerate the winding rate of the winch at the same time. In addition, this system has no provision for absorbing sudden changes in the load on the winch such as occur when the vessel is rolling.

Hydraulically driven winches are more desirable because they (1) are more efficient; (2) offer quicker acceleration; (3) have higher torque; (4) are easier to control and to handle in rough weather; and (5) are safer.

Recent Improvements in Rigging

Some new methods in rigging have been introduced in recent years. At present, however, these methods are not yet in common use and have still to be accepted throughout the fleet. The most important of innovations is concerned with the method of securing the main net towing lines on the centerline of the vessel. The common method of doing this is to so maneuver the vessel with a port helm that the taut towing lines cross the transom and can be manually secured to a chain downfall fastened to the deck and equipped with a hook. The block and fall at the end of the boom is also hooked around the cables and is used to hoist them about eight to nine feet above the deck. The towing cables remain in this position throughout the trawling period. This system has been the cause of many serious accidents on shrimp boats. If the fall parts while the vessel is towing, the bottom block is jerked down by the towing cables, often with enough force to go through the deck. The possibility of this occurrence makes the common practice of working on the afterdeck near or under the two lines extremely hazardous.

A small number of vessels have been equipped with a steel rod with a hook at its lower end, which is secured at the end of the boom. After the towing cables have been hoisted in place by means of the block and fall, the rod and hook are substituted for this running gear, which is then released, and the cables are then held in place by the steel rod and hook. The towing strain is then taken by the steel rod and hook and the rig is not dependent upon the strength of a piece of manila line. This operation has been further refined by the use of a yoke which is slotted at the centerline. As the cables cross the stern of the vessel, they slide up this yoke and settle in the slot. They are then locked in place by a steel finger which covers the top of the slot. This yoke, or gallows, is generally located at the forward end of the fish hold hatch, between it and the winch. This arrangement has three main advantages: the crew does not have to handle the cables other than to guide them up the yoke into the slot; the cables are led through a strong and permanent framework; and the towing point is moved forward, making the vessel more maneuverable. To release the cables the locking finger is released, and the cables are lifted out of the slot by a member of the crew. This is an adaptation of a method used in other fisheries and has been adopted by several Texas operators.

Equipment Requirements for Deep Water Shrimp Fishing

Springer (1955) suggests that a number of gear modifications are required to convert a regular shrimp vessel for the deep water shrimp fishery. A long torque spool able to take 800 fathoms of half-inch preformed cable must replace the regular winch drum. The usual two cables to the net are unnecessary, as a bridle not less than 25 fathoms in length may be substituted. The two sides of the bridle must be of identical length, quality, age and make because of the possibility of differential stretching.

The vessel requires a depth recorder with a range of 300 fathoms or greater. At these depths the captain will not be able to orientate his movements by the type of bottom, and accurate navigational equipment such as loran should be installed. Large anchors with adequate cable and a winch should be aboard. The use of echo-ranging devices would assist by scanning the bottom ahead of the trawl for obstacles likely to tear the net.

Correlation of bottom temperatures and highest shrimp catches have shown that a reversing thermometer would be required to attain the greatest measure of efficiency in shrimping. A small power-driven winch would be needed for operating this equipment. 9/

Engines

The expansion of the present day shrimp fishery is undoubtedly due, in large measure, to the acceptance and use of diesel motor power.

In a sample of vessels studied by the First Research Corporation of Florida, all but the motor boats fishing the inland waters were equipped with diesels ranging in power from 84 to 230 horse power. All of the vessels in the sample were equipped with reduction gears. The main engines, in most instances, were equipped with power take-offs to run the winch through a system of chains, shafts, and sprockets.

A twin-screw vessel which was included in the sample was slower, less maneuverable, and not as efficient as the other vessels in towing.

9/ See Bullis, H. R., Preliminary Results of Deep-Water Explorations for Shrimp in the Gulf of Mexico by the M/V Oregon (1950-56), Commercial Fisheries Review, December 1956.

The advantage of increased horse power, in this instance, was more than offset by the cumbersomeness of the twin-screw installation.

Main engine installation in most of the vessels was good and there were comparatively few breakdowns. Maintenance was kept as simple as possible. Many of the more experienced crew members are capable of making minor repairs at sea. If a breakdown cannot be repaired, other vessels fishing in the vicinity cooperate either by supplying spare parts and technical knowledge or by towing the disabled vessel into port. As these vessels usually fish in groups of 10 to 100 boats, assistance is nearly always at hand.

According to a recent article by Mr. Jan-Olof Traung in Fisheries Bulletin, engine efficiency is directly related to the length of the hull. 10/ Mr. Traung cites several examples in support of his findings that additional hull length decreases the required horse power per ton of hull weight. It is claimed that tank tests have proved that a 65.5-foot and a 105-foot boat can both be driven at 9 knots by a 200 h.p. main engine, although the bigger boat has a beam of 24 feet 2 inches compared with 19 feet 7 inches of the smaller boat and a displacement of 320 tons compared with 110 tons.

Mr. Traung is of the opinion that there is a tendency to overpower fishing craft. The wastefulness of this practice is demonstrated by experiments which have shown that a 69-foot boat can be driven at 10 knots by a 200 h.p. engine, and that doubling the engine horse power to 400 will only add 1 knot to the speed.

Engine costs vary with make and power. Typical engines of vessels in the 60- to 65-foot class (25-30 net tons) acquired in the years 1953-54 were carried on the books at $8,000 to $10,000, according to statistics on vessel costs collected by the Federal Trade Commission. This amount, in many instances, represented a substantial part of total fixed investment of the boat owner.

Freezing Equipment

The practice of freezing shrimp at sea is expanding. Three freezing methods are used in the shrimp fleet: (1) shelf or plate freezing, (2) blast freezing, and (3) immersion freezing.

Shelf or plate freezers require substantial amounts of space and involve considerable investment in equipment. In this process the shrimp are prepacked in 5-pound cartons and placed on refrigerated, thin, corrosion-resistant metal plates. The chilling is effected mainly through the bottom of the carton, and since paper cartons are poor conductors of heat, freezing is relatively slow. Because of their thickness,

10/ Article by Jan-Olof Traung, Chief of the Fishing Boat Section of the Fisheries Division, Food and Agriculture Organisation, in F.A.O. Fisheries Bulletin, Oct.-Dec. 1955, as condensed in the March 1956 issue of Fisheries Newsletter, published by the Commonwealth Director of Fisheries, Department of Primary Industry, Sydney, Australia.

the use of 25-or 50-pound cartons is precluded. Weighing and packaging of the 5-pound cartons requires a great deal of hand labor which is not always available at sea.

Blast freezing requires less space for freezing compartments. The method, however, has the potential disadvantage that shrimp may be subjected to dehydration, a condition commonly referred to as 'freezer burn'.

Where blast freezers are used, the freezing process is accomplished by exposure of the shrimp to rapidly moving, intensely cold air which is usually obtained from a blower through coils chilled by a refrigerant such as ammonia or "Freon". The shrimp ordinarily are packaged in 5-pound cartons placed on racks below deck and frozen.

In one instance a blast freezer installed in the fall of 1954 on board a shrimp vessel cost approximately $20,000. Amortization of investment, cost of upkeep, and life of equipment must be considered in determining the economic advantage to be obtained from an installation of this sort. The approximate savings by the equipment amounted to (1) $2,500 annually on ice otherwise required for chilling, (2) an additional income of approximately five cents per pound (seven cents premium price less two cents additional packaging and handling charges) for the shrimp frozen on board vessel. Additional economies resulted from the avoidance of downgrading often applied to fresh shrimp, lower freight costs, and the elimination of time normally lost in running to the transport vessel for transfer of the shrimp at sea. A further advantage was the lengthening of the trips. Trips of the vessel prior to the installation ordinarily were of 45 to 50 days' duration. The first two trips after conversion were 88 and 89 days respectively. In addition, the vessel was able to freeze the catch of its sister ship and thereby increase the length of the trips of that vessel from about 45 to 79 days.

In the immersion process the shrimp are headed, washed, and individually frozen in a sugar-salt solution in a deck tank, then packaged in 25-or 50-pound cartons, and stored in a holding room below deck. This system has the same inherent savings as the blast and plate freeze systems: the problem of quality deterioration of iced shrimp is eliminated, product can be sold at a premium price, and longer more efficient trips can be made. In 1955 the equipment for an immersion freezer installation sold for $9,500 f.o.b. Savannah, Georgia; the installed price was in the neighborhood of $14,000. The system, because of its compactness and fewer problems encountered in maintenance, was judged as probably the best yet developed for small vessels. (see figure II - 22)

Navigational and Fishing Aids

Electronic instruments aboard fishing vessels usually serve both as navigational and as fishing aids. They guide the fisherman

FIGURE II - 22.--The first floating shrimp packing and freezing vessel, the "Betty Jean".

Fishing Gazette.

to the fishing grounds and, once there, provide him with information about the bottom he fishes.

The principal items of electronic equipment found on shrimp vessels are automatic pilots, depth recorders, and radio telephones. The only navigational instrument, however, common to all craft with the exception of motor boats, is the conpass. A few vessels are equipped with radio direction finders, loran devices, and "Fischlupes".

Automatic Pilot

Automatic pilots were introduced in the shrimp fleet to relieve the crew from the chore of steering which, on long runs, presents a considerable fatigue problem. Since a course steered electronically is more accurate than one steered by hand, both running time and fuel consumption are reduced by the use of automatic pilots. Unless equipped with remote control, however, the instrument's use is confined to maintaining a heading.

Some caution must be exercised in the use of automatic pilots. Errors in course may result from the circumstance that the pilot initially was set on the basis of an inaccurate compass.[11] Exclusive reliance on the automatic pilot by crews who left the wheel unattended have been responsible for serious accidents at sea. Two serious shortcomings of the instrument are its inaccuracy in rough seas and considerable wear on the steering gear caused by bad weather.

Depth Recorders

Depth recording equipment is utilized for both navigating and fishing. When used for navigating, depth of water and bottom contours are determined to obtain vessel position. When used for fishing, good bottom (smooth and muddy) is distinguished from bad bottom (rock or coral) by the appearance of the graph made on the recording paper. An instrument using a flashing light instead of a pen indicator is less desirable since no permanent record is kept and the continuous watching for the flashes imposes a strain upon the fisherman.

When properly used, depth recorders are possibly the most valuable instruments on board. A principal shortcoming of some of the depth recording equipment installed on shrimp vessels is the inadequate protection from salt spray and moisture afforded to the working parts. This deficiency increases the maintenance required. The maintenance problem may be complicated further by the ignorance of vessel personnel in the care and use of the device. Moreover, it is reported that some

11/ A five degree compass error in the heading from Tampa to Campeche would result in an error of about 60 miles if no corrective action is taken.

captains only use the recorder intermittently to conserve recording paper. This defeats one of the main functions of the instrument, i.e., detecting rough bottoms where gear might be lost.

Radio Telephone

A radio telephone is intended to function as a navigational instrument. When used in conjunction with a searchlight or other visual aids, it enables a vessel to be "talked in" to a group of vessels already on the fishing ground. In the Harwell, Knowles and Associates sample of vessels, transmitters used in connection with radio telephones ranged from an output of 5 watts to the maximum permissible of 150 watts, with some sets even exceeding this limit. Vessels fishing close to shore had either no radio telephone or an installation of low wattage. At the other extreme were vessels fishing in the Gulf of Campeche which had equipment capable of producing the maximum permissible power output.

Three types of aerials were in use. In the South Atlantic and Tortugas Areas the wire-coiled bamboo pole type was predominant. On newer vessels in the same area a metal antenna was common. In Texas, especially in the Brownsville fleet, so-called "flat top" type aerials were being used. The latter were copper wires strung from the boom via the mast to the bow of the vessel.

The service life of the bamboo type of aerial was estimated to be about one year. By then moisture absorbed by the bamboo would reduce the signal strength transmitted. The metal type aerial was considered to be more efficient than the bamboo type and was supposed to last approximately three years. The "flat top" aerial was found to be the most durable, efficient, and economical of the three types in use and was gaining steadily in popularity throughout the fleet.

Failure to adhere to the proper standards for use and upkeep of the radio equipment on the part of captain and crew diminished the benefit derived from the installation in some instances. Sets aboard some shrimp vessels were found to be inoperative because the 32-volt bank of batteries was charged by generators with the voltage regulator set to cut out at about 36 volts. The constant overload on the electronic equipment shortened the life of the tubes, resistors, condensors, etc., in the sets.

Use of improper crystals in the tuning circuits was found to be a major cause of signal output reduction in some instances. Some technicians fail to recognize the need for precise compliance with the requirements for crystals in each make and type of set.

Attempts to repair sets by technicians unfamiliar with a particular set, or worse even, by captain and crew members themselves, were responsible for the poor condition of some sets. Inadequate copper wiring, insulation, and copper grounding coupled with the other cited defects were responsible for the operation of some sets at about fifty percent of their theoretical output.

Radio Direction Finding Equipment

Radio direction finding equipment is considered to be of little value in the shrimp fleet at the present time. In the past, many of the larger vessels crossing the Gulf on the Campeche run had this equipment installed. It was found, however, that radio bearings were of limited accuracy at a distance, especially if the loop was an inside installation. Many captains would not turn the vessel to a position where the bearing could be taken without interference from the rigging. Few captains have been trained to make proper bearings and fewer still have been trained in the more advanced principles of navigation; information obtained from the direction finding equipment, therefore, is seldom used.

Depth Sounder with Cathode Ray Tube

A depth sounder with a cathode ray tube designed to function as a fish or shrimp finder is sometimes installed in the larger vessels. Supersonic signals transmitted downward are reflected back from the bottom schools of fish, and a clear visual indication is obtained on the cathode ray tube. Normal maximum range is 320 fathoms.

The practical value of this type of sounder from the standpoint of the shrimp fisherman has not as yet been clearly established. Research workers associated with the northeastern trawl fishery report that it takes captains from three to four months to get the feel of the instrument. So far shrimp vessels have not given the sounder this type of trial.

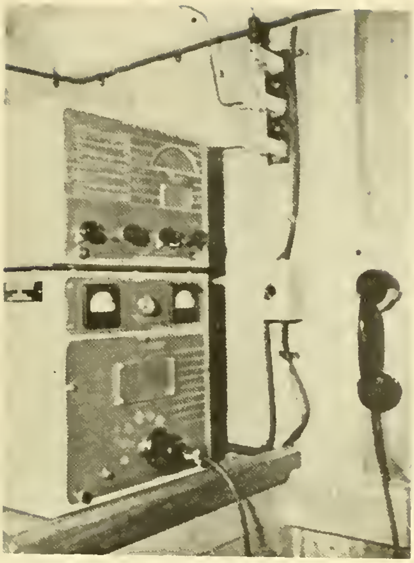
There is a possibility that the sounder might come into use once deep water fishing for Royal Red shrimp becomes more common. In deep water operations the instrument would view the bottom far enough in advance of the trawl to permit the skirting of major obstructions.

Loran

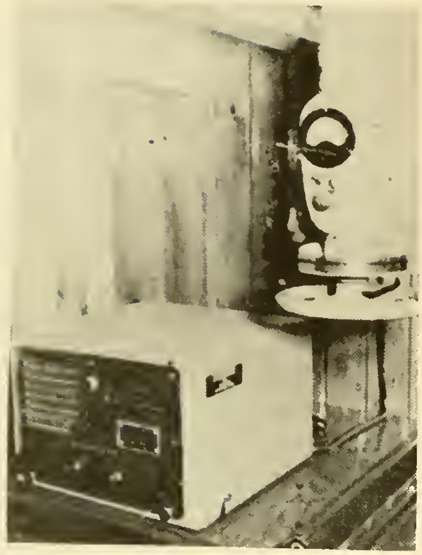
Loran is an electronic device which gives an accurate long range fix (750 miles by day, 1,500 miles by night, under ideal conditions).

The equipment operates satisfactorily, although in the Texas Area its use is limited by low signal strength from the master and slave stations in the eastern Gulf.

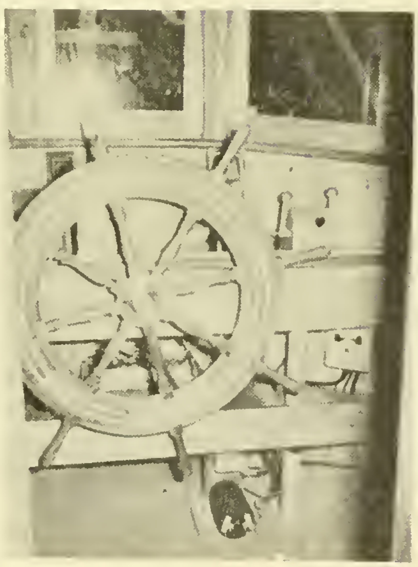
As with all electronic equipment, it is important that the firms installing loran provide the fisherman with adequate instruction in the use and maintenance of the device. The effective utilization of the device depends on the availability of competent repair service and trained crews.



Radio telephone

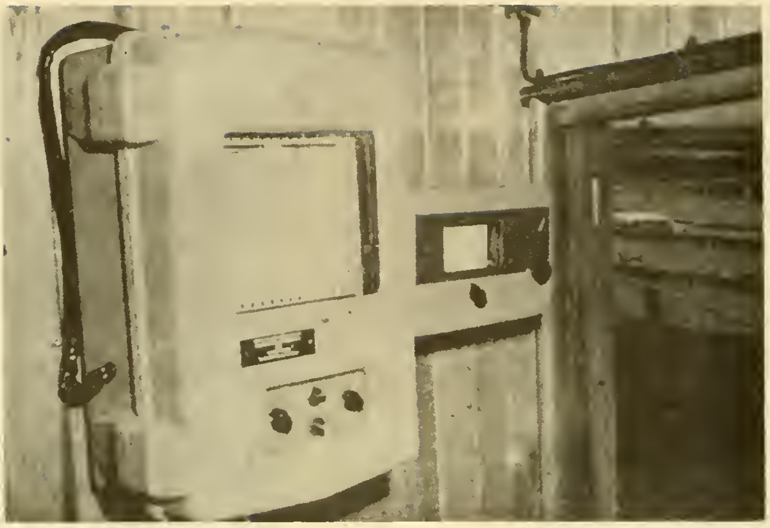


Direction finder

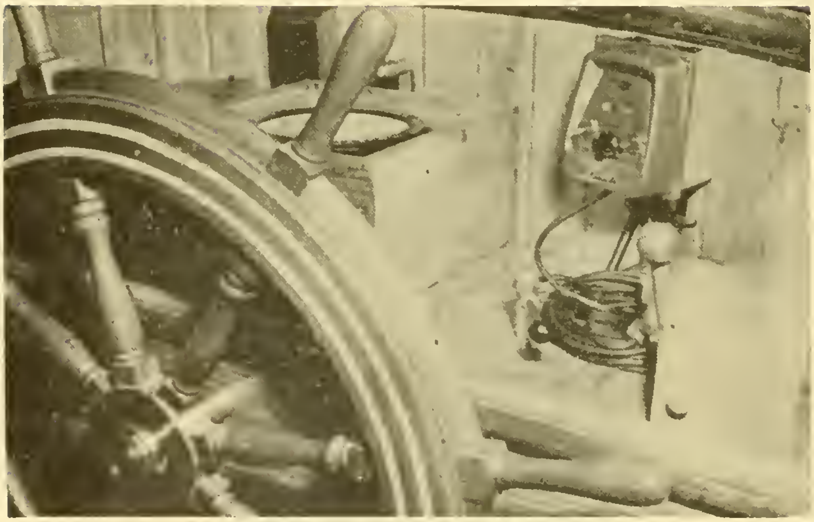


Automatic pilot
beneath the wheel

FIGURE II - 23.--Aboard the "Miss Powerama".
Southern Fisherman.



Depth recorder



Remote control unit for the automatic pilot, visible to the right of the compass and just above throttle and clutch control

FIGURE II - 24.--Aboard the"Miss Powerama". Southern Fisherman.

If the two latter conditions are satisfied, loran may offer the most promise of all the navigational aids available to the fishing industry. The equipment could substantially raise vessel efficiency by reducing travel time to and from the fishing grounds.

Radar

Vessels currently engaged in the shrimp fishery do not have radar installations. It is generally felt that radar is not justified because of its cost and limited value to the vessel.

Other Navigational Aids

Speed indicators and logs are generally dispensed with on board shrimp trawlers. Instruments or publications for celestial navigation as well as adequate means for taking reliable visual bearings are also frequently missing.

Extent of Use of Electronic Devices in the Shrimp Fleet

The extent of use of electronic devices as navigational and fishing aids in the shrimp fleet is closely related to length of vessel and length of trips. Vessels under 40 feet in length included in the Harwell, Knowles and Associates survey had no electronic devices whatsoever. Slightly less than half of the vessels in the 40-60-foot size class had automatic pilots, 39 percent had depth recorders, and 83 percent had radio telephones. All of the larger vessels, those over 60 feet in length, were equipped with automatic pilots, depth recorders and radio telephones. Around 13 percent of these vessels were also equipped with radio direction finding equipment. Shortly before the survey was made three of the larger vessels had installed loran and one a depth sounder.

Typical Prices of Electronic Devices

Prevailing costs of electronic equipment in shrimp vessels were surveyed in 1955. Automatic pilots could be installed for approximately $400. Depth recorder costs averaged about $1,000, although a small set which was little used by the fleet could be bought for half this price. Radio telephones were higher than $700 depending on the type and wattage of the installation desired. While the equipment could be rented and fully serviced for about $50 a month, most boat owners had bought the equipment outright. Aerials varied from $45 to $90 in price depending on the type used. A depth sounder with cathode tube cost $2,500 installed or could be rented for about $70 a month. War surplus loran, originally designed for aircraft, had been installed at a cost of $750 shortly before the survey was made by a small number of vessels operating out of Tampa, Brownsville, and Port Isabel. However, the research firm emphasized that no moderately priced loran was available on the market at that time.

Docking and Repair Facilities

Access to adequate docking and repair facilities is of cardinal importance to the success of fishing operations. Where boat owners operate independently they usually unload at the docking facilities of the raw shrimp plant which is buying their catch. Fleet affiliated boats are usually operated by processors who have docking facilities of their own. In these instances, all operations may be performed at the waterfront. Where dock space is at a premium processing facilities are usually located some distance from the place of landing. By the nature of their operations freezers and breaders require a considerable amount of space. These operations consequently are seldom integrated with raw shrimp plant operations.

Concentration of shrimping activities in the area has made the city of Brownsville, Texas, lay claim to the title of "Shrimp Capitol of the World." Remarkable strides have been made here in establishing a port which is particularly adaptable to shrimping operations. The harbor is designed especially for shrimp boats and is built in such a way as to make docking and accessibility to the fish house nearly ideal. The shrimp basin is operated by the Brownsville Port Authority which is supported by the users of the basin. Charges of $1.00 per day per boat are made for docking. This charge is paid by the boat owner. Fish houses pay $1.00 per foot each month for water front space. A fee of one percent of selling price is applied to shrimp unloaded over the dock, and a charge is also made for fuel and ice. In spite of these added expenses, users appear to be well satisfied with the basin. Their only complaint is that the basin is perhaps located too far from the open Gulf. Boats must travel 15 miles from the basin to reach open water.

Repairs of minor character are usually handled by the more experienced crews themselves, either while at sea or during stopovers at the dock. The rapid expansion of shrimp production in recent years, however, has led to the employment of many inexperienced crews which has had its effect on boat and equipment maintenance. The trend towards longer trips and more expensive complicated mechanical installations has magnified the maintenance and repair problem. The surveys conducted by the Bureau of Business and Economic Research of the University of Miami, by Harwell, Knowles and Associates, and by First Research Corporation of Florida, stressed the serious consequences of the incompetence of crews. Inefficient help places additional emphasis on the availability of adequate repair facilities in port. Not all ports have been able to measure up to the demands placed upon them by the increased activities based on their docks.

FISHERMEN

Boat Ownership

Ownership control of the shrimp fleet is vested in different interest groups. Boats may either be individually owned and operated, individually owned but operated as part of a processor's or wholesaler's fleet, or they may be owned and operated by a processor. Under these basic forms of control a large number of different arrangements are found. In the State of Florida there are, in addition to the independent fishermen who owns his boat and hires his crew: the fish-house which owns a fleet of vessels, individual owners who own one or several boats, wholesalers who own boats, processors who control vessels owned by the fishermen, and processors who own the vessels in their fleet. Finally, there are absentee owners who have their boats managed by a fish packing house, captain, wholesaler, or firm specializing in boat management.

There is little basic difference between the operating procedures of the individually owned and operated boat and of the boat which is individually owned but operated as part of a fleet. In general, the owner of a fleet-affiliated vessel has authority over his own vessel to almost the same degree as he would were he not affiliated.

The fleet operator may at times ask him to go to waters he does not particularly care for, or is not accustomed to fish, or may ask him to increase the length of his trip, or to decrease the amount of idle time at the docks. In most instances, such requests are in the interest of both the fleet and boat owner and create antagonism only when the boat owner is less ambitious than the fleet operator feels he ought to be. In Brownsville, Texas the majority of boats are fleet affiliated, and the prevailing sentiment is that a boat is independent because of the fleet's rather than the boat owner's choosing.

An affiliated boat is required to land its catch at the fish-house operated by the fleet controller. When circumstances warrant the landing of the shrimp at a port other than the home port the boat owner is freed from this obligation.

The larger processing establishments, canneries, fish houses, and freezer-breaders often own and operate their own vessels as a fleet. In many instances, the processing establishments own some boats and have other boats affiliated with them.

In most instances the crew complement on a processor-owned vessel shares in the receipts from the catch of the vessel in much the same manner as on an owner-operated boat with the exception that the owner's share accrues to the processor rather than to the owner-operator. The incentive to produce can, therefore, be likened to that motivating the piece worker in industry. In several locations, canneries employ some crews on a year-round basis at a fixed annual salary, but the motive to maximize production is far less compelling. In such circumstances the canneries are principally concerned with offering full-time employment to experienced crew members who can fish for oysters in the off-season. The desire on the part of the canners to stabilize production throughout the year may be sufficiently great to outweigh considerations of efficiency.

Other things being equal, highest productivity over a period of time is obtained through owner-operation of vessels. The owner-operator has to produce to survive. The greater effort expended in fishing by the owner-operator is demonstrated in comparisons made by Harwell, Knowles and Associates between the productivity of vessels captained by their owners and vessels skippered by hired captains.

It was found that owner-operated vessels generally fished more days per year and had bigger catches per day than other vessels fishing the same waters but skippered by hired captains.

Two owner-operated vessels fishing out of Thunderbolt, Georgia fished on 180 and 152 days in 1954 and caught 37,474 and 33,127 pounds, respectively. Their catches per day were 208 and 218 pounds of shrimp, respectively. Corresponding statistics for 3 vessels operating with hired crews out of the same port were: 152, 108, and 136 fishing days, total catches of 23,110, 21,375, and 24,665 pounds, and average daily catches of 152, 198, and 181 pounds. Similar differences between owner- and crew-operated vessels existed for vessels fishing out of Key West, Florida and Brownsville, Texas.

The fact that neither captain nor crew have any financial interest in the vessel has serious consequences at times. Personnel changes constantly. The crew usually has no pride in the vessel and will try to escape any maintenance work. It lacks loyalty to either vessel or owner. Little interest is shown in seamanship or vessel operation. The owner, or operator, has little regard for the crew. He is indifferent about the maintenance of safe working conditions. He is little interested in the safe operation of the vessel itself. His sole interest is in operating on the lowest cost level possible. In such circumstances, the shrimp fishery has little appeal for personnel with high standards.

On the basis of observations made in the course of their survey of work practices on a sample of shrimp fishing vessels First Research Corporation commented on relations between vessel owners and operators.

Conflicts between employer and employees are common in any industry, and the shrimp fishery is no exception. At present, vessels in some instances are owned and operated by people who are not familar with boats or the sea, and are, to a large measure, ignorant of the mechanics of the fishing procedure itself. Few of these people have ever made a trip on a fishing vessel and, as a rule, regard the vessel and its crew only as a profit-making combination. The vessel is regarded as a short-term investment in contrast to conditions found in other fisheries. In order to minimize expenses, maintenance is neglected, repairs--some necessary to the safety of the vessel--are delayed and the purchase of new gear to replace that worn out in service is deferred. On the other hand, taking advantage of the owner's lack of knowledge concerning the at-sea operation of the vessel, there are many instances where his property is being willfully destroyed, his gear sold without his knowledge, and the actual catch itself disposed of behind his back. The owner is in constant danger of having a dishonest captain and crew get the better of him. This is particularly true of the Campeche operation, where vessels are away from their home ports for extended periods of time and may return to other ports for unloading.

These conditions are largely responsible for the recent tendency of processors and other outside interests to divest themselves of ownership control of fishing operations. At the same time, pressing economic considerations have encouraged independent owner-operators to seek affiliation with fleets, a development which has contributed to the transformation of fishing to a large scale operation. The fleet operators in these instances are content to have the fishermen own their vessels, finding the economic forces conducive to fishermen's loyalty just as effective as a control device as outright ownership by the fleet operator.

Some boats are absentee-owned and operated by individuals or companies specializing in this type of work. One company at Key West, Florida operates 20 vessels owned by the company and over 30 vessels owned by others. The operating company is given almost complete control over the vessels and hires the captains. It is also responsible for the maintenance of the vessel. All costs of operation are taken out of the profits, if any, and the balance is divided between owner and operator. If operations of an individual boat have resulted in a net loss, the owner reimburses the operator for expenses incurred.

Boat management for absentee owners, in some instances, is a function performed by shrimp plant operators on a fee basis. The fee usually charged for such services is one to two cents per pound of shrimp landed.

Ordinarily only the captain is hired directly by the operator. The captain, in turn, hires the crew. The division of the proceeds of a trip is between the owner and the captain who then settles with the crew. In the majority of cases the proceeds are split on a 50-50 basis between the owner and the captain. In some instances the vessel gets a fixed price per pound for the catch.

The captain divides the employee's share with the crew on a percentage basis which either depends on arrangements customary in the region or in proportion to the individual crew member's experience and efficiency. Usually, the captain keeps 50 percent of the employees' share for himself. In general, the operator is responsible for vessel maintenance and overhead and supplies either fuel or ice or both. Stores and groceries usually are supplied by the captain and the crew and these expenses are deducted from the employees' share of the proceeds before division. Nets, rigging, and gear are usually provided by the owner or operator of the vessel. Generally whenever crews work on repairs and maintenance of the vessel during stays in port they are paid extra compensation. More commonly such repairs are performed by shore workers.

Under some arrangements crews may obtain a part interest in the fixed boat investment by helping to pay for the rig. Arrangements of this sort are usually encountered in cannery ownership. The acquisition of an ownership interest provides the crew an incentive for proper care of fixed equipment.

As far as the boat owner's relations with the fish house are concerned, two types of operations have been observed: under one type of arrangement the boat owner stays completely independent. This has an advantage for the boat owner in that he can shift from one fishing ground to another and put into the closest harbor or whichever port appears most advantageous for his operations. Advance radio notice is given of the boat arrival so that the fish house may have workers ready to pack the catch.

In another type of agreement the boat operator usually packs with one fish house. The operator gives him dock space to unload his catch, takes care of his packing, and often disposes of his catch, either buying it outright or acting as his agent.

Boat Owners' Organizations

In the shrimp industry individual boat owners may be affiliated with trade associations, producers' cooperatives, or labor unions. In some instances, the character of a specific organization makes classification impossible. Activities of certain fishermen's unions, which include boat operators among their membership at times are in the nature of cooperatives marketing fishery products and have been considered as such by Federal courts. 12/ In other instances, an organization may act as a labor union at one time, only to switch character and perform the functions commonly connected with trade association activities at some other time.

The types of organizations encountered in the fisheries to a large extent depend on the character of the industry in specific geographic markets. Wherever the interests of independent boat owners and crews coincide, i.e. where their primary concern is in maximizing receipts from their catch through negotiation with processors and dealers, they tend to band together to form unions which engage in price, and under the lay system ultimately, therefore, wage determination. In the absence of significant numbers of independent fishermen, the cleavage between employer and labor on the producing end becomes more pronounced and organizations devoid of vessel owner membership are encountered that can be more properly classified as labor unions. Wherever boat owners in a given market are led to believe that profits could be favorably

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12/ 34 F supp. 970, 974; 315 U. S. 143.

affected by their entering the marketing field, there exists a strong incentive for the formation of producers' cooperative marketing associations. Trade associations may be industrywide and have combined producer and dealer membership. Where interests of producers and dealers clash they may be composed exclusively of either fishermen or distributors.

Functionally, the distinction between the three types of organization can perhaps be drawn on the following basis:

(1) Trade associations are organizations concerned with activities other than marketing. Legislative, research, statistical and public relations work affecting the entire industry or a segment thereof, is within the normal sphere of operations.

(2) Labor unions in the fisheries, wherever the lay system of compensation is employed, are chiefly concerned with price negotiations and the specific terms of the lay. In the rarer instances, wherever the practice of compensating fishermen on a piecework (cents per pound caught) or time basis is encountered, the activities of the union are concentrated on wage negotiations. 13/

(3) The functions performed by marketing cooperatives vary a great deal from locality to locality. Originally marketing cooperatives were organized to eliminate certain handling costs charged by middlemen. Subsequently more specialized functions as quality control and coordinated selling have been undertaken. Some cooperatives more recently have branched out into processing and have succeeded in achieving integration of operations from fishing up to, but not including, retail distribution. As a result, there are today cooperatives in the fisheries which confine themselves to acting in the capacity of producers' agents in the marketing process as well as others which assume title and possess up-to-date processing and primary wholesaling facilities.

A listing of the principal organizations whose membership includes shrimp industry representation will be found on page 124.

The Twin City Fishermen's Cooperative Association

Cooperative marketing is an important factor in the distribution of frozen shrimp in the Morgan City, Louisiana area.

The Twin City Fishermen's Cooperative Association, Inc., was chartered under the provisions of the Louisiana Seafood Marketing Act and began activities in 1946. It is a non-stock corporation with paid-in capital obtained from the payment of membership fees.

13/ See the comments about the employment of fishermen beginning on page 112.

The association, a cooperative of shrimp boat-owning fishermen, handles the produce of its members through plants located in Morgan City, Louisiana and Port Isabel, Texas. Shrimp handled in Morgan City are frozen in commercial freezers but those handled through the Port Isabel facility are frozen and stored in the association's own plant, which also freezes and stores shrimp for non-members. The association also carries a stock of nets and boat supplies for sale to members in both Morgan City and Port Isabel. From the Morgan City headquarters, where the co-op owns large installations at the dock, the shrimp are distributed in wholesale quantities throughout the country under the association's own brand names. The shrimp are landed at the dock of the co-op in the Atchafalaya River and transported by conveyor belt to the plant. After grading and packing, the shrimp are transported to the public freezer plant, a distance of about one and one-half blocks, in trucks owned by the co-op. Here they are frozen and stored for market. Shipment to the northern markets is made by "exempt" motor carriers.

Shrimp sales are made by the association and in the association's name. However, the association allocates directly to the member any revenue from the sale. Cash settlement after deduction of a handling fee is made after receipt of the money from the buyer. Members are tied to the association by an exclusive selling agreement, and are requested to make a $100 advance for each boat load of shrimp handled over a specified minimum poundage. Net earnings (the excess of fees collected over costs) are distributable to the members on the basis of shrimp produced by them. So far the distribution has been made in the form of non-interest-bearing patronage notes due ten years from the date of issuance. Because of the fact that members are charged fixed fees for the processing and selling of their catch, the financial position of the co-op itself is not dependent on market fluctuations. During the year 1954 when shrimp prices were low, the association was in excellent financial condition. It had adequate working capital supplied by the advances for the handling of shrimp collected from its members and a high cash balance.

In general, the members of the association seem to be satisfied with the arrangements, and there has been little turnover of membership in the past years. Since members have considerable funds tied up in the patronage notes (on the average over $1,000), they are not very anxious to leave the cooperative. Some boat owners are reluctant to join the cooperative because of the time lapse involved between the sale and the receipt of the proceeds. The financially stronger boat owners are better suited for membership than those who operate on a hand-to-mouth basis.

The cooperative employs 9 permanent workers in Morgan City. The operation of the Marine Hardware Supply Division is conducted separately. Members are charged cost plus 8 percent for their purchases.

The distribution of the co-op's pack, put up in the institutional 5-pound form, is under 2 brand names.

Operations of the Port Isabel Branch of the association can be described as follows: The Branch has about 50 members and an equal number of boats and is an important factor in the Brownsville-Port Isabel area.

All sales are made by the Louisiana office. Members of the co-op must unload with the co-op unless their shrimp are landed at a port outside of the Brownsville-Port Isabel area. Shrimp are unloaded at the co-op's docks and stored in the boat owner's name. The boat owner is paid the Brownsville union price less processing and freezing costs. The co-op maintains its own freezing facilities and has a storage capacity of up to half a million pounds. It also does its own consumer packaging. Profits at the end of the year are redistributed in the form of patronage dividends. The co-op offers obvious advantages in the marketing process, in that it has facilities for holding shrimp and, because of large volume, is in a position to save its members the brokerage fees that are normally charged the independent boatman.

Other membership advantages are the availability of facilities for machinery maintenance and net repair. For these services the co-op charges cost plus 8 percent.

An examination of the accounting statements of the Twin City Fishermen's Cooperative Association indicates that the members of the cooperative realized on the average 53.9 cents (including patronage dividend) per pound of packaged frozen shrimp sold for them by the cooperative in 1954. Fishermen not associated with this cooperative who fished from the same ports, averaged 51.3 cents per pound for such products in the same year, according to the accounting records for a small sample of these operations examined by the Federal Trade Commission. The cooperative claims that the higher average prices realized by its membership can be explained by the larger size of the shrimp taken by its membership fleet than those taken by non-members. The cooperative claims its members throw undersized shrimp back into the sea.

A somewhat smaller co-op, the Gulf King Shrimp Exchange, is located in Aransas Pass. It came into being as the result of a merger of the Texas Fishermen's Co-op and the Texas Gulf Trawlers' Association. Historically, the need for a cooperative in Aransas Pass arose out of the dual function of the fish houses which at one time were both title-taking dealers and agents for the boat owner. The spread between the price paid to the fisherman and that received by the fish house ranged between 10 and 20 cents per pound. The cooperative forced the fish house out of its agency position.

Essentially, the cooperative acts in a manner identical with that of the other Aransas Pass fish houses, having no freezing or storage facilities and no highly developed sales organization. Profits are derived only from processing activities and these, rather than being redistributed in the form of dividends, are passed on in lowered processing fees to the fishermen.

Fishermen

Sailing and fishing skill of captain and crew frequently spell the difference between success and failure in shrimping operations. The opinion of people familiar with the south Atlantic and Gulf shrimp fisheries is that the rapid expansion of operations in recent years, with the concommitant necessity for hiring many inexperienced crews, was only accomplished at the cost of lowering the general level of skill of the fishermen employed. 14/ As a result, fishing standards in the southern shrimp fishery today are not as high as in other branches of fish or shellfish production. This generalization has to be modified to the extent that quality of crew differs widely from boat to boat and that some able skippers have been attracted from other fisheries by the earning opportunities in shrimping.

When shrimping was a comparatively small and localized industry, labor was drawn from the immediate vicinity of the home port. Fishing was often a family occupation where a son followed in his father's footsteps as soon as he was physically able to stand the rigors of the fisherman's life. Fishing skill and a love for the trade were virtually inherited along with the fisherman's attachment to his local environment.

The expansion of the industry and the shift in its geographic center has wrought considerable changes in this pattern.

A portion of the industry adjusted itself to the new circumstances by moving to permanent residences in the proximity of the new grounds when it became apparent that the fishing grounds in the Gulf would supplant those in the south Atlantic as primary source of supply. Some of the fishermen, shrimp plant operators, and processors now residing in ports on the Gulf coast of Florida and in Texas, originally followed their trades in the Carolinas, Georgia, or northern Florida.

Other fishermen still reside in Georgia and northern Florida, even when they fish for most of the year in the Gulf. This makes it necessary for them to return to their homes between fishing trips and reduces the utilization of the boat. The extension of the trips to Campeche has added to the hardships. While trips formerly were of 25 days' duration, they have become considerably longer. Since crews are no longer allowed on land in Mexico they are at sea for longer periods, working under primitive conditions and are entirely dependent on their vessel's supplies.

The geographic shift in a portion of the labor supply did not solve the general labor shortage problem created by the mushrooming

14/ Both First Research Corporation and the Bureau of Business and Economic Research of the University of Miami commented similarly.

of operations since 1950. In the absence of a skilled labor reserve many inexperienced crews had to be hired. Men who had little fishing experience and who were lacking in a thorough knowledge of vessel handling and seamanship frequently were employed as captains. The shrimp boat skipper now fishing in the Gulf sometimes lacks originality and seldom operates alone or attempts to hunt for new fishing locations. Experienced crews are difficult to find. The majority of the crew members encountered during one survey had only been to sea once or twice.

White labor is predominant in the industry, although its labor force is made up of many diverse races and nationalities. In areas which historically have been developed by specific national strains, the shrimp crews are, in the majority, made up from members of these groups. Thus, among the fishermen operating out of Louisiana ports, there are many men of French descent. In other instances, persons of Spanish, Portuguese or Yugoslavian origin predominate.

In the great majority of cases, boats are captained by Caucasians. In Florida ports, however, the use of Negro labor is becoming more and more important, as is the use of Mexican fishermen in Texas ports. Some Florida boats are operated successfully under the command of Negro captains. For the most part, however, Negroes and Mexicans aboard shrimp vessels work as crew members rather than as captains. Negro labor is used in all states except in Texas. While there is no prohibition of Negro labor in Texas, the position that the Negro holds in other areas is largely filled by Mexican labor there.

All shrimp fishermen and all shrimp cannery workers are covered by Old Age and Survivor Insurance. It does not matter whether the fishermen are hired labor or self-employed. The current rate of the Federal Insurance contribution tax, the basis of the Old Age and Survivors Benefits, is 4-1/2 percent of the first $4,200 of income of the employee and is collected in equal amounts (2-1/4 percent each) from employer and employee, the employee's contribution being deducted for him by the employer. Self-employed[15] pay the Federal Insurance contribution tax when their income is over $400 per year. The rate of the tax collected from them is 3-3/8 percent on the first $4,200 of net income. The benefits for employed and self-employed alike range from $30 to about $108 a month. Additional benefits are provided for dependent wives and survivors. (A new schedule becomes effective January 1, 1959.)

Employers who employ 4 or more persons for 20 weeks must contribute to the state unemployment compensation fund. However, few

15/ Among the self-employed in the industry covered by the law are:
1. A fisherman operating his own boat by himself or with a crew of one or more;
2. A processor owning and operating a fish-canning factory;
3. An owner and operator of a wholesale fish business, a retail fish store, or a fishing gear supply house.
4. A manufacturer of fishing gear or netting.

shrimp enterprises are affected by the unemployment provisions of the Social Security Act since only shrimp fishermen on vessels of 10 net tons and over are covered by the Federal legislation. The payroll tax, which is levied for the unemployment compensation fund, is 3 percent, and is levied from the employer. Fishermen who are covered by unemployment compensation may receive benefits varying from $20 to $45 for 26 weeks depending upon the provisions of the individual state laws.

The absence of contractual agreements between the hiring party and the fishermen is evidence of the looseness of working arrangements. The labor force is almost completely mobile and free to move wherever opportunity beckons. This circumstance creates a problem for the non-operating boat owner. For him the need for finding and retaining skilled labor in his business becomes paramount. Boat owners, therefore, try to make it economically possible for fishermen, especially skilled captains, to stay in one area throughout the year. Some canneries in the northern Gulf area, as has already been pointed out, for this reason employ a few selected crews on a year-round basis on fixed annual salaries. In other areas, where receipts are divided on a share basis, some operating boat owners prefer to operate their boats at a loss during the off-season rather than to tie them to the dock and free the crews to go elsewhere. In order to do this the owners suspend the normal share agreement during the off-season and offer the fisherman a flat salary or the total receipts of the catch (which are nominal) for this period.

In the days when haul seine operations were predominant in the industry, vessel crews were made up of as many as 8 members. The introduction of the shrimp trawl greatly reduced the need for the number of men required per craft. On the smaller vessel the captain and a single crew member, known as the striker, constitute the entire complement. The larger vessels are usually manned by a captain and 2 crew members.

A custom which is comparatively new, and encountered chiefly in Texas, is that of taking on a header for the trip. This man's sole function is to head the shrimp as they are hauled aboard. He is paid on the basis of the number of shrimp headed and does not participate in the share arrangement. Texas dealers, in general, do not approve of this practice. They believe that the header is replacing a regular crew member and that he is not capable of performing all of the duties required of a crew member. The fishermen claim that he is an extra man and that his presence can in no way impair the efficiency of the vessel.

The captain ordinarily has full discretion in the hiring and firing of crew. At sea he is in complete command of vessel operations and crew and is free to fish when and as he likes. The responsibility for the success of the trip is entirely his.

Because vessel productivity has been tied so closely to fisherman's skill, and in many instances the competence of the crews leaves much to be desired, suggestions have been made for the institution of a comprehensive training program in the industry. On the basis of its survey of the industry, First Research Corporation has outlined an educational and service program established on a closely-knit organization representing the owners and operators, insurance underwriters, fishermen's cooperatives, fishermen's unions, processing and marketing organizations, and the United States Government. This organization, it is recommended, should adopt and finance a program including: (a) dissemination of educational information for owners and operators to acquaint them with efficient and safe operation and maintenance of vessels as practiced within the shrimp industry, as well as in other fisheries through the world; (b) establishment of a training program for present or prospective captains of shrimping vessels comprising instruction in piloting and navigation, communications, rudimentary engineering, seamanship, and the latest developments in gear and fishing methods within the fishery; (c) establishment of one or two training schools for crewmen, with instruction being provided in seamanship, ship handling, maintenance and operation of deck machinery, rudimentary engineering, elementary piloting, and general fishing methods; (d) development of a system of financing the constru-tion of new vessels with the captain, and perhaps the crew, participating in the ownership; (e) the establishment of a regular vessel safety inspection system requiring inspection of all vessels before leaving port. The inspection would include careful analysis of the readiness of the vessel for sea with regard to seaworthiness, condition of navigational and mechanical equipment, presence of needed devices and information, and a general appraisal of the personnel. The authority entrusted with the responsibility of performing the inspection should have sufficient power to deny the vessel the right to depart from port unless properly outfitted, maintained and manned. Despite the expense and time involved, it is believed that such an agency would be of great economic value in helping to prevent accidents caused by defective equipment and poor personnel.

Compensation of Crews

Throughout the industry the majority of fishermen are paid on the lay system under which they receive a share of the receipts from the catch rather than a specific wage payment. The actual share agreement may vary between areas. Along the Atlantic coast, the receipts from the catch are generally divided half and half between boat owner and crew. The crew's share is commonly divided in the proportion of 60 percent to the captain and 40 percent to the rest of the crew. Thus, if the captain owns the vessel and employs a striker, he is entitled to 80 percent of the gross receipts as against 20 percent for the striker. Larger boats which are manned by a captain and two crew members most often divide the half accruing to the crew on a 40-30-30 basis. Since this division is one that is primarily up to the discretion of the captain and crew, the receipts may be divided in almost any conceivable ratio. A 50-50 split may be used on two-man vessels, or a 50-25-25 split may be utilized if the captain is an extremely capable one and crew members feel that they will earn more by working for 25 percent with him than by working for 30 or 33-1/3 percent with someone else.

In Biloxi, Mississippi, where it is estimated that 85 percent of the boats are cannery owned, a different type of share arrangement prevails. Here the most frequently used method is a five-way split. One share goes to the cannery, one to the captain, one to each of the two crew members and one to the rig. The boat rig consists of nets, net doors, cable, electronic equipment--such as depth recorder, radio direction finder, ship-to-shore telephone--shovels, blocks and falls, etc. On the cannery-owned boats, the share allocated to the rig is charged against the cost of the rig until it is paid for. When this is accomplished, the split is then four ways, with the captain and the two men in the crew each receiving one share and the company one share. When gear is worn out, damaged or lost, the share to the rig is once more instituted until all the gear has again been paid for. If a crew member leaves a vessel on which he has helped to pay for the rig, he is entitled to his share of one-half of the replacement value of the rig. Thus, if a vessel has equipment that costs $1,200, a crew member leaving the boat is entitled to one-third of one-half of the value of the rig--in this case, to one-third of $600, or $200. Similarly, a crew member taking the place of one who has left the vessel would be required to "buy on" or pay $200 for a share of the rig. This payment would be deducted from his share of the catch.

The canning companies seem to feel that it is equitable for captain and crew to pay for the gear items, and point out that the company pays the original cost of the gear and stands to lose money if production is poor. A practical result of this rig agreement, a field survey showed, was that crews in this area were much more considerate of the materials they partly owned than they were elsewhere where they had no ownership interest in the gear. No crewmen or captain interviewed in the course of the survey expressed objections to the rig agreement or considered the share allotted to the rig excessive.

A similar share agreement exists in Alabama.

Another type of agreement encountered now and then provides for the compensation of crews on the basis of a fixed price per pound of shrimp caught. The price paid depends on the quality and size count of the shrimp landed. The fishermen in these circumstances divide the trip receipts among themselves according to an agreement.

Except in the case of small vessels which measure the length of trips in terms of hours, and where the necessity for carrying groceries aboard ship is eliminated, the crew is responsible for paying the food bill. On Campeche trips, where food supplies averaging around $250 for a one-month trip must be taken along, the crew will pay for the groceries but the boat owner will guarantee payment to the store. This means that in case the crew upon return from the fishing trip is unable to pay for the groceries the boat owner will pay the bill.

It is an almost universal practice throughout the producing industry that the crew pay for one-half of the cost of the ice and the boat owner pay for the other half.

Costs of fuel and maintenance of the vessel are commonly borne by the boat owner.

The gross receipts figure to which the share split is applied is generally determined by the price obtained at the initial title transfer after the shrimp are landed. If the shrimp plant takes title, the price paid for the shrimp is divided according to the previously discussed share agreements. If, however, the shrimp plant does not take title but merely unloads, washes, packs, and delivers the shrimp to the buyer, charges for such services are deducted first before the net proceeds are divided on the basis of the share agreement.

Figure II-25 shows the distribution of catch receipts among individual crew members; the form is the equivalent of the payroll of a business enterprise.

Statistics on Fishermen

The increase in the number of fishermen employed in the shrimp fishery has kept pace with the growth of the fleet. While the number of shrimp trawls in the South Atlantic and Gulf regions increased from 2,427 in 1930 to 7,533 in 1956, the number of fishermen using these trawls rose from 4,849 to about 16,100 (see figure II-26). Average number of fishermen using shrimp trawls, remained relatively constant over the period. The average shrimp vessel crew was approximately midway between two and three over the period, the average motor boat crew slightly below two.

While fishing capacity of shrimp fishing craft has been expanding rather rapidly in recent years, the ratio of crew required per ton of fishing capacity has been decreasing. In 1956 average shrimp fishing capacity per fisherman was 5.5 net tons, whereas the comparable figure for 1930 was 1.4 net tons (see table II-4).

The distribution of the shrimp fishermen over the 8 states comprising the South Atlantic and Gulf region is shown in table II-5. According to this tabulation the States of Louisiana and Texas are the domicile of well over one-half of the number of shrimp fishermen in recent years. The 2 States employ approximately the same number of fishermen.

Labor Organizations

In the producing segment of the industry, organization of labor is either non-existent or local in nature. Local union organizations exist in Louisiana, Alabama, Mississippi, and Texas. Because

STATEMENT OF CREW'S SHARE OF SHRIMP CATCH

Date 10/5/4-

...ler A B C Captain Thomas - Period Nov. 27 to 10/5 1942

11.28				DATE		MEMORANDUM		
Bbls. Shrimp (under 15-C)—Headless @ $	$						$	
2 Bbls. Shrimp (15-20-C) Und 25 —Headless @ $ 22	$ 310	20					$	
Bbls. Shrimp (21-25-C)—Headless @ $	$						$	
Bbls. Shrimp (26-30-C)—Headless @ $	$						$	
Bbls. Shrimp (31-42-C)—Headless @ $	$						$	
TOTAL	$						$	
Heading 1410 lbs. @ 1¢ $	$ 14	10					$	
TOTAL SHRIMP CATCH $	$ 324	30					$	

LESS EXPENSE:
- Ice $ 42.00
- Net Repairs $
- Unloading $ 1.10
- TOTAL $ 43.10

GROSS AMT. $ 281.20

LESS OTHER CREW EXPENSES:
- Groceries $ 45.00
- Union Dues $ 2.20
- Other $
- TOTAL $ 47.20

NET AMOUNT EARNED $ 234.00

Gross Amount $

Less S. S. Tax $

Less Inc. Tax $

TOTAL $ $

TOTAL AMT OF CHECK $

Paid by Check No. Date

STATEMENT OF SOCIAL SECURITY AND INCOME TAX

NAME AND STATUS	Net Amt. Earned	% Shared	No. of Days	Social Sec.	Tax Per Day	Total Income Tax	Total Withheld	NET AMOUNT AFTER TAXES
Thomas -	93.60	40	38	94	No	No	94	92 66
John -	70 20	30	38	70	No	No	70	69 50
Henry -	70 20	30	38	70	No	No	70	69 50
TOTALS	234 00			234			234	231 .66

We, the undersigned members of the crew, certify that the above information is correct.

FIGURE II - 25

FIGURE II - 26.--NUMBER OF FISHERMEN SHRIMPING WITH TRAWLS IN THE SOUTH ATLANTIC AND GULF STATES, SPECIFIED YEARS

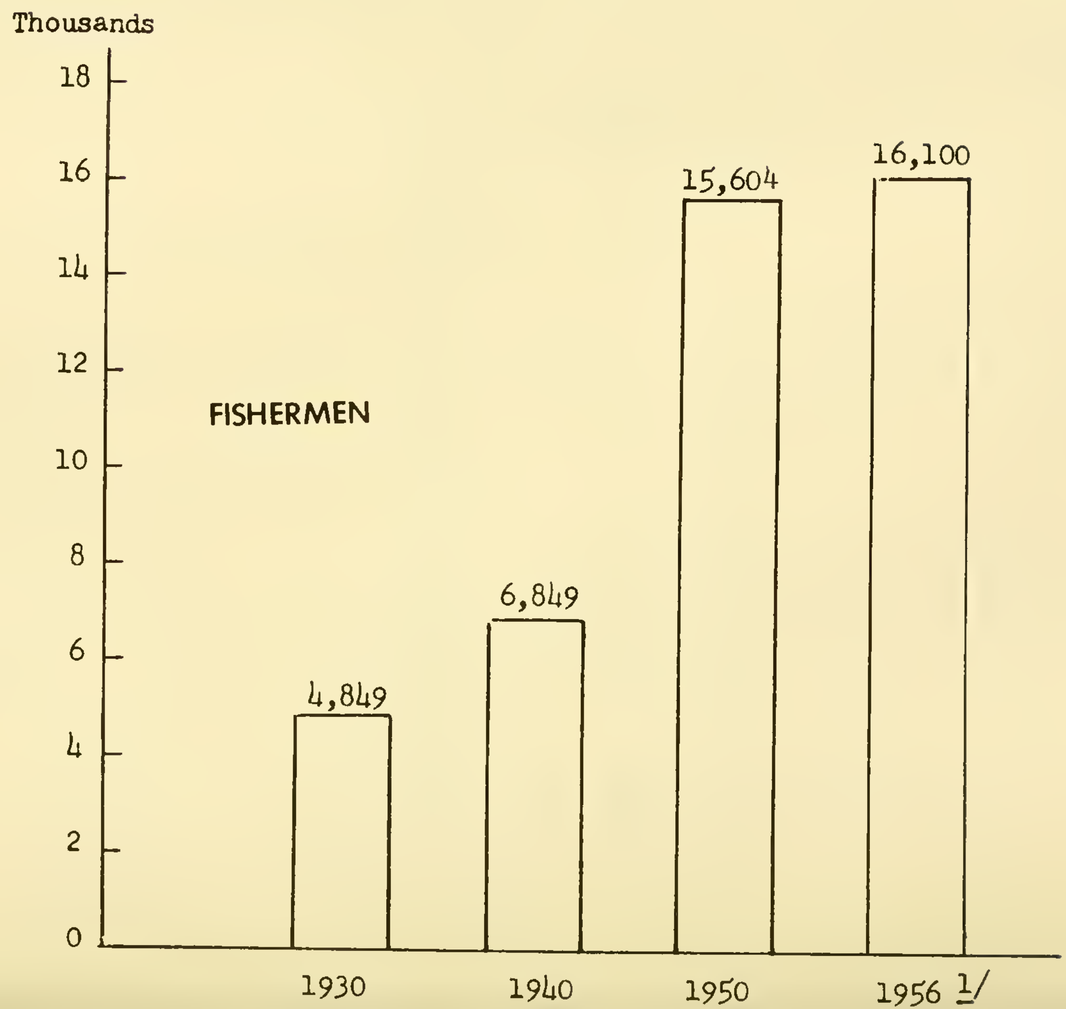

TABLE II - 4.--AVERAGE FISHING CAPACITY (NET TONNAGE) PER FISHERMAN IN THE SOUTH ATLANTIC AND GULF STATES SHRIMP FISHERY, SPECIFIED YEARS

Year	Fishing capacity	Number of fishermen	Net tons of fishing capacity per fisherman
	Net tons		
1930	6,714	4,849	1.4
1940	11,610	6,849	1.7
1950	51,003	15,604	3.3
1953	1/ 56,739	1/ 14,600	3.9
1954	1/ 70,795	1/ 15,500	4.6
1955	1/ 76,050	1/ 14,700	5.2
1956	1/ 88,370	1/ 16,100	5.5

1/ Data adjusted to eliminate duplication in reporting.

TABLE II - 5.--FISHERMEN ON SHRIMP VESSELS AND MOTOR BOATS, SOUTH ATLANTIC AND GULF STATES, SPECIFIED YEARS

State	1930	1940	1950	1953	1954	1955	1956
	Number	Number	Number	Number	Number	Number	Number
North Carolina	104	451	2,201	2,136	1,963	1,766	1,824
South Carolina	77	143	453	718	575	730	826
Georgia	349	478	613	502	506	587	713
Florida	764	539	1,468	2,403	2,813	2,796	2,955
Alabama	276	356	822	677	637	646	772
Mississippi	832	1,022	1,578	1,635	1,155	1,202	1,734
Louisiana	1,899	2,995	4,975	4,422	4,778	4,875	5,191
Texas	548	865	3,494	3,697	4,744	3,738	3,846
Total	4,849	6,849	15,604	14,600 (1)	15,500 (1)	14,700 (1)	16,100 (1)

1/ Data adjusted to eliminate duplication in reporting.

of the relatively short coastlines , union influence is felt in nearly all landing areas of the northern Gulf States. In Texas unions exist only in Galveston and Brownsville but the influence of the Brownsville union is felt in the Port Isabel area.

The primary function of the union, regardless of location, is participation in price, hence wage, determination. The fishermen closely watch the current market price of shrimp and the differential between that price and the ex-vessel price they receive. If they feel that the differential is growing too large and that they are not receiving their fair share of receipts, the union committee meets with the buyers in the area, whether they be canners, freezers, or assembling wholesalers, and negotiates an increase in ex-vessel prices. Conversely, when the market price is depressed, the buyers will seek a reduction in the ex-vessel price. There is no written contractual agreement between the union and the buyer nor is there an agreement between the individual fisherman and the union. The industry in general is characterized by an absence of written contracts.

Because of the peculiar composition of the membership and the nature of the lay system of compensation, labor organizations in the fisheries have at times been the targets of antitrust proceedings initiated by Federal and state authorities. In the summer of 1955, the officers of the Gulf Coast Shrimpers and Oystermen's Association, a union with headquarters in Biloxi, Mississippi were prosecuted under United States antitrust laws. The court, in this instance, found against the union and its officers.

The president, the secretary and the treasurer of the union were convicted of price fixing under the Sherman Anti-Trust Act on June 27, 1955, and sentenced to 90 days in jail each. The case was appealed in the Federal courts in New Orleans. Prior to the court decision, the Biloxi union had been quite strong. Field reports indicate the conviction virtually paralyzed all union activity in the area.

Officials of the union claim that shrimp prices in Biloxi have dropped considerably with the union non-functioning. They claim that there is a $25.00 a barrel differential in the price for comparable shrimp in Pascagoula and in Biloxi. The price in Pascagoula is based on a union-management negotiated contract, while the price in Biloxi now is determined by the canneries who control the majority of the boats. The actual prices quoted were $75.00 a barrel for 10-15 count shrimp in Pascagoula and $50.00 per barrel for the same grade of shrimp in Biloxi at the time the Bureau of Business and Economic Research of the University of Miami made its survey in the area.

One of the important considerations in the Biloxi case revolved around the question as to whether the fishermen were actually wage earners, or whether they were joint venturers. The determination of who owns and controls the vessels is of cardinal importance for decision making on this point. Vessel operations which are cannery owned, and which are manned by crews hired by the cannery and are directed by the cannery, can hardly be considered joint ventures. On the other hand, operators of individually owned vessels which merely sell their product to the cannery cannot be considered wage earners in the same economic sense. In Biloxi, Mississippi the union based its defense on the fact that some 85 percent of the boats here were cannery owned which tended to place the majority of the fishermen in the wage-earner class.

The court decision in the Biloxi case had its effect on union activities in adjoining areas. Since the verdict against the Biloxi union, the Alabama branch of the union reportedly has been rather inactive.

Unions can, and do, exercise an important role in price stabilization. In non-unionized ports, price fluctuations are frequent and often severe. When the union is operative, the ex-vessel price paid to the fishermen is changed only upon agreement between the fishermen and the buyers. Generally such agreements are negotiated only in cases where a substantial re-adjustment due to market changes is called for. For instance, in Brownsville, a re-adjustment is made only when the market price has fluctuated enough to warrant a five dollar increase per barrel (125 pounds heads-off, or 210 pounds whole). It is only under rare conditions that an adjustment of less than $5.00 per barrel takes place. Thus, the fisherman has a reasonable amount of assurance that the value of his catch will not be reduced by a sudden market depression. Nor, of course, will it be enhanced by a momentary upward market flurry. Should the ex-vessel price be changed while the boat is at sea, the boatman is still paid the price which was operative at the time he left the dock.

The unions are active to a small extent in fields other than price negotiations. They offer burial insurance policies and many fishermen cite this as the primary inducement encouraging union affiliation. The unions do not maintain health insurance programs. To the extent of their resources they aid fishermen in finding employment.

Both Texas unions, the one located in Brownsville and the one located in Galveston, claim to embrace 85 percent of the fishermen operating out of the ports in which they are domiciled. Fishermen landing shrimp in unionized ports are subject to union fees even though they are not members of the union. All fishermen receive the same price for their product regardless of whether or not they are affiliated.

LIST OF ORGANIZATIONS IN THE SHRIMP INDUSTRY

Producers Cooperatives

Florida

Tampa Shrimp Producers Association, Inc., Post Office Box 5706, Tampa 5
United Shrimp Producers Association, Inc., Post Office Box 1850, Fort Myers

Louisiana

Lafitte-Barataria Fishermen's Corporation, Lafitte
Trico Fishermen's Cooperative Association, Post Office Box 423, Golden Meadow
St. Mary Fishermen's Cooperative, Post Office Box 267, Patterson
Twin City Fishermen's Cooperative Association, Inc., Post Office Box 809, Morgan City--Branch at Post Office Drawer 518, Port Isabel, Texas

Texas

United Shrimp Marketing Association, Post Office Box 1047, Port Isabel

Fishermen's and Fish Shore Workers' Unions

Mississippi

Fishermen and Allied Workers Union, N.M.U., AFL-CIO, Post Office Box 315, Biloxi
Seafood Workers' Association of theGulf Coast SIU - AFL-CIO, Biloxi

Texas

Rio Grande Shrimp Fishermen's Association (Independent), Star Route Box 12, Brownsville
Texas Fishermen's Association, 306 Haden Building, Galveston

Trade Associations

National

National Fisheries Institute, Inc., 1614 Twentieth Street, N.W., Washington 9, D. C.
National Shrimp Breaders Association, Inc., 1860 Broadway, New York 2[illegible], New York; and 624 South Michigan Avenue, Chicago 5, Illinois

North Carolina

North Carolina Fisheries Association, Inc., c/o Fred. A. Whit[illegible]ker, Kinston

Trade Associations - Continued

South Carolina

South Carolina Seafood Producers Association, Beaufort

Florida

National Shrimp Congress, Inc., Key West
Southeastern Fisheries Association, Inc., Post Office Box 4481, Jacksonville

Louisiana

Jefferson Parish Fishermen's Association, 894 Avenue A, Westwego
National Shrimp Canners and Packers Association, c/o Tom Holcombe, Post Office Box 550, Houma

Texas

Brownsville Shrimp Producers Association, Inc., Post Office Box 130, Brownsville
Shrimp Association of the Americas, Post Office Box 1666, Brownsville
Texas Shrimp Association, Post Office Box 1666, Brownsville

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CHAPTER III

FISHING OPERATIONS

ABSTRACT

VESSELS OPERATING OUT OF PORTS ON THE SOUTH ATLANTIC COAST ARE RESTRICTED TO A SHORTER FISHING SEASON, MAKE SHORTER TRIPS, AND SPEND LESS TIME AT SEA THAN GULF COAST VESSELS. THEY ARE SMALLER IN SIZE AND LESS STURDY AND COSTLY THAN THE TAMPA-BASED VESSELS WHICH MAKE THE CAMPECHE RUN.

THE OPERATION OF DUAL-PURPOSE VESSELS MAY FREQUENTLY CONTRIBUTE TOWARD FASTER AMORTIZATION OF FIXED INVESTMENT. SINCE IT MAY BE THE ONLY MEANS OF INSURING YEAR-ROUND FISHING, IT MAY ALSO SERVE TO PROVIDE GREATER STABILITY OF EMPLOYMENT. THE DESIGN OF MANY CRAFT OPERATING IN THE SHRIMP FISHERY TODAY PLACES RESTRICTIONS ON THE USE OF THESE CRAFT IN OTHER FISHERIES.

TIME CONSUMED IN FISHING OPERATIONS AND IN THE HANDLING OF CATCH ABOARD VESSEL IS PRIMARILY A FUNCTION OF SKILL AND EFFORT OF CREW MEMBERS. TIME VALUES COLLECTED FOR A SAMPLE OF VESSEL OPERATIONS INDICATE THAT, ON THE AVERAGE, A TOTAL OF EIGHT MINUTES AND FORTY-TWO SECONDS WAS CONSUMED IN SETTING NETS, THE RANGE OF TIME VALUES SPANNING FROM THREE MINUTES AND FORTY-FIVE SECONDS TO TWENTY-TWO MINUTES AND SEVEN SECONDS. DRAGGING CONSUMED ANYWHERE FROM ONE HOUR TWENTY-FOUR MINUTES TO FIVE HOURS AND SEVENTEEN MINUTES, THE AVERAGE WAS SLIGHTLY OVER FOUR HOURS. OPERATIONS CONNECTED WITH THE HAULING OF NETS TOOK CREWS FROM FIVE TO OVER 32 MINUTES.

THE PRODUCTIVITY OF INDIVIDUAL VESSELS IS INFLUENCED BY NUMEROUS FACTORS, AMONG THEM GEOGRAPHIC, METEOROLOGICAL, SEASONAL AVAILABILITY OF SHRIMP, AND SKILL OF FISHERMEN. AVERAGE ANNUAL CATCH IN 1954 FOR A SAMPLE OF SHRIMP VESSELS STUDIED RANGED FROM 12,944 POUNDS FOR VESSELS OPERATING OUT OF MAYPORT, FLORIDA, TO 82,606 POUNDS FOR BROWNSVILLE, TEXAS OPERATIONS. AVERAGE CATCH PER DAY DURING THE YEAR WAS AS LOW AS 82 POUNDS, AND AS HIGH AS 372 POUNDS.

STATISTICS ON SHRIMP PRODUCTION FOR THE LAST QUARTER CENTURY REVEAL THAT THE STATES OF TEXAS AND LOUISIANA HAVE BEEN THE LEADING PRODUCERS. THE RATE OF EXPANSION OF THE SHRIMP FISHERY IN TEXAS HAS BEEN GREATER IN RECENT YEARS THAN IN LOUISIANA. OTHER TRENDS INDICATE THAT THE SHRIMP TRAWL VIRTUALLY HAS DISPLACED ALL OTHER TYPES OF GEAR IN THE SOUTHERN FISHERY. CATCH PER NET TON OF FISHING CAPACITY HAS DECREASED FROM APPROXIMATELY 6-1/2 TONS OF SHRIMP IN 1930 TO ABOUT 2 TONS IN RECENT YEARS. VALUE OF CATCH PER NET TON OF FISHING CAPACITY SHOWED A STEEP RISE OVER THE PERIOD. CATCH PER FISHERMAN AVERAGED ABOUT 17,000 POUNDS OF SHRIMP IN BOTH 1930 AND 1954. VALUE OF CATCH PER FISHERMAN ROSE FROM $612 IN 1930 TO $5,215 IN 1953, BUT DIPPED TO $4,367 IN 1956.

INTRODUCTORY COMMENTS

An analysis of fishing operations logically follows a study of the factors of production in the shrimp industry. A considerable amount of research was done on this subject by organizations under contract to the United States Fish and Wildlife Service, viz. Harwell, Knowles and Associates, First Research Corporation of Florida, the Bureau of Business and Economic Research of the University of Miami, and the Federal Trade Commission. The individual organizations were responsible for different portions of this work and no one contract covered the entire range of topics.

At the outset of this chapter, an analysis of vessel time was made to give some idea of the relationship between productive and unproductive time. Next, standard procedures for preparing for sea, operations at sea, and mooring and unloading of vessels are described. In conjunction with this phase of the work, time values for the detailed operations connected with fishing were obtained from a sample of vessels and motor boats. Following next is a study of vessel productivity with emphasis on the effects of various technological and biological factors on vessel catch.

This study leads into a discussion of costs of operations. Information for the latter purpose was obtained on the principal elements of expense incurred in the fishing segment of the industry. In addition, regional comparisons of costs for a sample of vessels and motor boats for the years 1952-1954 were made from the books of vessel operators on the basis of operating statements supplied by them.

USE OF VESSEL TIME

There are only three usual places where a fishing vessel can be encountered. The vessel is either out at sea, tied up at the dock, or temporarily out of commission at the repair yard. Time-at-sea can be divided into income-producing fishing time and non-income producing running time to and from fishing grounds and time anchored at sea. Time-at-dock may be spent in unloading, icing, refueling, and other functions connected with operations or may represent idleness traceable to inclement weather, or unfavorable market conditions. A vessel may be idle because repairs may have to be made on the hull, engine, gear or other equipment. The repairs may be necessitated by defects inherent in these items, human negligence or error, or circumstances beyond control.

In summary fashion, a classification of vessel time appears as follows:

<u>Breakdown of Vessel Time</u>

Time-at-sea	fishing-time)	
	anchored)	income - producing time
	running-time)	
Time-at-dock	unloading)	
(Other than required	refueling)	non-income - producing time
for repairs)	icing, etc.)	
	idle time)	
Time-under-repair	ways or engine repair)	

Other things being equal, operating efficiency is related directly to amount of time spent in income-producing fishing. Good fishermen endeavor to cut down as much as possible on idle time at the dock or in the repair yard and on unproductive time at sea.

Time devoted to actual fishing is to a certain extent dependent upon geographic factors. The location of the shrimp grounds in relation to home port will determine length of trip; it will also determine the size of boat required and the methods of preserving the catch. The relative abundance and availability of shrimp on different grounds may make a longer trip profitable and thus make up for a reduction in the time that can be spent fishing.

The ratios of vessel time spent in alternate uses are of interest for a number of reasons. The ratio of time at sea (high risk) to time at the dock (low risk) is of direct concern to insurance companies in the writing of marine insurance policies. The ratios of running time or fishing time, respectively, to length of trip has a bearing on vessel depreciation. A high ratio of running time to other time must be offset by good fishing conditions on distant grounds. To make possible an extension of fishing time and to assure a payload, larger and more costly vessels have to be employed.

The results of the study by Harwell, Knowles and Associates on the use of vessel time for a sample of 40 vessels operating out of various Gulf and south Atlantic ports in 1954 are summarized in table III - 6.

Vessels operating out of ports on the Atlantic coast, on the average, are smaller in size, are restricted to a shorter fishing season, make shorter trips, and spend less time at sea than Gulf coast vessels. Vessels domiciled in Rockville, South Carolina represented in the sample of vessels studied were 40 to 45 feet in length, could fish only from 105 to 120 days during the year (1954) and made trips averaging one day. They worked approximately 48 to 55 days in actual shrimping operations.

Tampa, Florida vessels shrimping the Campeche grounds were from 65 to 72 feet or more in length, fished 225 to 263 days of the year, made trips of 32 to 45 days' duration, spent the equivalent of 91 to 105 days fishing. Shrimping out of Thunderbolt, Georgia, and Mayport, Florida, resembled the Rockville operations in character. Shrimping operations out of Key West, Florida; Biloxi, Mississippi; and Brownsville, Texas bore some similarity to those in Tampa.

The Key West fishermen who favored the Tortugas grounds as well as the Biloxi and Brownsville fishermen who fished off the Mississippi and Texas coasts enjoyed a longer fishing season than the Atlantic coast fishermen. They spent on the average as much time as the Tampa fishermen in actual shrimping operations, viz. the equivalent of ninety days or a fourth of the year. Because of the relative proximity of the fishing grounds, they spent less time traveling when compared to the long Campeche trip. Only some of the newer vessels equipped to undertake the Campeche trip operating out of Brownsville, were comparable in size to the Tampa boats.

The ratios of time-at-dock to time-at-sea and of fishing-time to unproductive time-at-sea are highly significant from an economic standpoint. The greater the fixed investment in the vessel, the more expensive becomes all idle time. The less time spent at sea and the shorter the trip, the smaller are expenditures for ice and fuel and fewer crew comforts are required. The longer the trip and the greater the weather hazard, the higher the insurance rates.

The size of variable (or trip) expenses, as determined by length of trip, has its influence on the business risk involved in connection with the fishing operation. A period of declining shrimp prices or a reduction in the catch can be expected to lead to a change in the operations of a fleet accustomed to fish at a distance from home port. In 1954, the year of depressed prices, for example, the fleet operating out of Brownsville, Texas, which had been traveling to the Campeche grounds in preceding years confined its operations to the waters of the local coast.

One arresting fact about Gulf coast shrimping as shown by tables III-6 and 7 is the relatively large amount of non-productive time at sea. From at least one viewpoint, the comparisons of non-productive time at sea are not altogether valid. Anchorage time for Gulf coast vessels is sometimes used for mending nets or making other repairs which could have been done at the docks. On the Atlantic coast, repairs of this type are normally made at the dock since vessels go to sea for only part of the day.

OPERATIONAL PROCEDURES

Preparation for Sea

Only the most general observations can be made with respect to preparation of shrimp vessels for sea. The procedure for getting underway, according to a study of work practices on fishing craft undertaken by First Research Corporation of Florida, varies a great deal with the types of vessels concerned, their operations, and the condition of vessel and gear. Differences in the availability of fuel, ice, and stores would render meaningless any time factors obtained for these operations.

Many of the more successful shrimp vessel operators keep in mind that a vessel does not earn any money while tied up at the dock. Preparations for sea, therefore, must be completed as expeditiously as possible.

Based on observation of a sample of vessels, First Research Corporation outlines the prevailing types of procedure for getting underway in the principal centers of the domestic fishery:

(1) On the Atlantic coast, almost all fishing is done inshore. The vessels are stocked for trips of short duration, generally not exceeding 12 hours. They are fueled weekly with enough fuel for six or seven days operation. This is done either at the dock where the vessel is lying, or at a nearby fuel dock. Two vessels observed took on 600 and 300 gallons of fuel, respectively. The process took less than half an hour. Very little ice was carried, one 300 - pound block was used for the day's operation. A small amount of provisions sufficient only for breakfast and the mid-day meal were carried aboard by the crew.

TABLE III - 6.--USE OF VESSEL TIME,
SAMPLE OF 40 SHRIMP VESSELS OPERATING OUT OF SOUTH ATLANTIC
AND GULF PORTS, 1954

Vessel time	Rockville, South Carolina		Thunderbolt, Georgia		Mayport, Florida		Key West, Florida	
	Average number of days per vessel	Percent	Average number of days per vessel	Percent	Average number of days per vessel	Percent	Average number of days per vessel	Percent
	(4 vessels)		(5 vessels)		(3 vessels)		(5 vessels)	
Days at dock	303	83.0	256	70.1	293	80.3	147	40.3
Days at sea:								
Fishing	52½	14.4	73	20.0	59	16.1	91	24.9
Traveling	9½	2.6	9	2.5	13	3.6	19	5.2
Anchored	-	-	27	7.4	-	-	108	29.6
Total at sea	62	17.0	109	29.9	72	19.7	218	59.7
Total vessel time	365	100.0	365	100.0	365	100.0	365	100.0

Vessel time	Tampa, Florida		Biloxi, Mississippi		Brownsville, Texas	
	Average number of days per vessel	Percent	Average number of days per vessel	Percent	Average number of days per vessel	Percent
	(8 vessels)		(4 vessels)		(11 vessels)	
Days at dock	90½	24.8	122½	33.6	141	38.7
Days at sea:						
Fishing	93½	25.6	93½	25.6	92½	25.3
Traveling	50	13.7	23½	6.5	8	2.2
Anchored	131	35.9	125½	34.3	123½	33.8
Total at sea	274½	75.2	242½	66.4	224	61.3
Total vessel time	365	100.0	365	100.0	365	100.0

TABLE III - 7.--USE OF VESSEL TIME, VESSEL LENGTH AND POWER, FOR 40 SHRIMP VESSELS OPERATING OUT OF SOUTH ATLANTIC AND GULF PORTS, 1954

Area and vessels	Time spent fishing (range in days)	Actual fishing days (range)	Days per trip (range)	Vessel length (range in feet)	Horse power (range)
Rockville, South Carolina (4 vessels)	48 - 55	105 - 120	.5 - 1.5	40' - 45'	165
Thunderbolt, Georgia (5 vessels)	54 - 91	108 - 180	1.5 - 2.5	48' - 50'	72 - 165
Mayport, Florida (3 vessels)	34 - 72	90 - 191	.5 - 1.5	40' - 50'	75 - 100
Key West, Florida (5 vessels)	82 - 96	197 - 231	2.9 - 5.5	45' - 58'	77 - 165
Tampa, Florida (8 vessels)	1/91 - 105	1/225 - 263	32.0 - 45.0	65' - 72'	120 - 330
Biloxi, Mississippi (4 vessels)	79 - 103	189 - 247	6.6 - 8.5	48' - 57'	77 - 110
Brownsville, Texas (11 vessels)	81 - 101	2/194 - 249	3/5.5 - 9.2	47' - 110'	115 - 330

1/ 7 vessels. 2/ 13 vessels. 3/ 14 vessels.

(2) In the Key West fishery, two vessels were prepared for sea on the day of departure. The preparations consisted of fueling, icing and provisioning. Fuel was obtained at a dock close by the mooring dock and both vessels were fueled to capacity. One vessel was fueled in 47 minutes. Both vessels were iced at another dock, also near the mooring dock. The ice, in block form, was transported by conveyer from the icehouse to the pier, a distance of approximately 200 feet. A power machine crushed the ice and blew it into the hold. One vessel took on 6,000 pounds of ice; the other 8,000 pounds. Neither was iced to capacity. Icing took approximately one hour for each vessel. One man of the crew directed the stream of ice into the bins.

Both vessels were stocked for a seven-day trip. Provisions on one vessel were very meager, and the crew subsisted chiefly on shrimp and fish. The other vessel was better provisioned with meat, fresh vegetables, bread, etc. Water was procured at the dock while fueling. Provisions were delivered to both vessels at their berths. Preparation for sea was accomplished with a minimum of effort and time, the entire operation took less than three hours.

(3) On the Texas coast, the preparations for sea are similar to those found in Key West. The vessels here, however, are apt to make trips lasting from 7 to 20 days. As a rule, they are fueled to capacity, although one vessel with an 8,000 gallon capacity was fueled to only 5,000 gallons. Fueling had taken place at a pier about one-half mile from her berth, the fueling time consumed about one and one-half hours. The ports on the Texas coast often have one basin or section devoted entirely to shrimp vessels. A considerable number of vessels are continually arriving or departing. Many are tied up for their lay-over. Inasmuch as they make longer trips than the Key West vessels, their lay-over period is longer, lasting 4 to 10 days. Frequently, the vessels do not return to their port of departure. Fuel is taken on where available at nearby fuel docks and the vessels are iced by local concerns. Ice is loaded mechanically, the quality and quantity of stores taken on were observed to be superior to those put aboard in other areas. Refrigerated vessels are not iced and frequently carry sufficient stores to last for periods longer than the anticipated trip.

(4) Vessels preparing to fish the Gulf of Campeche fuel, ice, and provision for longer voyages. These vessels frequently make trips of 30 to 90 days. The preparation for sea is by necessity more thorough and takes a longer time than in other fisheries. For the most part, the home ports of these vessels are Tampa and Fort Myers where efficient facilities for fueling, icing, and supplying stores are available. The vessels are fueled and iced to capacity, often carrying extra amounts of these items in order to restock vessels already on the fishing grounds.

Many are equipped to perform major repairs, both for themselves and other vessels.

Due to the length of the trips, the lay-over period of these vessels is longer than in other fisheries. They stay in port for a period of a week to ten days after a voyage of 30 to 60 days. During this period repairs to the vessels are made by shore crews. Unless major repairs are necessary, the vessel can be prepared for sea in one day. The ship's crew, after a short vacation, returns to the vessel and performs necessary repairs to the rigging.

(5) Fueling is the main job in preparing a motor boat for shrimping in inland waters. The two boats studied were both bait-shrimping boats and carried no ice. Sufficient stores to prepare lunch and a jug of water were the only provisions brought aboard. The operation of getting underway was as simple as taking a pleasure boat out for an afternoon's sail. One boat fished out of Corpus Christi and was owner-operated. She was fueled with 55 gallons of gasoline from a dock next to her home berth. This was enough for a two-day operation. The other boat, fishing out of Dunedin, Florida, was not owner-operated, but was fueled at the owner's dock about 100 feet away from her berth. The tank had a capacity of about 60 gallons and 41 gallons was the average consumption for a night's fishing. No set procedure for preparing these boats could be ascertained as the work was done in accordance with the custom of the individual operator.

Procedure for Setting and Trawling

When in port, the outriggers are hoisted inboard. They are lowered during the outbound trip and remain rigged-out unless the vessel is going alongside another boat. The doors are stowed on deck, lashed to the rigging or bulwarks.

Upon arrival at the fishing grounds, the net doors are swung out to hang from the starboard outrigger by the towing cables, preparatory to streaming the net and lowering the gear. As this operation is being performed, the tickler chain, if not secured to the bottom of the net, is lowered over the side. The vessel is stopped during this operation. After the doors are swung out and cleared, the vessel gets underway at her best speed, either upwind or downwind. The net is then streamed over the starboard quarter bulwark rail and towed until it is clear.

After the net has streamed clear, the vessel's way is maintained and the doors and nets are lowered to the proper depth. The towing lines still lead from the blocks on the starboard outrigger.

In order to permit the vessel to maneuver, the towing cables must be secured on the centerline, at a point reasonably near the vessel's turning center. In general practice, the towing cables are held together and down by a chain and open hook secured to a deck pad. They are then hoisted up in the air by the block and fall leading from the end of the boom. During this operation, the helm is put over hard to port and speed is reduced to about two knots. One man handles the block and fall, which is hooked on to the towing cables in a position just aft of the hook and chain downhaul and rigs the hook and chain. A second man mans the winch and makes the final adjustments on the length of the towing cable. The cables to the net lead through the downhaul and lifting hook on the vessel's centerline and directly over the transom. The net is dragged directly astern except when turning.

The length of the drag varies with fishing conditions, most frequently ranging from one to over five hours.(see table III - 8) Long hauls are made when shrimp are scarce and there is not much possibility of catching a large quantity of trash fish. In night shrimping offshore, two to three drags are made. The amount of the catch may be judged by the lead angle of the towing cables. This angle becomes more acute as the net is filled and enables the captain to judge when it is time to haul his net. Along the Atlantic coast, it is customary to make shorter drags. Motor boats used for bait fishing and inshore fishing may haul their nets as often as every five minutes.

During the trawl, frequent casts are made with the trynet which is a miniature of the large net, equipped with small doors. Frequently, one or two trynet drags are made before the large net is set, in order to determine the type of bottom and to estimate the probable size of the catch when the large net is set. The trynet is carried on the davit on the port quarter and is towed with a single cable leading through a sheave on this davit and the port outrigger and then to the winch. Due to the small size of the net (12 to 16 feet), setting it is an easy operation. It is swung out on the davit which is then locked in place. The doors and net are lowered and towed on the surface until the net is clear. The whole rig is then lowered to the desired depth, the towing lines being shorter than the main net towing lines so that the trynet is set slightly ahead of it. The average length of the trynet tow is about 30 minutes. When hauling, the net is heaved in until the doors are hanging from the davit. The bag of the net is then brought aboard, its contents dumped on deck, and a count of the catch made. The trynet is pulled in at frequent intervals. As soon as shrimp are taken in sufficient abundance to indicate grounds worth exploiting, the large trawl is put out. The trynet continues in operation just ahead of the large trawl and is pulled in at frequent intervals. By this means, the fisherman can tell whether he is still trawling through a concentration of shrimp or has passed beyond. When he has passed the concentration, he changes course and resumes trawling through the area where the trynet showed that shrimp were present. The entire trynet operation is easily handled by one man.

When the captain thinks that the net is ready for hauling, the speed of the vessel is decreased until there is enough slack in the towing cables to allow the crew on the stern to release the cables from the block and fall and the hook and chain on the centerline. When this operation is completed, the cables are again led directly from the starboard outrigger.

TABLE III - 8.--TIME CONSUMED IN SHRIMP FISHING AND HANDLING OF CATCH AT SEA, SAMPLE OF 8 SOUTH ATLANTIC AND GULF SHRIMP VESSELS

Operation	Average			Fastest			Slowest		
	Hrs.	Min.	Secs.	Hrs.	Min.	Secs.	Hrs.	Min.	Secs.
I. Net setting									
1. Rig outrigger	0	4	59	0	0	28	0	8	33
2. Swing out doors	0	1	30	0	0	30	0	5	4
3. Stream net	0	2	23	0	0	25	0	4	30
4. Lower and set net	0	2	12	0	0	33	0	6	9
5. Secure cables	0	1	8	0	0	36	0	2	20
6. Set cables	0	1	2	0	0	5	0	2	10
1-6 Total time to set net	0	8	42	0	3	45	0	22	7
II. Dragging	4	0	47	1	24	28	5	16	50
III. Net hauling									
1. Release cable	0	0	42	0	0	7	0	2	4
2. Two block doors	0	5	13	0	2	1	0	7	2
3. Rig tackle to net	0	1	49	0	0	30	0	3	55
4. Pull net aboard	0	3	25	0	1	35	0	9	9
5. Dump net	0	0	35	0	0	10	0	1	12
6. Clear net	0	2	25	0	0	40	0	9	33
IV. Trynet operations									
1. Swing out trynet	0	0	29	0	0	2	0	2	23
2. Lower and set	0	1	58	0	1	15	0	5	0
3. Drag	0	24	35	0	8	57	0	55	0
4. Heave in trynet	0	1	48	0	0	30	0	3	30
5. Dump trynet	0	0	40	0	0	10	0	2	10
V. Handling aboard 1/									
1. Head	2	36	6	0	20	30	4	24	30
2. Dump trash	0	15	26	0	1	50	0	54	0
3. Hose down	0	2	54	0	1	12	0	5	50
4. Clean shrimp	0	2	43	0	0	32	0	7	40
5. Stow below	0	22	40	0	3	36	1	0	0

1/ In man-hours.

As the net is now clear for hauling, the cables are brought in with the winch until the two doors are blocked at the outrigger. The vessel is generally stopped during this procedure, but occasionally some way is maintained to permit limited maneuverability. The net is hauled to windward of the vessel.

When the doors are up, the lazy line which is secured around the mouth of the bag of the net is led through the block of the running whip which is then hoisted to the boom's end. The lazy line is then led to the winch and is heaved in until the neck of the bag is above the bulwark rail. The block and fall at the end of the boom is then secured around the neck of the bag with gripe or sling. The bitter end of this tackle is then led to the winch and the bag of the net is raised out of the water and brought aboard and held suspended over the deck. One man can steady the net with a preventer while a second releases the slip-knotted tie rope securing the end of the bag. This dumps the catch on deck. During this operation, the vessel is stopped and the captain comes aft to assist the crew.

After the net is dumped and cleared of larger trash fish, the vessel is gotten underway, the net is streamed, and the fishing operation is repeated.

After the last haul for the trip, the net is cleared of trash as far as possible by hand. It is then streamed and towed at top speed for a period of three to five minutes. The vessel is again stopped and the net is taken on board, using the winch and whip line. The whip line is then used to bring the doors on board and the doors are secured as before. The vessel now is ready to anchor or proceed to port.

While the shrimp trawl gear is operated essentially in the same manner by the inshore and offshore fleets, there are differences between the fleets in methods of locating shrimp. Use of the trynet for locating shrimp is not as widespread among inshore vessels as among offshore vessels.

Three general types of fishing methods appear to be prevalent. In the first, the fisherman uses only the main trawl to locate shrimp. The length of drag is a matter of choice of the fisherman, but generally the trawl is fished for one-half hour to two hours for each haul. If the catch is sufficient, the trawl is again put over; otherwise, a new area is sought and the procedure repeated. The second method, still being employed in shallow water areas in Louisiana involves the use of a cast net thrown ahead of the boat as it moves slowly over the flats. When shrimp are taken in the cast net, the trawl is put out. As the trawling proceeds, the cast net is continually thrown ahead of the boat. If the boat passes into an area where shrimp can no longer be taken in the cast net, the boat is swung around to again cover the area where shrimp were found. The third, and most efficient method for locating shrimp, involves the use of the trynet before the large trawl is put into operation.

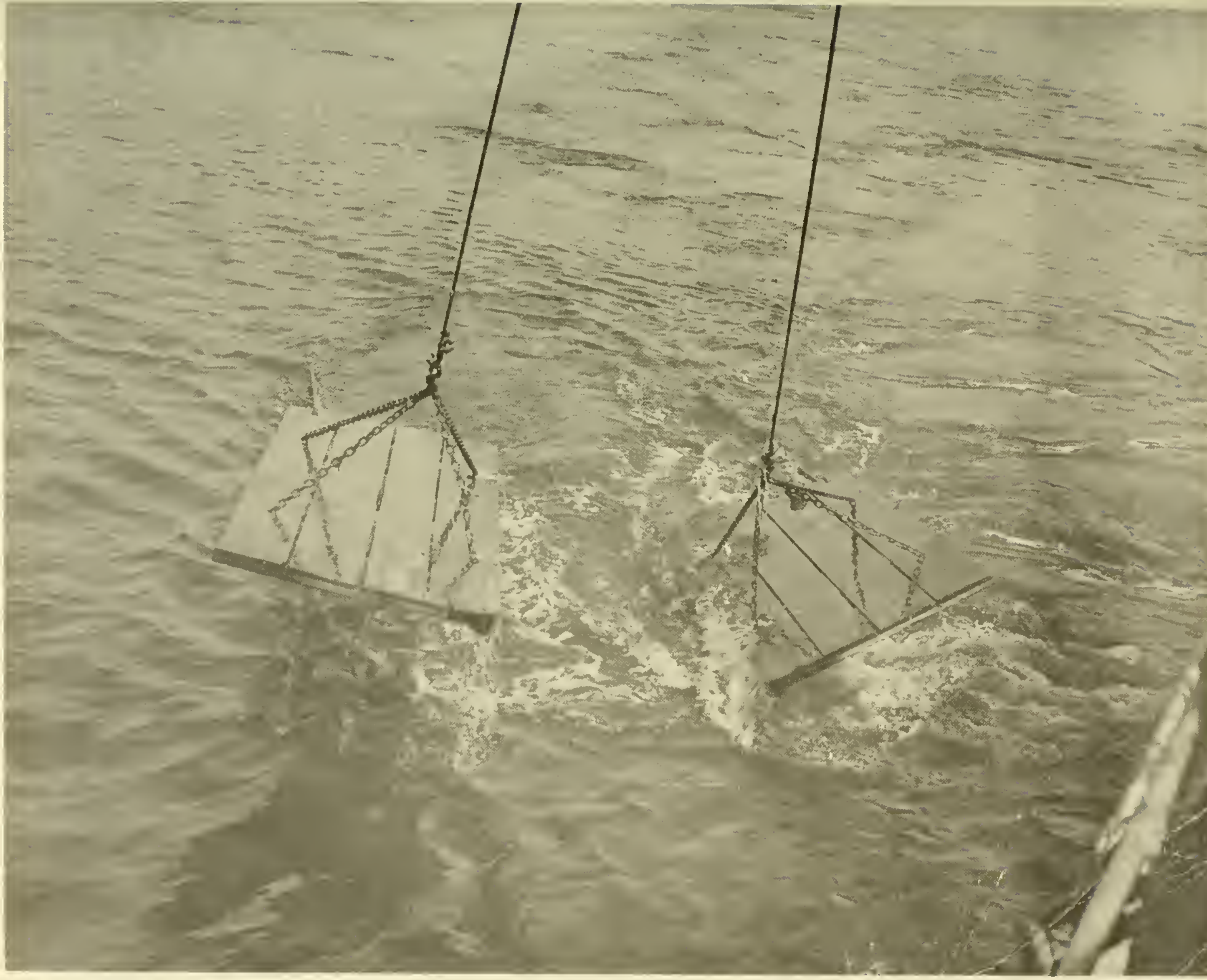


FIGURE III - 27.--Hauling in the otterboards.

FIGURE III - 28.--Securing the otterboards.

FIGURE III - 29.--Close-up view of otterboards secured.

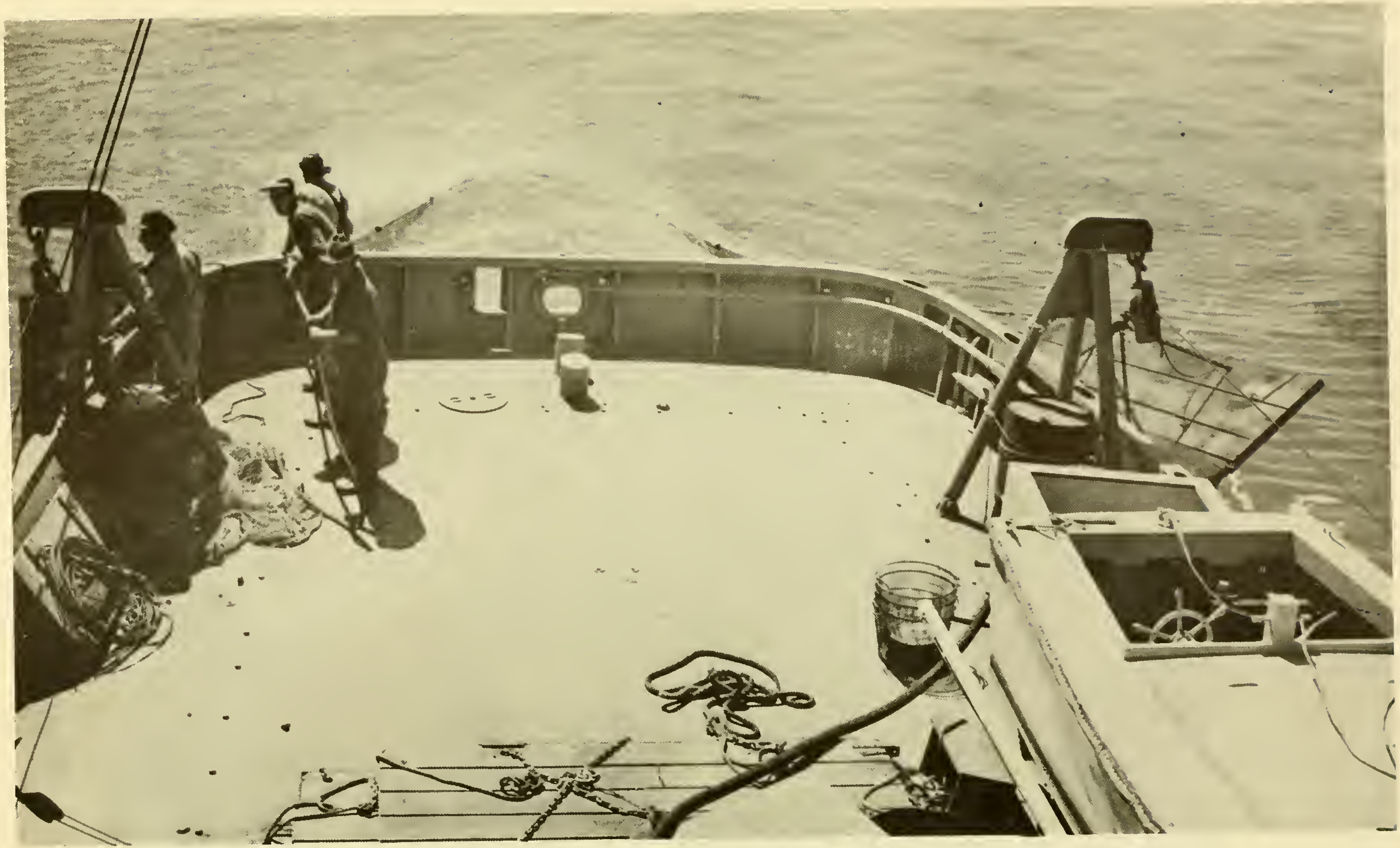


FIGURE III - 30.--Hauling in the cod-end.

In Mississippi, on occasions, fishermen have used as a trynet a conical bag of webbing attached to a semi-circular metal frame about three feet across the base. A short three-strand bridle is fastened to the frame for towing from a single rope. It is believed that this type of trynet has not been completely displaced by the miniature trawl.

Another method of locating shrimp has been observed in the shallow inside waters around Beaufort, North Carolina, and not elsewhere in the fishery. A long oar is put out from the side while the boat is running at slow speed close to shore. When shrimp are present, they can be readily seen jumping out of the water as the moving oar disturbs them.

Fishermen will always try a muddy patch of water whenever one is found, as concentrations of shrimp, presumably while feeding frequently will stir up quantities of mud. This is not infallible, as schools of fish also cause muddy patches.

Handling the Catch at Sea

Iced Vessels

After the drag has been completed the bag is pulled out on the deck and is opened at a height of no more than two feet above the deck so that its contents are not damaged during emptying. Because of the high prevailing temperatures on the decks of steel boats the deck is sometimes covered with wood or cement. Cement has proven to be much more durable and effective than wood for this purpose. Once the bag has been unloaded its contents are washed with salt water from a pressure hose and immediately afterward all trash fish are sorted out and thrown back into the ocean. Occasionally, edible crabs and commercially valuable fish are saved. In the operations observed during the survey of First Research Corporation from 40 to 80 percent of the catch consisted of trash fish, weeds, rocks, and other debris.

During the sorting operation gloves are worn because of the danger of bad cuts from trash fish. In most cases cotton work gloves are used; on board one of the vessels surveyed, rubber gloves were worn. The crew members during this operation sit on low stools and use small hand hoes to rake individual piles of shrimp and trash from the main heap.

Throughout the Gulf Area the general practice is to head the shrimp as they are sorted except where shrimp are caught for the canneries. In the Atlantic coast fishery in North Carolina, South Carolina, and Georgia, however, the shrimp are landed with their heads on and the heading is done in the shrimp plant.

In the other fisheries, because of the length of the trips, quality considerations would ordinarily make it risky to hold the shrimp heads on. Only when unusually large catches are made, and no hand can be spared for the heading operation, is a part of the catch iced down with heads on.

After the heading is completed, the baskets of shrimp are washed with salt water from the flushing pump and hose. The trash is shoveled overboard and the deck is hosed clean.

Next the shrimp are placed in metal wire baskets of 60- or 80-pound capacity, mixed with a small amount of crushed ice. On many vessels the shrimp are graded during this operation, the larger and smaller shrimp being placed in separate baskets.

The procedure for stowing the catch varies little from boat to boat. The baskets are lowered into the hold and dumped in a bin on a layer of ice, and shrimp and ice are thoroughly mixed together. In filling the bin a layer of ice is always placed over a layer of shrimp, the bottom layer of ice is never less than six inches thick if the hold is well insulated. On boats with deficient insulation the bottom layer should be considerably thicker. Once the stowing is completed, a thin layer of ice is spread on top, the bin-boards are replaced, and the hold cleaned up and the hatch cover secured.

On longer trips, especially during the last part of the journey, the bins first loaded are turned and re-iced. Turning is done with perforated shovels which, even if handled carefully, tend to cause some breakage of the shrimp.

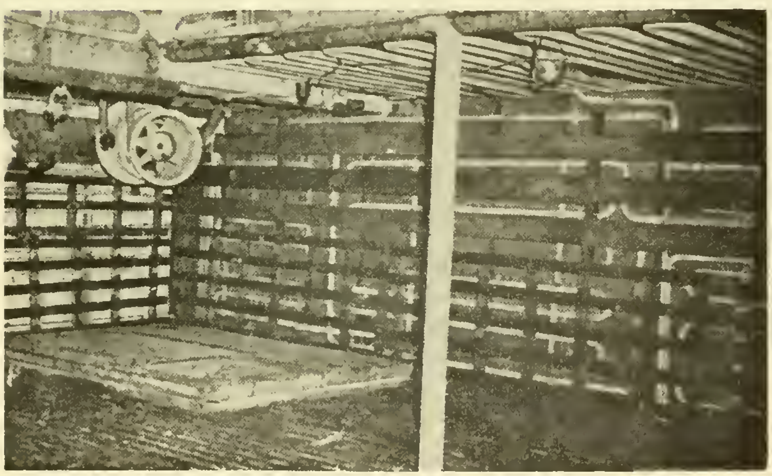
Freezer Vessels

The handling of the catch on freezer vessels depends on the type of freezer employed. In the discussion of refrigeration installations aboard vessels (Chapter II, p. 95) it was indicated that three types of equipment are used in the shrimp industry, i.e. plate, blast, and immersion freezers. The analysts of First Research Corporation observed operations on one vessel equipped with a blast freezer installation and on two vessels which employed the immersion method.

On the blast freezer ship the shrimp were handled as follows:

After the shrimp were landed they were washed with salt water and dumped by size on a packing table on deck. Next the shrimp were packed in 5-pound boxes already labeled for direct marketing. The boxes were placed on a balancing scale, filled, and weighed by one man. The first box from each basket was dumped and an actual count made. A second man took the boxes off the scale and stowed them in trays holding four boxes. The filled trays were placed on deck next to the hatch leading to the blast freezer and the cold storage hold. After all the boxes were filled, the hatch was opened and one man passed the trays below to another, who loaded them into the quick-freeze locker.

The freezer boat "Carol Ann" is anchored permanently and functions as a fixed plant at Port Isabel, Texas. The 138-foot vessel has a freezing capacity of 40,000 pounds daily.



One of the "Carol Ann's" refrigerated compartments.

FIGURE III - 31.--The "Carol Ann"

Southern Fisherman.

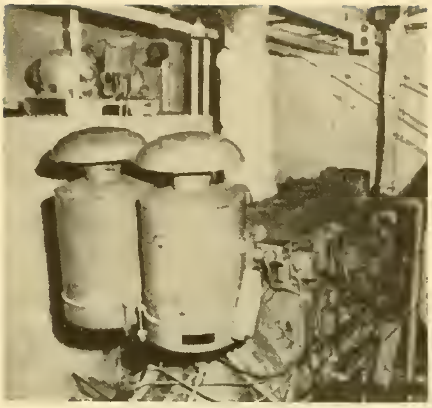
FIGURE III - 32.--"John Cruso" unloading at

Biloxi, Mississippi.

Fishing Gazette.

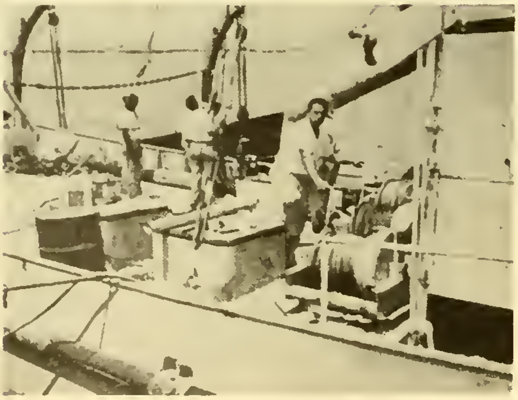
FIGURE III - 33.--The "Lois Kaye", rigged for deep-water trawling for shrimp and bottom fish, carries six separate brine tanks.

Fishing Gazette.



Port engine, Diesel 6-110, air-starting Diesel, equipped with 4-1/2; 1 reverse reduction and air-compressor.

The captain at the wheel; also shown is the depth recorder and telephone.



The "Lois Kaye" 3-drum hoists.

FIGURE III - 34.--Aboard the "Lois Kaye"

Fishing Gazette.

The locker, kept at a temperature of minus 40 degrees F., had a freezing capacity of 650 pounds of shrimp in eight hours. At the end of the freezing period the boxes were removed from the locker and placed on a work table adjoining the holding room. One man opened each box and turned over the contents. A second man sprayed the frozen shrimp with fresh water and replaced them in the same box, thereby glazing the shrimp. The 5-pound boxes were then placed in 50-pound master cartons and stowed in the holding room. This locker was kept at a temperature of 20-25 degrees below zero F.

The shrimp are usually frozen during the daytime. The entire night catch is ordinarily processed at one time. As handled on the vessel studied, the shrimp are preserved on board in such a manner that they can be shipped directly to market after they are unloaded.

On the two vessels equipped with immersion freezers the shrimp after washing were placed in 50-pound freezing baskets, weighed and lowered into the brine freezer tank. This tank contained sea water in which equal parts of salt and sugar had been mixed. The tank on one vessel held 230 gallons of water to which were added 600 pounds of sugar and 600 pounds of salt. The solution was kept at 10 degrees below zero F. A total of 200 pounds of shrimp could be frozen at one time in this tank.

The other vessel was equipped with a larger tank that had a freezing capacity of 250 pounds of shrimp and was filled with a brine solution of the same proportions as above. A full load in each tank raised the temperature about eight degrees. The loaded freezing baskets were left in the brine tank for periods ranging from ten minutes to one hour. The shrimp had been individually frozen and glazed when removed. Afterwards they were dumped in bulk into 50-pound master cartons and stowed below in the freezer hold which was maintained at a temperature of 20-30 degrees below zero F.

The virtues of the brine freezer method have been emphasized by technologists of the Bureau of Commercial Fisheries. Brine freezers, the technologists maintain, are adaptable to small boats, since packaged refrigeration units may easily be designed for small space. Brine-freezing of small and irregular-shaped products such as shrimp is efficient and fast. Complete protection against dehydration (freezer burn) during the freezing cycle is provided which is not always possible under the air-blast freezing method.

A study specifically related to the problems encountered in connection with the brine-freezing of shrimp at sea was made on board the Oregon during March and April 1952. As a result of this study the following procedure for commercial brine-freezing and processing of shrimp was recommended:

Aboard vessel:

(1) Use only fresh firm whole or headed shrimp.

(2) Chill shrimp in fresh ice water.

(3) Freeze shrimp in a strong (sodium chloride) brine (85-degree salinometer or 22.4 percent salt) at 0° to 5° F. Circulate brine continously during the freezing process.

(4) Remove shrimp from the refrigerated brine immediately after they are frozen, but in no case allow them to remain in the refrigerated brine longer than 4 hours. Rinse briefly in cold fresh water.

(5) Store the brine-frozen shrimp at temperatures no higher than 5°F. preferably lower. Protect from dehydration during storage.

Ashore:

(6) Thaw brine-frozen shrimp in running cold water at 60°F. (About 10 to 15 minutes).

(7) Remove shrimp from thawing tank. Remove heads from whole shrimp. Rinse and cull unsound shrimp.

(8) Pack uniformly in waxed cardboard cartons with a minimum of head space. Overwrap with a moisture-vapor-proof film.

(9) Refreeze shrimp at 10°F. or below and store at 0°F. or below.

Unloading Cargo and Mooring Vessel

Upon arrival in port iced vessels proceed to the raw shrimp plant dock where the catch is unloaded, either by basket and hoist or power conveyor. After unloading the bins are hosed down and left to air. Some boats steam or chlorinate their holds as a sanitation measure.

Speed in unloading freezer vessels is not too important since there is little danger of quality deterioration. Vessels with blast freezer installations are unloaded when a refrigerated truck is available for transportation either directly to a market or to a local cold-storage locker.

In immersion-type freezer vessels the shrimp are either unloaded at the raw shrimp plant (when frozen whole or unsorted) or the cartons are held aboard until a refrigerated truck is available to transport them directly to market. Whereas the unloading of an iced vessel is usually completed in a short time, the unloading of refrigerated vessels may take several hours, depending upon the disposal of the cargo and the availability of transportation.

After unloading, the vessels proceed to their berths for their stay in port. Some work may be done by the crew before they are paid off. The general procedure, however, is to leave the vessels unattended but locked up until it is time to prepare for sea.

TIME STUDY, FISHING AND HANDLING OPERATIONS

In its study of work practices on shrimp fishing craft First Research Corporation was able to obtain time factors for various fishing and handling operations aboard ship. Time values were recorded separately for operations connected with the setting of nets, the dragging and hauling of nets, the handling of trynets, and the handling of shrimp aboard ship. Table III-8 lists average, fastest, and slowest time values recorded for these operational steps. (See table III - 8, page 139)

On the average, setting nets took nearly nine minutes; the average drag was slightly over four hours, and hauling the nets took from about five to over 32 minutes.

Trynet operations were less time-consuming. Swinging out, lowering and setting of trynets took from about 1-1/2 to over 6 minutes, dragging time varied from 9 to 55 minutes, and heaving and dumping of trynets took from one to 5-1/2 minutes.

Time consumed in handling shrimp on board depends on the quantity of catch processed. To have any real meaning, time for such operations as heading, dumping trash, cleaning and stowing of shrimp must be recorded in terms of number of pounds of shrimp handled. The man-hour particulars collected by First Research Corporation, consequently, are significant only as an indication of the relationship of the time values for the individual handling operations to each other.

The variations in time required for the same operation by individual vessels are due principally to difference in skill and effort of crew members and cannot be attributed to any significant differences in methods employed. Size of vessel and gear have a relatively small influence on the time required to perform various operations. In general, the sample observations appeared to indicate that the smaller boats were capable of faster operations than the larger boats.

Only one vessel used the trynet with any degree of regularity for the purpose of estimating catches with the large net. Since the trynet operation is performed during the trawling cycle and is accomplished by the utilization of otherwise idle time, the First Research Corporation analysts were of the opinion that its use appeared highly desirable from the standpoint of vessel efficiency.

Concerning the processing of shrimp aboard ship it was noted that operations consumed little, if any, more time on a freezer vessel than on an iced vessel.

EMPLOYMENT OF THE SHRIMP FLEET IN OTHER FISHERIES

An important feature of the inshore fishing industry of Louisiana, Alabama, and Mississippi, is its close connection with oystering. Since the smaller shrimp boats and oyster boats have similar equipment, they lend themselves to interchangeable use. The seasons of the two fisheries are complementary and the processing of both oysters and shrimp is carried on in the same canneries.

Many of the larger shrimp vessels from Beaufort and Morehead City, North Carolina, engage in a trawl fishery for fish off Cape Hatteras during the winter months. The vessels fish from December until April and shrimp the remainder of the year. It is estimated that the income derived from trawling for fish accounts for nearly fifty percent of a vessel's total annual revenue. Vessel owners and captains believe that the average Florida-type vessel is too lightly constructed to withstand the rough weather operations in this fishery. Bow draggers are preferred, because of their sturdier construction and their method of towing the net through stern gallows as distinguished from the boom arrangement on the Florida-type vessel.

Some Florida-type trawlers have been successful in dragging for fish for catfood plants in Pascagoula, Mississippi. Conventional nets and doors are used.

The Texas shrimp fishery is more specialized than the shrimp industry in other States. Rarely is shrimping coupled with other operations. Occasionally, an operator may combine his shrimping activities with a charter operation. One shrimp plant in Freeport encourages boats to bring in snapper whenever possible. Fishermen, however, reportedly are hesitant to put forth any extra effort to catch snapper, among other reasons because of its highly erratic market price.

Few shrimp vessel captains, First Research Corporation believes, have the necessary experience to switch over to snapper fishing. If skippers familiar with both fisheries were available, an ideal operation would embody fishing for snapper during the spring when shrimping slacks off and dragging for shrimp in the summer as snapper fishing falls off.

Another reason why snapper and shrimp are not landed together in appreciable quantity is that at present the shore plants handling snapper and grouper discourage the production of fish on a part time basis by the shrimp vessel. They claim that the poor techniques for the handling of fish used by the shrimpers lead to an inferior product. In icing and handling, the crews naturally give first consideration to the more valuable shrimp catch and often neglect the fish that they have taken. In addition, any large increase in fish catches adversely affects the ex-vessel prices obtained by the regular snapper fisherman. Dealers cannot afford to jeopardize their regular source of snapper by encouraging production from shrimp vessels which will not bother with snapper when the catches of shrimp are plentiful or prices are good.

In the opinion of experts, careful consideration should be given to the long run benefit accruing to the industry from the development of a dual-purpose vessel capable of being used in other fisheries, as well as shrimping, without changing crew requirements. The possibilities of employment of vessels in alternate uses were explored.

The economics of a mixed shrimp-red snapper operation based at Pensacola, Florida, surveyed by Harwell, Knowles and Associates were described as follows:

> The vessel is a 75 foot Florida-type shrimp trawler equipped with mechanical reels and is currently fishing the Campeche banks for shrimp or red snapper. There are eight mechanical reels and wire lines aboard and room for a crew of eight while red snapper fishing and three while shrimping. Conversion from one operation to the other requires but a single day in port. The vessel fishes the Campeche snapper banks exclusively and the two trips for which data were obtained yielded 15,007 and 19,250 pounds of red snapper, respectively, together with several thousand pounds of less valuable grouper. These catches were valued at \$3,750 and \$4,812, respectively (25¢ per pound for snapper) representing a gross return of \$8,562 for the period of the two trips which were of 18 and 16 days duration, respectively. This period was equivalent to one Campeche shrimp trip, allowing 35 nights' fishing. The average catch of shrimp per night on the Campeche grounds during such a period was estimated (from catches of 4 Tampa vessels of similar size) at 200 pounds per night or 7,000 pounds of headless shrimp for the 35 nights. At 62¢ per pound (all top grade) only \$3,340 would have been realized from shrimping during this period.
>
> Diesel fuel for the 2 snapper trips would be about 3,000 gallons (\$450) compared to 5,000 gallons (\$750) for a comparable shrimp trip. The additional fuel for shrimping is used during the 10 to 12 hours dragging per night, while most of the fuel used during snapper fishing is the running to and from the grounds.
>
> Ice expense would also be less for snapper fishing with 30 tons of block ice (\$180) used during the two trips compared to 50 tons of crushed ice (\$300) for the one shrimp trip. While the net boat income from the red snapper catch and the owners share were higher, on this basis, the eight men individually earned less than three fishermen would have if the vessel had produced shrimp.

Because of the amount of interest aroused in the industry by the catches of yellowfin tuna in the Gulf of Mexico by the vessel Oregon of the Bureau of Commercial Fisheries in the course of recent explorations, thought has been given to the use of shrimp vessels as tuna long-line boats. The design of the Florida-type shrimp vessels is not considered favorable for this type of fishing. Wheel house forward and deck space aft make it difficult for the captain to guide the vessel, to lower the gear, to pick-up, and to watch the action at the line hauler which would be mounted somewhere near the winch installation. A lower riding vessel would be better for hauling the fish aboard. Furthermore, on vessels engaged part-time in the tuna fishery, freezer equipment would be necessary to hold the catch.

One 110-foot twin-engine shrimp vessel from Brownsville, Texas, is being fitted out for tuna long-lining. Loran and depth sounders have been installed but to date neither has been used in either fishing or shrimping operations. The owner-captain plans to operate the vessel for tuna or for shrimp, as conditions warrant. Brine-freezing facilities for 30 tons of tuna have been installed.

The observations of First Research Corporation on the subject of dual-purpose vessels were recorded as follows:

> A recently built vessel has been equipped as a refrigerated vessel with the dual-purpose of being employed in the menhaden fishery as well as the shrimp fishery. She is an 86-footer and carries a separate crew for each operation. Although she fished menhaden this past summer (1955) it is not known how successful she has been.
>
> It is believed that the crawfish and pelagic fisheries in the Gulf along the Central American coast and in the West Indies, might offer excellent opportunities for a dual-purpose refrigerated vessel. In British Columbia, a few multi-purpose vessels which are equipped for salmon seining, herring seining, dragging, and packing have been designed in the past few years. Some of the newest boats can perform as many as five different types of fishing operations. A few multi-purpose vessels have been developed for the New England fisheries with some success. One vessel built in 1951 is equipped for both trawling and scallop-dragging.

VESSEL PRODUCTIVITY

Vessel productivity depends on so many variables that the exact relationship between measurable statistical determinants and size of catch is difficult to ascertain. The fishing success of some shrimping operations may now and then be due primarily to "fisherman's luck". In discussing the fact that white shrimp often travel in dense schools, Hildebrand states:

"....it must be remembered.....that even the catch of two boats made at the same time and in the same general area cannot be compared with confidence for one boat may pass through the school and the other may miss it entirely." 16/

Naturally, the larger the amount of data that can be collected on comparable operations, the less important becomes the element of chance. Certain relationships between technological, geographical and other factors and vessel productivity can be discovered if catch information from an adequate sample of vessels fishing the same waters at the same time is obtained.

On the basis of limited sample observations, Harwell, Knowles and Associates relate such factors as length and power of vessel, seasonality, geographical location of fishery, and owner-operation to vessel productivity.

Table III-9 furnishes some clues to what extent geographical differences between fishing grounds influence size of catch. Average annual catch for vessels in the sample ranged from 12,944 pounds for vessels operating out of Mayport, Florida, to as much as 82,606 pounds for Brownsville, Texas, operations. Average catch per day was as low as 82 pounds, and as high as 372 pounds.

There is a clear indication that average annual catches of vessels operating out of south Atlantic ports are substantially below those made by boats fishing in the Gulf. This difference between the two areas is in part accounted for by the shorter fishing season in the waters of the Atlantic. Boats out of Rockville, South Carolina, fished on the average only on 114 days as compared to vessels operating in the Gulf where the season extended anywhere from 215 to 237 days. Campeche operations conducted out of Tampa, Florida, and Brownsville, Texas, were by far the most productive. These operations with few exceptions are restricted to the larger, more expensive boats. In the case of the vessels engaged in the Campeche fishery, trips are more hazardous and running costs much higher than elsewhere.

Seasonal characteristics of shrimp catches in the Thunderbolt, Georgia; Key West, Florida; Biloxi, Mississippi; and Brownsville, Texas, fisheries are illustrated in table III - 10. Average annual catches of boats in the Tortugas operations (operating out of Key West) were fairly

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16/ Henry H. Hildebrand, A Study of the Fauna of the Brown Shrimp Grounds in the Western Gulf of Mexico, publications of the Institute of Marine Science, Volume III, No. 2, November, 1954.

TABLE III - 9.--SAMPLE OF FISHING OPERATIONS FOR 46 VESSELS, SOUTH ATLANTIC AND GULF PORTS, 1954

Home port	Number of vessels	Average annual catch	Average catch per day (night)	Average number of fishing days	Fishing grounds
		Pounds	Pounds		
		(Heads off)			
Atlantic Beach, North Carolina	4	36,992	-	n.a.	Local
Rockville, South Carolina	4	20,854	183	114	Local
Thunderbolt, Georgia	5	27,950	192	146	Local
Mayport, Florida	3	12,944	82	157	Local
Key West, Florida	6	41,591	1/ 193	215	Tortugas
Tampa, Florida	7	73,874	1/ 312	237	Campeche
Biloxi, Mississippi	4	46,867	1/ 209	225	Local
Brownsville, Texas	13	82,606	1/ 372	222	Campeche

1/ Vessels fished by night.

n.a. - not available.

TABLE III - 10.--SEASONAL DATA ON PRODUCTIVITY OF SOUTH ATLANTIC AND GULF SHRIMP VESSELS, 1954

A.--AVERAGE DAILY CATCH, 1954

Home port	Number of vessels	Jan.-Apr.	May-Aug.	Sept.-Dec.
		Pounds	Pounds	Pounds
		(Heads	off)	
Thunderbolt, Georgia	5	-	141	248
Key West, Florida	5	193	164	221
Biloxi, Mississippi	3	98	281	215
Brownsville, Texas	6	210	283	542

B.--AVERAGE NUMBER OF FISHING DAYS, 1954

Home port	Number of vessels	Jan.-Apr. days (nights)	May-Aug. days (nights)	Sept.-Dec. days (nights)
		Number	Number	Number
Thunderbolt, Georgia	5	-	74	71
Key West, Florida	5	75	77	66
Biloxi, Mississippi	3	86	74	92
Brownsville, Texas	6	79	73	70

C.--DISTRIBUTION OF ANNUAL CATCH, 1954

Home port	Number of vessels	Jan.-Apr.	May-Aug.	Sept.-Dec.
		Percent	Percent	Percent
Thunderbolt, Georgia	5	-	37.1	62.9
Key West, Florida	5	34.7	30.1	35.2
Biloxi, Mississippi	3	17.5	42.5	40.0
Brownsville, Texas	6	21.6	27.4	51.0

uniformly distributed over the year. Thunderbolt boats, idle during the first four months of the year, took nearly two-thirds of their shrimp in the period from September through December. Biloxi, Mississippi, operations were more productive during the summer months than at any other time of the year; catches were off considerably during the first four months. Fishing off Brownsville, Texas, was much more productive during the last three months of the year; the boats accounted for over one-half of their total annual catches during this period.

Fishing in the more productive year-round fisheries in the Gulf of Campeche and off the coast of Texas is conducted by larger boats. The average annual catch, average catch per day, and average number of fishing days for these vessels in the Harwell, Knowles, and Associates sample, were greater than for vessels fishing other areas. Table III - 11 illustrates the relationship of size of vessel and the three factors aforementioned.

TABLE III - 11.--SAMPLE OF AVERAGE CATCH BY VESSEL SIZE FOR 43 SHRIMP VESSELS OF SOUTH ATLANTIC AND GULF PORTS, 1954

Vessel length 1/	Number of vessels studied	Average catch: Annual	Average catch: Per day (night)	Average number of fishing days
(Feet)		Pounds (heads off)	Pounds (heads off)	
40-44	4	15,533	121	128
45-49	11	37,331	203	184
50-54	5	26,020	160	163
55-59	3	50,952	213	239
60-64	4	73,462	340	216
65-69	10	76,751	338	227
70-74	5	79,899	347	230
110	1	150,000	725	n.a.

1/ Length of the vessels is reported as overall length.
n.a. - not available.

Vessel size and power to a certain extent are related to areas fished, depth of water fished, and size of the net and doors used. The smaller vessels (under 40 feet in length) generally restrict their operations to the bays and shallow inshore areas and their operations are seasonal in nature. For example, the smaller South Carolina vessels fish from May until December.

The medium sized vessels (40 to 60 feet in length) shrimp outside waters off North Carolina, South Carolina, Georgia, the east and west coasts of Florida, and in the Gulf as far west as Brownsville, Texas. These vessels are limited in their range by fuel and ice capacities and by the crew comfort provided by the vessel. In many instances they move from area to area along the coast to participate in the fishing seasons for the various species of shrimp.

The larger vessels (60 feet or larger) may operate in the same areas as medium sized vessels but they can also fish the Campeche banks off Mexico. These vessels have big fuel and ice capacities (or freezer equipment) and may remain at sea for periods up to three months.

Harwell, Knowles, and Associates attempted to assess the significance of owner-operation of vessels on productivity. The data (see Chapter II, page 106) appeared to indicate that owner-operated vessels, as a rule, fished more days per year, had lower maintenance costs because of proper handling and care of equipment, and, in general, caught more shrimp than vessels operated by hired crews.

STATISTICS ON PRODUCTION

This section contains a brief discussion of production trends in the shrimp fishery. Interspersed in the text are bar charts depicting particulars for selected prewar and postwar years as well as a few tables supplementing the data cited in the discussion.

Landings by State and Region

In 1930 Louisiana ranked first among shrimp-producing states with a catch of 38.6 million pounds. Louisiana, table III - 12 shows, continued to hold its leadership in shrimp production until 1954 when it was displaced for the first time by Texas. Next to Louisiana and Texas, shrimping operations conducted out of ports in the States of

TABLE III - 12.--UNITED STATES AND ALASKA SHRIMP CATCH, BY STATES, SPECIFIED YEARS

State	1930 1/	1940 1/ 2/	1950	1953	1954	1955	1956
	(	Thousands of pounds		-	heads-on basis		)
North Carolina	1,299	4,157	8,311	14,645	9,182	10,324	6,243
South Carolina	793	1,784	7,746	5,086	6,644	6,918	5,589
Georgia	8,853	9,336	11,157	7,535	7,742	7,161	7,991
Florida	16,848	8,368	22,906	58,471	50,878	52,734	54,810
Alabama	2,982	4,565	5,007	5,806	6,226	6,676	7,668
Mississippi	8,489	16,732	16,665	13,869	14,160	16,625	10,912
Louisiana	38,664	90,820	70,630	81,589	77,709	68,986	60,792
Texas	10,189	14,779	45,812	70,435	93,258	71,517	65,134
California	2,697	1,083	919	1,022	1,044	1,522	1,889
Oregon	-	-	-	26	-	23	6
Washington	88	55	55	15	21	8	77
Alaska	932	921	2,158	1,734	1,452	1,828	3,044
All others	346	14	107	124	18	13	18
Total	92,180	152,614	191,473	260,357	268,334	244,335	224,173

1/ Mississippi River and tributaries omitted.

2/ Sand shrimp omitted.

Florida, Georgia, North Carolina, and Mississippi have been consistently the most productive. Figure III -35 illustrates the trend in the regional distribution of the catch more clearly. The decline in the relative importance of the south Atlantic area fishery as well as the fisheries in the states outside the South is shown by comparison of the shaded bar areas. While the South Atlantic States accounted for 28.4 percent of total production in 1930, their share of the total catch in 1956 had shrunk to 11.4 percent. Similarly, the 4.4 percent share of the total catch in 1930 represented by the states outside the South had decreased to about two percent by 1956.

The rising significance of the Gulf region must be credited to the expansion of production by Texas and west coast of Florida operations. As indicated by the chart, the west coast of Florida had increased its share of the catch from 1.7 percent in 1930 to 25.4 percent in 1956, whereas the Texas share of the catch had risen from 11.1 to 33.6 percent during the same period.

A comparison of State catch statistics on a value basis (see table III-13) shows that the rankings of the individual states are similar to the rankings obtained on a quantity basis, with the exception that states where a larger percentage of higher-count shrimp are taken tend to rank lower in a value, than in a quantity, comparison.

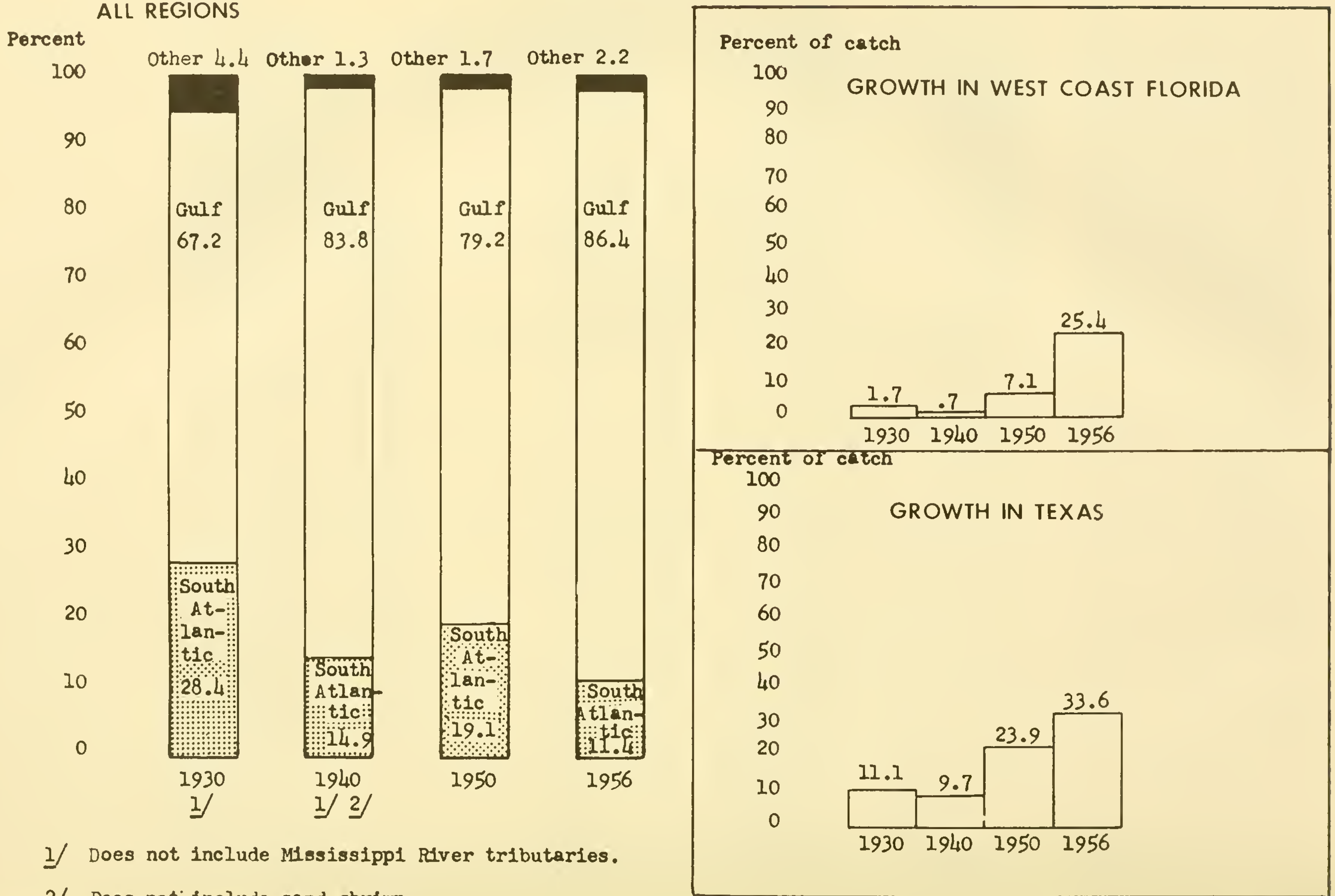
Catch by Type of Fishing Gear

Table III-14 indicates size of the catch by type of gear for specified years from 1930 to 1956. As can be seen from the tabulation, shrimp trawls accounted for all but about five percent of the total catch in 1930. This type of gear has continued to be the most important.

Landings Compared to Other Varieties and to Total Landings of Fish and Shellfish

In table III-15 quantity and value of the shrimp catch is compared to the quantity and value of the catch of all fish and shellfish for specified years from 1930 to 1956. While the total catch of all fish and shellfish in 1956 was almost 50 percent larger than in 1930, shrimp production increased from 92.3 million pounds to approximately 224 million pounds in 1956, with a record production of about 268 million pounds in 1954.

FIGURE III - 35.--PERCENTAGE OF REGIONAL SHARES OF TOTAL UNITED STATES SHRIMP PRODUCTION WITH GROWTH OF SHRIMP FISHERY, SPECIFICALLY SHOWN FOR WEST COAST OF FLORIDA, AND TEXAS, SPECIFIED YEARS



1/ Does not include Mississippi River tributaries.

2/ Does not include sand shrimp.

TABLE III - 13.--UNITED STATES AND ALASKA SHRIMP VALUE, BY STATES, SPECIFIED YEARS

State	1930 1/	1940 1/ 2/	1950	1953	1954	1955	1956
	(Thousands			of	dollars		)
North Carolina	41	125	1,999	3,623	1,836	2,369	1,594
South Carolina	32	55	2,169	1,482	1,661	1,591	1,393
Georgia	335	281	3,178	2,616	2,013	1,862	2,662
Florida	635	329	6,379	21,219	14,537	15,441	19,738
Alabama	97	182	1,107	1,800	1,039	1,349	2,223
Mississippi	319	686	3,713	3,746	2,596	3,076	2,753
Louisiana	1,159	3,644	14,696	16,427	15,451	13,745	16,292
Texas	377	591	9,904	25,354	21,402	21,971	23,650
California	42	14	61	82	81	123	155
Oregon	-	-	-	3	-	1	1
Washington	7	5	21	5	8	3	18
Alaska	42	37	173	225	189	238	396
All others	33	-	51	59	18	13	19
Total	3,119	5,949	43,451	76,641	60,831	61,782	70,894

1/ Mississippi River and tributaries omitted.

2/ Does not include sand shrimp.

TABLE III - 14.--UNITED STATES AND ALASKA SHRIMP CATCH BY GEAR, SPECIFIED YEARS

Gear	1930 1/	1940 1/ 2/	1950	1953	1954	1955	1956
	(	Thousands of pounds - heads on weight					)
Shrimp trawls	87,504	150,426	187,816	256,965	265,417	240,706	219,045
Beam trawls 3/	2,412	1,175	2,986	2,691	1,965	2,695	4,245
Bag nets	1,296	882	205	189	559	694	794
Haul seines	877	(3)	-	-	-	-	-
Drag nets	71	-	-	-	-	-	-
Shrimp traps 3/	9	2	41	4	9	2	25
Cast nets	6	126	7	-	(4)	10	60
Pound nets	-	3	-	-	-	-	-
Push nets	-	-	-	-	3	3	4
Dip nets	5	-	-	-	-	-	-
Channel nets	-	-	418	508	381	225	-
Total	92,180	152,614	191,473	260,357	268,334	244,335	224,173

1/ Does not include Mississippi River and tributaries.

2/ Does not include sand shrimp.

3/ Small catches by shrimp traps in Alaska are included with beam trawls.

4/ Less than 500 pounds.

TABLE III - 15.--SHRIMP CATCH (QUANTITY AND VALUE)

EXPRESSED AS PERCENTAGE OF ALL FISH AND SHELLFISH,

SPECIFIED YEARS

(Heads-on weight)

(Expressed in thousands of pounds and thousands of dollars)

Year	Total fish and shellfish catch	Shrimp catch	Shrimp as percent of all fish and shellfish	Total value	Shrimp value	Shrimp as percent of all fish and shellfish
	Quantity	Quantity	Percent	Value	Value	Percent
1930	3,286,580	92,327	2.8	109,349	3,134	2.9
1940	4,059,524	152,819	3.8	98,957	6,006	6.1
1950	4,884,909	191,474	3.9	343,876	43,452	12.6
1951	4,414,045	224,316	5.1	360,996	51,862	14.4
1952	4,418,442	227,221	5.1	360,135	55,103	15.3
1953	4,467,960	260,357	5.8	352,275	76,641	21.8
1954	4,741,843	268,334	5.7	355,639	60,831	17.1
1955	4,794,281	244,335	5.1	335,778	61,782	18.4
1956	5,251,686	224,173	4.3	369,018	70,894	19.2

Expressed as a percent of the total catch of all fish and shellfish, the shrimp fishery's share rose from 2.8 percent in 1930 to 5.8 percent in 1953. In terms of the total value of all fish and shellfish the shrimp catch with a value of $3.1 million represented only 2.9 percent in 1930, as against 19.2 percent in 1956, when fishermen received $70.9 million for their catch of shrimp.

When compared to individual species of fish and shellfish, shrimp ranked fourth in size of catch during 1953, 1954 and 1955, and fifth in 1956 as against ninth in 1930. In terms of dollars, the shrimp catch is more valuable today than the catch of any other species of fish and shellfish, whereas in 1930 there were nine other species which brought the fisherman more money than shrimp.(see figure III - 36)

Quantity and Value of Catch Per Shrimp Trawl in the South Atlantic and Gulf Area

Despite the fact that the total catch by shrimp trawls more than doubled over the period from 1930 to 1956, the catch per shrimp trawl today is virtually the same that it was at the beginning of the period. Value of the catch per shrimp trawl, on the other hand, has increased substantially, from about $1,200 in 1930 to $9,300 in 1956. In 1953 the value of catch per trawl reached a record of almost $11,500. (see figure III - 37)

Tons Caught Per Net Ton of Fishing Capacity in the South Atlantic and Gulf Area

By relating catch to fishing capacity statistics, an index of fleet productivity per net ton capacity can be constructed. This index can be interpreted as measuring the average productivity of a net ton of fishing capacity in different years. In 1930 according to the data depicted in figure III - 38, 6-1/2 tons of shrimp (heads-on basis) were taken for every ton of fishing capacity available. Since fishing capacity has expanded at a faster rate than catch this ratio by 1956 had decreased to 1.3 tons of shrimp for every ton of shrimping craft.

Value of catch per net ton of fishing capacity increased from $446 in 1930 to a high of $1,344 in 1953 but took a sharp dip in the following years. (see table III - 16)

Quantity and Value of Catch Per Fisherman in the South Atlantic and Gulf Area Compared to Other Fisheries

The productivity of the average shrimp fisherman fluctuated over the period for which data were computed, ranging from a high of about 22,000 pounds per fisherman in 1940 to a low of 12,000 pounds per fisherman in 1950. In recent years, the average catch per fisherman was about what it had been in 1930, viz. in excess of 17,000 pounds. Compared with the shrimp fishery the catch per fisherman in the fisheries

FIGURE III - 36.--VALUE OF CATCH OF FOUR LEADING SPECIES OF FISH AND SHELLFISH, SPECIFIED YEARS

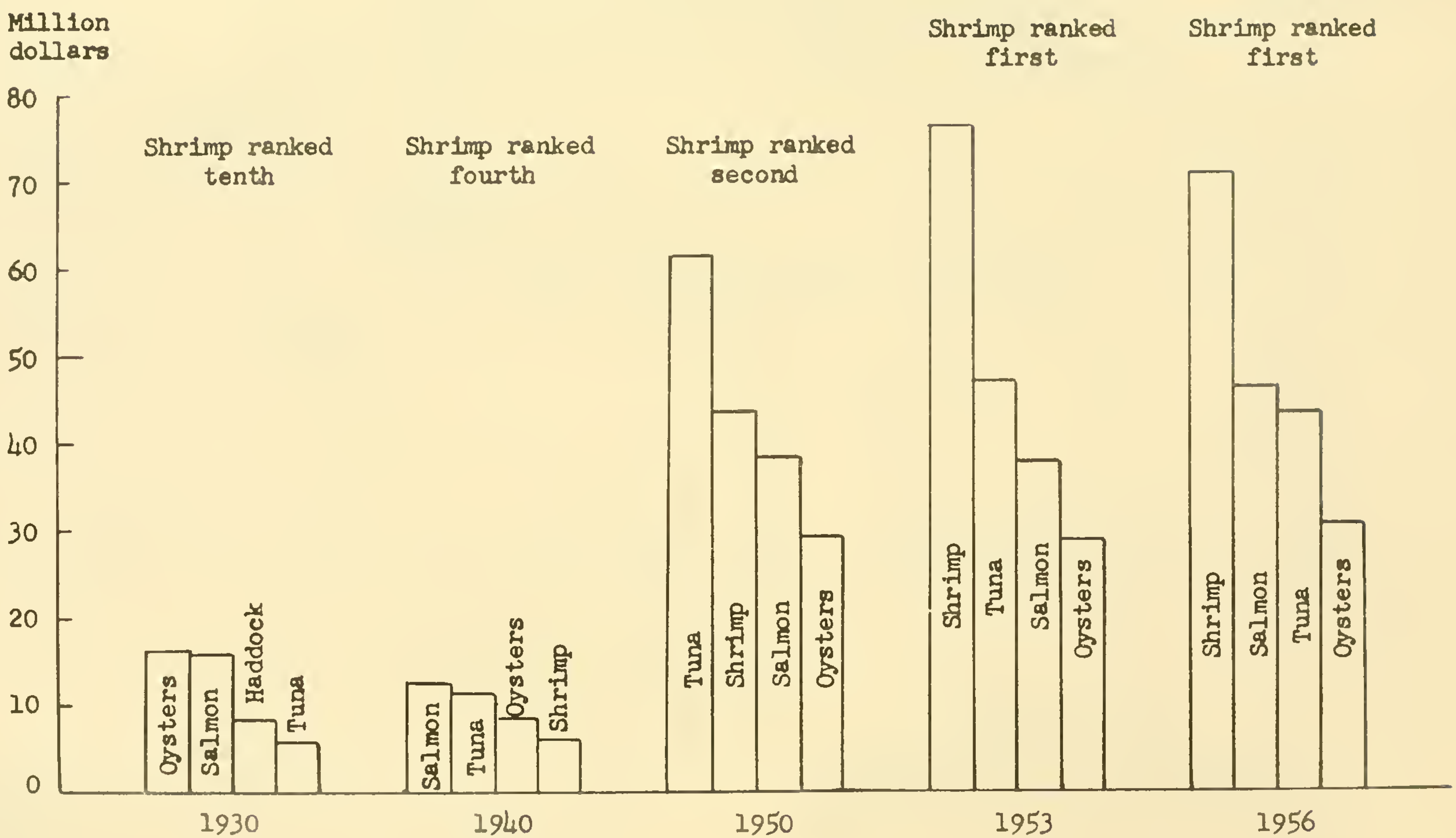


FIGURE III - 37.--VALUE OF CATCH PER SHRIMP TRAWL OPERATING IN THE SOUTH ATLANTIC AND GULF STATES, SPECIFIED YEARS

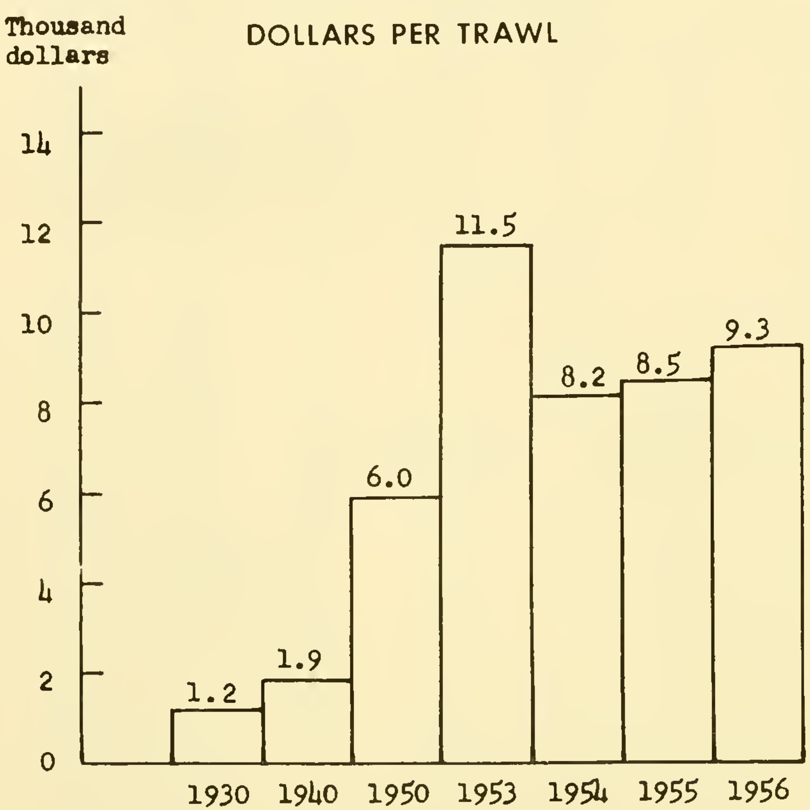
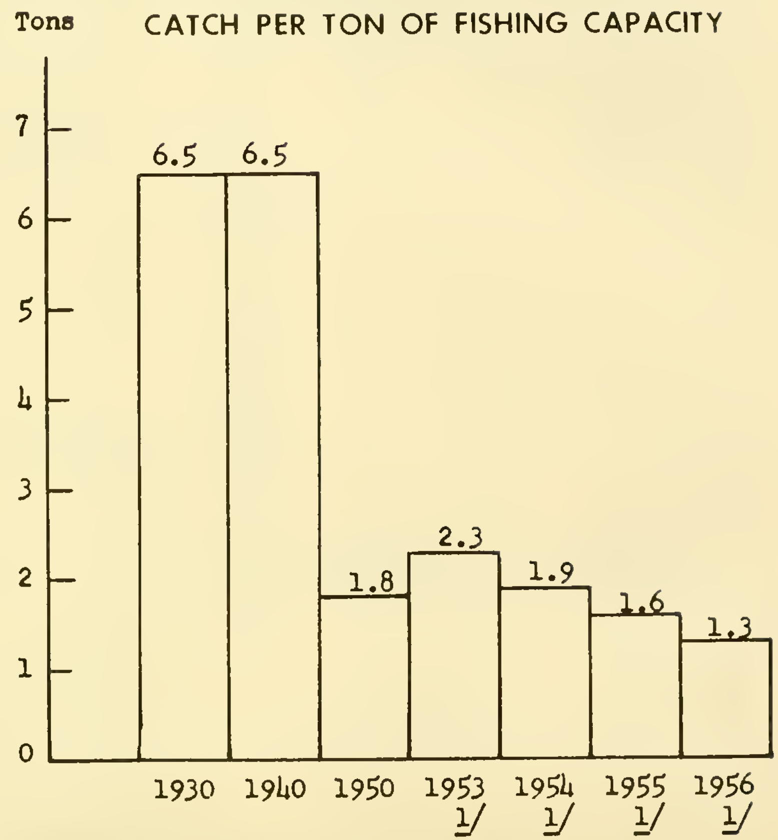


FIGURE III - 38.--SHRIMP CATCH (IN TONS) PER NET TON OF SHRIMP FISHING CAPACITY IN SOUTH ATLANTIC AND GULF STATES, SPECIFIED YEARS



1/ Data adjusted to eliminate duplication.

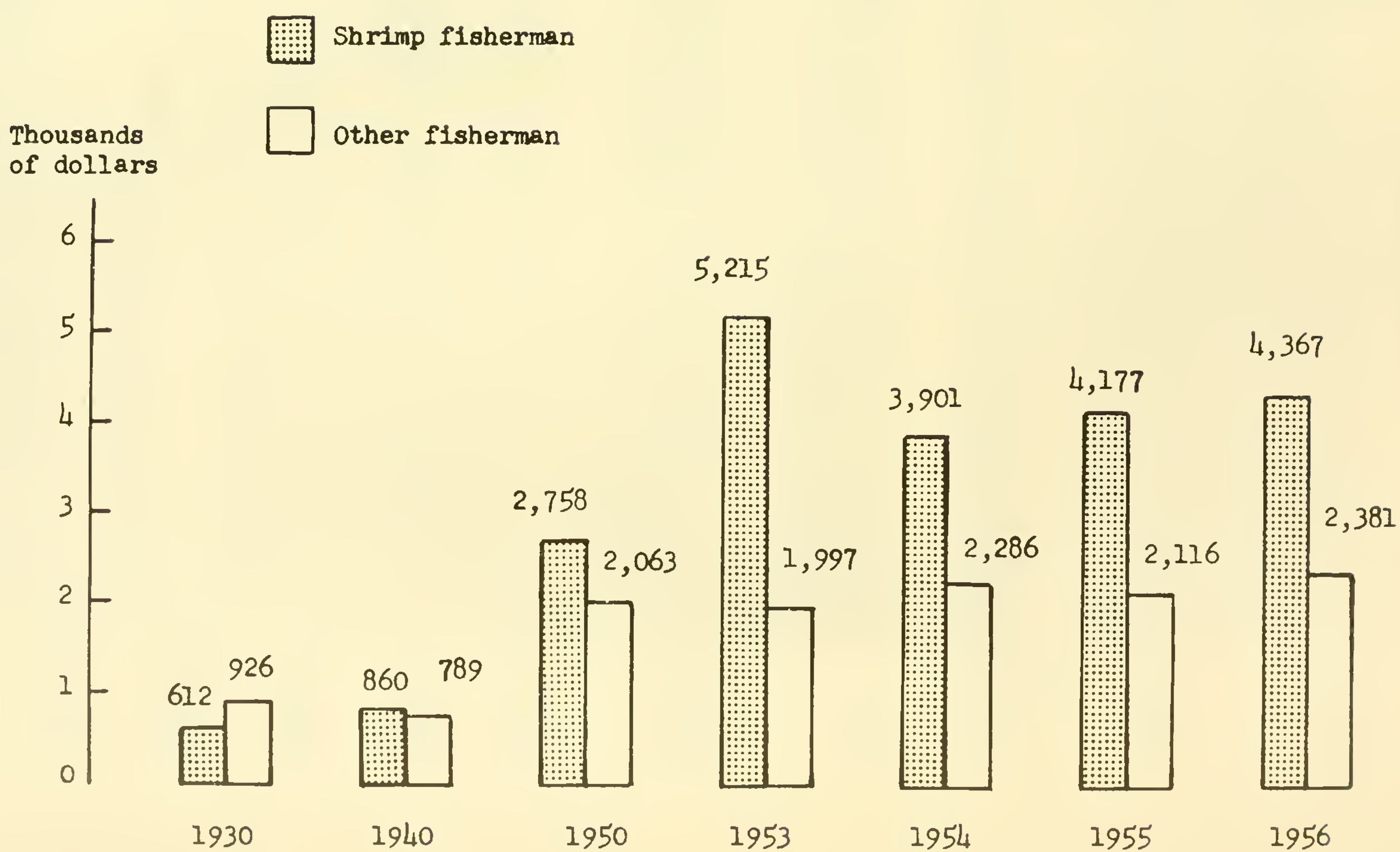
TABLE III - 16.--VALUE OF SHRIMP CATCH PER NET TON IN THE SOUTH ATLANTIC AND GULF STATES, SPECIFIED YEARS

Year	Value of catch (South Atlantic and Gulf)	Total tonnage of fishing capacity	Value of catch per ton of capacity
	Thousand dollars	Net tons	
1930	2,995	6,714	$446
1940	5,893	11,610	508
1950	43,145	51,003	846
1953	76,267	56,739	1,344
1954	60,535	70,795	855
1955	61,404	76,050	807
1956	70,894	88,370	802

for other fish and shellfish was higher in every year for which data have been computed. The differences would be much less pronounced if menhaden were eliminated from the comparison since the huge catch for this species is accounted for by a comparatively small number of fishermen.

A comparison on a value basis shows the reverse relationship. (see figure III - 39) With the exception of 1930 the average shrimp fisherman's catch has been consistently more valuable than the catch of the fishermen in other fisheries. Value of catch per fisherman in the shrimp fishery increased from $612 in 1930 to $4,367 in 1956 with a record figure of $5,215 in 1953. During the same period, the value of catch per fisherman in the remainder of the industry rose from $926 to $2,381.

FIGURE III - 39.--AVERAGE VALUE OF CATCH PER SHRIMP FISHERMAN, COMPARED WITH AVERAGE VALUE OF CATCH PER FISHERMAN ENGAGED IN OTHER FISHERIES IN THE SOUTH ATLANTIC AND GULF STATES SPECIFIED YEARS



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CHAPTER IV

PRODUCTION COSTS IN SHRIMP FISHING

ABSTRACT

COST OF PRODUCTION DATA IN THE SOUTH ATLANTIC AND GULF SHRIMP FISHERY FOR A SAMPLE OF SHRIMP CRAFT WERE SUMMARIZED SEPARATELY FOR CRAFT IN THE VESSEL AND MOTOR BOAT CATEGORIES AS WELL AS BY GEOGRAPHIC SUB-AREAS.

THE PRINCIPAL ELEMENTS OF "TRIP" EXPENSE, I.E., ITEMS WHICH ARE IN THE NATURE OF DIRECT OR VARIABLE COSTS, ARE CREW WAGES, FUEL, ICE, GROCERIES, AND COSTS OF PACKING AND UNLOADING WHICH ARE DEFRAYED BY THE VESSEL. "BOAT" EXPENSES--WHICH RESEMBLE INDIRECT OR FIXED COSTS--ARE REPAIR AND MAINTENANCE, FISHING GEAR AND RIGGING, DEPRECIATION, INTEREST, AND INSURANCE COSTS.

IN THE SAMPLE OF VESSELS FOR WHICH DATA WERE OBTAINED, TRIP EXPENSES AVERAGED ABOUT THREE-FIFTHS AND BOAT EXPENSES TWO-FIFTHS OF THE DOLLAR OF EXPENSE. COSTS OF OPERATION OVER A THREE-YEAR PERIOD SHOWED GREATER STABILITY THAN RECEIPTS FROM CATCH. AS A RESULT, OPERATIONS IN 1954, WHEN PRICES REMAINED DEPRESSED FOR THE ENTIRE YEAR WHILE COSTS DID NOT CHANGE SUBSTANTIALLY FROM THE LEVEL OF THE PRECEDING YEAR, WERE UNPROFITABLE IN THE MAJORITY OF INSTANCES. GROSS RECEIPTS PER POUND IN 1954 AVERAGED FROM 36.79 CENTS FOR 12 VESSELS IN THE ALABAMA, MISSISSIPPI, AND LOUISIANA REGION TO 47.27 CENTS FOR NINE VESSELS IN THE SOUTH ATLANTIC AREA; COST OF PRODUCTION PER POUND--FROM 30.35 CENTS FOR THE ALABAMA, MISSISSIPPI, AND LOUISIANA VESSELS TO 50.99 CENTS FOR TWO VESSELS IN WESTERN FLORIDA. AVERAGE RECEIPTS AND COSTS OF MOTOR BOAT OPERATIONS WERE GENERALLY LOWER THAN THOSE OF VESSELS FISHING THE SAME AREAS.

CREW WAGES, THE MOST IMPORTANT SINGLE ELEMENT OF COST, ACCOUNTED FOR 30 TO 47 CENTS OF EVERY TRIP EXPENSE DOLLAR SPENT. FUEL COSTS, RANKING NEXT IN IMPORTANCE AMONG TRIP EXPENSES, REPRESENTED FROM 7 TO 16 PERCENT OF TOTAL EXPENSES. REPAIRS AND MAINTENANCE AND VESSEL DEPRECIATION WERE THE BIGGEST BOAT EXPENSE ITEMS, ACCOUNTING TOGETHER FOR AT LEAST 14 CENTS AND FOR NEARLY 25 CENTS, IN SOME INSTANCES, OF EVERY EXPENSE DOLLAR. THE DISTRIBUTION OF THE MOTOR BOAT COST TOTAL OVER INDIVIDUAL COMPONENTS SHOWED A SIMILAR PATTERN.

FUEL AND ICE CONSUMPTION DATA OBTAINED FROM ANOTHER SHRIMP VESSEL SAMPLE INDICATED THE FOLLOWING:

VESSELS RANGING FROM 40 TO 60 FEET IN LENGTH ON THE AVERAGE CONSUMED BETWEEN 12,000 AND 16,000 GALLONS OF FUEL ANNUALLY. AVERAGE CONSUMPTION PER HOUR AT SEA, ACCORDING TO THE FIGURES BASED ON A 12-HOUR FISHING DAY WAS APPROXIMATELY FIVE GALLONS FOR THESE VESSELS. PER POUND OF SHRIMP TAKEN, FUEL CONSUMPTION AVERAGED CLOSE TO ONE-THIRD OF A GALLON. THE VESSELS IN EXCESS OF 60 FEET IN LENGTH, IN CONTRAST, CONSUMED ON THE AVERAGE OVER 27,000 GALLONS OF FUEL ANNUALLY AND AT LEAST 10 GALLONS PER HOUR AT SEA. IN TERMS OF THE NUMBER OF POUNDS OF SHRIMP TAKEN, FUEL CONSUMPTION OF THE LARGER VESSELS, EXCEPT IN ONE INSTANCE, DID NOT DIFFER APPRECIABLY FROM THAT OF THE SMALLER VESSELS.

TOTAL ANNUAL CONSUMPTION OF ICE ON VESSELS FOR WHICH DATA WERE OBTAINED BY HARWELL, KNOWLES AND ASSOCIATES RANGED FROM 169.5 TONS FOR ONE VESSEL WITH A 7-TON HOLD CAPACITY OPERATING OUT OF BILOXI, MISSISSIPPI, TO 432.6 TONS FOR A VESSEL WITH A 37-TON HOLD CAPACITY OPERATING OUT OF BROWNSVILLE, TEXAS. CONSUMPTION WAS LOWEST DURING THE JANUARY-APRIL PERIOD AND WAS HIGHEST DURING THE MONTHS OF MAY THROUGH AUGUST. IN TERMS OF POUNDS OF SHRIMP CAUGHT, HOWEVER,

ICE CONSUMPTION OF BILOXI, MISSISSIPPI, VESSELS (WHICH RANGED FROM 6.4 TO 7.9 POUNDS OF ICE PER POUND OF SHRIMP) WAS LOWEST DURING THE SUMMER MONTHS BECAUSE OF THE LARGE QUANTITY OF SHRIMP LANDED THEN. IN THE SAME PERIOD KEY WEST, FLORIDA, VESSELS AND VESSELS OPERATING OUT OF TEXAS PORTS USED FROM 10.5 TO 18.0 POUNDS OF ICE PER POUND OF SHRIMP CAUGHT. VESSELS HAVING INSULATED HOLDS WERE SUBSTANTIALLY MORE ECONOMICAL IN THEIR CONSUMPTION OF ICE THAN VESSELS NOT INSULATED.

INTRODUCTORY COMMENTS

Cost factors in shrimp production and processing were studied by several of the organizations under contract to the United States Fish and Wildlife Service.

Working from the books of vessel owners and shrimp processors, Federal Trade Commission accountants obtained cost information for a sample of operations for the 3-year period 1952 to 1954. Harwell, Knowles and Associates accorded special emphasis to such important elements of cost as fuel and ice in their study of vessel efficiency. The Bureau of Business and Economic Research of the University of Miami noted the customary charges made by vessel suppliers, shrimp plants, and processors for specific services or items needed on board ship describing the character of the industry on a local basis.

The sample of craft for which data were collected by the Federal Trade Commission included 81 vessels and 27 motor boats. Because of the relative importance of the industry domiciled along the South Atlantic and Gulf coasts compared to elsewhere, operations were surveyed in this area only.

Collection of data on costs was complicated by the difficulties encountered in tracing owners of vessels included in the original probability sample, by refusals to cooperate, and by inadequate or inaccurate methods of record keeping. In order to obtain a sufficient number of responses the Federal Trade Commission accountants, where necessary, were obliged to substitute operations for which particulars were readily available. The data collected by these accountants are considered generally representative of the industry.

Because of the marked regional differences in the character of the shrimp fishery the data collected are summarized separately for four areas, viz. (1) the South Atlantic, (2) the west coast of Florida, (3) the northern Gulf region comprising Alabama, Mississippi, and Louisiana, and (4) the State of Texas.

With few exceptions, the vessels for which data were obtained ranged from 40 to 60 feet in length and had rated capacities from 7 to 40 net tons. Vessels, in most instances, were acquired by present owners since the end of World War II and the total original investment in hull, engine, and special equipment varied from $600 to $50,000. Motor boat operations were carried on in craft usually measuring less than 30 feet in length. By this definition, the capacity of these craft is less than 5 net tons. A number of the smaller vessels and many of the motor boats were operated by their owners.

RESULTS OF FISHING OPERATIONS

Most of the vessels located on the Atlantic coast ranged from medium to small in size. The vessels for which particulars were obtained in the field study had hold capacities from 5 to 29 net tons. The fishery in this region is primarily inshore. Occasionally, some of the larger vessels fish the Tortugas grounds during a part of the year. According to information furnished the Federal Trade Commission accountants, these operations have not been profitable. Cost of vessel and equipment to the current owner averaged about $13,000 and ranged from as low as $600 to as high as $42,000.

For the most part, vessels based at Tampa and other southern Florida ports (Region II), take approximately three days to reach the Campeche fishing grounds. These vessels usually remain at sea for at least a month and send into port via incoming vessels the shrimp taken during each three or four day period. Fishing at such distances from home port naturally involves many hazards and requires larger and better equipped vessels. The few vessels for which data could be obtained in this region had capacities from 13 to 30 net tons. The original investment in vessel and equipment by the owner averaged $33,000, the range extending from $17,000 to over $49,000.

Operations along the Gulf coast in the States of Alabama, Mississippi, and Louisiana (Region III), are both inshore and offshore. The vessels contacted had net tonnages ranging from 6 to 36 net tons. Cost of vessels and equipment to the current owner averaged about $15,000 for these vessels, the range extending from $3,000 to $36,000.

State of Texas (Region IV) producers depend mostly on offshore grounds for their supply of shrimp. Their vessels, consequently, are larger in size, especially those built in recent years. The majority of vessels for which data were obtained were in the 20 to 35 net ton category. Cost of vessel and equipment to the current owner ranged from a low of $2,550 for a 7-ton, to nearly $47,000 for a 33-ton vessel, averaging about $23,000.

Comparisons Between Different Regions and Different Years

Vessels

In order to make possible comparisons for different years simultaneously with comparisons for different regions, only vessels for which complete data for 1952, 1953, and 1954 are available have been included in the presentation below, except for Region I where no data is shown for 1952. Tables IV - 17 through IV - 27 show gross receipts, cost of production, and operating profit (loss) for these vessels in dollars for each region and year. Table IV - 28 summarizes the data and presents gross receipts, cost of production, and operating profit (loss) of operations for each region and year in cents per pound of shrimp taken.

TABLE IV - 17.--1953 COST OF PRODUCTION AND PROFIT AND LOSS - ATLANTIC COAST SHRIMP VESSELS, REGION I

Item	Vessels									Total 11 vessels	Weighted average (cents per pound)
	A	B	C 1/	D	E	F	G	H 1/	I		
Pounds of shrimp caught (heads-off weight)	6,765	14,250	106,696	40,630	37,390	21,904	32,689	84,653	8,220	353,197	
Gross receipts	$2,819	$4,740	$68,918	$26,410	$23,698	$13,883	$20,558	$53,331	$5,691	$220,048	
Cents per pound	41.67	33.26	64.59	65.00	63.38	63.38	62.89	63.00	69.23		62.30
Trip expenses:											
Crew wages	-	1,178	18,362	6,907	5,235	3,478	4,576	22,470	1,887	64,093	18.14
Ice	-	-	1,920	1,138	1,069	657	945	1,209	-	6,938	1.96
Fuel	507	998	4,773	2,287	2,056	1,183	1,737	5,162	1,033	19,736	5.59
Packing and unloading	-	-	4,268	1,089	1,415	810	1,058	2,963	-	11,603	3.29
Groceries	149	-	1,499	-	-	-	-	-	-	1,648	.47
Miscellaneous	-	-	-	-	-	-	-	28	23	51	.01
Total trip expenses	656	2,176	30,822	11,421	9,775	6,128	8,316	31,832	2,943	104,069	29.46
Boat expenses:											
Repairs and maintenance	68	457	2/12,681	3,372	3,104	1,818	2,746	3,691	883	28,820	8.16
Boat supplies	21	1,000	-	203	187	118	164	3,208	232	5,133	1.45
Fishing gear	401	-	-	1,402	1,290	756	1,128	2,132	56	7,165	2.03
Insurance	-	-	1,911	825	793	935	1,161	1,196	-	6,821	1.93
Depreciation	60	120	4,086	1,004	965	1,138	1,391	3,012	250	12,026	3.41
Interest	-	-	1,178	-	-	-	-	-	-	1,178	.33
License and tax	18	35	190	114	114	114	114	674	-	1,373	.39
Miscellaneous	-	-	550	591	530	310	461	763	-	3,205	.91
Total boat expenses	568	1,612	20,596	7,511	6,983	5,189	7,165	14,676	1,421	65,721	18.61
Total expense	1,224	3,788	51,418	18,932	16,758	11,317	15,481	46,508	4,364	169,790	
Cents per pound	18.09	26.58	48.19	46.60	44.82	51.67	47.36	54.94	53.09		48.07
Net profit or lose	1,595	952	17,500	7,478	6,940	2,566	5,077	6,823	1,327	50,258	
Cents per pound	23.58	6.68	16.40	18.40	18.56	11.71	15.53	8.06	16.14		14.23

1/ Includes operations of two vessels.
2/ Combined repairs, boat supplies and fishing gear.

TABLE IV - 18.--1954 COST OF PRODUCTION AND PROFIT AND LOSS - ATLANTIC COAST SHRIMP VESSELS, REGION I

Item	Vessels									Total 11 vessels	Weighted average (cents per pound)
	A 1/	B	C 1/	D	E	F	G	H 2/	I		
Pounds of shrimp caught (heads-off weight)	1,524	8,584	85,996	39,377	25,878	25,143	37,063	95,670	5,927	325,162	
Gross receipts	$437	$2,289	$40,027	$18,276	$11,726	$11,158	$17,203	$49,218	$3,385	$153,719	
Cents per pound	28.67	26.67	46.55	46.42	45.31	44.38	46.42	51.45	57.11		47.27
Trip expenses:											
Crew wages 3/	-	587	10,277	4,530	2,908	2,767	4,274	17,864	854	44,061	13.55
Ice	-	16	1,231	1,132	1,268	1,206	1,046	1,463	-	7,362	2.26
Fuel	221	587	4,725	2,166	2,425	2,307	2,001	8,559	736	23,727	7.30
Packing and unloading	-	-	3,440	1,380	1,035	1,006	1,080	3,348	-	11,289	3.47
Groceries	72	-	1,486	-	-	-	-	-	-	1,558	.48
Miscellaneous	-	-	-	-	-	-	-	82	14	96	.03
Total trip expenses	293	1,190	21,159	9,208	7,636	7,286	8,401	31,316	1,604	88,093	27.09
Boat expenses:											
Repairs and maintenance	169	23	4/5,316	2,444	2,736	2,603	2,257	4,171	1,795	21,514	6.62
Boat supplies	-	-	-	169	111	108	159	3,721	245	4,513	1.39
Fishing gear	-	-	-	1,037	681	662	976	2,707	-	6,063	1.86
Insurance	-	-	2,086	825	891	1,050	1,284	-	-	6,136	1.89
Depreciation	-	120	4,086	1,004	965	1,138	1,391	5,900	250	14,854	4.57
Interest	-	-	299	-	-	-	-	-	-	299	.09
License and tax	35	35	205	114	82	82	82	442	-	1,077	.33
Miscellaneous	-	-	898	314	201	192	238	1,152	-	2,995	.92
Total boat expenses	204	178	12,890	5,907	5,667	5,835	6,387	18,093	2,290	57,451	17.67
Total expense	497	1,368	34,049	15,115	13,303	13,121	14,788	49,409	3,894	145,544	
Cents per pound	32.61	15.94	39.60	38.39	51.41	52.19	39.90	51.65	65.70		44.76
Net profit or loss	-60	921	5,978	3,161	-1,577	-1,963	2,415	-191	-509	8,175	
Cents per pound	-3.94	10.73	6.95	8.03	-6.10	-7.81	6.52	-.20	-8.59		2.51

1/ Owner operated - no crew.
2/ Combined operations of 2 vessels.
3/ Crews paid on a per pound basis according to size and quality of shrimp and furnish own groceries.
4/ Repairs, boat supplies and fishing gear combined.

TABLE IV - 19.--1952 COST OF PRODUCTION AND PROFIT AND LOSS -

FLORIDA WEST COAST SHRIMP VESSELS, REGION II

Item	Vessels A	Vessels B 1/	Total 2 vessels	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	73,359	93,243	166,602	
Gross receipts	$40,659	$63,970	$104,629	
Cents per pound	55.42	68.61		62.80
Trip expenses:				
Crew wages 2/	12,964	18,686	31,650	19.00
Ice	1,084	981	2,065	1.24
Fuel	2,125	2,656	4,781	2.87
Packing and unloading	2,826	3,495	6,321	3.79
Groceries	-	-	-	-
Miscellaneous	-	-	-	-
Total trip expenses	18,999	25,818	44,817	26.90
Boat expenses:				
Repairs and maintenance	2,456	2,620	5,076	3.05
Boat supplies	2,219	1,641	3,860	2.32
Fishing gear	922	1,426	2,348	1.41
Insurance	54	1,584	1,638	.98
Depreciation	2,141	3,512	5,653	3.39
Interest	-	1,001	1,001	.60
License and tax	535	76	611	.37
Miscellaneous	627	2,013	2,640	1.58
Total boat expenses	8,954	13,873	22,827	13.70
Total expense	27,953	39,691	67,644	
Cents per pound	38.10	42.57		40.60
Net profit or loss	12,706	24,279	36,985	
Cents per pound	17.32	26.04	22.20	22.20

1/ Operations ending June 30, 1953.
2/ Crews paid on a per pound basis according to size and quality of shrimp and furnish own groceries.

TABLE IV - 20.--1953 COST OF PRODUCTION AND PROFIT AND LOSS - FLORIDA WEST COAST SHRIMP VESSELS, REGION II

Item	Vessels A	Vessels B 1/	Total 2 vessels	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	102,628	80,919	183,547	
Gross receipts	$69,113	$45,363	$114,476	
Cents per pound	67.34	56.06		62.37
Trip expenses:				
Crew wages 2/	19,719	17,167	36,886	20.10
Ice	1,601	1,230	2,831	1.54
Fuel	4,565	2,915	7,480	4.08
Packing and unloading	4,164	3,512	7,676	4.18
Groceries	-	-	-	-
Miscellaneous	-	-	-	-
Total trip expenses	30,049	24,824	54,873	29.90
Boat expenses:				
Repairs and maintenance	4,438	3,757	8,195	4.46
Boat supplies	5,914	1,821	7,735	4.21
Fishing gear	1,596	1,979	3,575	1.95
Insurance	2,110	2,223	4,333	2.36
Depreciation	2,141	3,523	5,664	3.09
Interest	-	947	947	.52
License and tax	759	25	784	.43
Miscellaneous	1,013	1,048	2,061	1.12
Total boat expenses	17,971	15,323	33,294	18.14
Total expense	48,020	40,147	88,167	
Cents per pound	46.79	49.61		48.04
Net profit or loss	21,093	5,216	26,309	
Cents per pound	20.55	6.45		14.33

1/ Operation for year ending June 30, 1954.

2/ Crews paid on a per pound basis according to size and quality of shrimp and furnish own groceries.

TABLE IV - 21.--1954 COST OF PRODUCTION AND PROFIT AND LOSS -

FLORIDA WEST COAST SHRIMP VESSELS, REGION II

Item	Vessels		Total 2 vessels	Weighted average (cents per pound)
	A	B 1/		
Pounds of shrimp caught (heads-off weight)	63,407	38,500	101,907	
Gross receipts	$31,085	$15,951	$47,036	
Cents per pound	49.03	41.43		46.16
Trip expenses:				
Crew wages 2/	10,943	6,423	17,366	17.04
Ice	1,832	707	2,539	2.49
Fuel	4,212	1,881	6,093	5.98
Packing and unloading	3,392	1,583	4,975	4.88
Groceries	-	-	-	-
Miscellaneous	-	-	-	-
Total trip expenses	20,379	10,594	30,973	30.39
Boat expenses:				
Repairs and maintenance	2,094	1,309	3,403	3.34
Boat supplies	4,872	285	5,157	5.06
Fishing gear	1,637	416	2,053	2.01
Insurance	2,216	1,059	3,275	3.21
Depreciation	2,141	1,767	3,908	3.84
Interest	-	705	705	.69
License and tax	775	-	775	.76
Miscellaneous	885	831	1,716	1.69
Total boat expenses	14,620	6,372	20,992	20.60
Total expense	34,999	16,966	51,965	
Cents per pound	55.20	44.07		50.99
Net profit or loss	-3,914	-1,015	-4,929	
Cents per pound	-6.17	-2.64		-4.83

1/ Operations for six months ending December 31, 1954.

2/ Crews paid on a per pound basis according to size and quality of shrimp and furnish own groceries.

TABLE IV - 22.--1952 COST OF PRODUCTION AND PROFIT AND LOSS - EAST GULF COAST SHRIMP VESSELS, (ALABAMA, MISSISSIPPI AND LOUISIANA), REGION III

Item	Vessels												Total 12 vessels	Weighted average (cents per pound)
	A	B	C	D	E	F	G	H	I	J	K	L		
Pounds of shrimp caught (heads-off weight)	47,900	52,972	48,054	24,380	55,125	30,436	39,112	22,290	44,284	62,688	66,175	23,975	517,391	
Gross receipts	$23,468	$18,945	$15,751	$8,606	$23,248	$11,849	$14,628	$8,314	$16,961	$33,954	$31,090	$7,745	$214,559	
Cents per pound	48.99	35.76	32.78	35.30	42.17	38.93	37.40	37.30	38.30	54.16	46.98	32.30		41.47
Trip expenses:														
Crew wages	5,551	9,409	8,138	3,941	8,064	2,906	2,768	-	3,219	9,243	9,115	1,474	63,828	12.34
Ice	1,513	1,272	1,152	320	1,488	360	942	456	886	1,398	1,119	664	11,570	2.24
Fuel	2,054	1,961	1,636	1,072	3,149	1,350	1,494	461	1,151	1,937	3,334	578	20,177	3.90
Packing and unloading	-	-	-	-	-	-	-	-	-	179	-	-	179	.03
Groceries	836	1,213	1,124	1,004	1,991	-	608	712	796	2,038	1,319	1,184	12,825	2.48
Miscellaneous	-	-	144	-	-	-	-	-	-	-	-	-	144	.02
Total trip expenses	9,954	13,855	12,194	6,337	14,692	4,616	5,812	1,629	6,052	14,795	14,887	3,900	108,723	21.01
Boat expenses:														
Repairs and maintenance	1,011	809	1,358	525	3,880	2,535	717	2,503	1,415	5,306	2,481	323	22,863	4.42
Boat supplies	527	863	959	760	860	-	207	155	494	45	989	-	5,859	1.13
Fishing gear	1,655	2,250	1,688	1,765	1,250	-	604	-	1,496	1,256	626	67	12,657	2.45
Insurance	1,375	-	-	-	480	-	-	-	-	1,960	710	-	4,525	.87
Depreciation	2,298	1,579	-	-	1,200	1,020	1,100	700	1,050	3,320	955	627	13,849	2.68
Interest	478	-	-	-	-	-	-	-	-	-	-	-	478	.09
License and tax	38	-	-	-	-	-	-	-	-	-	-	-	38	.01
Miscellaneous	204	-	-	55	-	-	-	40	248	1,002	450	29	2,028	.39
Total boat expenses	7,586	5,501	4,005	3,105	7,670	3,555	2,628	3,398	4,703	12,889	6,211	1,046	62,297	12.04
Total expense	17,540	19,356	16,199	9,442	22,362	8,171	8,440	5,027	10,755	27,684	21,098	4,946	171,020	
Cents per pound	36.62	36.54	33.71	38.73	40.56	26.85	21.58	22.55	24.29	44.16	31.88	20.63		33.05
Net profit or loss	5,928	-411	-448	-836	886	3,678	6,188	3,287	6,206	5,270	9,992	2,799	43,539	
Cents per pound	12.37	-.78	-.93	-3.43	1.61	12.08	15.82	14.75	14.01	10.00	15.10	11.67		8.42

TABLE IV - 23.--1953 COST OF PRODUCTION AND PROFIT AND LOSS - EAST GULF COAST SHRIMP VESSELS

(ALABAMA, MISSISSIPPI AND LOUISIANA), REGION III

Item	Vessels												Total 12 vessels	Weighted average (cents per pound)
	A	B	C	D	E	F	G	H	I	J	K	L		
Pounds of shrimp caught (heads-off weight)	38,610	56,613	41,585	33,468	56,188	21,882	30,019	34,143	36,501	52,463	46,688	20,513	468,673	
Gross receipts	$19,495	$22,511	$16,452	$16,031	$29,157	$11,277	$14,199	$17,614	$18,214	$35,390	$29,472	$7,348	$237,160	
Cents per pound	50.49	39.76	39.56	47.90	51.89	51.54	47.30	51.59	49.90	67.46	63.13	35.82		50.60
Trip expenses:														
Crew wages	9,355	11,785	8,289	6,532	10,758	2,578	2,680	(1)	4,476	8,287	8,551	1,432	74,723	15.95
Ice	1,127	1,359	999	600	2,798	327	783	1,405	1,059	1,517	1,189	680	13,843	2.95
Fuel	1,815	2,235	1,798	1,091	4,135	1,781	1,519	1,386	1,715	2,041	3,267	743	23,526	5.02
Packing and unloading	-	-	-	-	-	-	-	-	-	73	-	-	73	.02
Groceries	1,083	1,458	1,100	914	1,621	-	578	1,413	970	1,889	1,317	938	13,281	2.83
Miscellaneous	-	-	139	-	-	152	-	-	-	-	-	-	291	.06
Total trip expenses	13,380	16,837	12,325	9,137	19,312	4,838	5,560	4,204	8,220	13,807	14,324	3,793	125,737	26.83
Boat expenses:														
Repairs and maintenance	942	2,717	1,342	525	4,850	264	1,541	2,005	1,256	2,269	1,558	125	19,394	4.14
Boat supplies	400	989	1,072	1,403	800	2,295	500	591	344	3,147	768	-	12,309	2.63
Fishing gear	703	2,823	1,191	844	800	-	762	2,136	679	1,523	255	152	11,868	2.53
Insurance	1,375	-	-	-	480	-	-	-	-	1,674	700	-	4,229	.90
Depreciation	2,303	1,579	-	-	1,200	1,020	1,159	700	1,050	1,251	1,296	387	11,945	2.55
Interest	-	-	-	-	-	42	17	396	437	-	-	-	892	.19
License and tax	20	-	-	-	-	-	-	-	-	-	-	-	20	(2)
Miscellaneous	187	-	-	55	-	-	-	-	-	1,416	379	30	2,067	.44
Total boat expenses	5,930	8,108	3,605	2,827	8,130	3,621	3,979	5,828	3,766	11,280	4,956	694	62,724	13.38
Total expense	19,310	24,945	15,930	11,964	27,442	8,459	9,539	10,032	11,986	25,087	19,280	4,487	188,461	
Cents per pound	50.01	44.06	38.31	35.75	48.84	38.66	31.78	29.38	32.84	47.82	41.30	21.87		40.21
Net profit or loss	185	-2,434	522	4,067	1,715	2,818	4,660	7,582	6,228	10,303	10,192	2,861	48,699	
Cents per pound	.48	-4.30	1.25	12.15	3.05	12.88	15.52	22.21	17.06	19.64	21.83	13.95		10.39

1/ Partners operate vessel. No crew employed.
2/ Less than .01 cent.

TABLE IV - 24.--1954 COST OF PRODUCTION AND PROFIT AND LOSS - EAST GULF COAST SHRIMP VESSELS

(ALABAMA, MISSISSIPPI, AND LOUISIANA), REGION III

Item	Vessels												Total 12 vessels	Weighted average (cents per pound)
	A	B	C	D	E	F	G	H	I	J	K	L		
Pounds of shrimp caught (heads-off weight)	49,062	42,401	40,916	27,640	55,938	35,259	23,062	32,479	34,645	57,225	48,800	23,488	470,915	
Gross receipts	$20,845	$12,291	$12,147	$9,619	$23,400	$12,325	$7,818	$11,725	$13,157	$22,127	$21,144	$6,671	$173,269	
Cents per pound	42.49	28.99	29.69	34.80	41.83	34.96	33.90	36.10	37.98	38.67	43.33	28.40		36.79
Trip expenses:														
Crew wages	4,002	5,607	5,297	4,215	9,046	2,524	1,076	(1)	2,671	5,837	5,669	1,243	47,187	10.01
Ice	932	1,017	981	350	2,182	741	699	1,280	693	1,337	1,330	727	12,269	2.61
Fuel	1,861	1,820	2,027	1,079	4,349	2,260	1,212	1,281	1,559	1,828	2,623	610	22,509	4.78
Packing and unloading	-	-	-	-	-	-	-	-	-	71	-	-	71	.02
Groceries	1,189	834	1,158	830	1,521	741	473	1,542	739	1,651	1,349	973	13,000	2.76
Miscellaneous	-	-	144	-	-	-	-	-	-	-	-	-	144	.03
Total trip expenses	7,984	9,278	9,607	6,474	17,098	6,266	3,460	4,103	5,662	10,724	10,971	3,553	95,180	20.21
Boat expenses:														
Repairs and maintenance	1,041	1,030	1,025	525	2,373	1,080	1,105	1,632	2,136	1,040	1,064	59	14,110	3.00
Boat supplies	712	335	693	465	511	-	32	225	676	2,411	978	-	7,038	1.49
Fishing gear	340	1,837	461	802	766	384	536	-	586	1,300	306	52	7,370	1.57
Insurance	1,375	-	-	-	480	-	-	-	-	1,612	650	-	4,117	.87
Depreciation	2,303	1,579	-	-	1,200	1,000	1,159	700	1,050	1,251	1,663	387	12,292	2.61
Interest	-	-	-	-	-	-	-	-	-	-	-	-	-	-
License and tax	38	-	-	-	-	-	-	-	-	-	-	-	38	.01
Miscellaneous	207	-	-	55	-	-	-	331	343	1,429	373	27	2,765	.59
Total boat expenses	6,016	4,781	2,179	1,847	5,330	2,464	2,832	2,888	4,791	9,043	5,034	525	47,730	10.14
Total expense	14,000	14,059	11,786	8,321	22,428	8,730	6,292	6,991	10,453	19,767	16,005	4,078	142,910	
Cents per pound	28.54	33.16	28.81	30.11	40.09	24.76	27.28	21.52	30.17	34.54	32.80	17.36		30.35
Net profit or loss	6,845	-1,768	361	1,298	972	3,595	1,526	4,734	2,704	2,360	5,139	2,593	30,359	
Cents per pound	13.95	-4.17	.88	4.69	1.74	10.20	6.62	14.58	7.81	4.13	10.53	11.04		6.44

1/ Partners operate vessel. No crew employed.

TABLE IV - 25.--1952 COST OF PRODUCTION AND PROFIT AND LOSS - TEXAS SHRIMP VESSELS, REGION IV

Item	Veseels													Total 13 vessels	Weighted average (cents per pound)
	A	B	C	D	E	F	G	H	I	J	K	L	M		
Pounds of shrimp caught (heads-off weight)	68,298	51,245	35,449	47,305	12,000	99,702	105,380	60,590	68,169	77,350	68,876	68,633	98,600	861,597	
Gross receipts	$27,959	$21,003	$14,250	$19,648	$3,708	$49,852	$51,742	$29,559	$38,003	$49,502	$32,016	$37,575	$56,531	$431,348	
Cents per pound	40.94	40.98	40.20	41.54	30.90	50.00	49.10	48.79	55.75	63.99	46.48	54.75	57.33		50.06
Trip expenses:															
Crew wages	12,887	9,399	6,436	8,888	275	18,388	16,362	12,520	11,664	11,166	1,638	8,412	11,846	129,881	15.08
Ice	2,184	2,205	1,377	1,872	56	2,586	2,515	1,775	1,877	3,252	1,878	2,099	2,901	26,577	3.08
Fuel	3,081	2,871	2,049	3,511	310	3,709	3,029	2,002	2,269	2,712	2,686	2,475	3,037	33,741	3.92
Packing and unloading	-	-	-	-	-	2,348	511	-	358	131	221	181	1,025	4,775	.55
Groceries	-	-	-	-	100	-	-	-	2,260	2,228	1,758	1,245	1,810	9,401	1.09
Miscellaneous	80	-	-	79	-	-	-	630	-	-	-	34	147	970	.11
Total trip expenses	18,232	14,475	9,862	14,350	741	27,031	22,417	16,927	18,428	19,489	8,181	14,446	20,766	205,345	23.83
Boat expenses:															
Repairs and maintenance	4,382	4,109	3,161	2,915	260	4,479	5,884	4,910	4,263	3,113	3,958	1,596	4,931	47,961	5.56
Boat supplies	1,276	1,970	1,877	1,679	258	1,390	377	-	2,839	4,231	3,615	1,729	-	21,241	2.47
Fishing gear	2,210	3,464	1,802	3,154	155	3,803	2,568	-	845	795	1,496	1,586	2,980	24,858	2.89
Insurance	1,275	1,270	1,148	1,275	-	1,681	1,819	2,743	1,671	-	1,097	1,018	1,774	16,771	1.95
Depreciation	2,159	2,159	1,951	2,050	255	3,052	4,292	5,555	2,337	271	271	199	2,449	27,000	3.13
Interest	-	-	-	-	-	19	661	868	1,123	-	-	-	375	3,046	.35
License and tax	-	-	-	-	-	-	-	-	21	-	21	-	35	77	.01
Miscellaneous	21	285	55	21	131	1,183	1,250	508	764	1,041	541	448	1,135	7,383	.86
Total boat expenses	11,323	13,257	9,994	11,094	1,059	15,607	16,851	14,584	13,863	9,451	10,999	6,576	13,679	148,337	17.22
Total expense	29,555	27,732	19,856	25,444	1,800	42,638	39,268	31,511	32,291	28,940	19,180	21,022	34,445	353,682	
Cents per pound	43.27	54.11	56.01	53.79	15.00	42.76	37.26	52.01	47.37	37.41	27.84	30.63	34.93		41.05
Net profit or loss	-1,596	-6,729	-5,606	-5,796	1,908	7,214	12,474	-1,952	5,712	20,562	12,836	16,553	22,086	77,666	
Cents per pound	-2.33	-13.13	-15.81	-12.25	15.90	7.24	11.84	-3.22	8.38	26.58	18.64	24.12	22.40		9.01

TABLE IV - 26.--1953 COST OF PRODUCTION AND PROFIT AND LOSS - TEXAS SHRIMP VESSELS, REGION IV

Item	Vessels A	B	C	D	E	F	G	H	I	J	K	L	M	Total 13 vessels	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	61,010	55,164	39,527	34,650	18,600	91,890	108,045	95,717	69,085	87,400	74,625	67,808	103,305	906,826	
Gross receipts	$31,916	$28,868	$19,798	$17,773	$5,795	$57,889	$69,257	$60,715	$46,867	$53,078	$46,752	$42,957	$68,638	$550,303	
Cents per pound	52.31	52.33	50.09	51.29	31.16	63.00	64.10	63.43	67.84	60.73	62.65	63.35	66.44		60.68
Trip expenses:															
Crew wages	14,866	13,453	9,160	8,246	1/883	2/19,433	2/21,268	2/22,113	10,710	11,821	4,447	10,702	15,586	162,688	17.94
Ice	2,185	1,962	1,478	1,281	100	2,942	2,962	3,467	2,311	2,207	2,392	2,211	2,118	27,616	3.05
Fuel	3,092	2,873	2,253	2,886	354	4,467	5,134	3,910	4,232	2,755	2,841	2,662	4,006	41,465	4.57
Packing and unloading	-	-	-	-	-	648	51	89	211	189	160	221	1,093	2,662	.29
Groceries	-	-	-	-	125	-	-	-	2,290	2,263	2,260	1,339	2,068	10,345	1.14
Miscellaneous	-	-	-	5	-	-	528	119	-	-	-	-	56	708	.08
Total trip expenses	20,143	18,288	12,891	12,418	1,462	27,490	29,943	29,698	19,754	19,235	12,100	17,135	24,927	245,484	27.07
Boat expenses:															
Repairs and maintenance	3,636	5,453	3,551	4,682	525	5,769	7,222	8,900	4,475	11,808	2,417	2,938	5,650	67,026	7.39
Boat supplies	2,180	2,518	1,843	1,517	425	3,484	-	3,520	2,045	2,153	2,035	2,232	-	23,952	2.64
Fishing gear	2,608	2,118	2,197	1,679	300	3,803	4,128	2,118	2,452	1,387	2,396	1,432	1,874	28,492	3.14
Insurance	1,382	1,382	1,256	1,382	-	1,757	1,816	2,609	1,374	-	1,102	1,023	1,798	16,881	1.86
Depreciation	2,138	2,101	1,869	2,031	255	3,300	4,292	5,315	2,258	589	562	2,042	2,449	29,201	3.22
Interest	-	-	-	-	-	203	914	-	454	1,025	86	926	-	3,608	.40
License and tax	-	-	-	-	-	-	-	-	21	21	-	-	43	85	.01
Miscellaneous	-	-	-	-	152	974	4,356	1,604	619	831	570	908	1,517	11,531	1.27
Total boat expenses	11,944	13,572	10,716	11,291	1,657	19,290	22,728	24,066	13,698	17,814	9,168	11,501	13,331	180,776	19.93
Total expense	32,087	31,860	23,607	23,709	3,119	46,780	52,671	53,764	33,452	37,049	21,268	28,636	38,258	426,260	
Cents per pound	52.59	57.76	59.73	68.42	16.77	50.91	48.75	56.17	48.42	42.39	28.50	42.23	37.03		47.00
Net profit or loss	-171	-2,992	-3,809	-5,936	2,676	11,109	16,586	6,951	13,415	16,029	25,484	14,321	30,380	124,043	
Cents per pound	-.28	-5.43	-9.64	-17.13	14.39	12.09	15.35	7.26	19.42	18.34	34.15	21.12	29.41		13.68

1/ The owner of this vessel acts as captain, and basis of paying crew is not known.

2/ Owner acts as captain and his share is not included in "crew wages"; gross receipts divided 2/5 to boat and 3/5 to crew, and crew pays for groceries and 1/2 of ice.

TABLE IV - 27.--1954 COST OF PRODUCTION AND PROFIT AND LOSS - TEXAS SHRIMP VESSELS, REGION IV

Item	Vessels													Total	Weighted average (cents per pound)
	A	B	C	D	E	F	G	H	I	J	K	L	M	13 vessels	
Pounds of shrimp caught (heads-off weight)	67,577	54,106	38,809	60,171	8,750	75,112	105,198	79,465	67,610	83,750	56,875	50,200	95,392	843,015	
Gross receipts	$24,819	$18,952	$13,745	$21,446	$2,153	$37,556	$41,132	$30,930	$28,991	$33,300	$25,408	$20,542	$52,066	$351,040	
Cents per pound	36.73	35.03	35.42	35.64	24.60	50.00	39.10	38.92	42.88	39.76	44.67	40.92	54.58		41.64
Trip expenses:															
Crew wages	1/11,341	1/8,557	1/6,123	1/9,797	436	2/12,675	2/15,027	3/15,312	7,187	8,132	4,191	4,229	13,922	116,929	13.87
Ice	2,137	1,938	1,499	1,851	65	2,506	2,949	2,536	2,957	2,714	2,207	1,727	2,414	27,500	3.26
Fuel	3,173	2,791	1,810	2,483	306	3,033	5,154	2,249	4,365	3,472	3,065	1,924	3,637	37,462	4.44
Packing and unloading	-	-	-	-	-	167	355	235	875	192	132	169	342	2,467	.30
Groceries	-	-	-	-	135	-	-	-	2,241	2,852	2,143	968	2,113	10,452	1.24
Miscellaneous	13	-	-	7	-	-	-	-	98	-	132	-	22	272	.03
Total trip expenses	16,664	13,286	9,432	14,138	942	18,381	23,485	20,332	17,723	17,362	11,870	9,017	22,450	195,082	23.14
Boat expenses:															
Repairs and maintenance	4,696	2,208	3,920	2,933	505	5,732	9,734	6,882	2,154	3,399	3,044	1,434	2,993	49,634	5.89
Boat supplies	1,715	814	1,461	971	503	3,909	393	1,936	1,952	1,808	2,142	1,931	-	19,535	2.32
Fishing gear	2,198	2,093	1,002	2,506	185	1,124	3,215	1,303	1,991	1,887	1,436	753	1,451	21,144	2.51
Insurance	1,518	1,518	1,355	1,518	-	1,663	2,750	1,043	1,427	1,377	1,047	949	1,952	18,117	2.14
Depreciation	2,098	2,083	1,875	1,983	255	4,007	4,292	5,019	2,258	2,736	535	3,928	2,450	33,519	3.98
Interest	-	-	-	-	-	1,064	863	1,047	54	126	-	154	-	3,308	.39
License and tax	-	21	21	24	-	-	-	-	21	41	21	-	21	170	.02
Miscellaneous	-	7	14	-	126	1,271	1,523	634	429	538	569	830	1,315	7,256	.86
Total boat expenses	12,225	8,744	9,648	9,935	1,574	18,770	22,770	17,864	10,286	11,912	8,794	9,979	10,182	152,683	18.11
Total expense	28,889	22,030	19,080	24,073	2,516	37,151	46,255	38,196	28,009	29,274	20,664	18,996	32,632	347,765	
Cents per pound	42.75	40.72	49.16	40.01	28.75	49.46	43.97	48.07	41.43	34.95	36.33	37.84	34.21		41.25
Net profit or loss	-4,070	-3,078	-5,335	-2,627	-363	405	-5,123	-7,266	982	4,026	4,744	1,546	19,434	3,275	
Cents per pound	-6.02	-5.69	-13.74	-4.37	-4.15	.54	-4.87	-9.15	1.45	4.81	8.34	3.08	20.37		.39

1/ 1/2 gross receipts, from which was deducted all groceries and 1/2 ice and 1/2 net repairs.
2/ Owner acts as captain and his share is not included in crew wages; gross receipts divided 2/5 to boat and 3/5 to crew; crew pays for groceries and 1/2 ice.
3/ Not owner-operated; 1/2 to boat and 1/2 to crew. The crew pays for groceries and 1/2 of ice.

TABLE IV - 28.--AVERAGE COST OF PRODUCTION AND OPERATING PROFIT AND LOSS OF TYPICAL SHRIMP VESSELS 1952, 1953 AND 1954

Item	Region I 9 vessels 1/		Region II 2 vessels			Region III 12 vessels			Region IV 13 vessels		
	1953	1954	1952	1953	1954	1952	1953	1954	1952	1953	1954
	(Cents per pound)										
Gross receipts	62.30	47.27	62.80	62.37	46.16	41.47	50.60	36.79	50.06	60.68	41.64
Costs of production	48.07	44.76	40.60	48.04	50.99	33.05	40.21	30.35	41.05	47.00	41.25
Profit or loss	14.23	2.51	22.20	14.33	-4.83	8.42	10.39	6.44	9.01	13.68	.39

1/ Data for 1952 insufficient for comparison.
Note: Table covers only vessels for which complete information for the three years was furnished.

The break-even analysis in a later section of this chapter, in addition to showing data for the operations for which complete information is available for three years, includes summaries for all operations in the Federal Trade Commission sample.

When details for individual operations are compared, wide variations in cost of production are noted. In 1954 production costs in Region I ranged from 15.94 cents per pound of shrimp taken for one operation in the Carolinas (Vessel B) to 65.70 cents per pound for a vessel operating out of Brunswick, Georgia (Vessel I) (see table IV - 18).

The two operations, one showing a profit, the other one a loss, were among the smaller in the sample with catches of 8,584 and 5,927 pounds of shrimp (heads-off) and total expenses of $1,368 and $3,894 respectively, for the year.

Size of catch, the same table shows, varied substantially from vessel to vessel ranging from as low as 1,524 pounds for an owner-skippered vessel in the Carolinas (Vessel A) to 39,377 pounds for a Thunderbolt, Georgia, operation (Vessel D). Catches of individual vessels in other regions during the same year (1954) were as high as 63,407 pounds on the west coast of Florida, Region II (see Vessel A, table IV - 21); 57,225 pounds in the northern Gulf, Region III (see Vessel J, table IV - 24); and 95,392 pounds in Texas, Region IV (see Vessel M, table IV - 27).

As indicated by table IV-28, there was a marked similarity in the fluctuations of gross receipts, costs, and profits in Region III (Alabama, Mississippi, and Louisiana) and Region IV (Texas) over the three-year period. The year 1953 saw a steep rise in the price received for the catch, amounting to about 20 percent in each of the two areas. This boost in prices was more than eradicated during the drastic decline in the market in 1954, when average receipts in the two areas amounted to about 36-1/2 and 41-1/2 cents, respectively. Profits fluctuated in corresponding fashion. The fluctuations in costs were somewhat less pronounced than the fluctuations in receipts which accounts for the poor profit showing in 1954, particularly in Texas (Region IV) where most operators barely broke even.

Results of operations in Region I (south Atlantic) and II (west coast of Florida) apparently did not differ substantially from those in the other two regions; the pattern here, though, is somewhat less clear because of the limited amount of information available for these two areas. 17/ In Region II, costs failed to recede with prices in 1954, resulting in heavy losses to the operators. It is possible that the two vessels for which comparable data are available for the three years are not sufficiently representative of operations in this area. Moreover, the data may show that these operations which involve longer trips and are substantially more costly, are particularly vulnerable during periods of market depression.

A region by region comparison of the data reveals at a glance that Region III enjoys a significant cost advantage over the others. This advantage is offset to a large extent by the lower prices received by the fishermen. The fact that a large proportion of the catch in this area is made up of the smaller shrimp used by canning and drying plants explains this difference in average receipts. This is demonstrated by table IV-29 which contains a detailed comparison of the elements of costs in the four regions.

In the above classification of costs, a distinction is made between trip and boat expenses. Trip expenses, in connection with boat operations, roughly correspond to the term commonly referred to in manufacturing cost statements as direct or variable expenses, i.e. costs which vary in direct proportion with operations. Boat expenses in contrast, would be equivalent to indirect or fixed expenses of production, i.e. costs which cannot be controlled in the short run.

Region III, table IV-29, shows a cost advantage, both with respect to trip and boat expenses. The lower boat expenses are easily explained in terms of the shorter distance to fishing grounds of ports in Alabama, Mississippi and Louisiana. The cost of insurance per pound of shrimp taken in Region III in 1954 was less than one cent as compared to approximately two cents in Regions I and IV, and over three cents in Region II. The more modest investment in boat and the lesser hazards and lesser wear and tear on fixed capital, characteristic of inshore operations, is reflected in lower interest and depreciation costs.

17/ No usable data were collected for the year 1952 in Region I. In Region II complete information for all three years could be obtained only for two vessels.

TABLE IV - 29.--AVERAGE COST OF PRODUCING SHRIMP BY ITEMS OF EXPENSE,

TYPICAL SHRIMP VESSEL OPERATIONS, 1952, 1953, AND 1954

Costs	Region I (11 vessels)		Region II (2 vessels)			Region III (12 vessels)			Region IV (13 vessels)		
	1953	1954	1952	1953	1954	1952	1953	1954	1952	1953	1954
	(Cents per pound)										
Trip expenses:											
Crew wages	18.14	13.55	19.00	20.10	17.04	12.34	15.95	10.01	15.08	17.94	13.87
Ice	1.96	2.26	1.24	1.54	2.49	2.24	2.95	2.61	3.08	3.05	3.26
Fuel	5.59	7.30	2.87	4.08	5.98	3.90	5.02	4.78	3.92	4.57	4.44
Packing and unloading	3.29	3.47	3.79	4.18	4.88	.03	.02	.02	.55	.29	.30
Groceries	.47	.48	-	-	-	2.48	2.83	2.76	1.09	1.14	1.24
Miscellaneous	.01	.03	-	-	-	.02	.06	.03	.11	.08	.03
Total trip expenses	29.46	27.09	26.90	29.90	30.39	21.01	26.83	20.21	23.83	27.07	23.14
Boat expenses:											
Repairs and maintenance	8.16	6.62	3.05	4.46	3.34	4.42	4.14	3.00	5.56	7.39	5.89
Boat supplies	1.45	1.39	2.32	4.21	5.06	1.13	2.63	1.49	2.47	2.64	2.32
Fishing gear	2.03	1.86	1.41	1.95	2.01	2.45	2.53	1.57	2.89	3.14	2.51
Insurance	1.93	1.89	.98	2.36	3.21	.87	.90	.87	1.95	1.86	2.14
Depreciation	3.41	4.57	3.39	3.09	3.84	2.68	2.55	2.61	3.13	3.22	3.98
Interest	.33	.09	.60	.52	.69	.09	.19	-	.35	.40	.39
License and tax	.39	.33	.37	.43	.76	.01	(1)	.01	.01	.01	.02
Miscellaneous	.91	.92	1.58	1.12	1.69	.39	.44	.59	.86	1.27	.86
Total boat expenses	18.61	17.67	13.70	18.14	20.60	12.04	13.38	10.14	17.22	19.93	18.11
Total expense	48.07	44.76	40.60	48.04	50.99	33.05	40.21	30.35	41.05	47.00	41.25

1/ Less than .01

There is an explanation for the differential in trip expenses which is found in Texas operations (Region IV). The explanation is a simple one. The principal element of trip expense is crew wages. The low crew wages in Regions III and IV, the principal reason for the lower trip costs in these areas, are explained, therefore, in terms of the smaller proceeds from catch.

The smaller proceeds are accounted for in part by the higher count shrimp constituting a large proportion of the Louisiana (Region III) catches, and by the lower price received for the brown shrimp in Texas (Region IV).

When the individual elements of cost are related to total costs it becomes apparent that the proportion of trip to vessel expenses in the sample of operations surveyed remained relatively constant from year to year and region to region. Trip expenses account for approximately three-fifths, and vessel expenses two-fifths, of total expenses. Crew wages, the most important single element of cost, accounted for 30 to 47 cents of every expense dollar, the corresponding range for operations in Regions III and IV (for which more complete data were available) was considerably smaller, i.e., 33 to 40 cents. Fuel costs, ranking next in importance among trip expenses, represented from 7 to over 16 cents of each dollar of expense. Repairs and maintenance and vessel depreciation were the biggest vessel expense items, accounting for 14 to 25 cents of every expense dollar.

Motor Boats

Tables IV - 30 through IV - 38 show gross receipts, cost of production and operating profit (or loss) for the Federal Trade Commission sample of shrimp motor boat operations in the South Atlantic and Gulf States for the years 1952, 1953, and 1954.

Production costs for motor boat operations showed a fair degree of uniformity. On the basis of data for the year 1954, the only year for which comparable data for all regions are available, costs in Region I appeared to exceed costs in the other three regions (see summary - table IV - 39). The unfavorable results of operations in 1954 in all regions must be blamed on the severe price decline in the market for raw shrimp.

The motor boats in tables IV - 30 through IV - 38 are identified by numbers. However not all the motor boats surveyed by the Federal Trade Commission furnished data which could be used for analysis.

TABLE IV - 30.--1954 COST OF PRODUCTION AND PROFIT AND LOSS -

ATLANTIC COAST MOTOR BOATS, REGION I

Item	Motor boats						Total 6 motor boats	Weighted average (cents per pound)
	1	2	3	4	5	6		
Pounds of shrimp caught (heads-off weight)	1,206	5,127	6,104	2,934	3,717	3,156	22,244	
Gross receipts	$337	$1,719	$1,526	$968	$1,227	$999	$6,776	
Cents per pound	27.94	33.53	25.00	32.99	33.01	31.65		30.46
Trip expenses:								
Crew wages 1/	(2)	565	393	636	636	148	2,378	10.69
Ice	-	-	-	-	-	-	-	-
Fuel	150	221	348	215	273	403	1,610	7.24
Packing and unloading	-	-	-	-	-	-	-	-
Groceries	-	-	-	-	-	150	150	.67
Miscellaneous	-	-	-	-	-	-	-	-
Total trip expenses	150	786	741	851	909	701	4,138	18.60
Boat expenses:								
Repairs and maintenance	200	121	369	91	63	115	959	4.31
Boat supplies	-	54	-	28	18	-	100	.45
Fishing gear	-	203	-	160	137	-	500	2.25
Insurance	-	296	-	-	-	-	296	1.33
Depreciation	120	790	150	170	176	100	1,506	6.77
Interest	-	-	-	-	-	-	-	-
License and tax	25	-	27	19	19	33	123	.55
Miscellaneous	-	-	-	-	-	-	-	-
Total boat expenses	345	1,464	546	468	413	248	3,484	15.66
Total expense	495	2,250	1,287	1,319	1,322	949	7,622	
Cents per pound	41.04	43.89	21.08	44.95	35.57	30.07		34.26
Net profit or loss	-158	-531	239	-351	-95	50	-846	
Cents per pound	-13.10	-10.36	3.92	-11.96	-2.56	1.58		-3.80

1/ Data were not obtained to show basis of crew wages paid to helpers on these owner-operated motor boats.
2/ Owner operated; no crew employed.

TABLE IV - 31.--1953 COST OF PRODUCTION AND PROFIT AND LOSS -

FLORIDA WEST COAST MOTOR BOATS, REGION II

Item	Motor boats 7	Motor boats 8	Total 2 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	47,930	23,414	71,344	
Gross receipts	$11,164	$5,862	$17,026	
Cents per pound	23.29	25.04		23.86
Trip expenses:				
Crew wages 1/	5,478	2,740	8,218	11.52
Ice	355	242	597	.84
Fuel	824	455	1,279	1.79
Packing and unloading	-	-	-	-
Groceries	458	400	858	1.20
Miscellaneous	-	-	-	-
Total trip expenses	7,115	3,837	10,952	15.35
Boat expenses:				
Repairs and maintenance	385	493	878	1.23
Boat supplies	320	317	637	.89
Fishing gear	265	310	575	.81
Insurance	-	-	-	-
Depreciation	521	420	941	1.32
Interest	-	-	-	-
License and tax	-	-	-	-
Miscellaneous	-	-	-	-
Total boat expenses	1,491	1,540	3,031	4.25
Total expense	8,606	5,377	13,983	
Cents per pound	17.95	22.97		19.60
Net profit or loss	2,558	485	3,043	
Cents per pound	5.34	2.07		4.26

1/ Basis was to deduct fuel, ice and groceries from gross receipts and divide balance 1/2 to boat and 1/2 to crew.

TABLE IV - 32.--1954 COST OF PRODUCTION AND PROFIT AND LOSS - FLORIDA WEST COAST MOTOR BOATS, REGION II

Item	Motor boats 7	Motor boats 8	Total 2 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	29,735	25,255	54,990	
Gross receipts	$5,882	$5,157	$11,039	
Cents per pound	19.78	20.42		20.08
Trip expenses:				
Crew wages 1/	2,335	2,030	4,365	7.94
Ice	275	317	592	1.08
Fuel	868	741	1,609	2.92
Packing and unloading	-	-	-	-
Groceries	480	569	1,049	1.91
Miscellaneous	-	-	-	-
Total trip expenses	3,958	3,657	7,615	13.85
Boat expenses:				
Repairs and maintenance	632	581	1,213	2.21
Boat supplies	450	354	804	1.46
Fishing gear	436	345	781	1.42
Insurance	-	-	-	-
Depreciation	521	420	941	1.71
Interest	-	-	-	-
License and tax	-	-	-	-
Miscellaneous	-	-	-	-
Total boat expenses	2,039	1,700	3,739	6.80
Total expense	5,997	5,357	11,354	
Cents per pound	20.17	21.21		20.65
Net profit or loss	-115	-200	-315	
Cents per pound	-.39	-.79		-.57

1/ Basis was to deduct fuel, ice and groceries from gross receipts and divide balance 1/2 to boat and 1/2 to crew.

TABLE IV - 33.--1952 COST OF PRODUCTION AND PROFIT AND LOSS -

NORTHERN GULF MOTOR BOATS, REGION III

Item	Motor boats 10	11	18	21	22	Total 5 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	9,578	18,525	15,056	18,461	18,988	80,608	
Gross receipts	$3,094	$6,187	$4,866	$5,852	$6,589	$26,588	
Cents per pound	32.30	33.40	32.32	31.70	34.70		32.98
Trip expenses:							
Crew wages	1,010	2,038	240	1,188	1,697	6,173	7.66
Ice	116	230	266	430	498	1,540	1.91
Fuel	429	640	386	941	564	2,960	3.67
Packing and unloading	-	-	-	-	-	-	-
Groceries	262	587	473	503	520	2,345	2.91
Miscellaneous	-	-	-	-	-	-	-
Total trip expenses	1,817	3,495	1,365	3,062	3,279	13,018	16.15
Boat expenses:							
Repairs and maintenance	450	480	227	881	279	2,317	2.87
Boat supplies	344	952	-	327	117	1,740	2.16
Fishing gear	180	1,131	71	372	590	2,344	2.91
Insurance	-	-	-	-	-	-	-
Depreciation	-	-	300	29	600	929	1.15
Interest	-	-	-	-	-	-	-
License and tax	-	-	-	-	-	-	-
Miscellaneous	55	55	24	15	15	164	.20
Total boat expenses	1,029	2,618	622	1,624	1,601	7,494	9.29
Total expense	2,846	6,113	1,987	4,686	4,880	20,512	
Cents per pound	29.71	33.00	13.20	25.38	25.70		25.44
Net profit or loss	248	74	2,879	1,166	1,709	6,076	
Cents per pound	2.59	.40	19.12	6.32	9.00		7.54

TABLE IV - 34.--1953 COST OF PRODUCTION AND PROFIT AND LOSS -

NORTHERN GULF MOTOR BOATS, REGION III

Item	Motor boats 10	11	18	21	22	Total 5 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	6,731	7,328	12,974	20,769	19,381	67,183	
Gross receipts	$3,150	$3,290	$4,289	$8,557	$9,167	$28,453	
Cents per pound	46.80	44.90	33.06	41.20	47.30		42.35
Trip expenses:							
Crew wages	1,088	1,313	430	2,047	1,629	6,507	9.69
Ice	120	120	213	508	503	1,464	2.18
Fuel	380	365	294	979	639	2,657	3.95
Packing and unloading	-	-	-	-	-	-	-
Groceries	270	369	411	359	646	2,055	3.06
Miscellaneous	-	-	-	-	-	-	-
Total trip expenses	1,858	2,167	1,348	3,893	3,417	12,683	18.88
Boat expenses:							
Repairs and maintenance	450	480	174	722	574	2,400	3.57
Boat supplies	321	630	-	351	546	1,848	2.75
Fishing gear	259	264	52	431	26	1,032	1.54
Insurance	-	-	-	-	-	-	-
Depreciation	-	-	300	58	600	958	1.42
Interest	-	-	-	-	-	-	-
License and tax	-	-	-	-	-	-	-
Miscellaneous	55	55	21	15	182	328	.49
Total boat expenses	1,085	1,429	547	1,577	1,928	6,566	9.77
Total expense	2,943	3,596	1,895	5,470	5,345	19,249	
Cents per pound	43.72	49.07	14.61	26.34	27.58		28.65
Net profit or loss	207	-306	2,394	3,087	3,822	9,204	
Cents per pound	3.08	-4.17	18.45	14.86	19.72		13.70

TABLE IV - 35.--1954 COST OF PRODUCTION AND PROFIT AND LOSS -

NORTHERN GULF MOTOR BOATS, REGION III

Item	Motor boats 10	11	18	21	22	Total 5 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	1,513	3,019	17,450	14,038	15,868	51,888	
Gross receipts	$478	$984	$5,967	$4,113	$5,568	$17,110	
Cents per pound	31.59	32.59	34.19	29.30	35.09		32.97
Trip expenses:							
Crew wages	161	326	1,197	371	590	2,645	5.10
Ice	20	40	409	465	456	1,390	2.68
Fuel	272	314	334	976	593	2,489	4.80
Packing and unloading	-	-	-	-	-	-	-
Groceries	181	169	769	308	226	1,653	3.18
Miscellaneous	-	-	-	-	-	-	-
Total trip expenses	634	849	2,709	2,120	1,865	8,177	15.76
Boat expenses:							
Repairs and maintenance	450	480	225	454	252	1,861	3.59
Boat supplies	390	246	-	216	307	1,159	2.23
Fishing gear	506	637	100	208	302	1,753	3.38
Insurance	-	-	-	-	74	74	.14
Depreciation	-	-	300	58	516	874	1.68
Interest	-	-	-	-	-	-	-
License and tax	-	-	-	-	-	-	-
Miscellaneous	55	55	22	164	122	418	.81
Total boat expenses	1,401	1,418	647	1,100	1,573	6,139	11.83
Total expense	2,035	2,267	3,356	3,220	3,438	14,316	
Cents per pound	134.50	75.09	19.23	22.94	21.67		27.59
Net profit or loss	-1,557	-1,283	2,611	893	2,130	2,794	
Cents per pound	-102.91	-42.50	14.96	6.36	13.42		5.38

TABLE IV - 36.--1952 COST OF PRODUCTION AND PROFIT AND LOSS -

TEXAS MOTOR BOATS, REGION IV

Item	Motor boats 24	Motor boats 27	Total 2 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	6,992	12,411	19,403	
Gross receipts	$2,566	$4,555	$7,121	
Cents per pound	36.70	36.70		36.70
Trip expenses:				
Crew wages	(1)	(1)	-	-
Ice	52	48	100	.51
Fuel	375	259	634	3.27
Packing and unloading	-	-	-	-
Groceries	52	155	207	1.07
Miscellaneous	-	-	-	-
Total trip expenses	479	462	941	4.85
Boat expenses:				
Repairs and maintenance	367	560	927	4.78
Boat supplies	282	-	282	1.45
Fishing gear	-	-	-	-
Insurance	-	-	-	-
Depreciation	400	450	850	4.38
Interest	-	-	-	-
License and tax	-	-	-	-
Miscellaneous	26	37	63	.32
Total boat expenses	1,075	1,047	2,122	10.93
Total expense	1,554	1,509	3,063	
Cents per pound	22.23	12.16		15.78
Net profit or loss	1,012	3,046	4,058	
Cents per pound	14.47	24.54		20.92

1/ Owner-operated; no crew employed.

TABLE IV - 37.--1953 COST OF PRODUCTION AND PROFIT AND LOSS -

TEXAS MOTOR BOATS, REGION IV

Item	Motor boats 24	Motor boats 27	Total 2 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	7,351	12,687	20,038	
Gross receipts	$2,698	$5,087	$7,785	
Cents per pound	36.70	40.10		38.85
Trip expenses:				
Crew wages	(1)	(1)	-	-
Ice	41	114	155	.77
Fuel	338	411	749	3.74
Packing and unloading	-	-	-	-
Groceries	-	184	184	.92
Miscellaneous	-	-	-	-
Total trip expenses	379	709	1,088	5.43
Boat expenses:				
Repairs and maintenance	279	609	888	4.43
Boat supplies	131	-	131	.65
Fishing gear	-	-	-	-
Insurance	-	-	-	-
Depreciation	400	578	978	4.88
Interest	-	37	37	.19
License and tax	26	-	26	.13
Miscellaneous	-	-	-	-
Total boat expenses	836	1,224	2,060	10.28
Total expense	1,215	1,933	3,148	
Cents per pound	16.53	15.24		15.71
Net profit or loss	1,483	3,154	4,637	
Cents per pound	20.17	24.86		23.14

1/ Owner-operated; no crew employed.

TABLE IV - 38.--1954 COST OF PRODUCTION AND PROFIT AND LOSS -

TEXAS MOTOR BOATS, REGION IV

Item	Motor boats 24	Motor boats 27	Total 2 motor boats	Weighted average (cents per pound)
Pounds of shrimp caught (heads-off weight)	8,930	14,801	23,731	
Gross receipts	$2,171	$3,508	$5,679	
Cents per pound	24.31	23.70		23.93
Trip expenses:				
Crew wages	(1)	(1)	-	-
Ice	15	77	92	.39
Fuel	131	197	328	1.38
Packing and unloading	-	-	-	-
Groceries	80	94	174	.73
Miscellaneous	3	-	3	.01
Total trip expenses	229	368	597	2.51
Boat expenses:				
Repairs and maintenance	265	432	697	2.94
Boat supplies	83	-	83	.35
Fishing gear	-	-	-	-
Insurance	-	-	-	-
Depreciation	571	450	1,021	4.30
Interest	-	-	-	-
License and tax	-	-	-	-
Miscellaneous	97	26	123	.52
Total boat expenses	1,016	908	1,924	8.11
Total expense	1,245	1,276	2,521	
Cents per pound	13.94	8.62		10.62
Net profit or loss	926	2,232	3,158	
Cents per pound	10.37	15.08		13.31

1/ Owner-operated; no crew employed.

TABLE IV - 39.--AVERAGE COST OF PRODUCTION AND OPERATING PROFIT AND LOSS OF TYPICAL MOTOR BOAT OPERATIONS, 1952, 1953 AND 1954

Costs	Region I	Region II		Region III			Region IV		
	1954	1953	1954	1952	1953	1954	1952	1953	1954
	(Cents per pound)								
Gross receipts	30.46	23.86	20.08	32.98	42.35	32.97	36.70	38.85	23.93
Cost of production	34.26	19.60	20.65	25.44	28.65	27.59	1/15.78	1/15.71	1/10.62
Profit (or loss)	-3.80	4.26	-.57	7.54	13.70	5.38	1/20.92	1/23.14	1/13.31

1/ Crew wages not included since boats were owner-operated. Data consequently not comparable with those of other three regions. Two additional Region IV motor boats for which 1954 data were available, and which were not owner-operated, operated at a loss.

Motor boat receipts were considerably below those of the large vessels for corresponding regions and years. The smaller radius of operations and the smaller and less valuable shrimp caught by motor boats in all probability account for this difference.

When measured in cents per pound of shrimp taken, trip expenses of motor boats are substantilly lower than those of vessels. The big differential in trip costs is accounted for by low crew wages. Many of the motor boat operations are conducted by one man. Where a helper is taken on, his wages under the lay system of compensation depend on boat receipts which are lower in the case of motor boats than in the case of vessels. Aside from crew wages, trip expenses of motor boats are lower because of smaller fuel and ice consumption. Average grocery expenses appear larger since the grocery purchases of the owner-operator show up on his operating statements in contrast to the practice on craft manned by hired labor where the crew pays for its food.

By components of cost the motor boat expenses were distributed as follows: (see table IV - 40)

TABLE IV - 40.--AVERAGE COST OF PRODUCING SHRIMP,

BY ITEMS OF EXPENSE, TYPICAL MOTOR BOAT OPERATIONS,

1952, 1953, AND 1954

Costs	Region I	Region II		Region III			Region IV		
	6 motor boats 1954	2 motor boats 1953	2 motor boats 1954	5 motor boats 1952	5 motor boats 1953	5 motor boats 1954	2 motor boats 1952	2 motor boats 1953	2 moto[illegible] boat[illegible] 195[illegible]
	(Cents	per	pound)						
Trip expenses:									
Crew wages	10.69	11.52	7.94	7.66	9.69	5.10	(1)	(1)	(1)
Ice	-	.84	1.08	1.91	2.18	2.68	.51	.77	.3[illegible]
Fuel	7.24	1.79	2.92	3.67	3.95	4.80	3.27	3.74	1.38
Packing and unloading	-	-	-	-	-	-	-	-	-
Groceries	.67	1.20	1.91	2.91	3.06	3.18	1.07	.92	.7[illegible]
Miscellaneous	-	-	-	-	-	-	-	-	.0[illegible]
Total trip expenses	18.60	15.35	13.85	16.15	18.88	15.76	4.85	5.43	2.5[illegible]
Boat expenses:									
Repairs and maintenance	4.31	1.23	2.21	2.87	3.57	3.59	4.78	4.43	2.94
Boat supplies	.45	.89	1.46	2.16	2.75	2.23	1.45	.65	.35
Fishing gear	2.25	.81	1.42	2.91	1.54	3.38	-	-	-
Insurance	1.33	-	-	-	-	.14	-	-	-
Depreciation	6.77	1.32	1.71	1.15	1.42	1.68	4.38	4.88	4.30
Interest	-	-	-	-	-	-	-	.19	-
License and tax	.55	-	-	-	-	-	-	.13	-
Miscellaneous	-	-	-	.20	.49	.81	.32	-	.52
Total boat expenses	15.66	4.25	6.80	9.29	9.77	11.83	10.93	10.28	8.11
Total expense	34.26	19.60	20.65	25.44	28.65	27.59	15.78	15.71	10.62

1/ Crew wages not included since boats were owner-operated. Data consequently are not comparable with those of other regions.

Boat expenses, item by item, are lower on motor boats than on vessels. Interest costs, with one exception, do not appear on the motor boat cost summary. Whether this is the result of the relatively modest capital investment required (cost at acquisition of motor boats on the Federal Trade Commission tabulations ranging from $1,000 to $3,500 fully equipped) which can be met by the owner himself or stems from a reluctance on the part of lending agencies to extend credit for the acquisition of these craft, could not be determined.

Comparison Between Iced and Freezer Vessels

Among the vessels in Region II (west coast of Florida), for which 1954 cost information was obtained, was one unit which had a freezer installation on board. While this vessel sustained a net loss during this year of depressed prices (data for other years would have to be gathered before the economics of this type of operation can be properly assessed) the data permit a rough comparison with the operations of iced vessels fishing out of the same ports and making the Campeche trip.

The freezer vessel not only was able to obtain a better price for its catch but also managed to save on trip expenses as compared to the iced vessels. In contrast to these advantages is the substantially greater depreciation charge in the case of the freezer vessel. This amounted to over 14 cents per pound, nearly three times the amount charged off annually to iced vessels.

INDIVIDUAL ELEMENTS OF FISHING COSTS

Trends in cost can be observed most readily by a comparison of average total costs. In order to identify the areas where economies may be effected, the average total cost must be broken down into its individual components.

There is little that can be done to effect savings in the short run as far as certain areas of cost are concerned. In other fields prospects for cost cutting are brighter. A thorough examination of the variables having a bearing on the magnitude of individual elements of cost is required before these fields can be discovered.

Thus, a study of fuel costs will lead to an evaluation of engine efficiency. A discussion of icing costs will involve a study of hold insulation. Sources of credit and financing problems have to be considered in connection with interest expense. A thorough analysis of these and other factors affecting individual elements of fishing costs would lead beyond the scope of this report. It will suffice to point out here the principal considerations in a study of cost economies.

Trip Expense

Heading

Proceeds from catch are affected by whether or not heading is done on board ship. In some locations on the south Atlantic and in the northern Gulf area where shrimp are landed heads-on, a fixed charge is deducted from the price paid to the fisherman.

Crew Wages

Crew wages depend on the method of compensation prevailing locally. The principal methods of paying vessel labor were discussed in Chapter III - Agents of Production.

Where the owner operates his own vessel without crew, as in two operations in the Carolinas surveyed by the Federal Trade Commission, the amount otherwise paid in wages to captain and crew accrues to the owner-operator. In one instance, the owner-operator netted from $1,500 to $1,600 in both 1952 and 1953, but suffered a net loss of $60 in 1954 when his catches were consistently very low. On the basis of the data for this operation, it would appear that low productivity was responsible for the failure to attain a break-even catch. The favorable results of a similar operation in the same geographic area must be cited in contrast, where the owner-operator fishing without crew was able to net $3,126 in 1954 on a catch over 25 times as large as that of the other owner-operator.

Where the owner functions as captain and hires a crew, the net profit from operations includes whatever amount a hired captain would receive as compensation. Individual owner-captains fared differently in various locations, no two operations were exactly comparable. In 1954 some owner-captains suffered fairly substantial losses while others managed to net in excess of $10,000. Wages of hired crew members varied considerably depending upon the nature of the lay system, the number of fishermen employed on the vessel, and the success of operations. Total annual earnings of the crew members from the shrimp fishery in 1954, in some instances, were below $1,000 and at the other limit of the range, as high as $5,000.

Fuel, Ice and Groceries

Fuel and ice costs, to a varying degree, are borne by both boat owners and crew. Cost of ice, more frequently than not, is split between boat owner and crew, while costs of groceries, for the most part, are borne by the crew. Deviations from these practices, however, are common. In Alabama and Mississippi fuel and groceries are often deducted from receipts before the distribution of shares to the boat and crew is made. In Morgan City, Louisiana, gross receipts, in some operations, are split between boat and crew, the crew paying for all groceries and for one-half of the ice costs. Some crews operating out of Sabine Pass-Orange, Texas, receive one-half of the gross receipts from which all groceries and one-half of both ice and net repair costs are deducted.

As reported by the Bureau of Business and Economic Research of the University of Miami, fuel and ice costs were fairly uniform in some sections of the Gulf coast at the time the Bureau's survey was made. In Texas ice costs in the summer of 1955 averaged around $7.50 per ton loaded and fuel varied in price from 11 cents to 13 cents per gallon. Ice costs here were high compared with Tampa, Florida, where they were $5.50 per ton and Mississippi where they were $7.00 per ton. Fuel costs elsewhere were either about the same (Tampa: 11.5 cents per gallon) or higher (Mississippi: 14.9 cents). Some boat operators were able to secure discounts on these items by purchasing through the fleet with which they were affiliated. Costs were slightly lower in the more active southern ports than they were farther north.

Small local vessels, according to Harwell, Knowles and Associates, have fuel capacities from 250 to 600 gallons and ice capacities from 3 to 10 tons. The smaller of the off-shore vessels can load 600 to 1,000 gallons of fuel and 7 to 12 tons of ice. The larger Campeche type vessels have capacities of 2,500 to 11,000 gallons of fuel and 28 to 50 tons of ice.

Fuel, water, and ice capacities of shrimp vessels in the South Atlantic and Gulf region surveyed by Harwell, Knowles and Associates are shown in table IV - 41.

TABLE IV - 41.--MAXIMUM LOAD CAPACITY OF FUEL, WATER, AND ICE. SAMPLE OF 40 SHRIMP VESSELS, SOUTH ATLANTIC AND GULF STATES, 1954

Type of hull and length of vessel (Feet)	CAPACITY		
	Fuel (Gallons)	Ice (Tons)	Water (Gallons)
WOODEN			
30-47	250- 600	3-10	20- 150
48-55	600- 1,000	7-12	50- 150
56-62	700- 3,000	10-28	150- 350
63-69	2,500- 6,000	28-40	ca. 400
70-80	3,000- 9,000	36-45	ca. 900
81	8,000	(1)	(1)
96	10,000	50	(1)
STEEL			
64	9,000	40	2,200
70	10,000-11,000	50	1,000

1/ Not available.

An attempt was made to correlate length of vessel, type of engine, and horsepower with quantity of fuel used per fishing day, quantity used annually, and quantity used per pound of shrimp taken. The tabulations for the limited data available are shown below.

TABLE IV - 42.--AVERAGE NUMBER OF GALLONS OF FUEL USED ANNUALLY, PER FISHING DAY AND PER POUND OF SHRIMP TAKEN, BY LENGTH OF VESSEL, SELECTED SOUTH ATLANTIC AND GULF STATES SHRIMP VESSELS, 1954

Vessel length (feet)	Number of vessels	Average gallons used annually	Average gallons per fishing day	Average gallons per pound of shrimp caught
42-46	1	12,254	61.9	.33
47-51	4	12,531	59.1	.31
52-56	2	12,786	55.0	.29
57-61	2	15,960	66.8	.30
62-66	1	27,458	131.4	.43
67-71	4	27,243	121.8	.34

TABLE IV - 43.--AVERAGE NUMBER OF GALLONS OF FUEL USED ANNUALLY, PER FISHING DAY AND PER POUND OF SHRIMP TAKEN, BY TYPE OF ENGINE AND HORSEPOWER, SELECTED SOUTH ATLANTIC AND GULF STATES SHRIMP VESSELS, 1954

Type of engine and horsepower	Number of vessels	Average gallons used annually	Average gallons per fishing day	Average gallons per pound of shrimp caught
Diesel				
77	1	10,780	42.4	.23
83	1	8,551	41.9	.22
100	1	14,792	65.4	.35
110	2	12,447	56.6	.32
120	5	24,252	110.0	.36
165	3	14,940	69.2	.34
170	1	31,198	125.3	.30

TABLE IV - 44.--TOTAL FUEL CONSUMPTION, CONSUMPTION PER NIGHT/DAY, AND PER POUND OF SHRIMP TAKEN, DATA FOR INDIVIDUAL SHRIMP VESSELS IN THE SOUTH ATLANTIC AND GULF STATES, 1954

Vessel	Tonnage		Dimensions in feet			When built	Engine		Net		Gallons of fuel			Fishing grounds
	Gross	Net	Length	Breadth	Depth		Type	Horse power	Size	Type	Total	Per day	Per lb. of shrimp caught	
							Key West, Florida							
A	26	11	44.8	16.0	6.3	1946	Diesel	165	62'	S.B.	16,679	76.2	.37	Tortugas Grounds
B	22	8	41.1	14.2	5.9	1948	Diesel	110	62'	S.B.	12,413	57.4	.35	Tortugas Grounds
C	28	11	46.1	16.2	5.4	1943	Diesel	100	62'	S.B.	14,792	65.4	.35	Tortugas Grounds
D	21	8	41.8	14.7	6.3	1947	Diesel	165	62'	S.B.	12,254	61.9	.33	Tortugas Grounds
E	48	33	52.8	15.9	8.3	1953	Diesel	165	65'	S.B.	15,887	68.7	.32	Tortugas Grounds
F	65	29	61.6	18.4	8.4	1953	Diesel	165	65'	S.B.	9,430	134.8	1/.34	Campeche Banks
G	63	28	58.7	18.5	8.2	1952	Diesel	120	65'	S.B.	8,602	108.8	1/.28	Campeche Banks
							Biloxi, Mississippi							
H	18	11	42.5	14.3	4.4	1944	Diesel	110	55'	B.	12,481	51.8	.29	Delta Area
I	49	33	57.1	17.6	6.4	1943	Diesel	120	64'	B.	16,032	61.2	.28	Delta Area
J	22	14	48.2	15.7	4.3	1942	Diesel	77	52'	B.	10,780	42.4	.23	Delta Area
K	16	10	42.9	14.3	4.5	1945	Diesel	83	56'	B.	8,551	41.9	.22	Delta Area
							Brownsville, Texas							
L	53	23	59.9	18.5	6.9	1951	Diesel	120	86'	F.	25,717	137.9	.48	Banks off Brownsville
M	57	25	54.2	18.9	8.2	1950	Diesel	120	86'	F.	27,458	131.4	.43	Banks off Brownsville
N	57	23	59.5	17.9	7.7	1951	Diesel	120	86'	F.	27,822	115.9	.33	Banks off Brownsville
O	57	23	59.5	17.9	7.7	1951	Diesel	120	86'	F.	24,233	114.3	.30	Banks off Brownsville
P	72	35	64.8	19.7	7.4	1952	Diesel	170	86'	F.	31,198	125.3	.30	Banks off Brownsville
Q 2/	73	34	66.9	19.0	9.2	1954	Diesel	330	110'	F.	17,000	204.8	1/.41	Banks off Brownsville

1/ September through December only.

2/ Steel.

S.B. - Semi-balloon.
B. - Balloon.
F. - Flat.

Details for individual operations as well as for different home ports are shown in table IV - 44.

Vessels ranging from 40 to 60 feet in length on the average consumed between 12,000 and 16,000 gallons of fuel annually. Average consumption per hour at sea, according to the figures per 12-hour fishing day shown in the table, was approximately five gallons for these vessels. Per pound of shrimp taken, fuel consumption averaged close to one third of a gallon. The vessel in excess of 60 feet in length consumed on the average over 27,000 gallons of fuel annually and at least 10 gallons per hour at sea. In terms of the number of pounds of shrimp taken, fuel consumption of the larger vessels, except in one instance, did not differ appreciably from that of the smaller vessels.

Engines with less than 100 horsepower were significantly more economical than the larger engines. Two of these smaller engines had an average annual consumption of fuel of about 10,000 gallons and an hourly consumption of less than four gallons. Consumption per pound of shrimp taken, in these operations, was slightly more than one-fifth of a gallon. The average consumption of fuel of the bigger installations was appreciably higher, with 120-and 170-horsepower engines averaging approximately ten gallons per hour. Three 165-horsepower engines of a different make from the other more powerful engines were considerably more economical, consuming on the average less than six gallons per hour.

If it is assumed that the average cost of fuel at the time the survey was made, was between 11 and 13 cents per gallon, total annual fuel costs of the vessels making up the sample included in the two tabulations above ranged anywhere from about $1,000 to $4,000. Since the number of sample observations was considerably larger in the Federal Trade Commission study than in the Harwell, Knowles and Associates survey, the range of total annual fuel costs was consequently wider.

The amount of ice required to maintain a certain standard of quality depends on numerous factors, among which are the material used in the construction of the vessel (wood or steel), the capacity of the hold, the material used for the insulation of the hold, the time of the year, the size of the catch, and the type of ice used for chilling.

Among other factors, the length of time which the shrimp is to be stored in the vessel's hold will determine the amount of ice that must be carried. In Louisiana, the lugger-type vessel which shrimps for eight or ten hours occasionally carries no ice at all. In such case the shrimp are protected by an awning which is spread over the vessel's deck. Trips to Campeche require that the vessel carry 30 or more tons of ice.

Total annual consumption of ice on vessels for which data were obtained by Harwell, Knowles and Associates ranged from 169.5 tons for one vessel with a 7-ton hold capacity operating out of

Biloxi, Mississippi, to 432.6 tons for a vessel with a 37-ton hold capacity operating out of Brownsville, Texas. Consumption was lowest during the January-April period and was highest during the months of May through August. Ice consumption of Biloxi, Mississippi, vessels which ranged from 6.4 to 7.9 pounds of ice per pound of shrimp was lowest during the summer months, in terms of pounds of shrimp caught, because of the large quantity of shrimp landed then. In the same period Key West, Florida, vessels and vessels operating out of Texas ports used from 10.5 to 18.0 pounds of ice per pound of shrimp caught. Variations in consumption between individual vessels are shown in table IV-45.

Vessels with insulated holds are substantially more economical in their consumption of ice than uninsulated vessels. (see table IV - 45) A preference was expressed by some vessel owners for foam plastic as insulating material. On the basis of their observations Harwell, Knowles and Associates made the following recommendations with respect to icing and insulating methods:

(1) Avoid insulating material that is likely to crumble and form voids when adjacent to ribs.

(2) Reduce vapor and conductivity by putting two layers of 30-pound asphalted felt on hull and bulwarks.

(3) Seams formed by insulating material slabs should overlap to avoid air gaps.

(4) The slabs should be secured to each other with an adhesive such as hot tar, or other suitable compound, rather than by nails driven into the hull planking.

(5) It is important that a proper balance be struck between the need for reduced temperature and the need for the bathing of the shrimp in water from the melting ice. Too heavily insulated holds will preserve the catch but will result in the formation of "black spot" on the shrimp shell since adequate water film will not form to protect the shrimp against access to oxygen. Three-inch insulation of the hull and four-inch of the deck and engine room bulkhead appears to approximate this balance. An additional inch is recommended for steel hulled vessels.

(6) An alternate and perhaps better method of insulation can be employed. The insulation in bins can be increased so as to reduce meltage of unused stocks of fresh ice to a minimum and provide a vent to let a controlled amount of warm air into bins where shrimp are already iced. This will permit proper bathing of the shrimp and at the same time conserve ice not in use.

Recently, antibiotic ices have been developed which extend the keeping life of shrimp four to six days (Camber, 1955). The application of such ices to commercial catches, however, is still barred by Federal Law.

TABLE IV - 45.--TOTAL ICE CONSUMPTION, CONSUMPTION PER NIGHT/DAY, AND PER POUND OF SHRIMP TAKEN,

SEASONAL DATA FOR INDIVIDUAL SHRIMP VESSELS IN THE SOUTH ATLANTIC AND GULF STATES, 1954

Vessel	Insulation	January - April			May - August			September - December			
		Tons ice	Pounds ice per night	Pounds ice per pounds shrimp	Tons ice	Pounds ice per night	Pounds ice per pound shrimp	Tons ice	Pounds ice per night	Pounds ice per pound shrimp	Hold capacity tons
Key West, Florida											
A	Bulkhead	64.5	1,616	10.7	99.7	2,588	18.0	48.8	1,659	8.1	7
B	Alfoil	69.2	1,707	8.7	99.5	2,318	12.6	84.0	2,584	9.7	27
C	none	64.7	1,882	9.8	87.1	2,419	15.1	66.0	2,316	10.8	10
D	Bulkhead	88.6	2,364	10.4	82.5	2,615	14.8	109.1	2,692	13.2	n.a.
E	Bulkhead	58.3	1,667	8.3	83.7	1,951	12.7	73.0	2,087	9.5	11
F	Foam plastic	33.7	924	4.4	n.a.	n.a.	n.a.	44.3	1,340	4.7	8
G	Foam plastic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	84.4	2,413	6.2	30
H	Foam plastic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	83.8	2,122	5.4	n.a.
Biloxi, Mississippi											
I	Bulkhead	39.5	1,039	14.8	88.5	2,391	7.2	41.5	1,537	8.5	7
J	Bulkhead	35.0	886	9.4	64.0	1,855	6.4	79.0	1,490	8.1	8
K	Bulkhead	63.0	1,312	11.2	92.0	2,389	7.6	75.0	1,685	6.9	10
L	Bulkhead	35.5	855	11.1	74.0	1,922	7.9	71.0	1,753	7.8	7
Brownsville and Freeport, Texas											
M	Rock wool	90.5	2,082	11.3	177.0	4,530	13.2	138.5	3,700	6.6	28
N	n.a.	95.2	2,540	13.6	152.1	4,066	16.4	139.2	n.a.	n.a.	n.a.
O	Spun glass	115.5	3,500	12.2	121.6	3,426	13.4	150.4	4,012	7.1	28
P	Cork	122.4	2,781	16.0	97.8	3,104	10.5	142.3	3,753	8.1	28
Q	n.a.	87.9	2,344	13.0	126.1	3,656	14.7	136.6	4,204	8.1	28
R	n.a.	109.6	2,674	9.7	154.3	3,811	12.4	168.7	3,924	6.0	37
Port Isabel, Texas											
S	Foam plastic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	186.4	4,493	9.3	50

n.a. - not available.

(7) Ice used for preservation should be made of certified pure de-mineralized water. Metal ions in the ice will assist the formation of black spot. Research by the Marine Laboratory of the University of Miami (unpublished) has shown that clear ice which was aerated while being frozen contained from two to three times as much oxygen when melted as the non-aerated opaque ice. The latter is recommended and is currently being used by many vessels of the Tampa fleet.

(8) Chilling imparted per unit of time is a function of the surface area of the chilling agent and its temperature. The smaller the ice particles, the greater the area in contact with the shrimp. Observations made at the Marine Laboratory indicate that flat ice surfaces are more efficient than round surfaces in chilling shrimp. Finely crushed ice preserves shrimp for two or three days longer than the larger "rickey" ice particles.

In many areas the nightly needs of ice in insulated holds may be supplied by one-ton flake ice machines. Such machines are very compact and are reported in use aboard a number of fishing vessels in France. In the domestic fleet such machines would prove particularly useful to the small Atlantic seaboard vessels which, since they rarely fill their hold to capacity, might do with half-ton units.

Variations in grocery costs between different operations are explainable in terms of the different agreements for compensating crews. Where the crew buys its own groceries before going out on a trip and the boat owner does not share in the cost, no charges for this item will be found on the books of the vessel operators. Where receipts are divided after deduction of grocery costs, the boat owner assumes at least a portion of the costs. In some instances, particularly in the case of longer trips involving a considerable outlay for groceries, the boat owner guarantees payment of groceries purchased by the crew. The boat owner under these circumstances assumes at least a contingent liability for the payment.

Packing and Unloading

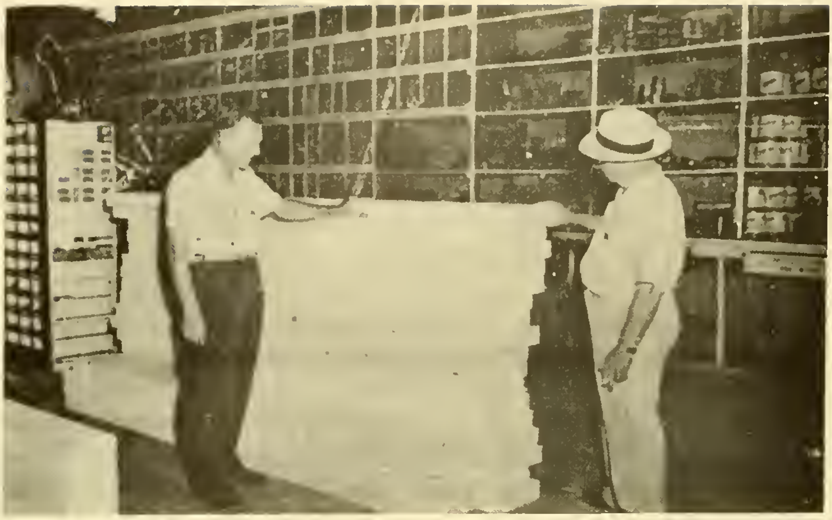
Packing and unloading costs are defrayed by the boat owner where these operations are performed by a shrimp plant which does not take title. Where the shrimp plant takes title or where packing and unloading is performed in facilities owned by integrated companies, these costs are not properly chargeable to the boat. Where packing and unloading is done on a custom basis for the independent boat owner, the charges made will vary considerably depending on the type of service performed by the shrimp plant. In Mississippi the shrimp plant--at the time the Bureau of Business and Economic Research of the University of Miami (1955) made its survey--was receiving 6-1/2 cents per pound of shrimp handled for unloading, washing, grading, heading, and readying the shrimp for the freezer. In Alabama a charge of 4-1/2 cents covered washing and packing costs. In Florida ports, according to the same source, the charges were 3 cents plus 1/2 cent extra for boats that landed catches of other boats. On the total fee the shrimp plant reportedly realized a net profit averaging one cent. In Texas, shrimp plant charges tended to grow smaller from north to south.

Processing charges which included costs of unloading, washing, grading, and packing for removal by trucks, averaged three cents per pound except in the Brownsville-Port Isabel area where they were only two cents. This difference was accounted for by the fact that in Brownsville-Port Isabel the shrimp were iced loose in the removing trucks whereas elsewhere the shrimp were packed, as a rule, in 100-pound boxes. An additional charge of one cent per pound was charged by shrimp plants for trucking to the processing plants. Ordinarily such costs are assumed by the buyer rather than the boat owner. In Brownsville, Texas, the boat owner has to pay a fee of $1.00 per day for dock space to the Brownsville Navigation District. (In addition, the raw shrimp plant is charged $1.00 per foot per month for waterfront privileges, one percent of catch value per ton unloaded, and has to pay a fee for fuel and ice loaded over Brownsville docks). The services made available to the fisherman at the Brownsville facilities were described in Chapter II, page 104.

The foregoing may explain the wide variations in unloading and packing costs collected by the Federal Trade Commission accountants. Depending on the type of services performed by the raw shrimp plant and the quantity of shrimp handled, the total costs incurred by boat owners in 1954 in connection with the packing and unloading of catch ranged from comparatively modest amounts to close to $3,500 per boat.

Boat Expense

The principal items of boat expense are repairs and maintenance, boat supplies, fishing gear, depreciation, interest and insurance. The classification of some of these items among fixed costs is somewhat arbitrary. The size of maintenance and repair costs is connected with the operation of the vessels. A boat will undoubtedly undergo more wear and tear when it is in operation than when it is tied up at the dock, making at least a portion of the total amount charged to this expense category variable. On the other hand, certain maintenance expenses will exist, regardless of whether the boat is actually shrimping or not. Proper maintenance requires that the boat be periodically dry-docked and its bottom scraped and painted; the interval between such maintenance operations does not vary according to the use to which the boat is put.



Examining insulating material.

Three-inch-thick insulation protects
the new shrimper's fishhold.

FIGURE NO. IV - 40.

Southern Fisherman.

Repair and Maintenance

Expenditures for repair and maintenance vary considerably from vessel to vessel. Condition of equipment, personal characteristics of the vessel operator, and even market conditions, will have a bearing on money and effort expended in keeping floating equipment in good repair. Some operators will schedule repairs on a regular basis, others will wait until a breakdown occurs before ordering major overhauls. When the market is weak, as during 1954, repairs were frequently postponed, as reported to the field investigators of the Bureau of Business and Economic Research of the University of Miami. The one phenomenon generally observed was the greater attention given to maintenance tasks by owner-operators than by hired crews.

Fishing Gear

Fishing gear costs will depend on such factors as number, type, and size of nets carried aboard, terrain fished, navigational aids on vessels, and skill of crew.

A 2-1/2-inch stretch cotton netting is commonly used throughout the industry. State regulations governing the mesh of nets allow, in most instances, a smaller mesh (1-1/2-inch stretch) and sport fishermen trolling for smaller shrimp often use a closer mesh. Nets may be of almost any size. Legal requirements and the size of the boat pulling the net usually have some bearing on size. One hundred twenty feet measured along the cork line seems to be an effective length for efficient shrimping although some larger nets may be seen in operation. In the summer of 1955 netting cost about $3.75 per pound. Commercial boats, with the exception of smaller boats operating close to shore in the Atlantic, carry at least two nets at all times.

The durability of a net is dependent on the type of bottom which is being shrimped and upon the skill of the fisherman. Experiments are now being made with a nylon netting which is considerably stronger than cotton. Nylon is more expensive than cotton but is lighter in weight and is considered to be substantially more durable.

Boat Supplies

Annual expenditures on spars and rigging which in the Federal Trade Commission cost tabulations are listed separately under the caption of boat supplies can be substantial, as statements for individual operations bear out. The high charges in such instances, may be due to the peculiarity of the accounting methods used by the vessel operator. There is reason to assume that at least a portion of the charge should have been capitalized or transferred to a miscellaneous expense category.

Depreciation

Depreciation rates have to be charged separately on hull, engine, and special equipment. In the Federal Trade Commission sample of vessels, depreciation rates on the hull of the vessel varied from 4 to 16-2/3 percent, on the engine from 12-1/2 to 30 percent, and on other equipment from 10 to 33-1/3 percent. In many instances a portion of the cost of special equipment was charged off at one rate and the remainder at another. The 10 percent rate for hull depreciation seems to be most common indicating an estimated service life of 10 years for a large portion of the fleet.

Depreciation schedules for the vessel operations in the Federal Trade Commission data are shown in table IV - 46.

Interest--Boat Financing

Inability to obtain adequate financing plays an important part in impelling fishermen to affiliate with fleets. The perils that shrimp fishermen with insufficient financial reserves are exposed to became apparent during the price break in 1954. Unfavorable shrimp prices at that time made it impossible for many boat owners to meet financial obligations and many boats were lost through foreclosure proceedings as a result.

Financing of individual vessels is done primarily through commercial banks. The banks' policies with regard to financing have varied with the shrimp market itself, being alternately lenient and strict. A write-off period of from three to five years is common. It is probably this relatively short financing period which presents the greatest problem to the individual boat owner. Many vessels currently being built cost forty to forty-five thousand dollars. The amortization of this amount in such a short time is feasible as long as production and prices remain relatively good. If a bad season is encountered or if production so outruns demand as to cause a sharp price reduction, payments can be met only with difficulty.

The shrimp fishery at times suffers from credit strictures. The banks in the southern States require amortization of their loans over a maximum period of five years and more often over a period of three years. The policy of the banks is to require the highest percentage possible of the revenue of each trip, for repayment of a loan. This policy may be designed to avoid the criticism of bank examiners employed by the United States Federal Reserve Banks. However, the need of repaying large amounts in comparatively short periods is an incentive to catch the largest amount of shrimp possible without regard for the principles of conservation and the maintenance of the fishery resources as a perpetual source of income for future generations of fishermen. The requirement to pay up loans as quickly as possible is even more stringent in

TABLE IV - 46.--VESSEL DEPRECIATION SCHEDULES,
FEDERAL TRADE COMMISSION COST STUDY

Vessel	Length and rated capacity		Year acquired			Cost when acquired				Rate of depreciation			Total annual depre-ciation
	Length	Net tons	Hull	Engine	Other equipment	Hull	Engine	Other equipment	Total	Hull	Engine	Other equipment	
Region I - South Atlantic States													
A - 1954	34'	6	1943	-	-	1/$600	-	-	$600	10%	-	-	-
B - 1954	36'	8	1951	-	-	1/1,200	-	-	1,200	10%	-	-	$120
2/C - 1954	49'	19	1947	-	-	1/22,859	-	-	22,859	10%	-	-	2,286
2/C - 1954	49'	13	n.a.	1954	-	n.a.	$5,400	-	5,400	(3)	33-1/3%	-	1,800
D - 1954	45'	12	n.a.	-	-	n.a.	-	-	-	-	-	-	1,004
E - 1954	46'	13	n.a.	-	-	n.a.	-	-	-	-	-	-	965
F - 1954	42'	8	n.a.	-	-	n.a.	-	-	-	-	-	-	1,138
G - 1954	51'	23	n.a.	-	-	n.a.	-	-	-	-	-	-	1,391
2/H - 1954	57'	23	1948	1948	-	1/19,000	-	-	19,000	10%	-	-	1,900
2/H - 1954	63'	21	1953	1953	-	16,000	8,000	-	24,000	20%	10%	-	4,000
I - 1954	40'	6	1948	1948	-	2,500	600	-	3,100	10%	(2)	-	250
Region II - Florida West Coast													
A - 1954	39'	28	n.a.	n.a.	n.a.	-	-	-	-	-	-	-	$2,141
B - 1954	39'	28	n.a.	n.a.	n.a.	1/$35,125	-	-	$35,125	10%	-	-	4/1,767
Region III - East Gulf Coast													
A - 1954	47'	17	1948	1948	1948-1952	$20,220	-	$1,100	$21,320	10%	-	20-33-1/3%	$2,303
B - 1954	58'	16	n.a.	-	-	n.a.	-	-	-	-	-	-	1,579
C - 1954	47'	10	n.a.	-	-	n.a.	-	-	-	(3)	-	-	-
D - 1954	52'	27	1948	1948	-	6,875	$4,500	-	11,375	(3)	-	-	-
E - 1954	49'	10	1944	-	-	1/15,000	-	-	15,000	8%	-	-	1,200
F - 1954	42'	6	1946	1946	-	1/9,000	-	-	9,000	8½%	-	-	1,000
G - 1954	39'	7	1947	1950	1953	10,000	1,000	409	11,409	10%	10%	10%	1,159
H - 1954	n.a.	n.a.	1949	1949	1949	1/14,000	-	-	14,000	5%	-	-	700
I - 1954	41'	11	1950	1950	-	10,500	-	-	10,500	10%	(3)	-	1,050
J - 1954	65'	22	1948	1948	1951	8,000	11,500	2,200	21,700	10%	20%	10%	1,251
K - 1954	42'	12	1946	1946	1953	7,000	-	8,528	15,528	10%	-	20-33-1/3%	1,663
L - 1954	37'	7	1951	1952	-	3,867	1,200	-	4,067	10%	5%	-	387
Region IV - Texas													
A - 1952	54'	21	1948	1948	1948	5/$25,000	-	$378	$25,378	8-1/3%	-	20%	$2,159
B - 1952	54'	21	1948	1948	1948	5/25,000	-	378	25,378	8-1/3%	-	20%	2,159
C - 1952	47'	12	1947	1947	1947	5/22,500	-	348	22,878	8-1/3%	-	20%	1,951
D - 1952	57'	33	1949	1949	1949	5/19,500	-	500	20,000	10%	-	20%	2,050
E - 1952	33'	7	1945	1945	1945	1/2,550	-	-	2,550	10%	-	-	255
F - 1954	59'	29	1951	1951	1953-1954	5/27,500	-	5,509	33,009	11.11%	-	25%	4,007
G - 1954	56'	25	1950	1950	1950	22,159	$8,381	2,000	32,540	10%	20%	20%	4,292
H - 1954	90'	92	1952	1952	1942	16,000	8,000	8,039	32,039	10%	25%	25-33-1/3%	5,019
I - 1954	51'	17	1952	1952	-	10,658	8,220	-	18,878	8½%	16-2/3%	-	2,258
J - 1954	50'	23	1951	1951	1951	12,000	8,000	1,610	21,610	8½%	16-2/3%	25%	2,736
K - 1954	52'	22	n.a.	n.a.	1952	n.a.	n.a.	3,383	3,383	(3)	(3)	8½-25%	535
L - 1954	51'	21	1952	1952	1952	5/17,000	-	2,277	19,277	20%	-	20-25%	3,928
M - 1954	61'	40	1950	1950	1950	13,600	6,400	4,974	24,974	16-2/3%	12½%	12½-25%	2,450

1/ Covers cost of vessel complete. 2/ Operating cost combined. 3/ Fully depreciated.
4/ Six months operations ending December 31, 1954. 5/ Cost of hull and engine. n.a. - not available.

cases where vessel loans are given, not for certain time periods, but on a demand basis with an arrangement that repayments are to be made in accordance with the owner's income from the vessel, but not later than 36 months.

Most vessel loans in the Gulf States are secured by a preferred mortgage which is registered at the Custom House where the boat is registered. Vessels on which loans are given must be covered by full marine insurance. They must also be covered by protection and indemnity policies. These insurance expenditures are very high. Part of the loan must often be used not only for acquisition of the vessel but also for the first year's insurance payments.

The reasons why the banks do not extend longer credits are manifold. Among these reasons the following should be mentioned:

(1) Commercial banks can only allow part of their deposits to be used for long term loans because they have received most of the deposits under the condition that they can be withdrawn by the depositor without notice.

(2) Very few banks have enough experience in the fishing business to make the type of loans which are requested for fishing vessels. Reference is made to the words of W. F. Aberly, vice-president, Gibbs Corporation, expressed in the November 1953 meeting of the Gulf and Caribbean Fisheries Institute "... this stringent requirement by the bankers is the result, not of a lack of confidence in the shrimp industry, but of a lack of knowledge of the industry, its operations, marketing techniques, etc., due in great measure to the reluctance of the industry to bring the bankers into its confidence."

(3) Commercial banks regularly ask for additional security since the boat owner is often unable to obtain adequate insurance coverage against loss. In many cases the additional security consists of an endorsement of the note by the construction company which has built the vessel. This company often guarantees the obligation of the fishermen, who bought the vessel and mortgaged it.

To date the Maritime Administration (formerly Maritime Commission) alone among government agencies has had the power to guarantee payment to commercial banks or other financial institutions which lent money to the fishing industry for the construction of vessels. A statute of June 29, 1936 established the Federal Ship Mortgage Insurance System under which the Maritime Administration was enabled to insure mortgages for construction or reconditioning of fishing vessels. In spite of this opportunity to obtain insurance on loans only a few tuna vessels have qualified in the past to obtain this protection under the Federal Ship Mortgage Insurance Act of 1936.

In earlier years the predecessor of the Maritime Administration, the Maritime Commission, was approached several times with the request to insure mortgages on shrimp vessels and New England trawlers, but without success. Requests were denied because of (1) instability of the fishing trade, (2) inadequate standards maintained in the construction of the vessel in question, or (3) exhaustion of the guarantee fund.

In the course of a conference called at the request of the industry on January 6, 1955, the Maritime Administration expressed its readiness to insure mortgages given for the construction or reconditioning of shrimp vessels. Among the reasons which prompted this decision were: (1) shrimp vessels of today are big modern boats, the construction of which involves a substantial investment. They are equipped with modern navigation equipment including radio, loran, depth finders, etc., (2) the experience of commercial banks with the financing of shrimp vessels has been good, (3) there is a distinct need for reconditioning vessels in many instances, (4) modernization of the fleet is considered to be in the national interest.

Unfortunately, few vessel owners have taken advantage of the provisions of this plan to date. One of the main reasons for this reluctance is a feeling that too much red tape is involved in obtaining a guarantee. Nevertheless, a step in the right direction was taken. The most significant consequence of the agreement of January 1955 was that some shipbuilders as well as some local banks have adopted a five-year repayment plan on loans for shrimp vessels as compared with the previous three-year plan.

The enactment of the Fish and Wildlife Act of 1956 (70 Stat. 1119) provided another source of loan funds to fishing vessel owners and operators. Under the provisions of Section 4 (reproduced below) of this law, operators of shrimp vessels as well as operators of other fishing craft ought to find it comparatively easy to obtain adequate financing.

> SEC. 4. (a) The Secretary [of the Interior] is authorized under rules and regulations and under terms and conditions prescribed by him, to make loans for financing and refinancing of operations, maintenance, replacement, repair, and equipment of fishing gear and vessels, and for research into the basic problems of fisheries.
>
> (b) Any loans made under the provisions of this section shall be subject to the following restrictions:
>
> (1) Bear an interest rate of not less than 3 per centum per annum;

(2) Mature in not more than ten years;

(3) No financial assistance shall be expended pursuant to this section unless reasonable financial assistance applied for is not otherwise available on reasonable terms.

(c) There is hereby created a fisheries loan fund, which shall be used by the Secretary as a revolving fund to make loans for financing and refinancing under this section. Any funds received by the Secretary on or before June 30, 1965, in payment of principal or interest on any loans so made, shall be deposited in the fund and be available for making additional loans under this section. Any funds so received after June 30, 1965 (at which time the fund shall cease to exist), shall be covered into the Treasury as miscellaneous receipts. There are hereby authorized to be appropriated to the fund the sum of $10,000,000 to provide initial capital.

(d) The Secretary, subject to the specific limitations in this section, may consent to the modification, with respect to the rate of interest, time of payment of any installment of principal, or security, of any loan contract to which he is a party.

Suppliers of marine equipment and supplies have in the past been notably lenient about granting terms and extending payments. The drastic fall in shrimp prices in 1954, however, forced them to revise their policies, and many are now requiring payment on a strict 30-day basis. This fact is partially responsible for the trend back to fleet affiliation since affiliation often enables the individual fisherman to obtain financial backing from the fleet operator and thus purchase supplies on a term payment basis. Similarly, the position of the marketing cooperative has been strengthened by virtue of its ability to aid the boat owner in times of financial stress.

Insurance

In order to obtain financing for his boat the boat owner is required by the lending agency to carry both hull and protection and indemnity insurance. Insurance of this type is expensive. Rates range from as low as 3-1/2 percent of the value of the boat to as high as 18 percent. The insurance company uses varying criteria to determine the rate to be charged for the insurance, among which are age of the vessel, its condition, and type of ownership. Until recently, insurance companies have felt that boats that are fleet-affiliated are less subject to loss than are individually owned and operated vessels. This bias was predicated upon the belief that fleets exercise stricter control over the maintenance and repair of the vessels than do individual owners. The banks, however, in loaning on vessels, have historically judged the quality of the risk by the character of the vessel operator rather than by his affiliation. More recently, insurance companies have taken the same attitude.

Shrimp boat insurance at times has been highly unprofitable to the insurance companies. Many general agencies have ceased writing insurance on such vessels altogether. Losses were particularly high in 1954. There have been rumors in the industry connecting this situation with the fact that shrimp industry profits were particularly low in that year. Regardless of their validity, these allegations have had detrimental effects on the ability of fishermen to obtain insurance. In point of fact, the following observation can be made: the preceding year had been one of abnormally high profits and had attracted many newcomers to the industry. The use of less experienced crews, in some instances, may have had some bearing on the number of claims filed.

Whatever the reasons for it, the abnormally high loss ratio in shrimp vessel insurance forces premium rates up. Many boat owners do not carry insurance unless they must for purposes of financing.

The answer to the insurance dilemma is not clear-cut. Increased emphasis on crew training would undoubtedly reduce the loss ratio and result in a lowering of premium rates. The introduction of a new type of policy written especially for shrimp boats would also be beneficial, since existing marine insurance policies fail to take into account the special characteristics of the shrimp industry. Finally, a stabilization of the market for shrimp would make the shrimp fisherman a better insurance prospect by tending to effect a decrease in loss claims and policy lapses because of "bad years".

Some examples of 1952 premiums are cited as follows: for a wooden diesel shrimper valued at $25,000 (about one-half of the replacement cost), the insured paid 5.4 percent ($1,350) which included hull and limited protection and indemnity insurance for trips not exceeding 100 miles offshore. In a similar case the vessel was valued at $22,000 and the premium was $1,450 (6-1/2 percent); for a third vessel of this type valued at $20,000 ($200 deductible) the premium was $977.50 or 4.9 percent, for a marine research vessel of a university (hull coverage limited to $10,000, protection and indemnity limited to $100,000 for any one accident, $50,000 for any one person) the premium was $544.50. The policy in this instance covered the vessel only when used in coastal or inland waters.

The above data as well as premium costs for a few additional vessels are shown in table IV - 47.

TABLE IV - 47.--INSURANCE PREMIUMS FOR SELECTED COMMERCIAL SHRIMP AND RESEARCH VESSELS, 1952

Vessel type	Declared value	Total annual insurance cost	Premium	Remarks
	Dollars	Dollars	Percent of declared value	
Wooden diesel Shrimper A	$25,000	$1,350	5.4	Protection and indemnity limited to trips of 100 miles offshore.
Wooden diesel Shrimper B	22,000	1,450	6.5	Protection and indemnity limited to trips of 100 miles offshore.
Wooden diesel Shrimper C	20,000	978	4.9	Protection and indemnity limited to trips of 100 miles offshore-deductible clause $200.
Marine research vessel D	10,000	544	5.4	Only to be used in coastal or inland waters.
Marine research vessel E	25,000	1,250	5.0	Hull insurance only.
Shrimp vessel F	25,000	1,250	5.0	Restricted to 500 miles off Key West.

A large shrimp fleet operator at Brownsville, Texas paid 4.0 percent on hull insurance and 1.8 percent on protection and indemnity insurance. His fleet operates over the entire Gulf of Mexico. A similar large operator in Louisiana paid 4.2 percent for hull insurance and 2.8 percent for protection and indemnity insurance. However, his fleet includes menhaden vessels as well as shrimp vessels. A Tampa boat owner, operating a fleet of ten shrimp vessels paid 5.0 percent for hull insurance and 2.8 percent for protection and indemnity insurance. A large shipyard company in Jacksonville, Florida requests that the purchaser of a shrimp vessel carry insurance at the rate of 8.0 percent for hull and 2.5 percent for protection and indemnity coverage to be paid in accordance with a three-year installment plan.

Recently individual owners of shrimp vessels in the Gulf area have banded together, in some instances, to obtain insurance on their vessels at lower rates ranging from 4.75 - 3.25 percent for steel diesel vessels and from 5.75 percent to 4.25 percent for wood diesel vessels, the rates decreasing in proportion to the increase of the deductible clause.

Miscellaneous

Among the elements of cost which, in some instances, are not separately shown on the boat owner's cost statements are license fees paid to state authorities. Where license fees have to be paid to more than one jurisdiction, the amount shown on the cost statements under 'Miscellaneous Expenses' may be considerable.

COST COMPARISON 1942-1943 AND 1952-1954

In connection with a study of distribution methods and costs of important food products completed during World War II, the Federal Trade Commission obtained cost of production particulars for two shrimp fishing vessels for the years 1942 and 1943.

The two shrimp vessels operated out of ports located in the State of Louisiana. Data obtained for these two operations can be used as bench marks for a rough comparison of costs of producing shrimp in the war years with costs in the survey years 1952-1954. When the 1942-1943 data are checked against corresponding data for Region III (which includes State of Louisiana operations) it appears that prices and costs in the years 1952-1954 were approximately twice their corresponding wartime level. The boat owners' profit in this region averaged one-fifth of ex-vessel prices in both periods.

The relative importance of individual cost items as components of total cost appears to have undergone a significant change in the decade between survey years. Crew wages, grocery, and fuel costs represented larger proportions of the total expense dollar in 1952-1954 than in 1942-1943, while the reverse held true of fixed expenses and costs of ice.

BREAK-EVEN ANALYSIS

Profit and loss and break-even charts are simple and useful tools in analysis and control of business operations. These charts, in recent years, have found wider and wider application in industry. Ordinarily used in conjunction with each other, the two charts relate costs to sales and measure profit as a function of this relationship.

Among the many examples of the types of questions answered by profit and loss and break-even analysis the following may be cited:

(1) Are current costs in line with what could be expected on the basis of long-term trend?

(2) Given the current cost and price structure, what is the quantity of product that must be sold to break even?

(3) Given currently prevailing costs, how much will an increase in selling price add to profits (assuming that demand in the short run is relatively inelastic)?

The first of these questions can be answered by a glance at the profit and loss chart. This chart delineates the long term relationship between costs and sales and makes it possible to discover deviations from expected trend values for a particular year. For practical purposes, if it is decided that an excess of actual, over estimated, costs cannot be defended on grounds of fundamental changes in the cost structure of the operations under scrutiny, control measures can be initiated without delay.

While the profit and loss chart reflects how profit varied over a period of years and illustrates whether current results of operations are in line with general trends, the break-even chart focuses on operations during a single year and facilitates the assessment of the effects of alternative policies on profit showing. It is, therefore, ideally adapted to furnishing the answers to questions (2) and (3) above.

A break-even analysis for the shrimp industry is somewhat handicapped by the lack of representative cost data for years prior to 1952 as well as by the limited number of operations for which cost data were obtained by the Federal Trade Commission. Since cost information for three consecutive years (1952-1954) is not adequate for the construction of a profit and loss chart, the analysis below was confined to preparation of break-even charts for typical operations.

Break-even charts were constructed separately for vessels and motor boats. From the samples of operations surveyed in each year average values for catches, receipts, and costs were computed and break-even catches determined.

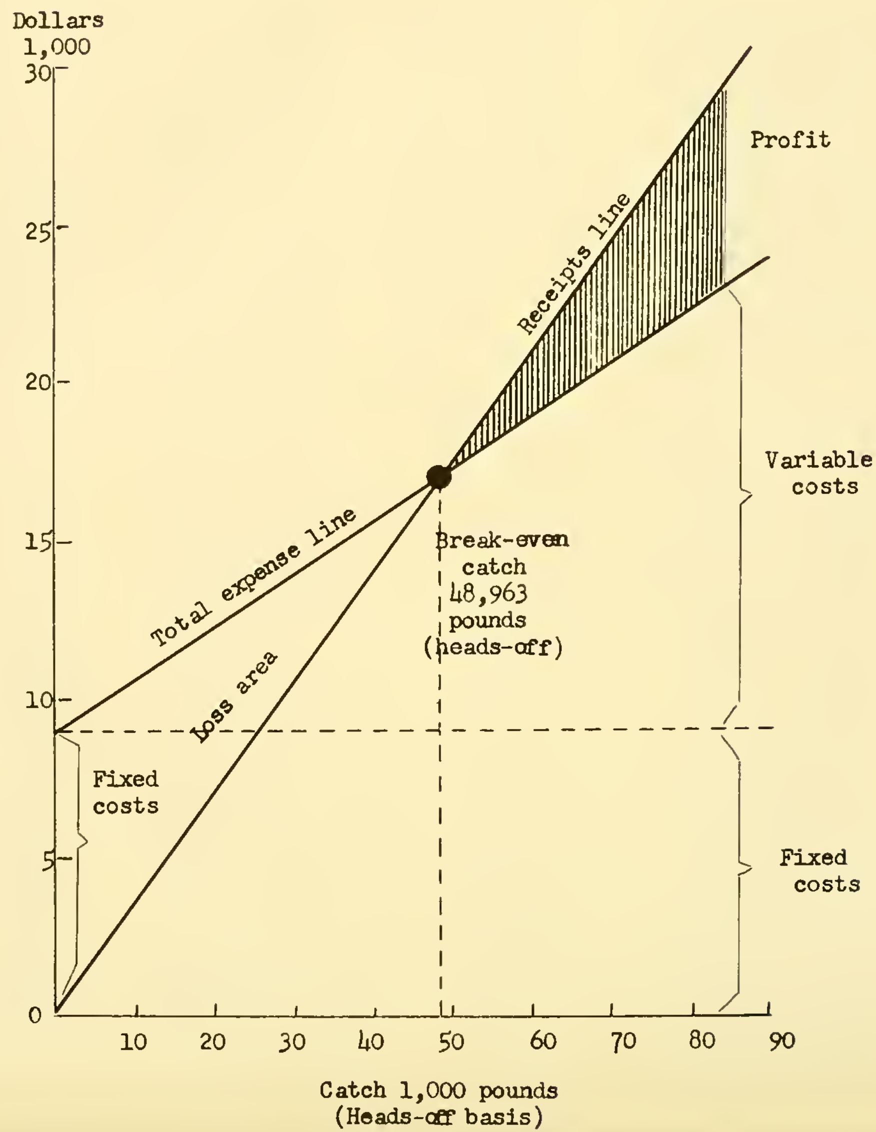
To permit comparison of data for successive years, charts were constructed for the 38 vessels in the Federal Trade Commission sample for which complete cost information for both 1953 and 1954 were available (see figures IV - 41 and IV - 42). In addition to these charts, break-even charts were also constructed for 7 motor boats (figures IV - 43, IV - 44 and IV - 45) for which complete information for 1952, 1953 and 1954 was available.

Average break-even catches of 7 motor boat operations, on the basis of the Federal Trade Commission data, were in the neighborhood of 6,900 pounds in 1952, about 4,800 pounds in 1953 and 6,200 pounds in 1954.

Compared to the data for vessels, the motor boat figures were lower in each instance. The two series of data, however, bear some resemblance to each other. The break-even points for vessels and boats alike moved at the same time and in the same direction during the three-year period studied.

An effort has been made to construct break-even charts for the fishery as a whole. For this purpose the ratios for boat (fixed) and trip (variable) expenses, to gross receipts for vessels and motor boats included in the Federal Trade Commission sample were computed separately for each year. The two ratios were then applied to total annual catch figures for each year to make rough estimates of total fixed and variable costs in shrimp production for these years. The resulting charts are shown below (profits, as shown, are before State and Federal income taxes) in figures IV - 46, IV - 47 and IV - 48.

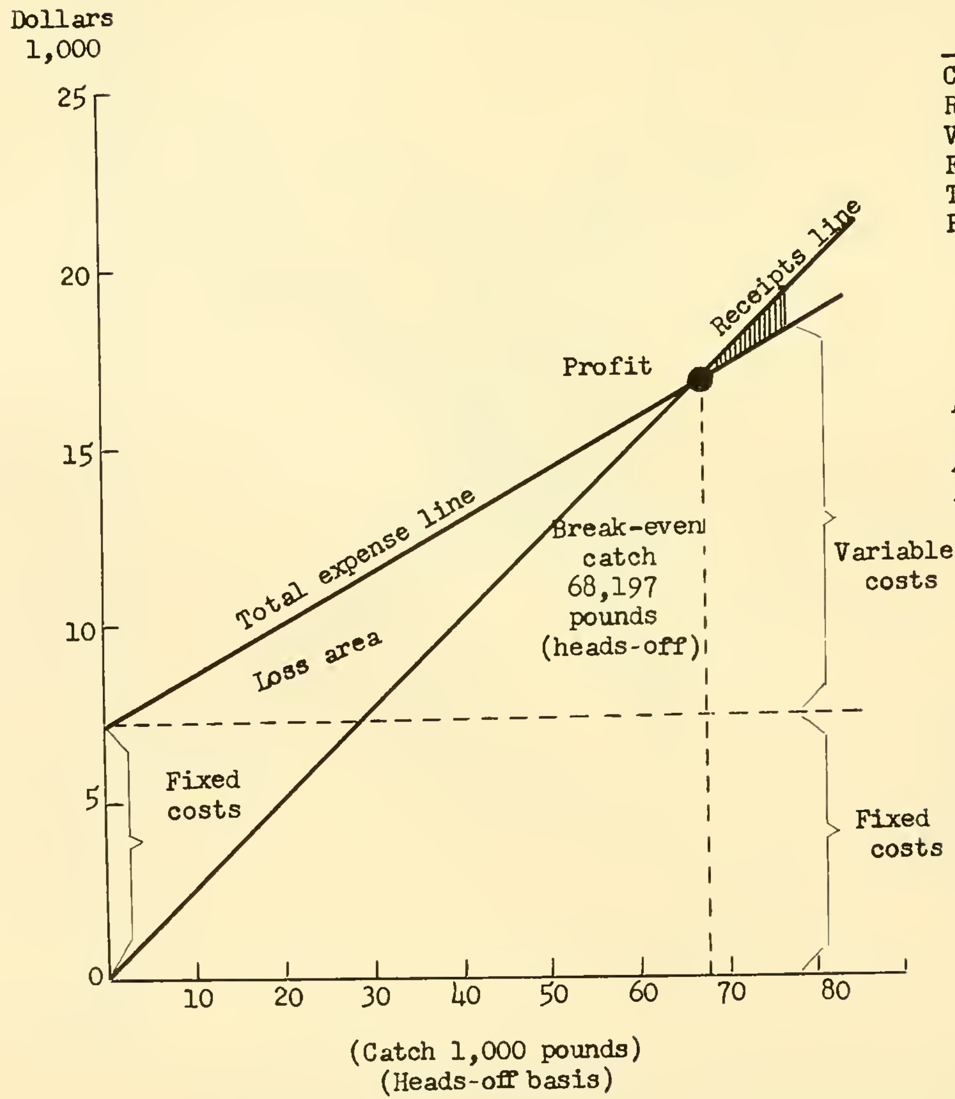
FIGURE IV - 41.--BREAK-EVEN CHART BASED ON AVERAGED DATA FOR 38 VESSELS ENGAGED IN SHRIMPING IN 1953



Average for 38 vessels		
Catch (heads-off)		84,575 pounds
Receipts		$29,526
Variable	Costs	$13,952
Fixed	Costs	$9,014
Total	Costs	$22,966
Profit		$6,560

	Cents per pound (heads-off)
Average ex-vessel receipts	34.9
Average total costs	27.2
Average profit (before Federal taxes)	7.7

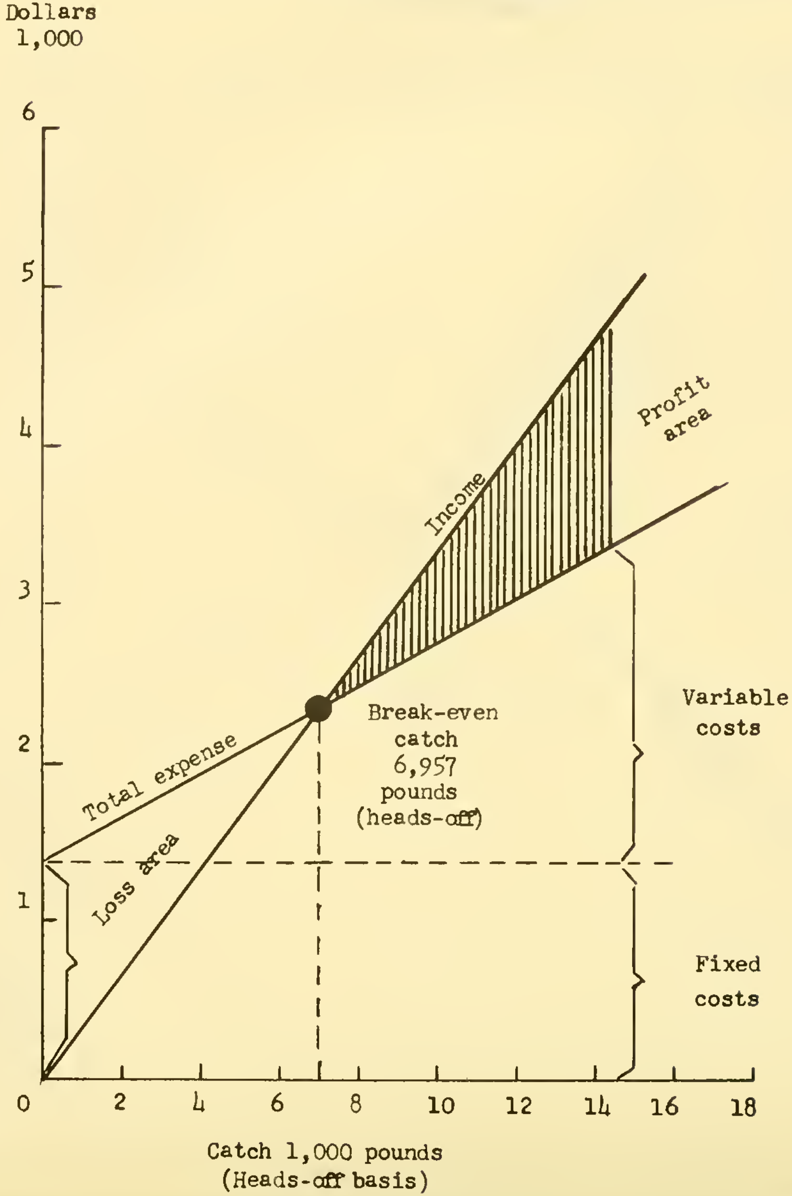
FIGURE IV - 42.--BREAK-EVEN CHART BASED ON AVERAGED DATA FOR 38 VESSELS ENGAGED IN SHRIMPING IN 1954



Average for 38 vessels	
Catch (heads-off)	77,001 pounds
Receipts	$19,054
Variable)	$10,772
Fixed) Costs	$7,338
Total)	$18,110
Profit	$944

	Cents per pound (heads-off)
Average ex-vessel receipts	24.7
Average total costs	23.5
Average profit (before Federal taxes)	1.2

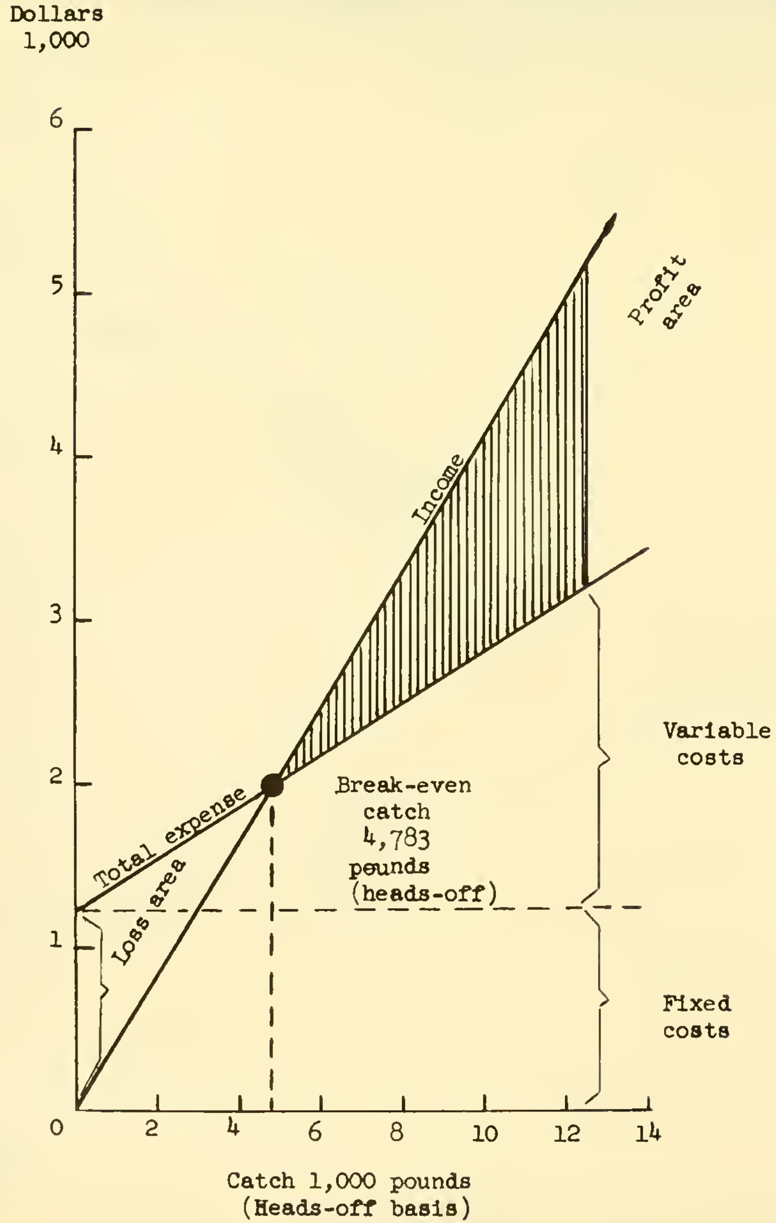
FIGURE IV - 43.--BREAK-EVEN CHART BASED ON AVERAGED DATA FOR 7 MOTOR BOATS ENGAGED IN SHRIMPING IN 1952, REGIONS III AND IV



Average for 7 motor boats	
Catch (heads-off)	14,287 pounds
Receipts	$4,816
Variable	$1,994
Fixed	$1,374
Total	$3,368
Profit	$1,448

	Cents per pound (heads-off)
Average ex-vessel receipts	33.71
Average total costs	23.57
Average profit (before Federal taxes)	10.14

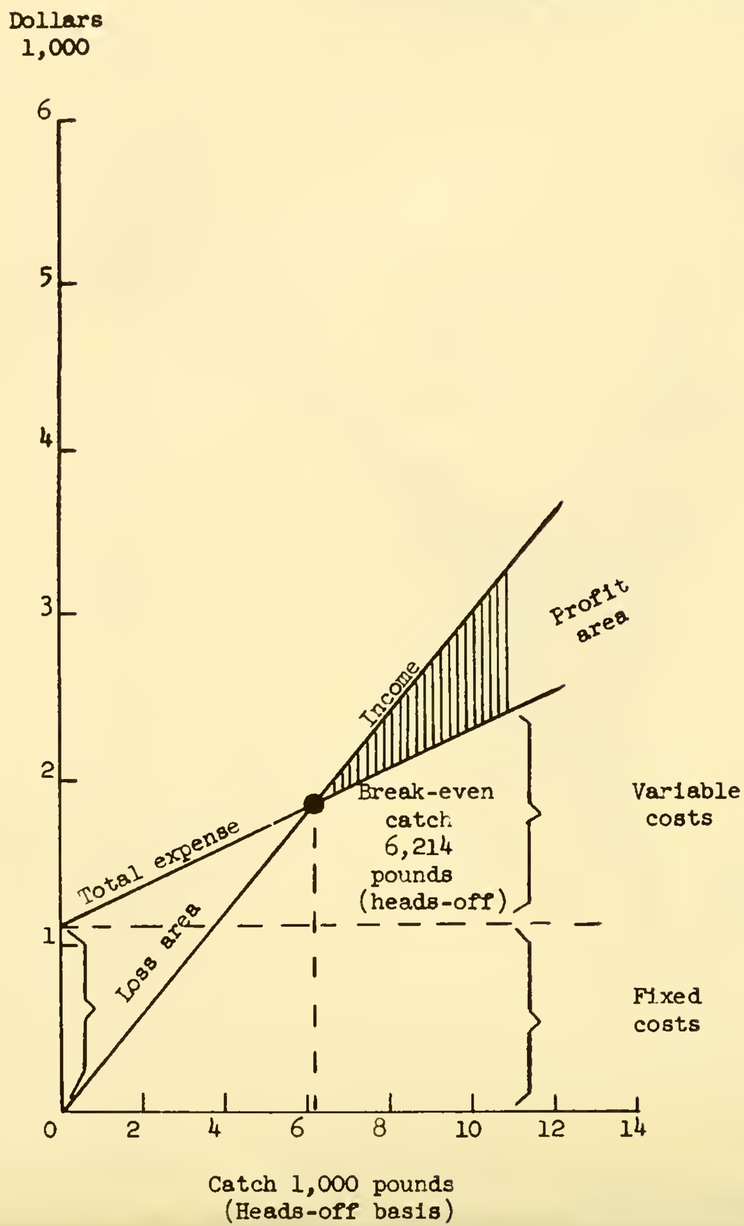
FIGURE IV - 44.--BREAK-EVEN CHART BASED ON AVERAGED DATA FOR 7 MOTOR BOATS ENGAGED IN SHRIMPING IN 1953, REGIONS III AND IV



Average for 7 motor boats	
Catch (heads-off)	12,460 pounds
Receipts	$5,177
Variable	$1,967
Fixed	$1,232
Total	$3,199
Profit	$1,977

	Cents per pound (heads-off)
Average ex-vessel receipts	41.55
Average total costs	25.67
Average profit (before Federal taxes)	15.88

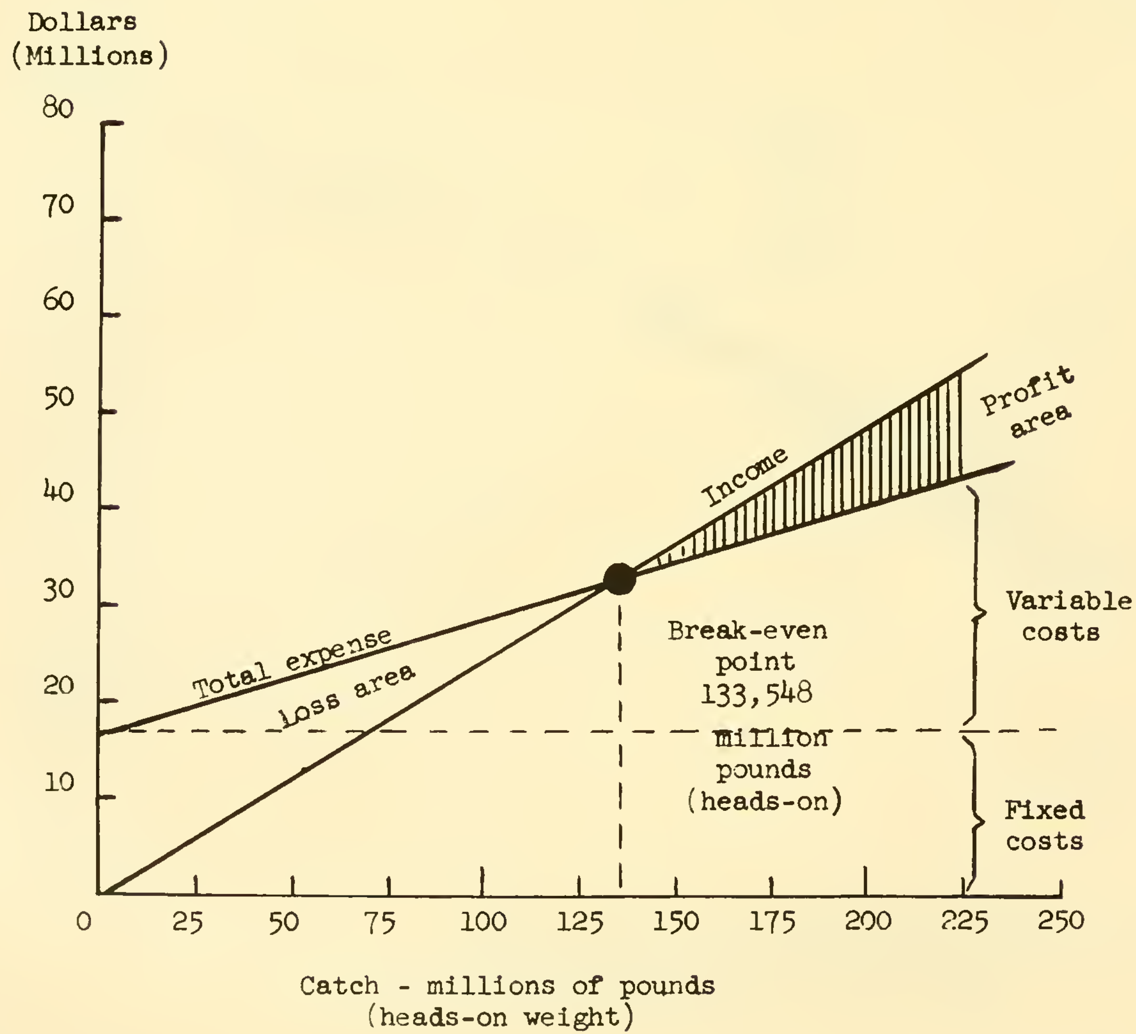
FIGURE IV - 45.--BREAK-EVEN CHART BASED ON AVERAGED DATA FOR 7 MOTOR BOATS ENGAGED IN SHRIMPING IN 1954, REGIONS III AND IV



Average for 7 motor boats	
Catch (heads-off)	10,803 pounds
Receipts	$3,256
Variable	$1,253
Fixed	$1,152
Total	$2,405
Profit	$ 851

	Cents per pound (heads-off)
Average ex-vessel receipts	30.14
Average total costs	22.26
Average profit (before Federal taxes)	7.88

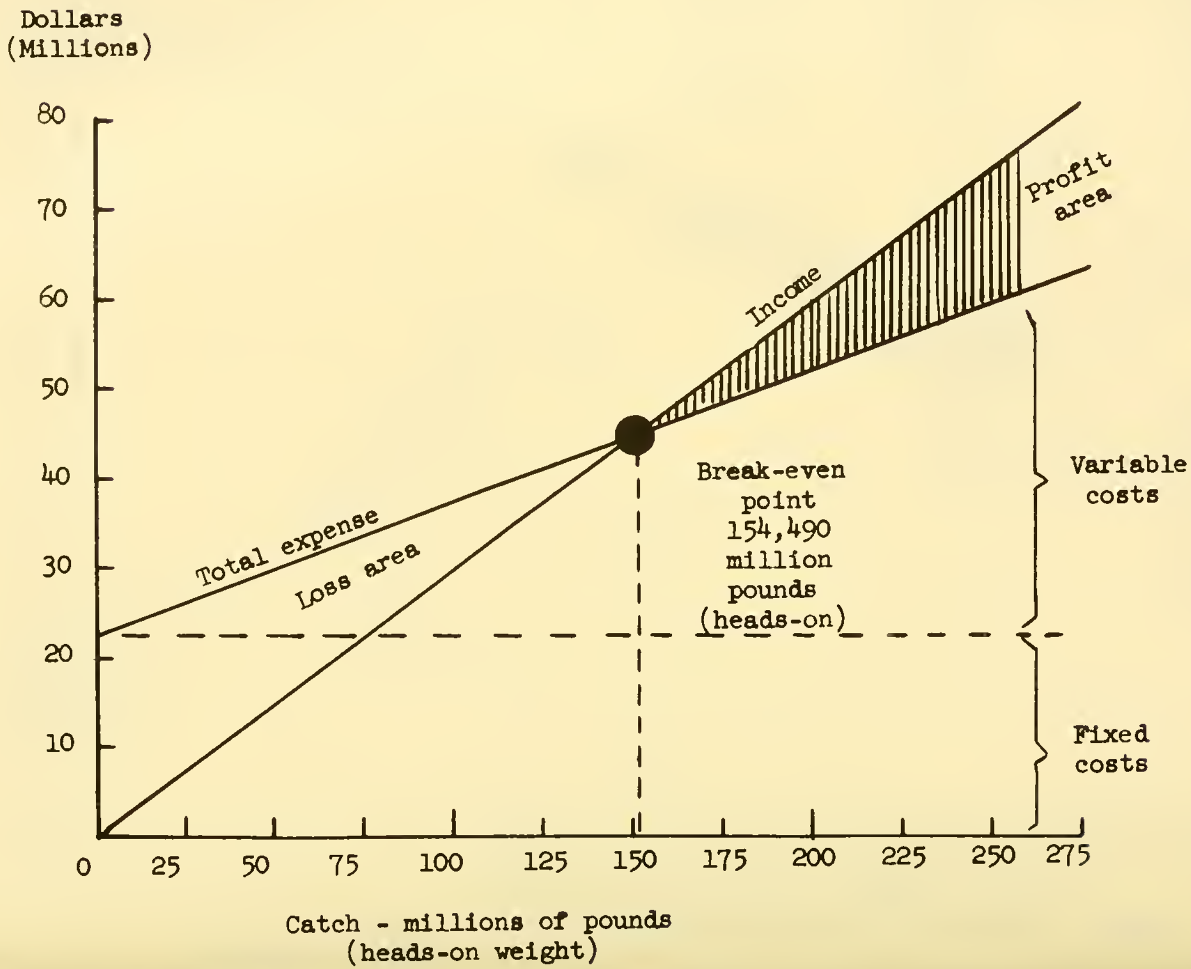
FIGURE IV - 46.--BREAK-EVEN CHART FOR SOUTH ATLANTIC AND GULF STATES SHRIMP FISHERY, 1952
(Based on average data for vessels and motor boats surveyed by Federal Trade Commission)



	Millions
Catch	223,939 pounds
Income	$54,755
Costs:	
Variable	$26,282
Fixed	$16,974
Total	$43,256
Profit	$11,499

	Cents per pound (heads-on)
Average ex-vessel receipts	24.4
Average total costs	19.3
Average profit (before Federal taxes)	5.1

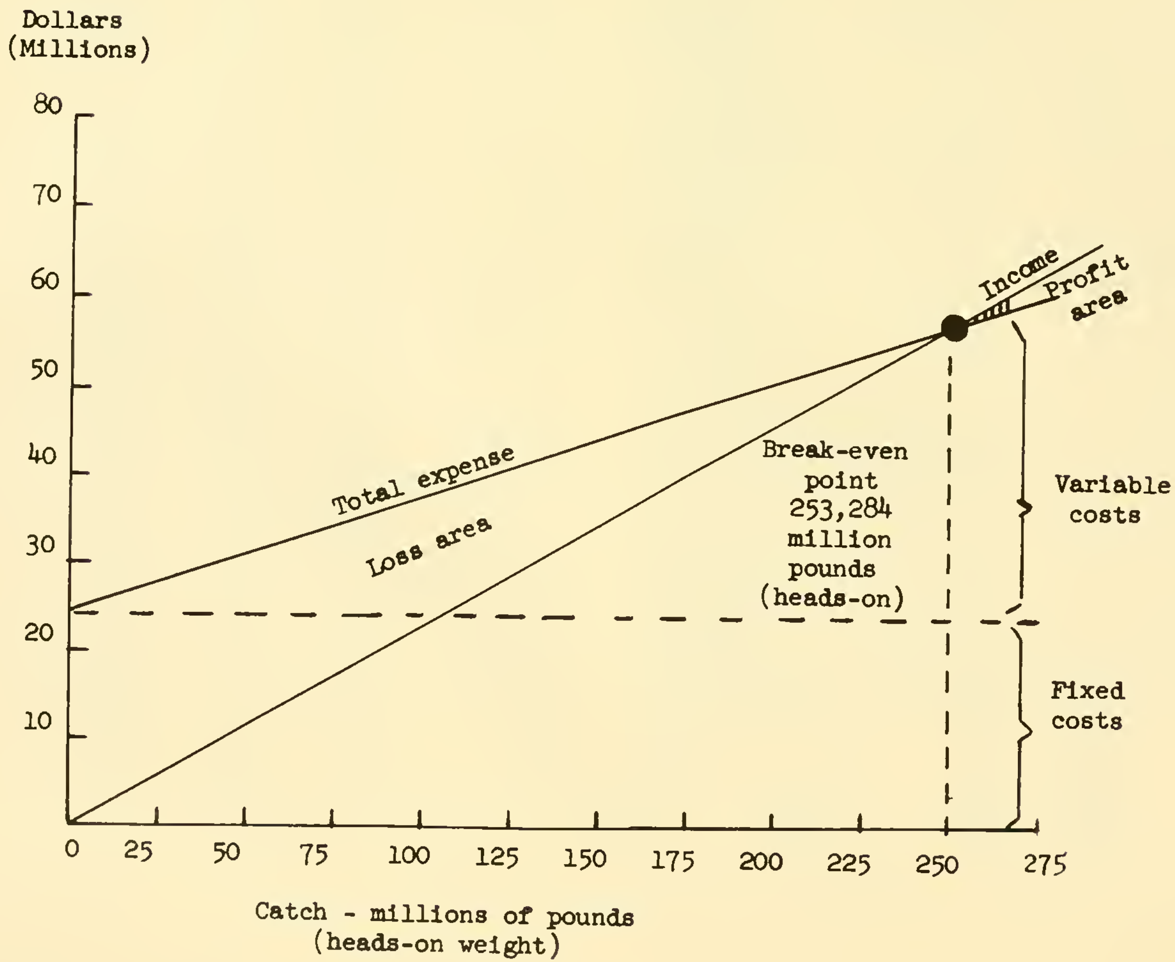
FIGURE IV - 47.--BREAK-EVEN CHART FOR SOUTH ATLANTIC AND GULF STATES SHRIMP FISHERY, 1953
(Based on average data for vessels and motor boats surveyed by Federal Trade Commission)



	Millions
Catch	257,436 pounds
Income	$76,267
Costs:	
Variable	$38,134
Fixed	$22,880
Total	$61,014
Profit	$15,253

	Cents per pound (heads-on)
Average ex-vessel receipts	29.6
Average total costs	23.7
Average profit (before Federal taxes)	5.9

FIGURE IV - 48.--BREAK-EVEN CHART FOR SOUTH ATLANTIC AND GULF STATES SHRIMP FISHERY, 1954
(Based on average data for vessels and motor boats surveyed by Federal Trade Commission)



	Millions
Catch	265,799 pounds
Income	$60,535
Costs:	
Variable	$35,110
Fixed	$24,214
Total	$59,324
Profit	$ 1,211

	Cents per pound (heads-on)
Average ex-vessel receipts	22.8
Average total costs	22.3
Average profit (before Federal taxes)	.5

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CHAPTER V

UTILIZATION AND PROCESSING

ABSTRACT

MORE SHRIMP ARE MARKETED IN THE FROZEN FORM THAN IN ALL OTHER FORMS COMBINED. PACKAGED HEADLESS SHRIMP RANKS FIRST IN POPULARITY. OTHER PRODUCTS COMMONLY SOLD FROZEN ARE RAW PEELED AND DEVEINED, COOKED AND PEELED, AND COOKED AND UNCOOKED BREADED, SHRIMP. FRESH SHRIMP ARE PREFERRED IN SOME MARKETS, NOTABLY IN NEW YORK CITY. CANNED SHRIMP WITH THE EXCEPTION OF THE WAR YEARS WHEN THE SIZE OF THE PACK WAS AFFECTED BY THE TIN SHORTAGE, HAVE RETAINED THEIR MARKET; DRIED SHRIMP PRODUCTION HAS DECLINED AS THE RESULT OF THE LOSS OF ITS PRINCIPAL EXPORT MARKET.

IN 1956 THE VALUE OF MANUFACTURED SHRIMP PRODUCTS AT THE PROCESSOR'S LEVEL WAS $109.5 MILLION. FROZEN PACKAGED PRODUCTS ACCOUNTED FOR 83 PERCENT, AND CANNED PRODUCTS FOR 15 PERCENT, OF THIS TOTAL. THE REMAINING TWO PERCENT WAS DRIED AND OTHER MISCELLANEOUS SHRIMP PRODUCTS.

FRESH SHRIMP PLANTS, IN GENERAL, ARE VERY SIMPLE ESTABLISHMENTS. SOME ESTABLISHMENTS ONLY FREEZE SHRIMP BUT THE MAJORITY PROCESS A VARIETY OF OTHER FISHERY AND NON-FISHERY ITEMS IN ADDITION TO SHRIMP. SHRIMP CANNERS AND BREADERS, USUALLY, ARE MORE SPECIALIZED THAN SHRIMP FREEZERS. THERE ARE A NUMBER OF PLANTS WHICH ALSO PROCESS COMPLEMENTARY PRODUCTS, SUCH AS OYSTERS AND CRABS.

THE DEGREE OF MECHANIZATION IN THE PLANTS IS SMALL; EVEN IN THE MOST HIGHLY MECHANIZED SEGMENT OF THE INDUSTRY, I.E. CANNING, MOST OPERATIONS ARE STILL PERFORMED BY MANUAL LABOR. A STUDY OF THE FLOW OF OPERATIONS IN A SAMPLE OF PROCESSING ESTABLISHMENTS INDICATES THAT THERE IS OPPORTUNITY FOR IMPROVING PLANT LAY-OUT AND MANUFACTURING PROCEDURES.

PRODUCTION COST DATA WERE OBTAINED IN THE COURSE OF ANOTHER STUDY FOR A SMALL SAMPLE OF PROCESSORS. RAW SHRIMP COSTS AVERAGED ABOUT THREE FIFTHS OF TOTAL COSTS IN BOTH BREADING AND CANNING PLANTS. IN ESTABLISHMENTS PRODUCING ONLY PACKAGED FROZEN SHRIMP, THE PROPORTION OF TOTAL COST REPRESENTED BY RAW MATERIAL WAS SUBSTANTIALLY HIGHER.

A SECONDARY USE OF SHRIMP IS FOR BAIT BY SPORTS FISHERMEN. MODIFICATIONS OF THE OTTER AND BEAM TRAWL CALLED FRAME AND PIPE TRAWLS, AS WELL AS CHANNEL OR LIFT, CAST, PUSH, DIP AND BRIDGE NETS ARE AMONG THE EQUIPMENT ENCOUNTERED IN THIS FISHERY.

A SMALL SHRIMP WASTE INDUSTRY CONFINED TO LOUISIANA AND THE CAROLINAS IS HANDICAPPED BY COMPETITION FROM OTHER FISHERY BY-PRODUCTS RICHER IN PROTEIN. SHRIMP MEAL IS USED AS AN ANIMAL FEED SUPPLEMENT.

INTRODUCTORY COMMENTS

Shrimp is one of the most popular varieties of seafood included in the human diet. Although of minor significance, shrimp are also used for bait purposes in sports-fishing. The waste material from a few shrimp canneries and drying establishments at times, is transformed into meal and marketed as an animal feed supplement.

The United States Fish and Wildlife Service collects statistics on the quantity and value of manufactured shrimp products as well as on the quantity and value of shrimp meal manufactured. The quantity of shrimp used for bait purposes is not segregated in the catch statistics.

SUPPLY AND UTILIZATION IN 1956

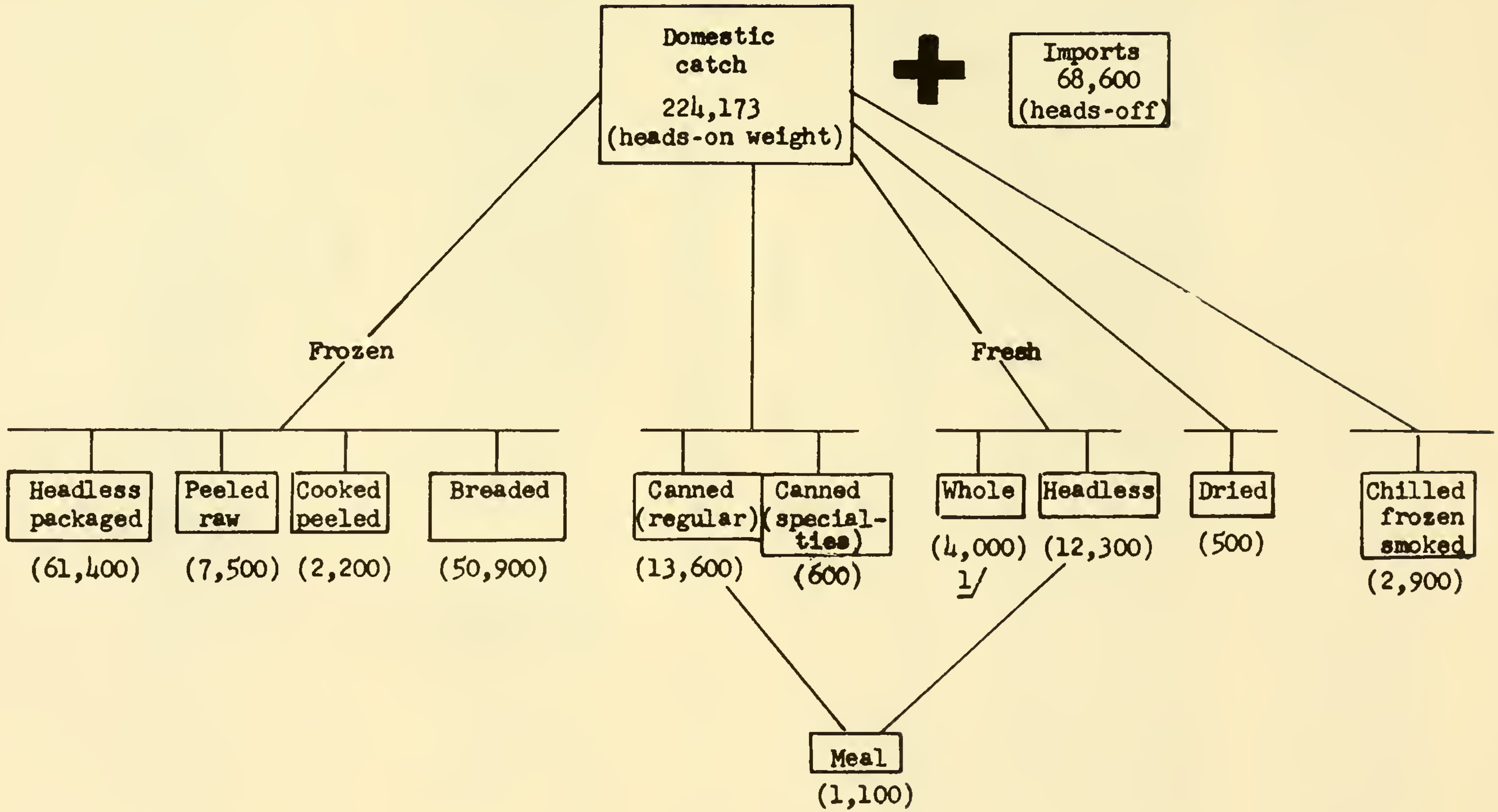
Figure V - 49 is a diagrammatic presentation of the United States and Alaska shrimp catch and utilization picture in 1956.

About 160 million pounds, or more than three-fourths of the total United States shrimp supply of about 202 million pounds heads-off weight in 1956 was used in the processing of frozen products. In manufactured weight, 61.4 million pounds of frozen packaged headless shrimp, 50.9 million pounds of frozen breaded cooked and uncooked, as well as smaller quantities of frozen raw peeled and deveined, and frozen cooked and peeled shrimp, were produced from this quantity.

The equivalent of approximately 53.0 million pounds of heads-on shrimp was utilized in canning (including canned specialties) 920,950 standard cases. Of the total pounds of shrimp marketed in fresh form, it is estimated that roughly 4 million pounds were sold whole and the remainder headless. About 3.6 million pounds of shrimp were utilized in the manufacture of sun-dried product, while another 2.9 million pounds were consumed in the processing of smoked and chilled specialty products. From the shrimp waste of the canning and drying processes, a total of 1.1 million pounds of shrimp meal was produced.

FIGURE V - 49.--FLOW AND DISTRIBUTION OF THE 1956 SHRIMP CATCH INCLUDING IMPORTS

(Expressed in thousands of pounds)



1/ Fresh shrimp includes an undertermined quantity utilized for bait purposes.

Note: Figures in parentheses represent manufactured weight.

To the supplies derived from the domestic catch must be added some 68.6 million pounds of shrimp imports, the majority of which was imported as packaged frozen headless. Conversely, somewhat more than 4.1 million pounds of exported manufactured products must be subtracted before the net supply available for domestic consumption can be determined.

TRENDS IN UTILIZATION

In 1930 more than 50 percent of total supply went into manufacture of the canned product. By 1956 only about 7 percent of total supply was utilized in this manner. The production of frozen shrimp was relatively insignificant at the beginning of this period, whereas in 1956 shrimp freezers took about 60 percent of the total supply. Frozen breaded shrimp alone, a new product introduced only a few years ago, today utilizes about 20 percent.

PROCESSING FOR HUMAN CONSUMPTION

Product Yields

Technological progress in most industries can be expected to bring about improvements in product yields over a period of time. In the shrimp industry, the net effect of advances in processing techniques on product yields is somewhat difficult to assess.

The majority of processing operations today are performed by hand labor. In canning, the use of machine operations has been more conspicuous, and processing economies have been achieved. The latest peeling and deveining equipment, in addition to cutting down the manual labor required for operations, makes it possible to process very small shrimp formerly not used for commercial purposes. Product yields, however, have not improved as much as expected as the result of the replacement of manual by machine labor.

A study of processing yields of four different species (including the three species of Peneidea accounting for the bulk of domestic catches) was made by the College Park, Maryland, laboratory of the United States Fish and Wildlife Service. The results of these experiments were described as follows in the November 1952 issue of the Commercial Fisheries Review:

"The percentage of recovery for the boiled, peeled, and drained shrimp was the highest for the brown-grooved shrimp, and the lowest for the red Greenland shrimp. The latter species, being very small, would not ordinarily be deveined, but even before deveining the percentage of recovery after peeling and cooking was the lowest of the four varieties tested. The percentage of recovery for both the white and pink-grooved shrimp was the same when cooked, peeled, and deveined. However, when only cooked and peeled, the pink-grooved shrimp showed in these tests a higher percentage of recovery than the white shrimp. The sizes (count per pound) for three of the five lots of white shrimp were larger than for the other species of shrimp. However, these three lots had a slightly lower average percentage of recovery. It is not known if size has any relation to the percentage of recovery."

While yields may vary with the species and count (size) of shrimp processed, it is possible to utilize average yield factors for rough conversions.

Average yield factors commonly employed for various shrimp end products are as follows:

	Percent
Frozen green headless	59.5
Frozen raw peeled 1/	49.0
Frozen cooked and peeled	27.6
Frozen breaded uncooked 2/	83.3
Frozen fantail raw	50.0
Dried 3/	13.0
Canned 4/	27.0

1/ Hand peeled.

2/ Yield varies considerably depending on amount of breading added.

3/ Head and shell removed after drying.

4/ Yield from whole shrimp (includes pre-cooked or blanched shrimp.)

Geographic Location of Processing Facilities

A large proportion of the shrimp taken on the Atlantic and Florida Gulf coasts is marketed fresh. The Central Gulf States account for the bulk of the canned shrimp and dried shrimp packs. Processors in the State of Texas have concentrated on freezing and breading operations.

Historically, the industry developed first along the south Atlantic seaboard. This location made it possible to transport the fresh product to a mass market at a low cost.

The Central Gulf States have heavy landings of small shrimp which lend themselves best to the canning and drying processes. Canning and drying developed prior to freezing and breading. The industry in Louisiana, Mississippi and Alabama started their development between 1870 and 1880.

Freezing is particularly suited to Texas and Florida since the trade in frozen products shows a preference for the larger shrimp landed there. Freezing is a simpler processing method requiring less fixed capital and labor than canning.

In contrast to the other processes which had their origin in efforts to introduce new preserving methods, breading has come into existence in an attempt to meet consumer demand. Essentially, the breading process is an extension of freezing, and more often than not, plants which bread also market the frozen headless product.

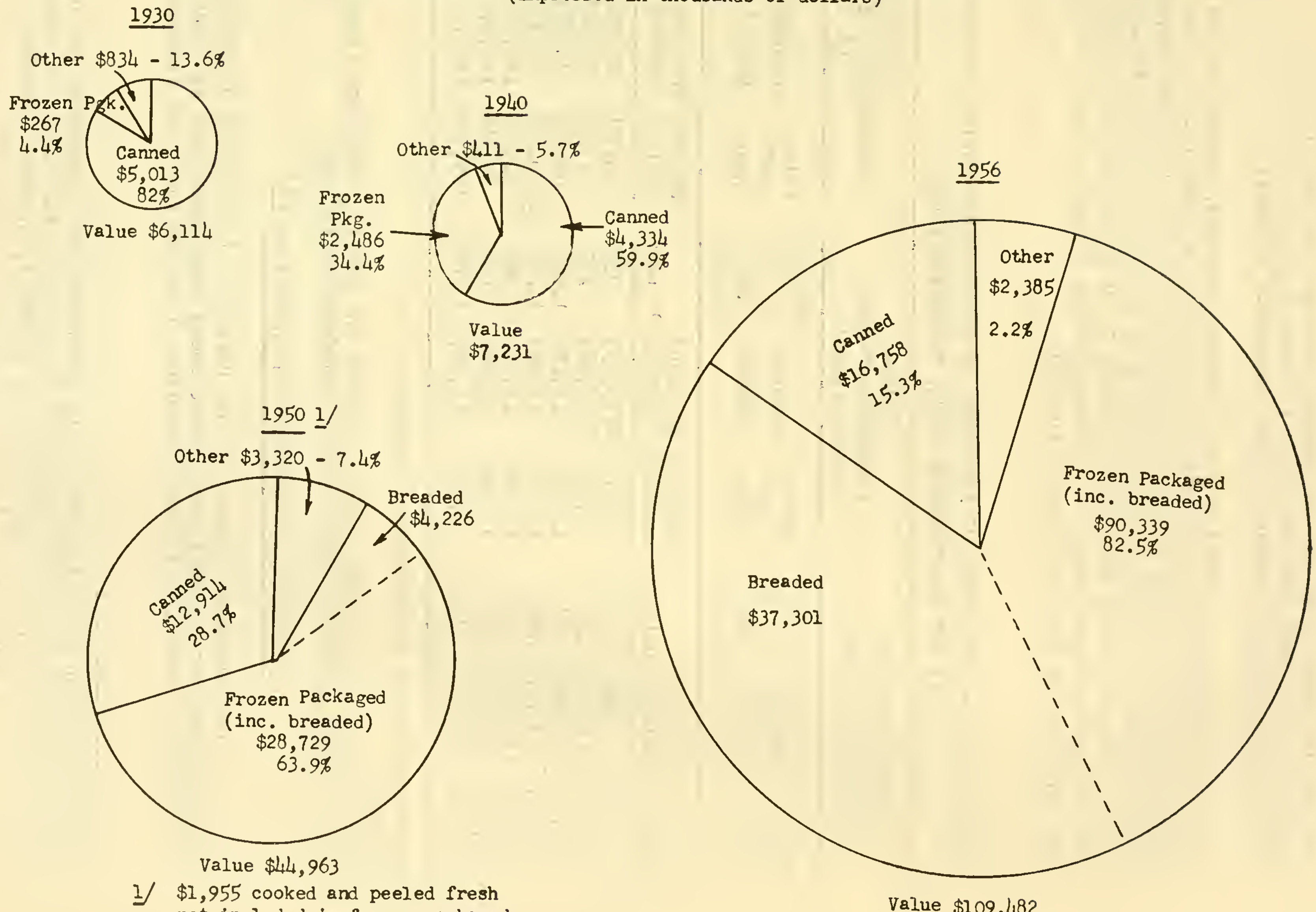
The processing of shrimp waste into meal today is confined to Louisiana and the Carolinas.

Value of Manufactured Products

Within a period of twenty-five years there has been a more than ten-fold expansion in shrimp processing, as measured by the increase in the value of manufactured shrimp products at the processor's level.

Figure V - 50 shows, in addition to the increase in total value of manufactured products from $6.1 million in 1930 to $109.5 million in 1956, that there has been a change in the relative importance of the principal classes of manufactured products over the years. In 1930, canned products accounted for as much as 82 percent, and in 1956 for only 15 percent, of the total value of manufactured products. Frozen packaged products show the reverse trend, rising from 4 to 83 percent of total value. Other manufactured products that fall neither in the

FIGURE V - 50.--VALUE OF PRINCIPAL CLASSES OF MANUFACTURED SHRIMP PRODUCTS AT THE PROCESSORS' LEVEL, SPECIFIED YEARS, 1930, 1940, 1950 AND 1956
(Expressed in thousands of dollars)



1/ $1,955 cooked and peeled fresh not included in frozen packaged.

category of frozen packaged nor canned products have declined in importance. In 1956 they accounted for only 2 percent of the total value of manufactured products at the processor's level.

Average per-pound values of frozen packaged, canned, and all manufactured shrimp products have been computed in table V - 48. The table shows that a pound of frozen packaged shrimp at the manufacturer's level in 1930 was valued at 18 cents and at 74 cents in 1956. Per-pound value of canned shrimp rose from 37 cents to $1.18 during this period. The average value per pound of all manufactured shrimp products increased from 27 cents in 1930 to 78 cents in 1956.

TABLE V - 48.--AVERAGE VALUE PER POUND OF MANUFACTURED SHRIMP PRODUCTS AT THE PROCESSOR'S LEVEL, SPECIFIED YEARS

Year	Frozen packaged (Including breaded)			Canned (Including canned specialties)			Total manufactured products 1/		
	Value of pack	Quantity packed	Average value per pound	Value of pack	Quantity packed	Average value per pound	Value of pack	Quantity packed	Value of pack
	Thousand dollars	Thousand pounds	Dollars	Thousand dollars	Thousand pounds	Dollars	Thousand dollars	Thousand pounds	Dollars
1930	267	1,485	.180	5,013	2/13,633	.368	6,114	23,084	.265
1940	2,486	16,118	.154	4,334	16,883	.257	7,231	38,503	.188
1950	28,729	3/52,764	.544	12,914	12,102	1.067	44,963	70,659	.636
1953	56,396	80,797	.698	19,149	15,653	1.223	4/76,537	99,379	.770
1954	65,355	112,981	.578	13,792	14,326	.963	80,269	130,592	.615
1955	74,291	116,617	.637	13,678	13,802	.991	89,746	133,679	.671
1956	90,339	121,992	.741	16,758	14,207	1.180	109,482	140,735	.778

1/ Includes dried and miscellaneous products.
2/ Estimated.
3/ Does not include 1,520,326 pounds of cooked and peeled, fresh and frozen.
4/ Includes 5,915 pounds of smoked shrimp manufactured in 1950.

Processing Facilities and Operations 18/

Raw shrimp are landed either directly at the docks of processing establishments or at public or private docks from which they are trucked to a plant or market. With the exception of shrimp which are frozen at sea

18/ Information on shrimp processing facilities and procedures has been gathered for the Bureau of Commercial Fisheries by the Bureau of Business and Economic Research of the University of Miami, by First Research Corporation of Florida, and by the Federal Trade Commission.

after heading and packaged ready for the market, nearly all shrimp landed are shore-processed in some manner before entering market channels.

Upon landing, the shrimp ordinarily are taken directly from the boat to the shrimp plant where they are initially processed. The essential task of the plant is to wash and weigh the shrimp, head them if necessary, and pack them in whatever form is required.

Fresh Shrimp, Whole or Headless

Fresh-shrimp plants, in general, are relatively simple establishments. Since the fixed investment required for operations is small, some raw-shrimp dealers on the Atlantic coast are in a position to operate at various locations up and down the coast in the course of a year. They participate in the fall run in South Carolina or Georgia, the winter run in Florida, and return to South Carolina or Georgia for the spring season. Their plants apart from some office space may consist of nothing more than unpartitioned buildings containing tables for heading shrimp, washing vats, scales, ice crushers, and space for storing boxes and fishing gear. Functionally, establishments of this sort confine themselves to unloading, weighing, heading, washing, and packing in ice. (see figure V - 51)

On the Gulf coast, fresh shrimp plants tend to be establishments of more permanent character. The larger firms may have their own fuel tanks, machine shops, boat ways, etc., as do many of the canneries. In addition, establishments of this size may operate their own fishing fleets, or at least take title to the catch, own freezers and breading plants and maintain their own sales staff as part of integrated operations. From a technological point of view, it is desirable to head the shrimp on the boat as soon as they are caught. Decomposition starts in the head rather than in the tail of the shrimp, and if the head is removed early, spoilage is markedly retarded.

The practice of including a header among the crew of a fishing vessel is of recent origin. Aside from heading, this man may perform incidental tasks aboard ship such as washing down the decks, etc. The practice at present is making rapid headway in south Texas ports and may spread to other Gulf coast ports in the future. Some non-operating vessel owners disapprove of the system. They feel that a header takes the place of a skilled crew member on board vessel. Since the header is not capable of performing all of the duties performed by a fisherman, they fear that boat operations and maintenance suffer when a header is taken along.

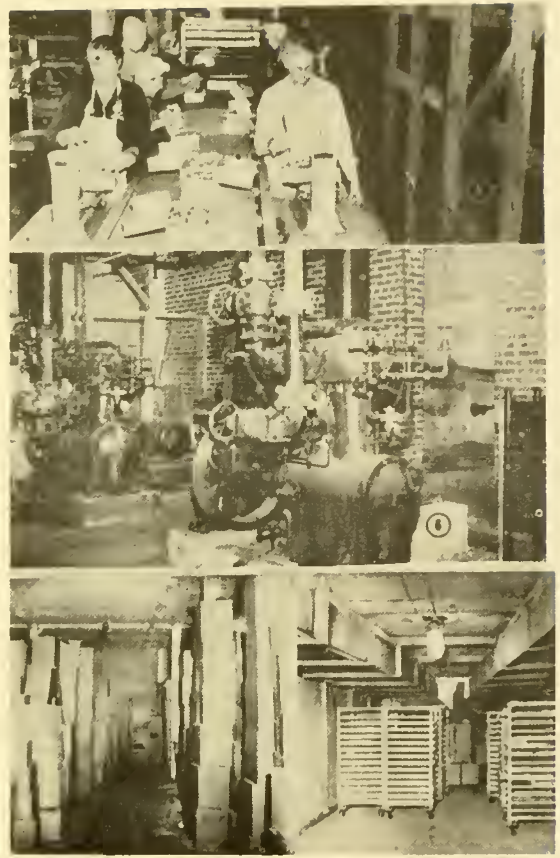
Packing methods vary primarily according to the distance over which the shrimp are moved. By far the most common method is to pack the shrimp imbedded in chipped ice in 100-pound wooden crates or boxes.

Shrimp washing, de-icing and inspection belt.

De-veining and peeling table.

Packing cooked-peeled, deveined shrimp.

Using glacing unit before freezing shrimp in 5-lb. cartons.



Weighing and inspection table.

Refrigeration machinery; first stage compression, using two 8" by 6" booster compressors.

Cold storage room. Freezing tunnels, showing air-blast vents.

FIGURE V - 51.--Scenes at a shrimp plant.

Southern Fisherman.

In packing, each box is filled with 102 to 106 pounds of shrimp, the excess being an allowance for waste, water and for shrinkage en route.

If delivery is for a plant located near the docks, the box packing step is eliminated. In the southern Texas ports where the bulk of the shrimp are taken to local freezers and breaders, the shrimp mixed with crushed ice are loaded loose into insulated trucks for shipment.

When the shrimp plant is located adjacent to the cannery or freezing or breading plants, as in some Texas and Georgia ports, trucking is eliminated. A section of the processing establishment is devoted to the initial functions of unloading, washing, and heading. This section is physically incorporated into the plant so that the shrimp may be passed directly from the boat into the processing line.

In the course of its survey of domestic shrimp-plant efficiency First Research Corporation of Florida had occasion to observe operations in one fresh shrimp plant located in Florida. The layout of this plant was described as follows:

Plant layout.--The receiving, packing, and shipping area was a closed shed-type structure housing the necessary equipment for unloading, weighing and icing the containers of fresh headless shrimp for shipment.

The equipment used for receiving, packing, and shipping consisted of two power hoists, one for each of two docks; two wash vats; two chain mesh conveyors, operating between wash vats and scales; two large pan scales and the necessary lengths of roller tracks to move filled containers to the shipping area.

The receiving area handled not only fresh headless shrimp but other types of fish and shellfish as well. Because of this, utilization of area, equipment, and manpower was good with a minimum of idle time during the work day.

In addition to the equipment mentioned above, a mechanical ice crusher with blower attachment for loading crushed ice in bins was located in the receiving area. This machine was set to turn out finely crushed ice.

A grading machine had been installed to accommodate customers who wish to buy within a specific graded size category rather than the general "fisherman's count" sizes. (see figure V - 52)

Plant procedure.--The step-by-step operational procedure of the plant is as follows:

FIGURE V - 52.--Grading machine.
Southern Fisherman.

1. Unloading: Vessels are docked at one of two receiving docks. Crew members remove the hatch covers and lower themselves into the hold. The iced headless shrimp is shoveled into a basket lowered and raised from dockside by means of a power hoist. The power hoist was operated by one man.

2. Washing and de-icing: The filled basket was raised from the vessel hold and swung into position near a wash vat. A worker manually emptied the shrimp from the basket into the wash vat. Water within the vat washed the shrimp and flushed away ice remaining from vessel storage.

3. Inspection: A mesh-chain conveyor, one end operating within the vat, removed the shrimp and fed them past inspectors who removed by hand shrimp of inferior quality. The inspectors took frequent one-pound samplings in order to check the number of shrimp per pound to establish count category or shrimp size. Boat crews are paid on and sales prices are based on size designations.

4. Weighing: After passing the inspectors the shrimp were discharged into the pan of a large scale. When a hundred pounds of shrimp were in the pan the weighing operator, by means of an electric switch, stopped the conveyor until the scale pan was emptied.

5. Packing: A worker took a wooden container from a stack adjacent to his work station, poured a large shovel load of finely crushed ice from a bin into the container, mixed another shovel load of ice in the pan of shrimp on the scale, emptied the scale pan of shrimp and ice into the container, and topped off the filled container with an additional shovel load of crushed ice. Another worker then dragged the filled container along rollers to the shipping platform for loading on the shipping conveyance. The shrimp are usually shipped out on the day they are received from the vessels.

Man-hour requirements and production per man-hour.--Production per man-hour and man-hour requirements per hundred pounds of headless shrimp processed for the above steps are shown in table V - 49.

TABLE V - 49.--FRESH HEADLESS SHRIMP PRODUCTION RATES AND MAN-HOURS REQUIRED TO PROCESS 100 POUNDS, 1 PLANT, 1955

Operation	Type of operation	Production per man-hour (Pounds)	Man-hours required (Hundred pounds)
Unload from vessel	Manual and machine	750	0.134
Wash	Manual	3000	0.033
Inspect	Manual	1000	0.100
Weigh	Machine	3000	0.033
Pack and store	Manual	1500	0.066

Cost of operations.--Because of the substantial differences from establishment to establishment in size of plant, scale of operations, and functions performed, it is difficult to gather any representative cost data for fresh shrimp plants.

The Bureau of Business and Economic Research of the University of Miami reports that on a fee of four cents per pound commonly charged to Florida boat operators for handling (this fee includes a one-half cent charge made to boats landing catches of other boats in addition to their own) the shrimp plant averages a net profit of one cent. Labor costs, the principal element of expense, in these plants are held down by keeping the permanent staff at a minimum. Whenever additional help is required, production workers are hired on a temporary basis. The workers employed in these establishments are not unionized and wages are usually pegged to the legally fixed minimum. In those shrimp plants where heading is included among the functions performed, larger staffs are needed to operate the heading tables. Heading labor is paid on a piece-work basis. The prevailing rate at the time the field survey was made (May 1955) was fifty cents per 12-quart bucket. A good header reportedly could produce in the neighborhood of thirty buckets of headed shrimp per day. Work was not steady since employment depended upon shrimp runs.

Since the income of independent fresh-shrimp-plant operators depends primarily on the quantity of shrimp handled, charges being made on a fee basis, there is considerable competition among them for vessel patronage. The inducements offered to the vessel operators are generally not financial in character since the fees exacted are uniform at least within the port area, and sometimes even within the entire state. Competition takes the form of special services that are offered to the fishermen. In certain establishments shower facilities are made available to the incoming fishermen. Elsewhere cold beer may be offered or bookkeeping services and assistance in the preparation of tax returns may be provided gratis. Some shrimp plants have facilities for boat and net maintenance, though usually only on a very limited scale. These facilities serve only the needs of boats owned by the establishment, though in some instances they may be made available to patrons on a fee basis.

Frozen Headless Shrimp

The introduction of economically feasible freezing methods caused a major revolution in the industry. Refrigeration opened new markets for shrimp since many new customers in inland areas where shrimp was virtually unknown could be reached. Actually, the shrimp industry was somewhat slow in adopting the new processing method.

Although the quick freezing of fillets was an established factor in fish processing in the 1920's thanks to the techniques then introduced by Clarence Birdseye and other pioneers in the field, it was not until the latter part of that decade that the shrimp industry began to use this method of processing and preserving. Production of frozen shrimp increased steadily but slowly until the end of World War II. In the postwar years it took a sudden upturn. Today, the freezing industry is the primary outlet for the catch of shrimp.

Freezing today may take place either directly on board vessels equipped with freezer installations or on shore in specialized freezing establishments. Shore freezers produce the bulk of the shrimp processed in frozen form.

Shrimp freezing-establishments have equipment which varies from simple, crude, and inexpensive to large, complex and costly. Many handle other perishables for cold storage. Some do a public cold storage business, others are entirely private. The public freezers charge a fixed fee for their services. Some freezing plants are independent, others fit into the frame of integrated operations carried on by primary wholesalers, producer cooperatives, or other processors such as canners or breaders.

Since fixed expenses tend to make small scale operations unprofitable, there is some indication that more and more shrimp are frozen on a custom basis by plants which freeze and store a variety of fish and other food products or by large processing firms which do their own freezing in conjunction with other processing or producing activities. The specialization of custom freezing and cold storage warehousing is encouraged by financial considerations. If the shrimp are held in public cold storage, it is not difficult to obtain a loan on the frozen inventory against a warehouse receipt. The opportunity to have the product frozen and stored on a custom basis depends on the ready access to adequate freezing facilities.

The better types of freezers are constructed of steel and concrete with an envelope of corkboard for insulation. However, many are of frame construction with sawdust, felt, or other cheaper material for insulating purposes.

The freezing chambers are usually small rooms, having a capacity from 15,000 to 40,000 pounds, though in some plants larger rooms are used.

The glazing room is usually located conveniently at some point on the route from freezer to storage. When there is no room for this purpose a corridor is often used. Sometimes movable glazing tanks are employed in the storage rooms. More often a glacing tank is built permanently at a convenient place.

Shrimp may be frozen either for direct distribution through wholesale and retail channels or for further processing, e.g. breading.

Shrimp are readied for the market in any one of five different ways by freezing establishments, i.e. in the frozen headless, frozen peeled and deveined, frozen cooked and peeled, uncooked frozen breaded and cooked frozen breaded form.

Plant capacity.--The findings and recommendations with respect to freezing plant capacities resulting from the plant efficiency survey made by the First Research Corporation are listed below.

Among the plants surveyed that packed only frozen headless shrimp, capacity was governed by two factors, namely, availability of shrimp and size of freezer facilities. None of these plants was operating at capacity at the time of the survey nor fully utilizing its freezing facilities.

In certain installations which processed a variety of end-products, capacity usage of freezer space was more general due to production diversification.

It is believed that all operators who limit themselves to the packaging and freezing of frozen headless shrimp only, expose their enterprise to all the inherent hazards of a "one crop" operation and all adverse economic factors pertaining thereto.

Freezer installations were visited that, in addition to a large volume of frozen headless shrimp, also processed such end-products as fish and shellfish, fruits, vegetables, etc. Packers of frozen headless shrimp, not generally operating at capacity, should investigate the practicality of diversifying their end-products to realize full equipment potential.

Plant procedure--typical operations.--In the course of its survey First Research Corporation established that mechanization in freezer establishments was limited in scope. In nearly all of the six plants visited mechanization was limited to a conveyor system for transporting the product to the grading machine, the blast freezer installation proper, and a glazing device. The operations involved in readying frozen headless shrimp for the market were as follows: (see figure V - 53)

1. Receiving and unloading: Where plants are located dockside the shrimp are unloaded directly from the vessel to the plant; where they are located away from the water, the shrimp are trucked from dockside to the plant. Some dockside plants, during periods of scarcity, have shrimp trucked in from other ports.

In some areas the shrimp are washed and weighed immediately after they come off the vessel; in other areas the catch is paid for on the basis of "packed out" weight, thus eliminating the initial weighing upon discharge of the cargo.

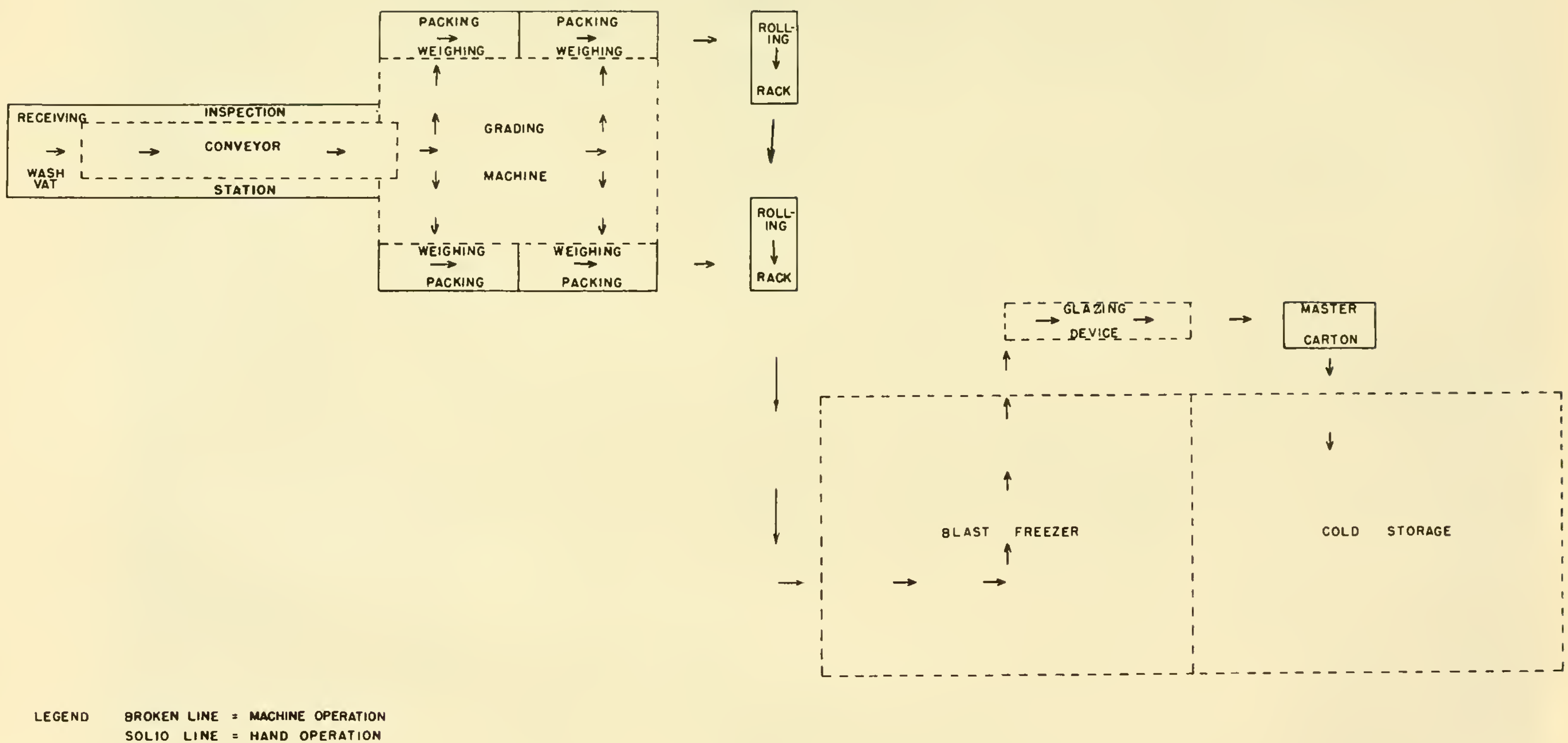


FIGURE V - 53.- A TYPICAL FLOW PLAN — FROZEN HEADLESS SHRIMP PLANT.

First Research Corporation.

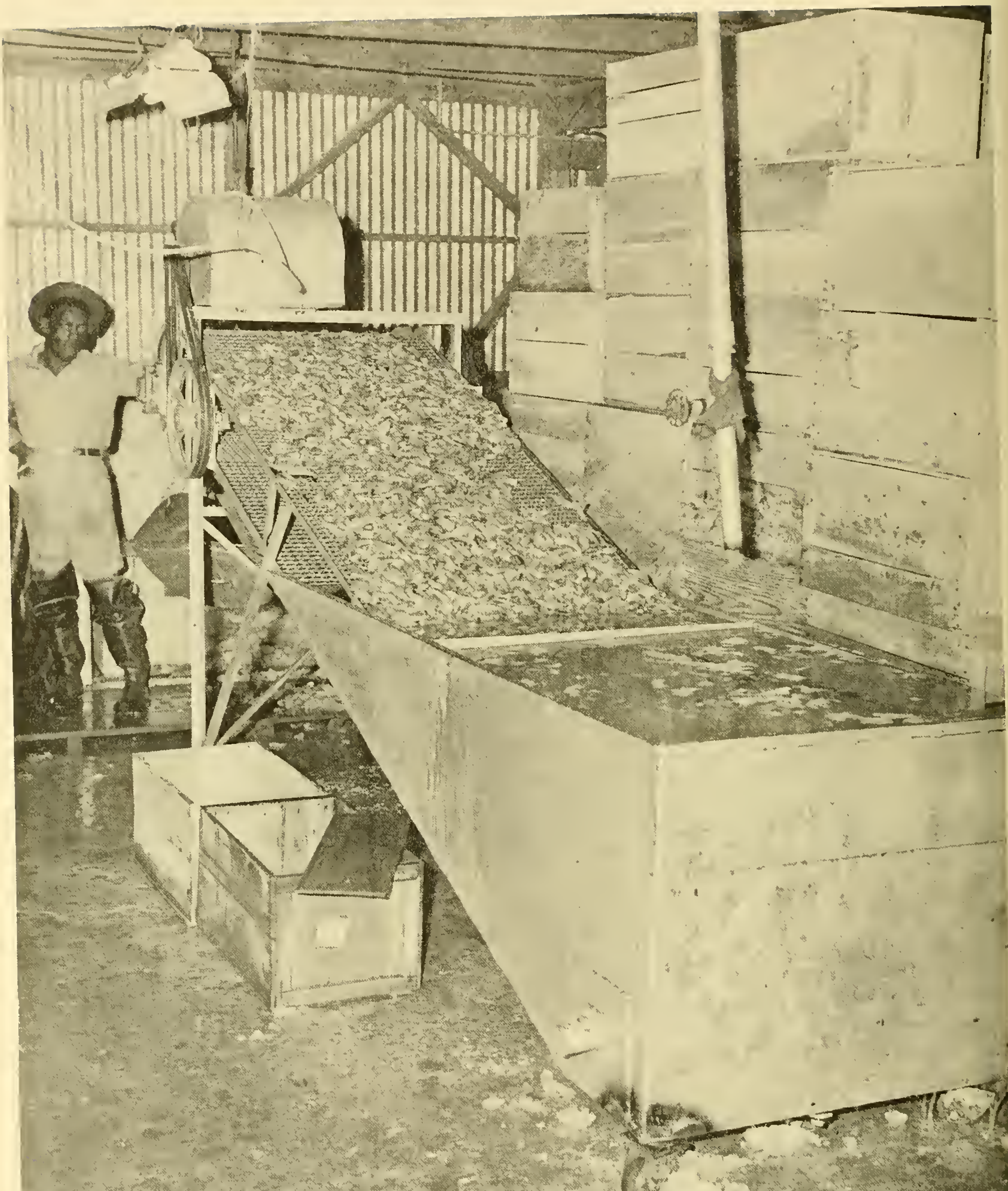


FIGURE V - 54.--Washing machine installed in shrimp processing plant of Twin City Fishermen's Cooperative, Morgan City, Louisiana.

Twin City Fishermen's Cooperative, Association, Inc.

The receiving and unloading procedure, where the processing plants are located dockside, has been described in connection with fresh shrimp plants(see p. 249 of this chapter). When shrimp are received by truck they have already had an initial washing. One or more men manually unload the shrimp directly into the wash vat either by shoveling or emptying the boxes. The shrimp are washed and the ice is flushed away.

When a plant is unable to handle and process the shrimp immediately on arrival, they are held on the trucks or the trucks are unloaded directly into holding bins located in the processing work area.

First Research Corporation suggests that whenever practicable present methods of unloading shrimp from vessels and trucks be replaced by portable power conveyors. Conveyors of this type are presently in operation in some of the shrimp canneries and are used for unloading shrimp from both vessels and trucks.

2. Inspection and grading: When quick freezing was first adopted by the industry a wide variety of package sizes was used and little attention was given to size grading before packaging. The grading that was undertaken was a hand operation. This method still prevails in some of the smaller plants. Recently perfected grading machines have replaced hand operation in nearly all of the larger plants. Moreover, package size has been standardized. The standard package today is the five-pound carton, with other sizes accounting for only a small part of the total production. The present method of inspecting and grading shrimp, as detailed below, is based upon a survey of six plants, all using grading machines.

A conveyor belt removes the shrimp from the wash vat and feeds them into the receiver of the grading machine. As the shrimp move from the wash vat to the grading machine, they pass inspectors who remove all extraneous matter and shrimp of visually inferior quality. A single operator mans the grading machine, which mechanically sorts the shrimp into four size categories and discharges the graded shrimp onto four conveyor belts or through four metal chutes for delivery to the packing stations. Some plants have additional inspectors stationed between the grader and each of the four packing stations to check machine errors in grading.

The six plants inspected by First Research Corporation that process frozen headless shrimp all have comparable operational facilities and functions. Installations for moving shrimp from the wash vats to the grader and thence to the packing stations appeared adequate and further mechanization was not indicated.

There were significant differences between individual plants in the man-hours required to unload, inspect, and grade a hundred pounds of headless shrimp (see table V - 50). These differences may have been due to variations in distances between the vessel and the packing stations or else they may have resulted from the uneven "flow" of shrimp from the vessel, truck, or storage bin to the packing stations which accounted for occasional idle time on the processing line.

TABLE V - 50.--FROZEN HEADLESS SHRIMP
AVERAGE MAN-HOURS REQUIRED TO PROCESS
100 POUNDS OF END-PRODUCT, 6 PLANTS, 1955

Company	Operations				Total
	Receiving, inspecting and grading	Packing and weighing	Loading freezer	Glazing and master carton	
	(Man-hours)				
A	0.292	0.467	0.067	0.267	1.093
B	.400	.500	.050	.130	1.080
C	.333	.400	.050	.120	.903
D	.257	.258	.057	(1)	-
E	.233	.267	.053	(1)	-
F	.365	.299	.133	.111	.908
Average	.313	.365	.068	.157	.996

1/ Company does not have a freezer. These operations performed at commercial freezer.

The study made indicates that, with the adoption of a conveyor unloading system, and through minor changes in operational procedures in certain plants, the man-hours required to unload, inspect, and grade a hundred pounds of headless shrimp could be reduced by as much as 35 percent (see tables V - 50 and V - 51).

TABLE V - 51.--FROZEN HEADLESS SHRIMP, ESTIMATED PRODUCTION RATES, NUMBER OF WORKERS AND MAN-HOURS REQUIRED TO PRODUCE 100 POUNDS OF END-PRODUCT, HYPOTHETICAL PLANT USING SYNTHESIZED PROCEDURES AND LAYOUT

Operation number and name	Estimated number of workers 1/	Type of operation	Production per man-hour	Man-hours required per 100 pounds
			Pounds	Man-hours
1. Receiving and unloading	2	Machine	2,000	0.050
2. Inspecting and grading	8	Hand and machine	500	.200
3. Packing and weighing	8	Hand	500	.200
4. Overwrapping	3	Machine	1,334	.075
5. Loading freezer 2/	3	Hand	10,000	.010
6. Mastering	4	Hand	1,000	.100
Total man-hours per 100 pounds			-	.635

1/ Based on a desired average production rate of 4,000 pounds of frozen headless shrimp per hour.
2/ Part time.

3. Packing and weighing: After the grading machine has sorted the shrimp into four size categories, they are normally delivered to four packing stations. Some plants subdivide the chutes enabling them to set up eight packing stations.

The standard procedure in packing and weighing headless shrimp was found to be as follows:

Set up folded five-pound waxed carton.
Fill carton with shrimp.
Weigh filled carton and adjust for correct weight.
Rubber stamp shrimp size on carton.
Place carton on shelf, pallet, or rolling rack for removal to plant freezer; or in open wooden crates for removal to commercial freezer.

In the six plants inspected, the weighing crews ranged from two to five. Where the crew consisted of only two, one performed the first two functions, and the other the remaining three. With a crew of three men one performed the first two functions, one the third, and one the remaining two. In the plant employing a crew of five, there was one operator for each of the first three functions, a fourth operator added water to the filled cartons, and the fifth operator performed the last two functions. In some plants inspectors continuously spot checked the packing operations.

The number of man-hours required to pack and weigh a hundred pounds of shrimp is reflected in the size of the crews used. About twelve percent more man-hours were required by a crew of five than by a crew of three, and about eighty percent more than by a crew of two.

Most plants have well designed conveyor systems for moving the shrimp through the packing and weighing lines. There were instances where minor adjustments would have made for a more efficient operation. In some plants there appeared to be an over-allocation of manpower; this could have been remedied by combining certain functions.

4. Freezing: Methods of handling headless shrimp from the packing and weighing line to the freezer are more or less standard. The principal differences found depend upon whether the processing plant operates its own freezer or uses the facilities of a public freezer.

In the former case, the packed cartons of shrimp are placed on pallets or rolling racks which are manually rolled or trucked to, and loaded into, the blast freezer. The temperature in the freezer is maintained at -30° F. to -40° F. Freezing is usually completed in approximately fifteen hours. If the freezer room is exceptionally large and loaded to capacity, freezing times may vary.

Where the facilities of a public freezer are used, the five-pound cartons of shrimp are placed in an open wooden crate as they come off the packing and weighing line. The crates are hand-trucked to an ice bin where crushed ice is shoveled over the filled cartons. The iced crates are then manually loaded on trucks for transporting to the freezer.

In most processing plants that operate their own freezer the packed and weighed shrimp are loaded directly from the packing line into the freezer. Most of the freezers covered in the survey consisted of only one freezing tunnel or room. There are plants, however, where the freezing unit consists of two or more tunnels or rooms of different capacities.

In one of the plants surveyed, the freezer had a chill room connected with it. Here, shrimp were placed in the chill room and held at -10° F. until the particular production run was completed, then the entire load was placed in one of two blast-freezing rooms. This method of handling eliminates the frequent opening of freezer doors and reduces freezing costs.

The number of man-hours required to take a hundred pounds of headless shrimp from the packing and weighing line and load them into the freezer was fairly uniform for five of the six plants inspected, ranging from 0.050 to 0.067 man-hours for processing plants operating with adjoining freezing facilities and for processing plants using public freezers. For the sixth plant this operation took 0.133 man-hours. Here, the freezing unit was located approximately 150 yards from the processing plant and all handling operations were performed manually (see table V - 50).

5. Glazing and mastering: Procedures for glazing and packing frozen headless shrimp in master cartons were found to be more or less standardized in the six plants surveyed.

The shrimp are removed from the blast freezer on the rolling racks or pallets on which they were frozen. Each carton lid is opened prior to placement on a conveyor equipped with a water spray. About eight ounces of water are added, the lid is closed, the carton is inverted and then packed top-side down, ten five-pound cartons to a master. The master is then sealed and placed in cold storage to await shipment.

For two of the six plants inspected, glazing and packing were done at public freezers. The other four plants operated their own freezers.

The number of man-hours required to glaze and pack a hundred pounds of frozen headless shrimp in plants operating their own freezers varied from 0.111 to 0.267. The plant with the lowest man-hours employed a 5-man crew for these operations; the other plants used crews of 11 or 12 men. The man-hours required for these operations do not appear to have been greatly influenced by the size of the crew performing them. For example, one plant employing a 12-man crew had a man-hour rate only slightly higher than the plant using a 5-man crew.

On the basis of their observations the First Research Corporation engineers concluded that some plants would benefit from more efficient methods of operation which might be developed after "trial and error". By equalization of the workload spotty idling time could be reduced in a number of the establishments.

First Research Corporation recommends that the water glazing process be replaced by overwrapping the cartons. It was estimated that the adoption of overwrapping in lieu of glazing, the replacement of the power hoist with a portable power conveyor for unloading shrimp and efforts to obtain a more efficient distribution of labor on the production line, would result in a saving of upwards of 40 percent in the man-hours required to produce a hundred pounds of packaged frozen headless shrimp (see tables V - 50 and V - 51).

Based on the assumption that each producer operates his own freezing plant First Research Corporation has devised a recommended procedure for processors of frozen headless shrimp. This procedure which combines the best features of the plant operations surveyed with certain modifications suggested by the engineers who made the study is reproduced below. A synthesized layout as well as a tabulation of estimated man-hour values for individual operations under the streamlined procedure is included.

Plant procedure--synthesized operations.-- (see figure V - 55)

1. Receiving and unloading: Two men, working as a team in the hold of the fishing vessel, shovel iced headless shrimp onto a portable power conveyor. The conveyor elevates the shrimp from the vessel hold and discharges them into a wash vat located on the dock, where storage ice is washed away from the shrimp.

2. Inspecting and grading: A conveyor removes the shrimp from the vat and feeds them past a team of seven inspectors. The inspectors remove by hand all extraneous matter and shrimp of inferior quality. The inspected shrimp are discharged into the receiving hopper of a grading machine. A single operator oversees the grading machine which mechanically sorts the shrimp into the size categories, and through four discharge outlets, ejects the shrimp according to size to the packing stations.

3. Packing and weighing: At each of the four packing stations a team of two operators is stationed. The first operator sets up the folded five-pound size waxed carton, fills the carton with graded shrimp and passes the filled carton, lid open, to the second operator. The second operator weighs the carton, closes and places it on a conveyor belt feeding to the wrapping machine.

4. Overwrapping of carton: An operator, stationed at the loading end of the wrapping machine, removes the cartons of shrimp from the conveyors feeding from the packing stations and places them on the feed belt of the wrapping machine. The wrapping machine mechanically overwraps and seals the filled cartons and discharges them to a team of two workers who load the wrapped cartons on rolling shelf racks for transport to the freezer.

5. Blast freezing: The rolling racks of filled cartons are manually loaded into the chill room of the freezer installation. This room should be designed and utilizable for freezing when volume production warrants it. The shrimp are left in this area until the production run is completed and then loaded into either a large or a small blast freezer room, depending upon the quantity of the production run. The approximate capacity of these blast freezer rooms should be 10,000 pounds and 20,000 pounds.

6. Mastering: The frozen five-pound cartons of shrimp are removed from the blast freezer by two teams of two men each and packed ten cartons to the master carton. The master carton is then sealed and placed in cold storage to await shipment.

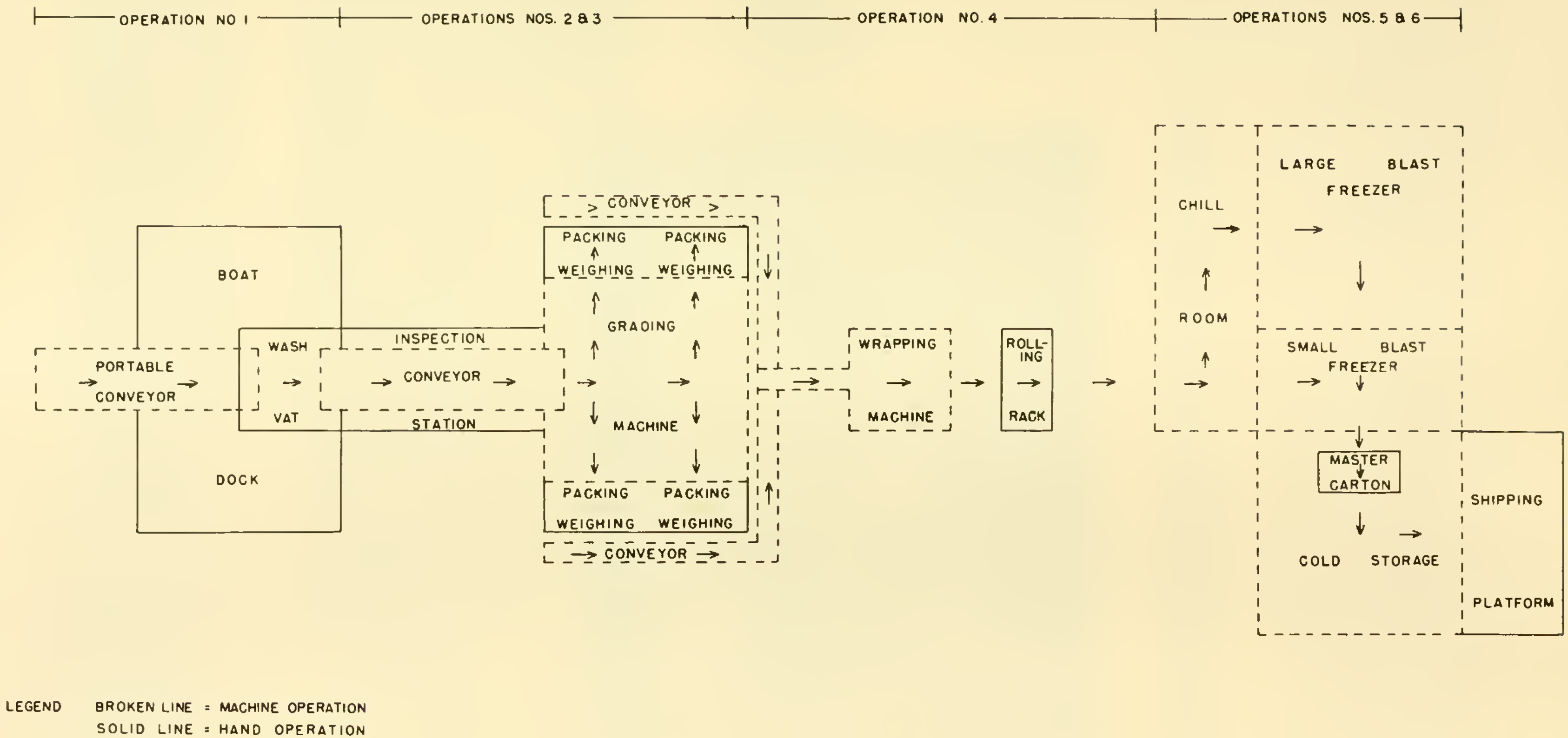


FIGURE V - 55.--SCHEMATIC FLOW DIAGRAM, SYNTHESIZED LAYOUT - FROZEN HEADLESS SHRIMP PLANT.

First Research Corporation.

Plant operation--summary and special problems.--In the opinion of the First Research Corporation, the ideal plant for packing frozen headless shrimp would be situated on a waterway, thus enabling shrimp fishing vessels to unload directly into the packing plant. This would eliminate excessive handling and transportation. The plant should have adequate facilities for grading and packing and a well-designed flexible freezer arrangement.

Of the plants chosen by First Research Corporation as representative, only one incorporated all of the above desirable features. The others operated under one or more of the following handicaps.

Shrimp had to be trucked to the processing plant.
The plant had no freezing facilities on the premises.
The plant freezer was constructed as one large unit rather than sub-divided to fit production needs.

Frozen Peeled and Deveined Shrimp

One company included in the First Research Corporation sample of processors of frozen shrimp specialized in the packing of individually frozen peeled and deveined headless shrimp. Equipment used, and procedure followed, in the preparation of this end-product were described as follows:

Plant procedure.--

1. Receiving and grading: Iced fresh headless shrimp are delivered by truck in hundred-pound boxes. The boxes are unloaded through a wall opening directly into a cold holding room. From the holding room shrimp are emptied into a vat where the storage ice is flushed away and the shrimp are washed. A conveyor belt removes the shrimp from the vat and feeds them past a team of inspectors who manually remove any extraneous matter and damaged shrimp. The inspected shrimp are then fed into the grading machine which sorts them into six size categories and discharges each size through one of six metal chutes. The shrimp are caught in metal containers which when filled are pulled manually along roller tracks to a scale. The weight is checked by a recording clerk and the shrimp are rolled back into the cold holding room to await further processing.

2. Peeling and deveining: The shrimp are transported in buckets from the holding room to peeling machines and emptied into hoppers. The machine operator removes the shrimp from the hopper and places them in the machine receiver one by one. The peeled and deveined shrimp are discharged onto a conveyor feeding to an inspection station, the shells and veins are discharged onto a waste belt.

FIGURE V - 56.--A part of the peeling and deveining room at a Texas shrimp plant.

Southern Fisherman.

3. Inspection: The peeled and deveined shrimp are fed past a team of inspectors who check for any remaining shell or vein, pulling aside any shrimp needing further cleaning, the clean shrimp continue on to the next operation. The incompletely cleaned shrimp are diverted to hand operators who complete the operation and place the shrimp back on the conveyor feeding to the next operation.

4. Preparation for freezing: The peeled and deveined shrimp are discharged by the conveyor to two adjoining work stations where two teams of five workers each place the shrimp on thin aluminum sheets. Each sheet holds approximately 2-1/2 pounds of shrimp, and the shrimp are spaced so as not to touch each other. The aluminum sheets are separated by angle irons and placed in twelve stacks of five each on a rolling rack and manually rolled into the freezing tunnel.

5. Freezing: The blast freezing tunnel holds 24 racks. Operators of the plant state that the tunnel is operated at approximately -65° F. and that the shrimp are "flash" frozen in approximately 25 minutes.

6. Glazing: The racks of frozen shrimp are manually removed from the freezer and placed by a work station where an operator empties the aluminum sheets of shrimp onto a funnel top table. The frozen shrimp drop through the funnel opening into an open mesh basket. A second operator takes the filled basket, dips it into a glazing tank, and empties the glazed shrimp onto one of two packing tables.

7. Packing and overwrapping: An operator at each of the packing tables scoops a waxed carton full of glazed shrimp, and places it on a conveyor feeding past the weighing stations. The shrimp are weighed, the carton lid is closed and the carton is placed on a conveyor feeding the wrapping machine. The wrapping machine overwraps 120 retail-size, or 60 institutional-size cartons per minute. After overwrapping the cartons are manually packed into master cartons, which are sealed and placed in cold storage to await shipment. Frozen peeled and deveined shrimp are produced by this plant in eight, twelve and sixteen ounce and two pound containers.

Frozen Cooked and Peeled Shrimp

In most plants cooked and peeled shrimp is packed as a second product in conjunction with a processor's principal end-product. According to First Research Corporation, the quantity of shrimp packed in this form usually accounts for only a small fraction of a processor's total production. A few canning plants customarily put up cooked and peeled shrimp in larger quantities. Similarity of processing procedures makes the packing of cooked and peeled shrimp particularly adaptable to canning operations. The bulk of the cooked and peeled shrimp pack is frozen.

In order to get a picture of processing operations for cooked and peeled shrimp, First Research Corporation selected two canning establishments which packed the product on a regular basis. The two plants selected were both located directly on waterways to receive raw materials from the fishing vessels and concentrated on the production of the same type of end-products. Here the similarity between the two operations ended. One plant, recently completed, had installed the most up-to-date processing equipment, and devoted about 15 percent of its capacity to the production of cooked and peeled shrimp.

The other plant had been in operation for a number of years. It did not possess the most modern type of equipment for the processing of cooked and peeled shrimp, a product which constituted approximately 35 percent of its total production. Plant No. 1 made use of portable power conveyors for unloading shrimp vessels, had an automatic peeling and deveining machine, and food pumps for transporting the product at certain operational stages. At plant No. 2 vessels were unloaded by means of a basket and power hoist and the shrimp were peeled and deveined by hand.

Since processing of cooked and peeled shrimp takes place primarily in canning establishments, the comments made with respect to seasonality of production and quality inspection in the discussion of operations in these plants also apply here.

Plant procedure.--As a result of lengthy observations and direct contact with equipment manufacturers, a synthesized plant layout (see figure V - 57) and procedure has been drafted. The procedure for cooked and peeled shrimp is for all practical purposes identical with that of canned shrimp up to and including the point of can filling. (see discussion under 'Canned Shrimp', page 284)

Cooked and peeled shrimp are usually packed for institutional use in four or five-pound metal containers. In recent years a portion of the pack has been marketed in consumer size containers. All shrimp are packed dry. Most producers vacuum pack by utilizing vacuum closing machines.

After closure the cans are either placed in ice storage to await shipment as "Fresh pack" or to await movement to the freezer.

Manpower requirements and production per man-hour.--If the synthesized layout and procedure are utilized, estimated production in terms of end-product per man-hour and man hours required per 100 pounds, would be as follows: (see table V - 52)

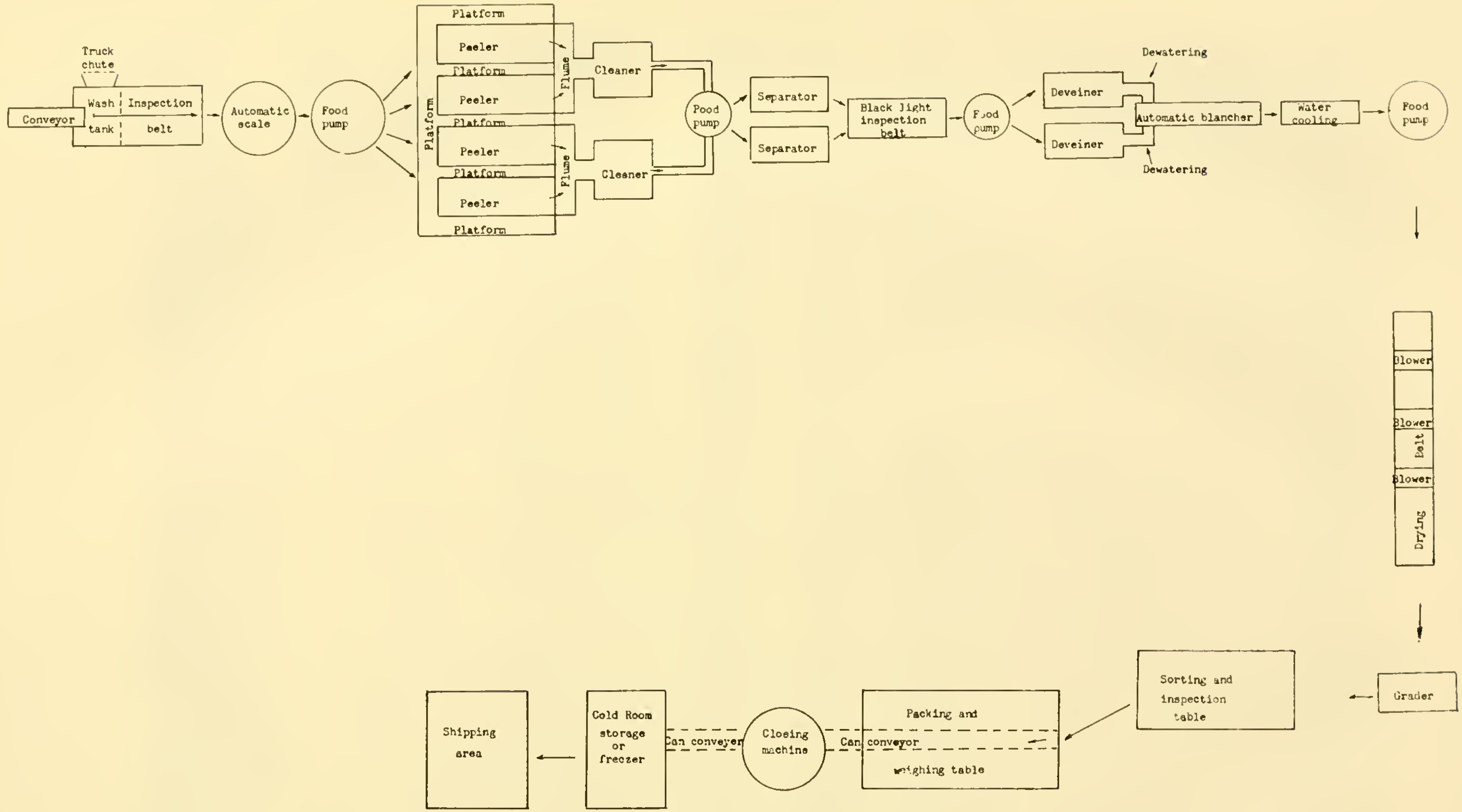


FIGURE V - 57.--SYNTHESIZED LAYOUT - COOKED AND PEELED SHRIMP PLANT.

Lawrence W. Strasburger.

TABLE V - 52.--FROZEN COOKED AND PEELED SHRIMP, ESTIMATED PRODUCTION RATES AND MAN-HOURS REQUIRED TO PRODUCE 100 POUNDS OF END-PRODUCT, HYPOTHETICAL PLANT USING SYNTHESIZED PROCEDURES AND LAYOUT

Operation	Type of operation	Production per man-hour (end-product weight) (Pounds)	Man-hours required (Per 100 pounds of end-product)
Receiving and inspection	Hand	173.3	0.577
Peeling	Machine	1040.0	0.096
Black light inspection	Hand	130.0	0.769
Deveining, blanching and general	Machine	1040.0	0.096
Grading	Machine	1040.0	0.096
Sorting and inspection	Hand	130.0	0.769
Packing and weighing	Hand	346.6	0.288
Can closing	Machine	1040.0	0.096
Storage or freezing	Machine	1040.0	0.096

A production rate of 4 barrels (840 pounds) of head-on shrimp per hour per peeling machine and a yield of 65 pounds of end-product per barrel has been used as a basis for these calculations. Assuming 1,040 pounds of end-product per hour is produced by 4 peeling machines, the man power needed at each operational stage would be as follows:

Operation	Number of workers
Receiving and inspection	6
Peeling	1
Black light inspection	8
Deveining, blanching and general	1
Grading	1
Sorting and inspection	8
Packing and weighing	3
Can closing	1
Storage or freezing	1

Packaging of frozen cooked and peeled shrimp in Alaska where most of the catch is processed in this form is accomplished as follows:

With the improvements in refrigerated transportation in recent years the Alaskan shrimp are almost completely marketed in the dry frozen state and are packed in No. 10 double-seamed cans, 5 pounds of meats to the can (until about 1940, the meats were packed 5 pounds to a 1-gallon can and shipped in ice). Owing to the increased demand for frozen products in the home in recent years, 1-pound and even smaller containers are used. A consumer-size can (307 x 113) holding 4 ounces of meats sealed under vacuum has been marketed. Vacuum packing increases the frozen-storage life of the product and minimizes toughening over long periods of frozen storage.

Besides being marketed as cooked picked meats, some Alaskan shrimp are prepared in other ways. Spot shrimp are cooked whole and frozen in waxed cartons, 20 pounds to the box; frozen raw picked meats of large side-stripe shrimp are packed 6 pounds to a No. 10 can and hermetically sealed. Alaskan shrimp are usually marketed within 6 months after being packed.

In the South Atlantic and Gulf Areas only a small proportion of the shrimp are marketed as frozen cooked. Instead of being cooked in fresh water then peeled, and given a second cook in brine as in Alaska, the shrimp here are raw peeled and then boiled in a brine solution. The cooked shrimp, after being cooled, should be packaged immediately. Waxed cartons are widely used with overwraps having good moisture-vapor-proof qualities; No. 10 cans and cans holding only 5 ounces and 7 ounces are also used and are usually hermetically sealed. The packaged shrimp should be stored at a temperature not exceeding 0° F. The cooked shrimp have a very short frozen-storage life and soon become tough, with a loss of flavor. Peeled boiled shrimp should not be stored longer than 4 months, whereas unpeeled boiled shrimp have been found in tests to be acceptable after storage up to 6 months. These storage periods are probably maximum, and in practice, it is believed that considerably shorter storage periods should be used. Production should, therefore, be planned so that a rapid turnover in stock will occur.

The following problems merit special consideration in connection with the packaging of frozen shrimp products:

Large losses in moisture which can occur through the use of packages and overwraps that have low resistance to the passage of moisture vapor.

Loss of moisture and rapid quality deterioration as the result of improper glazing or failure to reglaze when necessary.

Product losses due to failure to make periodic inspection of frozen storage holdings.

Statistics on Frozen Packaged Shrimp Production (Other Than Breaded)

Trends.--Figure V - 58 reveals that production of frozen packaged shrimp increased from 1.5 million pounds in 1930 to 16.1 million pounds in 1940, 46.2 million pounds in 1950 and by 1954 production had risen to 88.2 million pounds and decreased to about 71.1 million pounds in 1956. Value of product at the manufacturer's level during the 27-year period increased from a quarter million dollars to over 53 million dollars in 1956 (excluding breaded shrimp).(see figure V - 59)

Seasonal characteristics of shrimp freezing.--The seasonal pattern of shrimp freezing closely follows the seasonal pattern of shrimp landings. Freezings reach a peak during the period of high production in the months of September through October and are at their low during the first four months of the year.

Monthly freezing statistics for the years 1940, 1945, and 1950-1956 are shown in table V - 53. The same data are expressed as percentages of total annual freezings in table V - 54. As can be seen from this tabulation, the 1940 data show evidence of a secondary peak of production in May and June as well as the succeeding summer lull which was characteristic before the expansion of the grooved shrimp fishery.

TABLE V - 53.--SHRIMP FREEZINGS, MONTHLY DATA, SPECIFIED YEARS

(Thousands of pounds)

Months	1940	1945 1/	1950 1/	1951 1/	1952 1/	1953 1/	1954 1/	1955	1956
January	703	1,262	1,936	2,931	4,936	3,307	2,918	3,675	4,389
February	625	866	2,331	2,171	3,218	2,047	2,549	3,126	3,328
March	809	512	2,034	2,384	2,556	3,049	1,967	2,981	3,060
April	573	617	2,517	2,628	2,899	2,996	2,526	2,442	2,895
May	1,517	1,094	5,560	3,659	4,124	4,662	3,125	2,566	2,919
June	2,176	919	4,970	4,079	4,416	3,762	3,589	3,942	3,849
July	675	749	4,115	5,255	4,096	5,670	4,415	7,158	6,136
August	293	2,566	6,578	6,867	5,089	7,155	8,169	5,559	7,334
September	1,440	4,350	7,752	6,619	6,787	7,051	7,492	5,840	7,396
October	2,134	5,538	8,265	10,713	8,476	7,461	7,769	6,722	9,983
November	3,102	3,945	5,451	6,384	4,517	6,330	2/8,166	3,228	7,690
December	1,939	2,400	4,174	4,901	3,891	3,210	2/5,407	2,804	6,125
Total	15,986	24,818	55,683	58,591	55,005	56,700	58,092	50,043	65,104
Average	1,332	2,068	4,640	4,883	4,584	4,725	4,841	4,170	5,425

1/ Includes shrimp meat.
2/ Includes 2,126,687 pounds of other than raw headless in November and 1,928,686 pounds in December. These data were not collected separately prior to November.

Note: The statistics on shrimp freezings were obtained from firms which make monthly reports on their cold storage holdings to the United States Fish and Wildlife Service. Since the coverage of firms is not complete, the above statistics are not to be construed as representing total United States freezings of shrimp products.

FIGURES V - 58 and 59.--QUANTITY AND VALUE OF FROZEN PACKAGED SHRIMP (OTHER THAN BREADED),

SPECIFIED YEARS

FIGURE 58

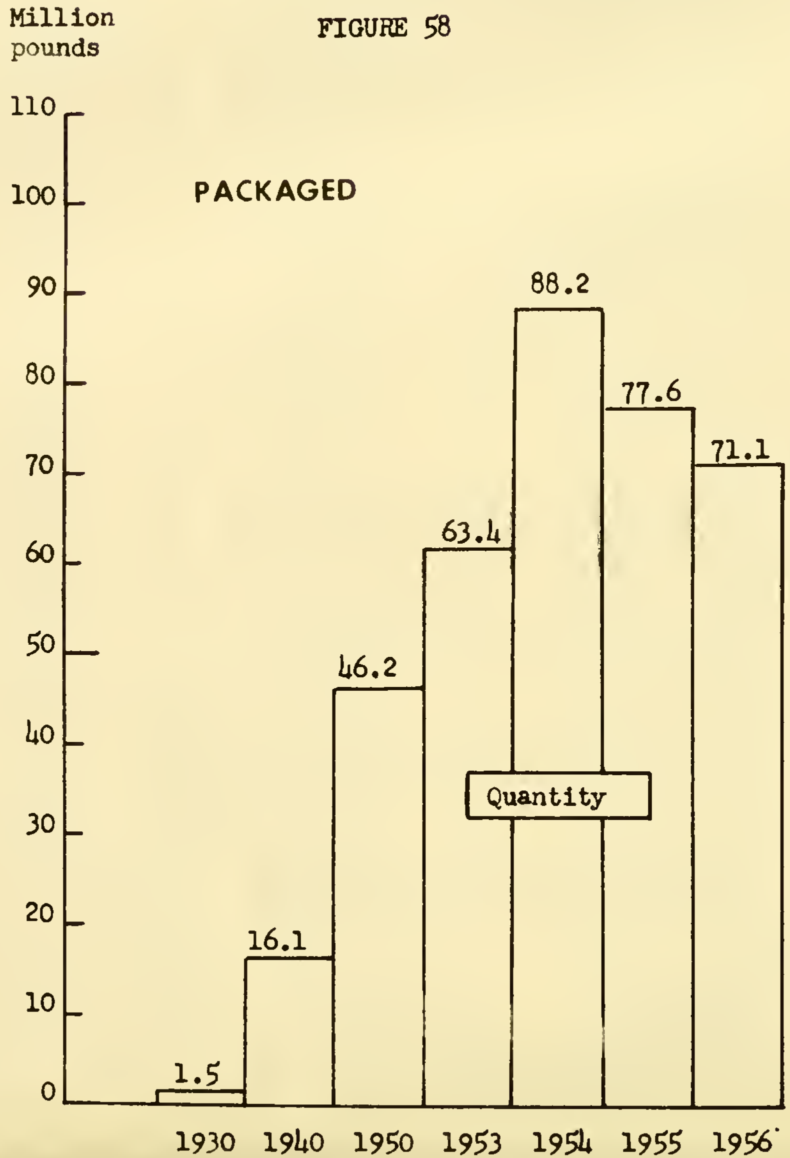


FIGURE 59

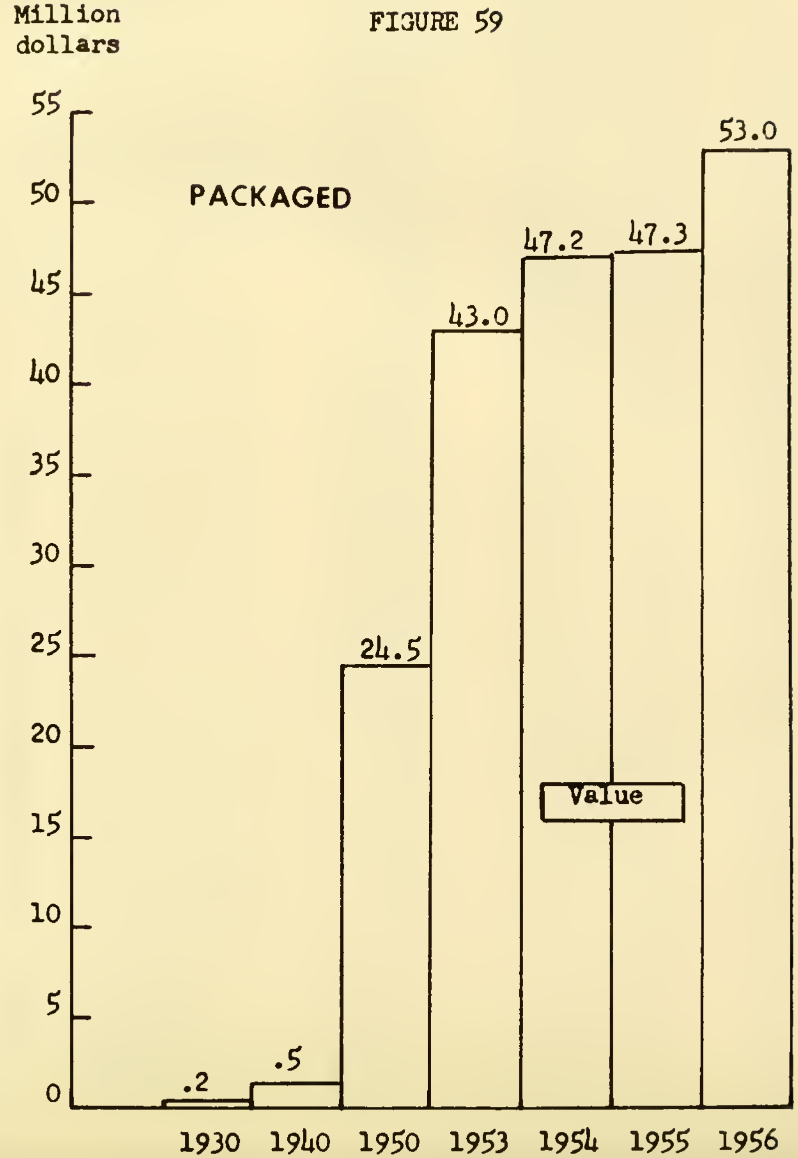


TABLE V - 54.--SHRIMP FREEZINGS, MONTHLY DATA IN PERCENTAGES OF ANNUAL TOTALS, SPECIFIED YEARS

Months	1940	1945	1950	1951	1952	1953	1954	1955	1956
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
January	4.4	5.1	3.5	5.0	9.0	5.8	5.0	7.3	6.8
February	3.9	3.5	4.2	3.7	5.9	3.6	4.4	6.2	5.1
March	5.1	2.1	3.7	4.1	4.6	5.4	3.4	6.0	4.7
April	3.6	2.5	4.5	4.5	5.3	5.3	4.3	4.9	4.4
May	9.5	4.4	4.6	6.2	7.5	8.2	5.4	5.1	4.5
June	13.6	3.7	8.9	7.0	8.0	6.6	6.2	7.9	5.9
July	4.2	3.0	7.4	9.0	7.4	10.0	7.6	14.3	9.4
August	1.8	10.3	11.8	11.7	9.3	12.6	14.1	11.1	11.3
September	9.0	17.5	13.9	11.3	12.3	12.4	12.9	11.7	11.4
October	13.4	22.3	14.8	18.3	15.4	13.2	13.4	13.4	15.3
November	19.4	15.9	9.8	10.9	8.2	11.2	14.0	6.5	11.8
December	12.1	9.7	7.5	8.3	7.1	5.7	9.3	5.6	9.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Charges for Freezer Services

Charges made by custom or public freezers vary with the type of services performed. The Bureau of Business and Economic Research of the University of Miami obtained the following information on practices found in this branch of the industry.

Consumer packages may contain from twelve ounces to two and one-half pounds of shrimp. The most commonly used institutional package for headless shrimp contains five pounds. The individual cartons are packed in master cartons, usually containing 50 pounds of shrimp.

Headless shrimp may or may not be taken to the freezer already packed in individual cartons, depending upon the extent of the operations performed by the shrimp plant. Most commonly, the freezer receives the product in bulk and performs all packaging functions. In certain areas, such as Galveston, Texas, the shrimp plant makes all preparations up to and including packaging in the individual carton. In such cases, the freezer charges about 1-1/2 cents per pound for handling in and out of quick freezer, glazing, making up of master cartons, marking and checking, and one month's storage. Since the five-pound institutional package is the most common type, the freezer charges for smaller packages are slightly higher.

If the freezer performs more services than indicated above, costs rise accordingly. The largest operator in Brownsville charges 3 cents per pound for removal by conveyor from delivering truck, culling, grading, freezing, glazing, mastering and loading on the removing truck. In almost every instance, the owner of the shrimp provides his own individual carton, but if he does not, the freezer will supply cartons at a cost of 1.8 cents per pound. Storage charges are not included here because many public freezers located on the Texas coast do not have sufficient facilities for storing large quantities. Hence, those who use facilities of public freezers do so with the understanding that their shrimp will be stored only until they have accumulated a full truck load.

In Alabama, the cost of freezing at the time of the Bureau's survey was 2 cents per pound with the person holding title paying for the cartoning, glazing, and the preparation for freezing. The charge for warehousing was 50 cents per 100 pounds per month.

A 1-1/2 cent-per-pound charge in Mississippi included glazing and packing in master cartons but did not cover the cost of the carton and the preparation of the shrimp for the freezer. While the 1-1/2-cent charge allowed for one month's free storage, additional storage was provided at a cost of 35 cents per 100 pounds per month.

Freezer charges in the State of Louisiana varied from 1-1/2 cents per pound, if the customer supplied his cartons, 3 cents if materials were provided by the freezer. If complete packing and freezing services were performed, a charge of 5 cents was made which included one month's free storage. Charges for additional storage varied between 50 to 75 cents per month per 100 pounds.

Rate schedules for custom packing and freezing of shrimp furnished to the United States Fish and Wildlife Service by two companies are reproduced in tables V - 55 and V - 56.

TABLE V - 55.--COMPANY 'A'
CHARGES FOR CUSTOM PACKING AND FREEZING
SHRIMP EFFECTIVE MARCH 1, 1956

5 Pound Pack	
Processing, per pound	$ .035
Cases and cartons, per case	1.00
Cases only	.30
Cartons only	.70
2-1/2 Pound Pack	
Processing, per pound	.0525
Cartons (all belong to Company 'A' foods), each	.042
12/2-1/2 cases, per package	.011
2-1/2 Company 'A' labels, per package	.014
1 Pound Pack	
Processing, per package	.0642
(Company 'A' has no packing materials for 1 pound)	
12 Ounce Pack	
Processing, per package	.0642
12 ounce cartons, per package	.015
24/12 case, per package	.005
13" Plain wax O/W, per package	.005
Miscellaneous	
Handling and 1 month storage on frozen, per pound	.00583
Strapping charges per case, 2 straps	.29
Strapping charges per case, 3 straps	.35
Grading only, per pound	.0117

TABLE V - 56.--COMPANY 'B'
CHARGES FOR FREEZING, MASTERING
AND FIRST MONTH'S STORAGE
(In effect in August, 1956)

	If glazed		If overwrapped	
Boxes	Per cwt.	Per ton	Per cwt.	Per ton
5 pounds	$ 1.45	$ 29.00	$ -	$ -
2-1/2 pounds	1.65	33.00	1.50	30.00
1 pound	1.50	30.00	1.50	30.00
12 and 10 ounce	1.50	30.00	1.50	30.00

Note: All prices based on net weight.

Two companies furnished cost data on frozen headless, and on frozen peeled and deveined, shrimp to the Federal Trade Commission accountants for the year 1954 (see table V - 57). One other company was able to provide cost information by type of package for the month of October 1954 (see table V - 58).

TABLE V - 57.--AVERAGE COST PER POUND OF END-PRODUCT OF PRODUCING FROZEN HEADLESS, AND FROZEN PEELED AND DEVEINED SHRIMP, 2 PRODUCERS, 1954

(Cents per pound)

Item	Company A		Company B	
	Frozen headless	Frozen peeled	Frozen headless	Frozen peeled
Green shrimp	49.32	60.05	48.67	60.84
Containers	3.42	3.42	3.85	2.62
Labor	1.53	9.48	5.41	6.82
Overhead 1/	.63	3.90	.99	1.46
Total production costs	54.90	76.85	58.92	71.74

1/ Includes depreciation insurance, repairs and maintenance, utilities, supplies, payroll and property taxes.

Costs per pound of finished product for one company which furnished statistics on its total annual volume were close to 59 cents for frozen headless and somewhat less than 72 cents for peeled and deveined shrimp. Labor, packaging materials, and overhead costs, in this instance, were approximately 10 cents on frozen headless and 11 cents on peeled and deveined shrimp. The other company for which comparable data for the same year were available listed its total production costs for frozen headless as 55 cents, for peeled and deveined shrimp as 77 cents. Costs other than raw material, in this instance, was slightly higher than 5 cents for frozen headless, but nearly 17 cents for peeled and deveined shrimp. Comparable cost data for 1953 which were available for this company were higher than in 1954; this may be interpreted as a reflection of the price inflation in the raw shrimp market in the earlier part of 1953.

TABLE V - 58.--AVERAGE COST PER POUND OF END-PRODUCT OF PRODUCING FROZEN HEADLESS, AND FROZEN PEELED AND DEVEINED SHRIMP, BY SIZE OF PACKAGE AND SIZE CLASS OF SHRIMP, 1 PRODUCER, OCTOBER 1954

Item	Pounds of raw shrimp used	Raw shrimp	Con-tainers	Direct labor	Labor taxes	Freezing charges	Freezing labor	Other mfg. expense	Total cost
		Cents per pound of finished product							
Fresh-frozen headless shrimp:									
10 oz. package 21-25 count	450	45.00	4.50	2.25	.11	1.00	.50	3.83	57.19
10 oz. package 26-30 count	2,445	42.92	4.50	2.25	.11	1.00	.50	3.80	55.08
12 oz. package 26-30 count	4,931	41.99	4.50	2.25	.11	1.00	.50	3.78	54.13
12 oz. package 31-35 count	936	38.00	4.50	2.25	.11	1.00	.50	3.72	50.08
12 oz. package 40-50 count	666	25.00	4.50	2.25	.11	1.00	.50	3.53	36.89
12 oz. package 50 and up count	5,226	25.68	4.50	2.25	.11	1.00	.50	3.54	37.58
2-1/2 lb. package 15-20 count	270	52.00	2.15	1.50	.08	1.00	.50	2.87	60.10
2-1/2 lb. package 21-25 count	3,300	47.32	2.15	1.50	.08	1.00	.50	3.01	55.56
2-1/2 lb. package 26-30 count	11,400	34.87	2.15	1.50	.08	1.00	.50	2.62	42.72
2-1/2 lb. package 31-42 count	22,462	33.09	2.15	1.50	.08	1.00	.50	2.59	40.91
2-1/2 lb.package 50 and up count	15,735	23.48	2.15	1.50	.08	1.00	.50	2.45	31.16
5 lb. package 15-20 count	31,950	51.68	1.71	1.00	.02	1.00	.50	1.60	57.51
5 lb. package 21-25 count	69,890	46.49	1.71	1.00	.02	1.00	.50	1.90	52.62
5 lb. package 26-30 count	31,985	41.57	1.71	1.00	.02	1.00	.50	1.45	47.25
5 lb. package 31-35 count	485	39.00	1.71	1.00	.02	1.00	.50	1.41	44.64
Total	202,131	41.79	2.03	1.22	.04	1.00	.50	1.96	48.54
Peeled and deveined shrimp:									
10 oz. package - pieces	2,975	35.37	4.50	7.00	.35	1.00	.50	3.76	52.48
2-1/2 lb. package 15-20 count	1,047	25.96	3.10	15.00	.75	1.00	.50	6.77	53.08
2-1/2 lb. package 15-25 count	325	54.17	3.10	15.00	.75	1.00	.50	7.18	81.70
2-1/2 lb. package 21-25 count	3,935	52.73	3.10	15.00	.75	1.00	.50	7.16	80.24
5 pound package - pieces	2,887	28.50	1.80	4.96	.25	1.00	.50	1.67	38.68
5 pound package 31-35 count	51,213	43.77	1.80	7.00	.35	1.00	.50	3.84	58.26
5 pound package 36-42 count	1,705	37.05	1.80	7.00	.35	1.00	.50	3.74	51.44
5 pound package salvage	-	20.00	1.80	5.00	-	1.00	.50	3.15	31.45
Total	64,087	42.52	2.04	7.63	.38	1.00	.50	4.03	58.10

The influence of the size of shrimp used, and size of package, on processing costs is clearly illustrated in the statement of the company which furnished particulars. With the exception of the cost of freezing (including freezing labor) the tabulation, (table V - 58) indicates that all elements of cost are affected by size of package and size of shrimp, the costs varying in direct proportion with size of shrimp and in inverse proportion with size of package.

Information on fees charged and total costs incurred were obtained for one producers' cooperative with integrated facilities for unloading, packing, handling, freezing, and marketing shrimp. The cooperative follows a policy of charging its patrons separate fees for handling and marketing, and for freezing. The fees are not directly related to actual costs incurred in providing these services. Fees charged for handling and marketing provided for a comfortable margin above costs, the fees charged for freezing were slightly below costs.

Two Louisiana companies studied by the Federal Trade Commission listed cooked and peeled shrimp as their principal product. The shrimp were packed in institutional size metal containers and sold fresh or frozen depending upon market conditions.

Cost accounting records maintained by both companies pertained to daily operations and, as a rule, included costs that had to be allocated to more than one product. By selection of cost sheets for days when cooked and peeled shrimp exclusively were processed some idea of production costs for this product could be obtained.

From the data available, it appears that daily costs per pound of cooked and peeled product fluctuated mainly with the price of the raw shrimp which represent approximately three-fourths of the total cost of production. Total costs recorded for individual days in 1954 were as low as $.792, and as high as $1.717 per pound of product. The 1953 accounting records revealed similar daily cost variations. Considerable variations in prices paid to the fishermen and some differences in product yields explain this wide range of daily product costs.

Breaded Cooked and Uncooked Shrimp

The breading process is the most recent major innovation in the field of product development of the shrimp industry. Compared to the "fresh-frozen" segment of the industry, the breaders use smaller size shrimp. The breading plants prefer to bread fresh shrimp as they are brought in from the docks. In periods of high production the shrimp are often frozen and later defrosted, breaded, and re-frozen. This enables the breading plants to operate on a year-round basis.

In general, breaders are not specialists, but perform other processing operations as well. Some of them pack frozen shrimp in institutional packages and handle other specialties. Their freezing operations are often performed by custom freezers but they use their own facilities for packaging and shipping. Usually the freezing plant is located adjacent, or in very close proximity, to the breading plant.

On the basis of visits to five establishments the First Research Corporation concluded that plant facilities, for the most part, had been adapted to their present use rather than originally constructed for the processing of frozen breaded shrimp. Plant layout, therefore, has been greatly influenced by the physical limitations of the buildings.

As a result, a considerable amount of unnecessary handling and transporting takes place during processing. Examples cited are the awkward location of refrigeration space in relation to receiving and shipping facilities as well as the illogical location of the final operation of mastering in relation to the cold-storage area.

Mechanization in the plants studied was limited principally to conveyor systems for transporting product between operations, the mechanical grading of raw shrimp, and the automatic wrapping of cartons. One company used hand-fed machine peelers and deveiners; in another, mechanical splitting and deveining machines were employed after hand-peeling. The extent to which manual operations still predominate in this sector of the industry is demonstrated by the fact that machine operations in the sample of five plants accounted only for 3-1/2 to less than 14 percent of total man-hours consumed. The reason for this lop-sided dependence on manual labor is the absence of mechanical procedures for some--or all--of the following operations: Peeling, deveining, breading, and packing.

When attention is focused on the productivity of labor in the plants surveyed, substantial differences in man-hours required to produce a given quantity of products are noted. These variations are due in part to differences in methods and equipment employed. More importantly, they are traceable to sharply varying degrees of skill and effort of the labor force.

Plant procedure.--Combining the best features of currently used methods and equipment First Research Corporation arrived at the following synthesized picture of breading plant operations: (see figure V - 60)

1. Receiving: Hundred-pound boxes of shrimp are unloaded from trucks and fed by means of a roller conveyor directly into a cold holding room located adjacent to the receiving dock.

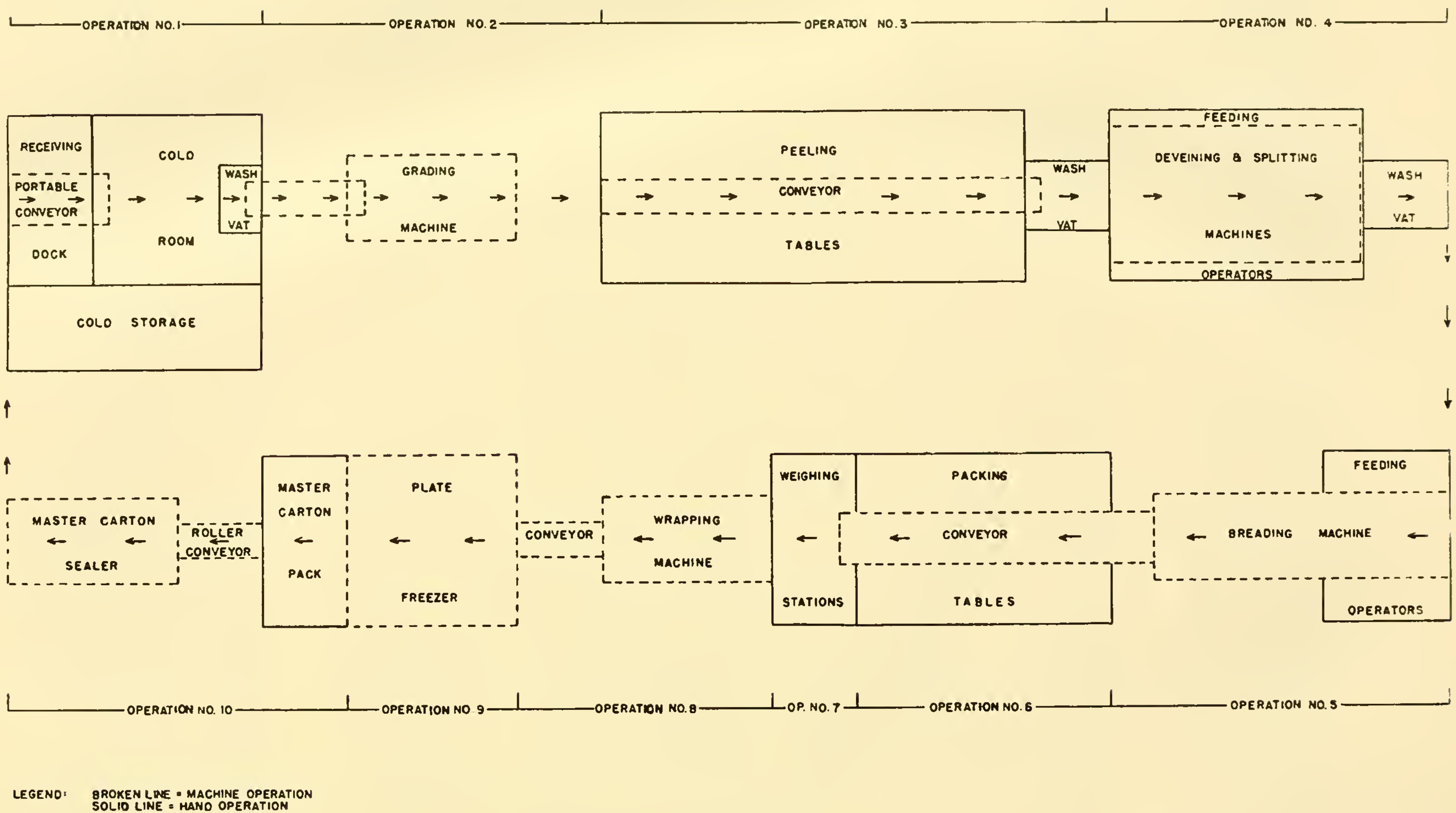


FIGURE V - 60.--SCHEMATIC FLOW DIAGRAM, SYNTHESIZED LAYOUT - FROZEN BREADED SHRIMP PLANT.

First Research Corporation.

2. Grading: Hundred-pound boxes of shrimp are emptied into a wash vat located inside the cold holding room. After washing the shrimp are conveyed through a cut-out in the wall of the cold room, directly to the receiving end of the grading machine. This type of procedure is superior to the common practice of dragging the boxes of shrimp from the cold room, hand-trucking and emptying the shrimp manually into a wash vat, and feeding them into the grader.

3. Peeling: Containers of graded shrimp are loaded manually on the conveyor feeding past the peeling work stations. The operators remove the shrimp from the conveyor, hand peel each shrimp leaving the tails on, and place the peeled shrimp in a container. When filled the container is placed on a conveyor and emptied into a wash vat.

4. Deveining and splitting: The peeled shrimp are removed from the wash vat by means of a wire mesh scoop and placed in a container. The container in turn is placed next to a splitting and deveining machine. The operator feeds the peeled shrimp individually into the receiver of the machine using both the right and the left hand. A rotary knife blade in the machine splits the shrimp to the desired depth, removing the vein by the cutting action of the knife blade. After discharge by the machine the shrimp are placed in a wash vat. The capacity of the splitting machine is governed by the rate of feed by the hand operator.

5. Breading: The shrimp are removed from the wash vat and brought to an automatic breading machine. This machine automatically breads the shrimp, discharging them ready for packaging. The machine is hand-fed by operators who position the shrimp on the receiving belt. From this point on to the discharge of the breaded shrimp the operation is fully automatic. It is claimed that, using a forty percent breading pick-up, 948 pounds of finished product can be produced per machine hour with this machine. To maintain this rate of production a hand feeding crew of 6 operators would have to be employed, the productivity per worker averaging 158 pounds per man-hour (one-sixth of the 948 pounds produced per machine-hour). A good operator breading shrimp manually, in comparison, will only produce 30 to 40 pounds of finished product per hour. In addition to the production advantages of the machine, an appreciable savings in breading waste is claimed, as well as a saving in floor space.

6. Packing: After breading, the shrimp are discharged on a conveyor flowing past packing operators who hand-pack the shrimp into cartons. The filled cartons are placed by the packer, lid open, on a conveyor feeding to the weighing station.

7. Weighing: Each filled carton is weighed by a team of two operators, the lid closed, and the carton placed on a conveyor leading to the packaging machine.

8. Packaging: The filled cartons are conveyor-fed into an automatic machine where they are overwrapped and sealed.

9. Freezing: From the packaging station the cartons are conveyor-fed to an automatic loading plate freezer where they are frozen and then discharged onto a table ready for mastering.

10. Mastering: The cartons of frozen shrimp are hand packed in the master cartons, placed on a conveyor feeding to a machine where they are sealed and discharged ready for cold storage.

Manpower requirements and production per man-hour.--Assuming that both the synthesized layout (see figure V - 60) and the synthesized operations described above were to be adopted, production per man-hour (in terms of end-product weight) and man-hours required per hundred pounds of end-product were estimated by the First Research Corporation engineers as follows:

TABLE V - 59.--FROZEN BREADED SHRIMP, ESTIMATED PRODUCTION RATES AND MAN-HOURS REQUIRED TO PRODUCE 100 POUNDS OF END-PRODUCT, HYPOTHETICAL PLANT USING SYNTHESIZED PROCEDURES AND LAYOUT

Operation number and name	Type of operation	Production per man-hour (end-product weight)	Man-hours required (per 100 pounds of end-product)
		Pounds	
1. Receiving	Hand	4,000	0.025
2. Grading	Machine	1,330	0.075
3. Peeling	Hand	26.6	3.759
4. Splitting and deveining	Machine	106.4	0.939
5. Breading	Machine	158	0.633
6. Packing	Hand	50	2.000
7. Weighing	Hand	250	0.400
8. Packaging	Machine	1,500	0.067
9. Freezing	Machine	900	0.111
10. Master carton	Hand and machine	334	0.299

An estimate of manpower needed at each operational stage based on a desired average production rate of 900 to 1,000 pounds of end-product per hour was arrived at as follows from the above figures:

Estimated Manpower Requirements

Operation	Number of workers	
1. Receiving	5 (Part time)	(Note: The part-time workers would serve as a service group where needed.)
2. Grading	2 (Part time)	
3. Peeling	36	
4. Deveining and splitting	7	
5. Breading	6	
6. Packing	20	
7. Weighing	4	
8. Packaging	1	
9. Freezing	1	
10. Master carton	3	

Statistics on breaded products.--The rapid pace at which the breading industry is expanding can be seen from inspection of figures V - 61 and V - 62. Production of frozen breaded cooked and uncooked shrimp in 1950, the first year for which statistics for breaded products are available, amounted to slightly less than 6.6 million pounds. In 1956 breaded production was in excess of 50 million pounds. The value of the pack increased from $4.2 million to $37.3 million.

While the production statistics cited above cannot be broken down between cooked and uncooked shrimp, it is known that the greater proportion of the breaded shrimp production is marketed uncooked.

Costs of operations (breaded shrimp plant).--In the course of its study of costs of operation at the processor's level the Federal Trade Commission obtained production costs from three producers of breaded shrimp.

The following general observations regarding the operations of the three companies can be made: raw shrimp were purchased either from outside sources or obtained from subsidiary organizations in which the company had an interest in fishing operations. Companies which did not have freezing facilities of their own, froze and stored their products in public freezer and cold storage plants.

The raw shrimp were run through grading machines to produce uniform sizes. Certain sizes were used in the breading process and the remainder were marketed as frozen headless, peeled deveined, and cooked peeled shrimp. Breaded shrimp in all three cases was the principal product.

FIGURES V - 61 and 62.--QUANTITY AND VALUE OF FROZEN BREADED COOKED AND UNCOOKED SHRIMP, SPECIFIED YEARS

FIGURE 61

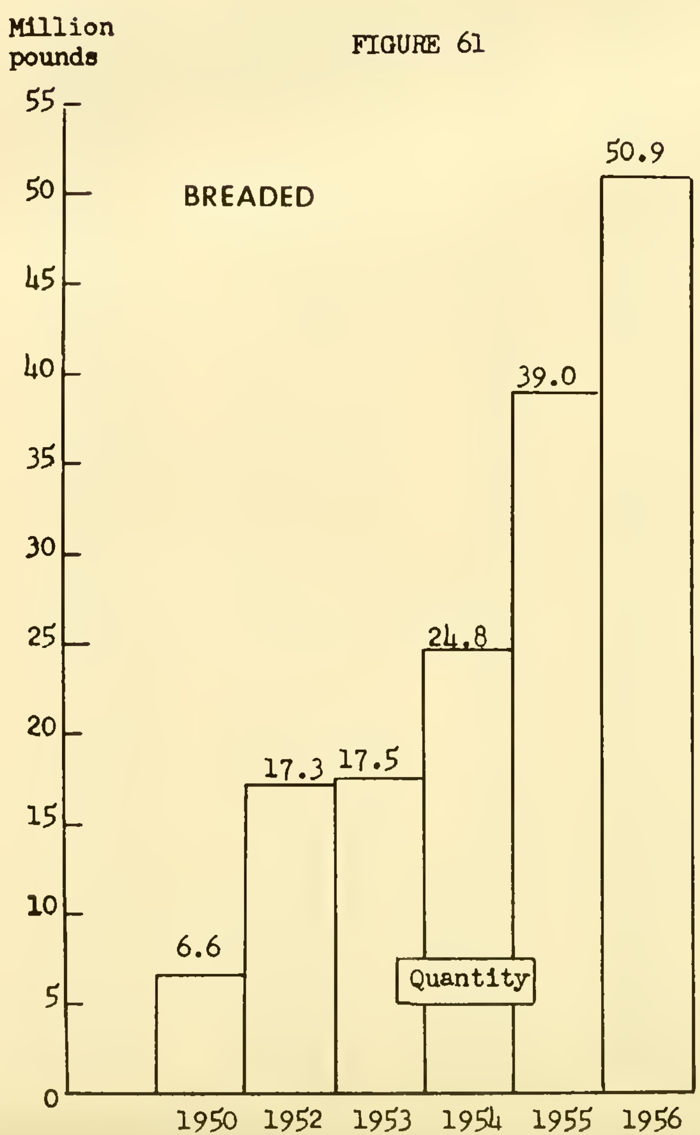
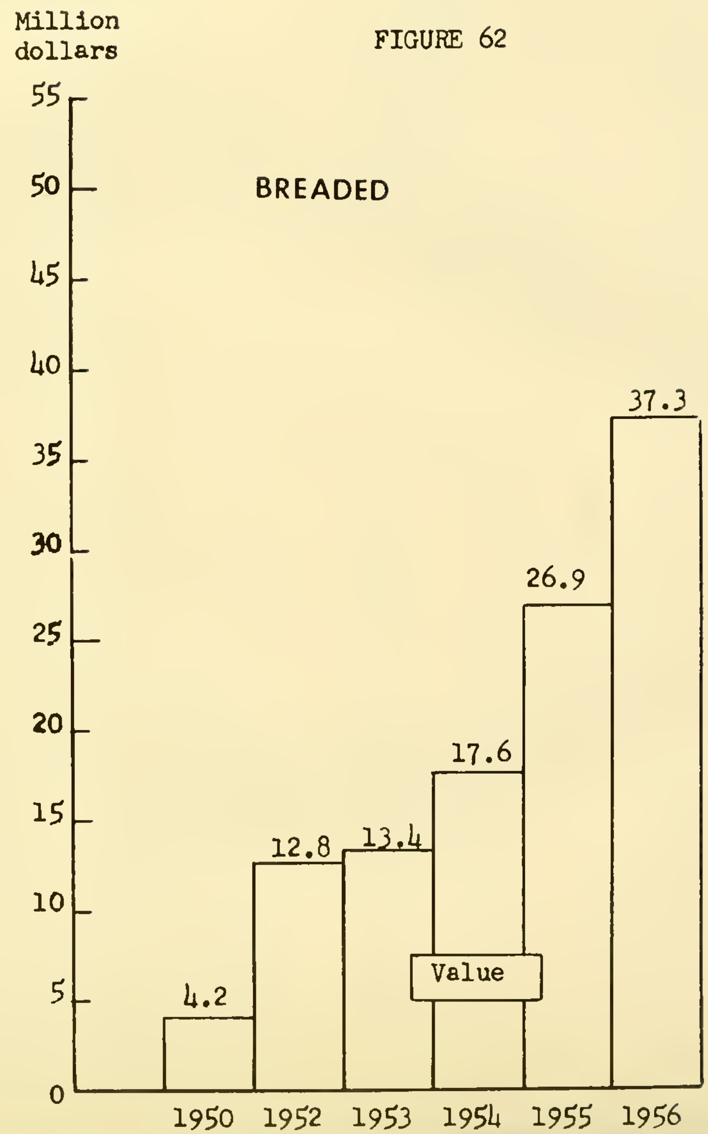


FIGURE 62



Shrimp were packed under the producers' and private brand names. Customers included retail food chains, wholesalers, and the Federal government.

The largest freezer-breader, according to the Bureau of Business and Economic Research of the University of Miami, had some 82 separate frozen shrimp items in its inventory in 1955. Since the breaded product is particularly well suited for household consumption, more and more of the processors concentrate on small packages ranging from six ounces to three pounds in weight.

Average cost of raw shrimp and total cost of breading in 1952, 1953, and 1954, in cents per pound of product, as reported by the Federal Trade Commission for three firms, were as follows:

TABLE V - 60.--AVERAGE COST PER POUND OF FROZEN UNCOOKED BREADED SHRIMP AND SHARE OF TOTAL COST REPRESENTED BY RAW SHRIMP, THREE PRODUCERS, 1952, 1953 AND 1954

	Cents per pound of product	Percent of total cost	Cents per pound of product	Percent of total cost	Cents per pound of product	Percent of total cost
	1952		1953		1954	
Cost of raw shrimp	40.7	65.2	49.8	68.6	36.3	61.5
Total cost of breaded product	62.4	100.0	72.6	100.0	59.0	100.0

Cost of the breaded product varied in direct proportion with the cost of raw shrimp which averaged approximately two thirds of the total. Breading, packaging materials, direct labor, and plant overhead were the other elements of cost.

Table V - 61 compares total costs of product in cents per pound for the three companies for which costs were obtained. The spread in costs between the least and the most economical operation was 10 cents in 1952 (data for two plants available only), almost 21 cents in 1953, and 14.5 cents in 1954. Plant A's costs exceeded those of the other two operations because of a relatively high allocation of overhead.

TABLE V - 61.--AVERAGE COST PER POUND OF PRODUCING FROZEN UNCOOKED BREADED SHRIMP, DETAILS FOR THREE PRODUCERS, 1952, 1953 AND 1954
(Cents per pound)

Item	1952	1953	1954
Company A	71.61	83.93	72.47
Company B	61.81	73.27	57.89
Company C	n.a.	63.07	58.99

n. a. - not available.

Detailed cost data for the three companies and two other companies for which information for part of the year is available are found in table V - 62.

Cost of breading materials in the plants studied averaged about ten percent of total production costs. The breading expense will depend on the amount of so-called 'pick-up', the quantity of breading mixture added to the raw shrimp meat. The 'pick-up' ranges from 35 to 60 percent.

Coarseness of breading material, consistency of batter-mix, and the number of dips into each are factors controlling the amount of 'pick-up'. The style of the end-product, i.e. tails on or off, butterfly style or round, affects the amount of breading mixture that can be added.

The consensus of processors interviewed by First Research Corporation was that somewhere between 35 and 40 percent of 'pick-up' would yield the most satisfactory product. Most of the processors reportedly would welcome the establishment of breading standards.

Canned Shrimp

Canned shrimp plants are the most highly mechanized segment of the shrimp industry. Nevertheless, First Research Corporation reports, hand operations still account for all but a relatively small fraction of the total time required to pack canned shrimp.

Mechanization has been applied to shrimp canning comparatively recently. It was not until the end of the year 1953, for instance, that all shrimp canning plants in Louisiana, as well as a number of the establishments in Mississippi and Alabama, were using automatic shrimp-peeling machines. Several plants at that time were using hand-feed deveining machines, though an appreciable quantity of shrimp is still deveined

TABLE V - 62.--AVERAGE COST PER POUND OF PRODUCING FROZEN UNCOOKED BREADED SHRIMP, DETAILS FOR 5 PRODUCERS, 1952, 1953 AND 1954 AND FIRST QUARTER 1955

Company	Cost per pound green shrimp purchased	Pounds green shrimp per pound finished product	Pounds peeled shrimp per pound finished product 1/	Cents per pound finished product: Green shrimp	Breading materials	Packaging materials	Direct labor	Plant overhead	Total production costs
	Cents								
1952									
A	47.79	.8729	.7175	41.72	3.29	4.48	13.23	8.89	71.61
B	51.54	.7895	.6316	40.69	6.75	4.20	7.16	3.01	61.81
1953									
A	61.98	.8659	.7168	53.66	3.68	3.91	12.25	10.43	83.93
B	68.56	.7560	.6048	51.83	7.12	4.28	6.89	3.15	73.27
C	62.14	.6109	.4887	37.97	5.78	3.79	12.27	3.26	63.07
D 2/	68.00	.8000	.6400	54.40	6.40	4.80	11.20	4.80	81.60
D 3/	46.00	.8000	.6400	36.80	6.40	4.80	11.20	4.80	64.00
1954									
A	48.03	.8381	.6894	40.01	6.02	3.91	12.77	9.76	72.47
B	48.67	.7420	.5925	36.11	6.65	4.34	6.79	4.00	57.89
C	49.32	.7034	.5627	34.69	4.45	3.42	11.66	4.77	58.99
D 4/	42.00	.8000	.6400	33.60	6.40	4.80	11.20	4.80	60.80
D 5/	32.00	.8000	.6400	25.60	6.40	4.80	11.20	4.80	52.80
E 6/	41.42	.7268	.5815	30.11	4.61	3.10	9.32	7.73	54.87
1955									
D 7/	44.00	.8000	.6400	35.20	6.40	4.80	11.20	4.80	62.40
E 8/	46.16	.7077	.5661	32.66	5.13	3.26	9.56	8.36	58.97

1/ Based on estimated peeling yield of 80 percent except for A., where actual figures were available.
2/ January 1 to June 30.
3/ July 1 to December 31.
4/ January 1 to June 30.
5/ July to December 31.
6/ Month of October only.
7/ January 1 to April 30.
8/ Month of February only.

Note: Data for D are for breaded shrimp packed in 10-ounce packages. Data for other companies include all package sizes.

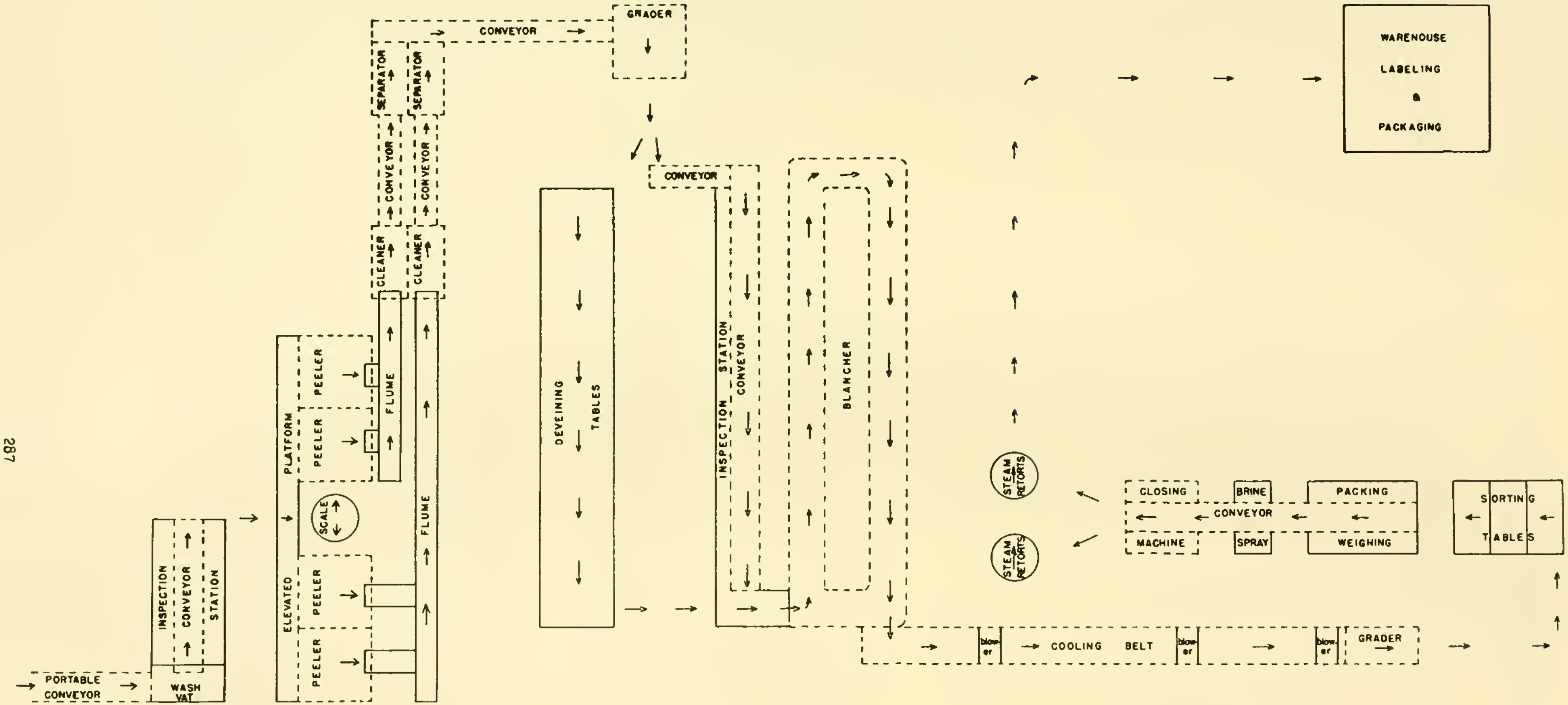
manually. A fully automatic procedure for peeling and deveining is the most recent innovation in the industry and is probably the most significant advance in technique made. Aside from greatly reducing manpower requirements, it has lent more flexibility to production planning. Furthermore, it allows the packers to use small shrimp that formerly could not profitably be packed.

First Research Corporation reports that functions connected with the unloading, peeling, deveining, blanching, grading, and closing of cans have been mechanized in many establishments, and that conveyors, flumes, and pumps for transporting the product between operations have been introduced. In three typical plants surveyed, hand operations still accounted for over 85 percent of total man-hours required for packing. Such time-consuming operations as sorting and inspecting after blanching as well as packing and weighing before can closure are still performed on a manual basis.

Plant layout.--Common faults observed in the layout of the plants surveyed by First Research Corporation were the remoteness of warehousing space from the final processing operation, and the considerable distance between receiving and inspection area and the area where initial processing took place, resulting in excessive transporting of product. Allowing for the use of most up-to-date machinery and endeavoring to eliminate whatever crossover or back-tracking of product between operations encountered in the plants visited, the analysts of First Research Corporation drew up a model layout plan for a shrimp cannery which may be of help to the plant intending to streamline its procedures (see figures V - 63 and V - 64 for the flow of operations in a typical plant and in a hypothetical plant using the synthesized layout and procedures recommended by First Research Corporation.)

Plant capacity.--Two of the three Louisiana plants surveyed had an average daily production (based on a one shift - ten hour operation) in terms of raw heads-on shrimp of 40,000 pounds, one an average of 60,000 pounds. These production rates were estimated to correspond to 70 to 90 percent of total capacity at standard or 100 percent efficiency. Since the plants in the past have usually closed twice yearly for a total of approximately two months' non-productive time, there are approximately 200 to 220 working days during the year. Total annual production in terms of raw material used, consequently, was upwards of eight million pounds for two plants, and twelve million pounds for one plant. Applying an average yield rate of 27 percent (27 pounds of finished, for each 100 pounds of raw product) to these figures, theoretical production in terms of finished product was over two million pounds in one instance and over three million pounds in the other in the plants surveyed by First Research Corporation. 19/

19/ Raw shrimp quantities ordinarily are listed in barrels of 210 pounds, whereas canned product quantities more often than not are given in standard cases of fifteen pounds. The quantities cited above were converted to pounds for ease of comparison.



LEGEND: BROKEN LINE = MACHINE OPERATION
SOLID LINE = HAND OPERATION

FIGURE V - 63.-- A TYPICAL FLOW PLAN - CANNED SHRIMP PLANT.

First Research Corporation.

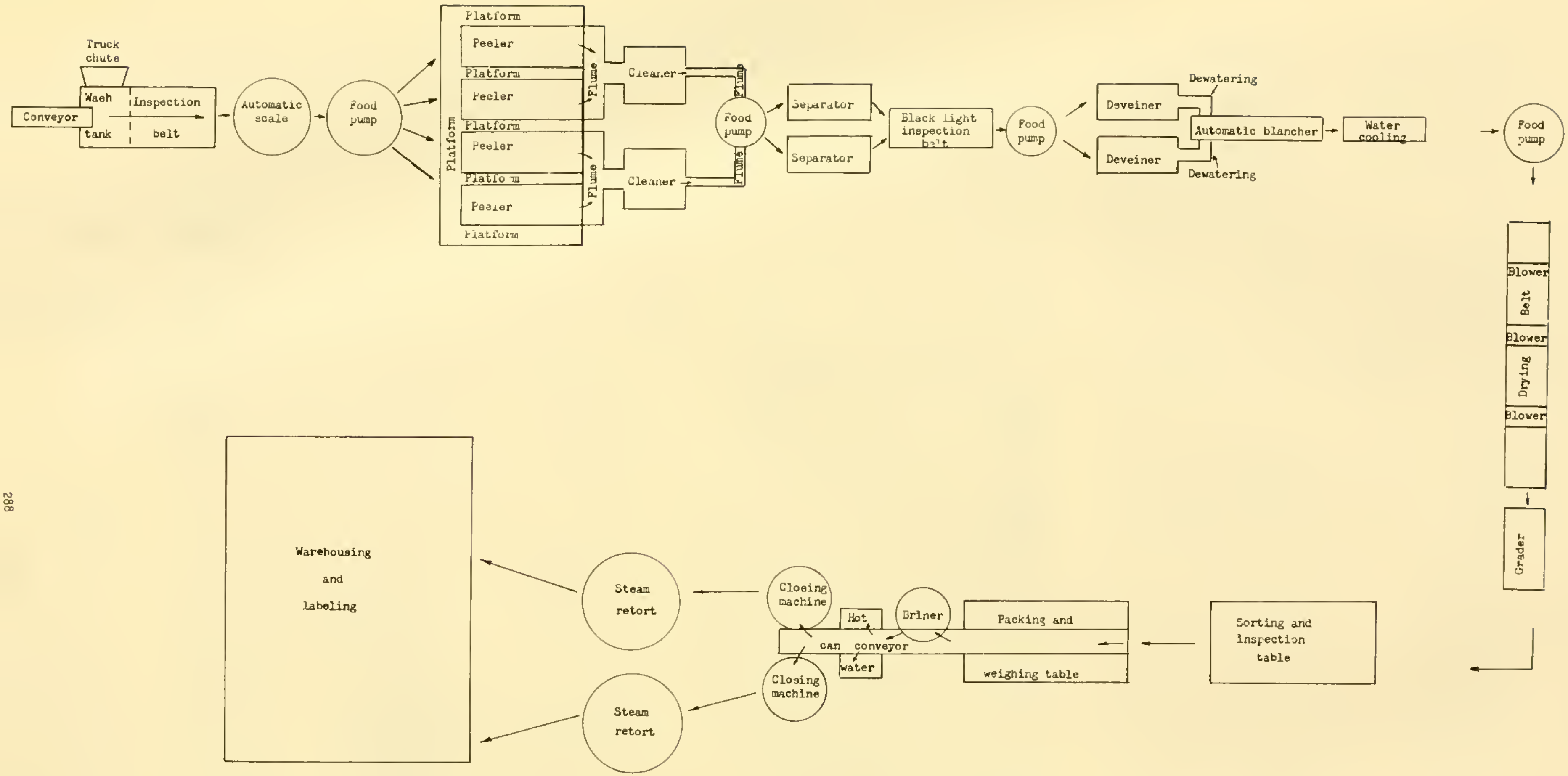


FIGURE V - 64.--SYNTHESIZED LAYOUT - SHRIMP CANNING PLANT.

Lawence W. Strasburger.

The practice of plants closing down twice a year is explained by Louisiana conservation laws which provide for the closure to fishing of inland waters during certain seasons of the year. The packers claim that the non-productive time is spent in needed plant and equipment overhaul. First Research Corporation is of the opinion that plant management should investigate the economic feasibility of securing shrimp from other sources during this time to assure year around operations. Maintenance and overhaul, it is believed by the analysts, could be readily accomplished without a complete plant shutdown at any time since most plants operate on a one shift per day basis. Among the factors which may possibly balk a realization of year around production are: (1) additional transportation costs that may have to be incurred in connection with obtaining supplementary supplies and (2) rapid deterioration of the small shrimp commonly used in canning operations which may place a limit to the distance from which supplies could be brought in.

Plant procedure.--By combining the best features of processes currently employed in the shrimp industry with features adapted from other food industries, a synthesized plant and operation was evolved.

The operations are as follows:

1. Receiving and inspection: Fresh shrimp are shoveled from the boat hold onto a power conveyor which discharges into a wash vat. The vat is an integral part of the inspection line. A wire mesh belt removes the shrimp from the vat and carries them past inspectors who remove by hand all decomposed, partially decomposed, or diseased shrimp and extraneous matter. The number of inspectors utilized will depend upon the quality of the raw material and the flow rate of the shrimp on the belt. The shrimp fall from the inspection belt onto an automatic weighing device which records the weight and discharges them into a food pump. The food pump line is so designed that one man, working from an elevated platform, may direct the flow of shrimp into any one of four peeling machines.

2. Peeling: The same worker who directs the flow of shrimp from the food pump operates the four peeling machines. These machines mechanically peel the shrimp and discharge them into flumes. The flumes carry the meats to a cleaning machine which discharges them into a food pump. This pump discharges the product onto a separator which removes loose shells, legs, swimmerettes, etc.

3. Meat inspection and deveining: From the separator, the shrimp are flumed onto a rubber food belt which is illuminated solely by ultra violet or "black light". The black light causes both loose and adhering shells to fluoresce, making them easily visible to the inspectors who remove them by hand. It is important that all shell be removed before the shrimp enter the deveiner, the next step in the procedure.

Shells dull the deveiner knives which lowers the efficiency of the machine and makes frequent blade changing necessary. The flow of shrimp must be stopped when such changes are made.

The shrimp drop from the inspection belt into the receiver of a food pump, which elevates them to the top of the deveiner. This machine first cuts the back muscle to expose the vein and removes it in a second operation. The food pump discharging into the deveiner should be equipped with a bypass for diverting shrimp which are not to be deveined.

4. Blanching: The shrimp are discharged from the deveiner or the bypass into a dewatering device which drops them into the automatic blancher. A number of different types of automatic blanchers have been perfected in recent years. Most blanchers are rather costly pieces of equipment, but accurate controls are needed at this point since yields are materially affected by the blanching. In the blanching operation the shrimp are either carried or propelled through a boiling saline solution. The strength of the solution used is ordinarily about 25 degrees salinometer. Blanching times are varied dependent upon the size of the shrimp. The usual time range is from 1-1/4 to 3 minutes for canning shrimp and 2 to 5 minutes for cooked and peeled shrimp. Blanching extracts water and certain solubles, sets color pigment and curls the shrimp. Unless the shrimp are properly curled they cannot be graded with the type of equipment now extant in the industry.

5. Cooling and grading: The shrimp are discharged from the blancher into a cold water vat. This immediately stops the cook, prevents loss of volatile flavors, increases firmness and helps control yields. A food pump removes the shrimp from the vat and discharges them onto a drying belt where they pass under a series of blowers to remove excess surface water. The shrimp are discharged onto an inclined vibrating metal plate which through a series of graduated size holes grades them into five categories. The graded shrimp are caught in trays placed immediately below the holes in the plate.

6. Inspection: The trays of shrimp are manually removed from beneath the grader and placed on a table. At this point workers remove by hand any remaining shell, walking legs, swimmerettes or antennae and cull out broken shrimp.

7. Packing and weighing: The trays of inspected shrimp are carried to the packing table where workers hand fill and weigh each can. The put-in weight is varied according to size, length of blanch, waters of origin, specie, and season of the year. The high cost of raw material necessitates very close supervision at this point. Too great a put-in weight will result in heavy monetary loss. Too small a put-in weight may result in failure to meet the United States Food and Drug Administration "Standard of Fill", and consequent seizure if the merchandise is not labeled according to the standards specifications. There is no automatic filling and weighing equipment that has been demonstrated to the industry which fits its peculiar needs. (see figure V - 65)

FIGURE V - 65.--Can filling and weighing.

8. Can closing: The sealers place the filled cans on a conveyor which feeds them past a brining machine. This machine automatically injects the proper amount of 96-100° salt brine into the can. The cans then pass under a perforated pipe which floods them with hot water, diluting the brine to the desired strength of approximately 25° salinometer. The temperature of the water controls the vacuum to be induced in the can. The cans are then fed to the closing machine which knocks out excess water to effect the proper headspace and seals on the can lid or cover. The sealed cans are discharged into metal retort baskets.

9. Processing: The filled metal retort baskets are moved on dollies to the retorts. A power hoist picks up the baskets and lowers them into the retorts which are then manually closed. Processing is by means of steam operating under pressure to give a temperature of 250° F. Time of processing is dependent upon the size container used. The usual consumer size cans, that is 211 x 300 and 307 x 113, are processed for 12 minutes. As soon as the processing time has elapsed, the steam valves are closed, blow-off valves are opened, and the retort is flooded with water. Immediate cooling of the containers is necessary to prevent overcooking with consequent softening and reduced shelf life of the product.

10. Warehousing and labeling: The baskets are removed from the retorts and moved on dollies to the warehouse where they are set on an angle to drain off all cooling water and dry the cans. If cans are cased out while wet, the cartons will be weakened and often the cans will rust to such an extent they become unsaleable. The cans are generally cased out of the retort baskets, 24 cans to the case. The cases are stacked with each size grade and code separated. Since the producer rarely knows what label will be placed on a given lot of shrimp until sales orders are on hand, it is impossible to label directly out of the process baskets. Warehoused stocks are labeled mechanically, usually just prior to shipment.

TABLE V - 63.--CANNED SHRIMP, ESTIMATED PRODUCTION RATES AND MAN-HOURS REQUIRED TO PRODUCE 100 POUNDS OF END-PRODUCT, HYPOTHETICAL PLANT USING SYNTHESIZED PROCEDURE AND LAYOUT

Operation	Type of operation	Production per man hour (end-product weight in pounds)	Man-hours required (per 100 pounds of end-product)
Receiving and inspection	Hand	173.3	0.577
Peeling	Machine	1040.0	0.096
Black light inspection	Hand	130.0	0.769
Deveining, blanching and general	Machine	1040.0	0.096
Grading	Machine	1040.0	0.096
Sorting and inspection	Hand	130.0	0.769
Packing and weighing	Hand	130.0	0.769
Can closing	Machine	1040.0	0.096
Processing	Machine	1040.0	0.096
Warehousing and labeling	Machine	346.6	0.288
Total			3.652

A production rate of 4 barrels (840 pounds) of head-on shrimp per hour per peeling machine and a yield of 65 pounds of end-product per barrel has been used as a basis for these calculations.

Assuming 1,040 pounds of end-product per hour is produced by 4 peeling machines, the man power needed at each operational stage would be as follows:

Operation	Number of workers
Receiving and inspection	6
Peeling	1
Black light inspection	8
Deveining, blanching and general	1
Grading	1
Sorting and inspection	8
Packing and weighing	8
Can closing	1
Processing	1
Warehousing and labeling	3

FIGURES V - 66 and 67.--QUANTITY AND VALUE OF PACK OF CANNED SHRIMP, INCLUDING SPECIALTIES, IN STANDARD CASES, SPECIFIED YEARS

FIGURE V - 66

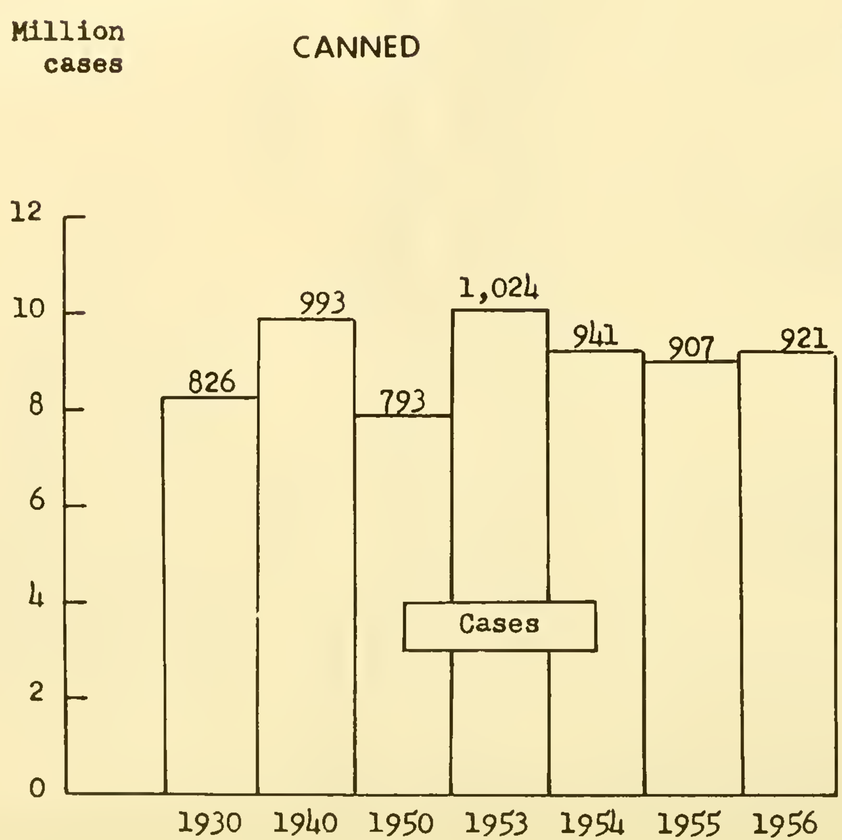
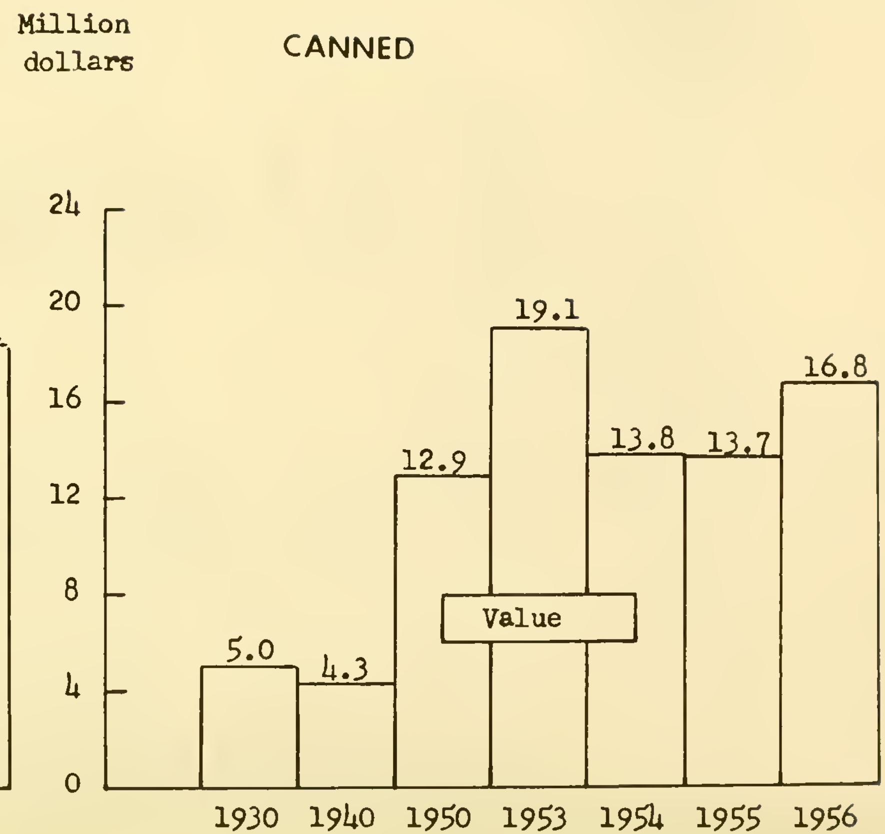


FIGURE V - 67



Statistics on canned shrimp production.--Production of canned shrimp, figure V - 66 shows, has remained relatively stable over the years since 1930. In that year a total of 826,242 standard cases of shrimp was put up by canning establishments, while in 1956 the canned pack amounted to 920,950 standard cases. A standard case of shrimp being equivalent to 15 pounds, the quantity of shrimp put up in cans, therefore, was approximately 12.4 million pounds in 1930 and 13.8 million pounds in 1956. Value of pack increased from $5 million in 1930 to $16.8 million in 1956. (see figure V - 67)

While the annual pack of canned shrimp has not varied much over the years, the number of canning plants reveals a long-term tendency to decline. Average pack per establishment, consequently, is larger today than it was twenty-five years ago.

The geographic concentration of canning operations is more pronounced today than it was years ago. Of the total of 69 plants in operation in 1930, 40 were located in the States of Louisiana and Mississippi, the remainder being distributed over the other six States comprising the Gulf and south Atlantic region. In 1954 Louisiana and Mississippi accounted for 37 of the 43 shrimp canning establishments then in existence.

Costs of operations.--Data on the cost of operations of eight representative canning plants during the period from 1952 through 1954 were obtained in the course of the Federal Trade Commission field study. For the purpose of this report only the five operations for which complete information is available are considered.

The operations of the canners in the Federal Trade Commission sample differ in scope. Three companies are fully integrated operations with fishing, canning, and distribution facilities. The other two companies, which do not own boats, extend financial assistance to vessel owners to assure themselves a supply of raw shrimp. Packing is under the canners' own brands and private labels.

At the time the cost study was made shrimp canning constituted only a portion of the five companies' operations. All but one company, however, listed canned shrimp as principal product. The fifth company concentrated on cooked and peeled shrimp packed in institutional size cans. Other seafood products canned and distributed by the five companies were oysters and crabmeat. Two companies, in addition to seafood, canned vegetables in plants located in other areas.

Average costs of the pack for the five companies for the years 1952, 1953, and 1954, were as follows:

TABLE V - 64.--AVERAGE COST OF PRODUCING CANNED SHRIMP, AND SHARE OF TOTAL COST REPRESENTED BY RAW SHRIMP, DOLLARS PER DOZEN FIVE OUNCE CANS PACKED, 5 PRODUCERS, 1952, 1953 AND 1954

Item	1952		1953		1954	
	Dollars per dozen	Percent of total	Dollars per dozen	Percent of total	Dollars per dozen	Percent of total
Cost of raw shrimp	2.079	57.16	2.581	63.03	2.376	62.25
Processing costs	1.558	42.84	1.514	36.97	1.441	37.75
Cost of pack	3.637	100.00	4.095	100.00	3.817	100.00

Processing costs represented in the neighborhood of two fifths of the cost of the pack; they were 5 cents lower in 1953 than in 1952 and declined another 7 cents in 1954. The cost of the pack, however, varied in direct proportion with the cost of raw shrimp which increased 50 cents in 1953 and fell 20 cents in 1954 per dozen five ounce cans packed.

The reduction in processing costs from 1952 to 1954 is accounted for by a decline in labor and packing materials costs, as illustrated in table V - 65. This drop was only slightly offset by a rise in other elements of cost, e.g. royalty and icing and storage expenses. Random observations on canning costs and labor made by the field investigators of the Bureau of Business and Economic Research of the University of Miami in the course of their survey were as follows:

Canning labor frequently is paid on an hourly basis, the usual wage being the minimum wage set by law. Where the workers in packing plants are affiliated with the Seafood Workers' Association of the Gulf Coast SIU, AFL-CIO union, however, fixed piecework rates for individual operations are established by contract in addition to hourly rates.

It was estimated that under piece work schedule,workers could earn between $8 and $12 per day when production is good.

TABLE V - 65.--AVERAGE PROCESSING COSTS CANNED SHRIMP, DOLLARS PER DOZEN FIVE OUNCE CANS PACKED, FIVE PRODUCERS, 1952, 1953 AND 1954

Item	1952		1953		1954	
	Dollars per dozen	Percent of total	Dollars per dozen	Percent of total	Dollars per dozen	Percent of total
Direct costs						
Cans, packing cases, etc.	.360	23.11	.328	21.67	.298	20.68
Labor	.647	41.53	.579	38.24	.544	37.75
Supplies, salt, etc.	.018	1.15	.018	1.19	.020	1.39
Royalties	.040	2.57	.066	4.36	.099	6.87
Total	1.065	68.36	.991	65.46	.961	66.69
Indirect costs						
Steam, power, fuel	.022	1.41	.020	1.32	.023	1.60
Icing and storage	.019	1.22	.029	1.92	.026	1.80
Processing overhead	.152	9.76	.136	8.98	.134	9.30
Fixed expense	.300	19.25	.338	22.32	.297	20.61
Total	.493	31.64	.523	34.54	.480	33.31
Total processing costs	1.558	100.00	1.514	100.00	1.441	100.00

The labor in processing plants is drawn from many segments of the labor force in the area. Migrant labor is uncommon. The larger canners and processors generally operate on a year-round basis and can offer employment on a permanent basis.

The introduction of machinery for deveining and peeling has had economic repercussions. It is estimated that one peeling machine replaces about 40 workers.

Peeling machines are installed on a minimum 3-year lease basis. The rent is calculated on the basis of machine utilization with a flat annual minimum. A company utilizing five peeling machines estimated that the daily cost of operations for all five machines was $600, or $120 per day per machine. The more recently developed deveining machines are also leased on a royalty basis.

Dried Shrimp

In the United States dried shrimp are produced almost exclusively in the States of California and Louisiana, the latter State accounting for most of the production. Methods of processing and drying are somewhat different in the two States. The methods detailed below are based upon a survey of one plant in Louisiana by the First Research Corporation and upon information available in the United States Fish and Wildlife Service.

Plant operations.--

1. Unloading: Raw whole shrimp are unloaded manually from the hold of the fishing vessel directly into a rectangular mesh basket holding approximately 200 pounds of shrimp.

2. Washing: The filled basket is lowered into a stream of running water where sand and other foreign matter are washed away.

3. Blanching: The washed shrimp are then emptied into smaller wire mesh baskets and transported manually to the cooking vat located about ten feet from the wash station.

The baskets of shrimp are placed in position in the cooking vat, allowing the shrimp to be covered by a boiling saline solution, but leaving the handles of the baskets exposed for ease in removal from the vat. The shrimp are boiled for approximately fifteen minutes, the time depending upon the species and size of the shrimp being processed. The cooking vat has a capacity of approximately 450 pounds per load.

4. Drying: The baskets of cooked shrimp are removed from the vat, emptied into a wheelbarrow with a perforated body, and rolled manually to the drying platform. The platform is built up on posts to allow free passage of air underneath to facilitate the drying process. The surface of the platform is constructed with a gently undulating surface in order that the shrimp may be swept to the crest of the "waves" and covered with tarpaulin when rain occurs and at night to keep off the dew. The shrimp are spread out on the platform with wooden rakes in a thickness of two to three inches. Every two or three hours the shrimp are "turned" with rakes to effect uniform drying. Drying is usually completed during the summer in three to four days, but in the winter five to ten days may be required. (see figure V - 68)

FIGURE V - 68.--A small shrimp drying platform on Bayou Grand Caillou below Houma, Louisiana.

5. Tumbling: After drying, the shrimp are raked to the edge of the platform adjacent to the peeling building. Through an opening in the building wall the dried shrimp are shoveled into the receiver of an open mesh cylindrical tumbler. When sufficient shrimp are in the tumbler, it is rotated by means of a drive motor which effects a tumbling of contents while allowing the heads and shells to drop through the mesh into a receiving receptacle and retaining the peeled shrimp meats within the cylinder.

6. Weighing and packing: The peeled shrimp meats are removed from the tumbler, weighed up in 100-pound bags, and stacked to await pickup by the wholesale buyer. The heads and hulls (shrimp meal or bran) are also sacked in hundred pound bags and purchased by the same buyer.

Summary: According to First Research Corporation the processing operations of the shrimp drying plant surveyed were adequately handled by a work force of two men. The processing methods involved do not lend themselves to mechanization.

Since most processing takes place in the open, the need for plant buildings is reduced to a minimum. The firm surveyed uses only two small buildings. One for housing miscellaneous work tools and materials, and the other for housing the tumbler equipment and scales. This building, in addition, contains the required storage space. All operations except peeling, weighing, sacking, and storing take place in the open.

At the plant surveyed, removing of heads and shells from the shrimp was the only mechanized operation. The cylinder of the tumbler had a capacity of about 1,500 pounds of whole dried shrimp, but operated more efficiently if loaded to one-half or less of capacity.

One hundred pounds of whole fresh shrimp will yield about 40 pounds of whole dried shrimp which in turn will yield 13 to 14 pounds of dried shrimp meats and 26 to 27 pounds of heads and hulls (shrimp meal or bran).

Cost of operations.--Cost data for two producers of dried shrimp were obtained by the Federal Trade Commission. One operation was a family business conducted by the owner and his unsalaried relatives. The dried shrimp operation of the other company was part of diversified activities performed by hired labor.

Production costs did not differ materially between the two companies. The average cost of a pound of end-product in both instances was in the neighborhood of $1.00 in 1953, and in the neighborhood of about 63 cents in 1954. The big difference in costs between the two years must be ascribed to the low raw material costs which prevailed throughout 1954.

Platform expenses (fuel, salt, repairs of equipment, depreciation, etc.) in the case of the company not depending on outside labor represented approximately one-tenth of total production costs, the remainder being accounted for by raw material costs. The percentage represented by platform costs in the case of the other establishment was only slightly higher. Labor costs were nearly twice as large as overhead. The difference in operational results between the two companies, one showing a loss, the other one a profit, in both years for which data are available, cannot be ascribed to a different cost structure. It was due rather to the better price obtained by the one company for a higher quality product.

Shrimp Specialties

Canned shrimp specialties to date have been only of minor importance in packing operations. Brand competition among processors and distributors, however, tends to place increasing emphasis on product diversification indicating a bright future for this still comparatively small branch of the industry.

Statistics on canned shrimp specialty production are currently collected for eleven styles of pack, viz.:

Aspic	Gumbo
Bisque	Newburg
Cakes	Paste
Cocktail	Smoked (in oil)
Creole	Soup
Curry	

In 1954 a total of 13 companies distributed over eight states packed the equivalent of a total of 6,364 standard cases [20] of one or more styles of canned shrimp specialty products; the products were valued at $100,702 at the manufacturer's level.

Statistics on chilled and frozen shrimp cocktails which are specialty products not coming under the general classification of canned products were collected by the United States Fish and Wildlife Service for the first time in 1954. In that year a total of 523,552 pounds (in manufactured weight) were put up in this form. The value of these products at the processor's level was placed at $459,819.

20/ A standard case contains 48 pounds net weight of product.

Smoked Shrimp

The chances of developing a market for smoked shrimp are considered promising by some specialists in the marketing of fish and shellfish. It has been pointed out that the smoking of shrimp is a simple process and that the public could be expected to pay a slight premium--necessitated by higher production costs--for the tasty and eye-appealing product.

Smoked shrimp are cooked shrimp which are smoked lightly for additional color and flavor. Shrimp smoked in the shells retain their flavor and texture and remain moist. Shrimp may be smoked also after the shells are removed but the finished product is usually dry-textured and bitter and the yield is smaller.

Pickled Shrimp

Pickled shrimp is a regional specialty of the New Orleans Area but is sold in fish markets from Key West to Washington, D. C.

UTILIZATION OF SHRIMP FOR NON-EDIBLE PURPOSES

Bait Shrimp

In addition to the very valuable commercial fishery for shrimp for human consumption, an important but more localized industry is engaged in capturing shrimp for sport-fishing bait. In some areas, notably New York and New Jersey, substantially the entire catch of shrimp is used for bait purposes. In Florida and Texas--which are among the leading producers of shrimp for human consumption--there are also substantial commercial shrimp fisheries devoted exclusively to supplying bait to sport fishermen. At times, some of the catch which would normally be sold for food purposes may be diverted to bait and at other times some of the bait catch may be used for human consumption depending on the market situation at a given moment.

Raw shrimp of a grade unfit for human consumption may be sold for bait provided it is dyed and labeled as "bait shrimp" in accordance with United States Food and Drug Administration regulations. The quantity of edible shrimp purchased annually by sports fishermen for use as bait is unknown. As no price differential is involved, the trade is not concerned about the quantity of holdings that may ultimately be used for bait. Since Louisiana permits taking such small shrimp that the heads-off count may run to about 85 per pound, dealers in that state get most of the bait shrimp business.

Bait shrimp are marketed either alive or dead, large amounts of the dead shrimp are frozen.

The method of keeping live shrimp for bait is described in a study of the Branch of Fishery Biology of the United States Fish and Wildlife Service. (see Fishery Leaflet 337, Keeping Live Shrimp for Bait). The species best adapted for this purpose, according to this publication, are brown-grooved shrimp (P. aztecus) and white shrimp (P. setiferus).

Handling of Live Shrimp

Shrimp taken for bait are kept either in boxes, ponds, or troughs. In Florida and in the other Gulf States, dealers in live shrimp for bait hold them for indefinite periods in live boxes (pens) floating in salt water. These boxes are of various sizes and frequently are covered with galvanized screen coated with asphaltum paint.

The wooden boxes used for holding the shrimp are coated inside with asphaltum paint for protection from sea water. The number of shrimp held in a container depends on its size. A No. 2 galvanized tub will hold fifty shrimp.

The water in the boxes must be kept at a temperature not over 60° F., the optimum temperature being 50-60°. The common practice is to have either a stream of water running through the tank or a continuous stream of air passing through the water. If aeration is impossible, the number of shrimp is reduced by at least eighty percent. Even in well-aerated salt water, the shrimp will die rapidly when the water temperature rises. The box must be kept under cover or in the shade in order to maintain the temperature of the water as low as possible.

The boxes and the water must be kept clean. Shrimp from one box are removed to a second while the first is being cleaned. Waste products must not be allowed to collect in the tank, since they will make the water stagnant. The same is true when tanks are overcrowded.

Shrimp will eat a variety of foods, e.g. minced clams, ground-up fish, and some varieties of canned dog food. Feeding the shrimp once a day is considered sufficient.

The methods of handling bait shrimp immediately after they are hauled from the water vary in different areas; they are also influenced by the type of gear used, depths fished, and the equipment employed for handling the catch.

Under any circumstance, the next operation, once the catch is hauled up, is the sorting of the shrimp from the debris in the net.

If the shrimp are to be marketed alive in the immediate vicinity of the landing area, they are held in boxes, floats, or pens of varying sizes. When they are shipped to more distant areas they are transported in aerated tank trucks holding approximately 20,000 shrimp. Bait dealers hold the shrimp in wooden or concrete tanks, or in galvanized iron tubs or cans. Shrimp so held will keep for several days if the containers are aerated or have a good flow of water, are sheltered from the sun, and the temperature of the water is maintained at 50-60° F.

Live shrimp are usually sold by the dozen or hundred, fresh dead shrimp by weight or measure, and frozen shrimp by weight. Live shrimp are, of course, the most desirable and the most expensive, bringing around fifty cents a dozen in some sport fishing areas.

If marketed as dead bait, the shrimp are placed in convenient containers until landed for sale to fishermen or to bait dealers.

Shrimp By-Products

The utilization of the waste of any industry is desirable because of (1) the increased profits if the proceeds from the sale of the by-products exceed the additional costs incurred in connection with their preparation for the market, (2) the elimination of the disposal problem which becomes more acute with the rising density of the population, and (3) the use of valuable and desirable materials that are often wasted. In the shrimp industry effective utilization would appear doubly desirable because of the relatively large percentage of waste present and the health hazards caused by careless disposal.

At present the only by-product of the shrimp-processing industry is shrimp meal or "bran". The product is prepared from the heads, hulls, and appendages of shrimp, the waste products of the canneries and drying platforms.

In addition to processing waste, shrimp that have become softened and discolored by improper handling and very small shrimp which cannot be economically handled for canning and cannot be marketed as fresh shrimp are available for by-product utilization.

The portion of the shrimp which constitutes waste is 43 to 45 percent of the weight of the shrimp. The extent to which this material is utilized is relatively small, varying with the locality. It is used raw for fertilizer, and in the dried form as shrimp meal.

When shrimp meal is prepared from cannery waste the raw material is flame-dried in a tubular dryer; when prepared from dried shrimp no further processing is necessary before marketing. A proportion of the product of both the canning and drying industries is ground before marketing.

Less than 25 percent of the total waste of processing plants is used in the production of shrimp meal. Production is confined to Louisiana and the Carolinas.

Among the factors limiting the production of shrimp meal are the lack of low-cost machinery for drying and grinding the waste in the smaller and somewhat isolated processing plants, and the limited and unstable market for the product.

Shrimp meal is in direct competition with fish meal, in that both are used in the preparation of poultry and animal feeds. Of the two products fish meal with its higher protein content is more valuable. Because of this product relationship the market for shrimp meal is influenced by the available supplies of fish meal and the extent of the price spread between the two products.

Average protein content of shrimp meal today is only about 38 percent as against over 50 percent some years ago. This is due to the more effective method of peeling by means of automatic peeling machines now in use in canneries; when shrimp is peeled by machine, less shrimp meat clings to the hulls, small particles are lost in the wash water and the protein content of the meal, consequently, is lessened. With hand peelers twenty pounds to the barrel was the normal yield. More recently the yield has been only about twelve pounds to the barrel.

Shrimp meal at one time was more nearly competitive with fish meal from a quality standpoint than it is today. This is indicated by the following data supplied by Manning in connection with a chemical analysis of shrimp in 1934 21/

TABLE V - 66.--CHEMICAL
ANALYSIS OF SHRIMP MEAL

	Percent
Moisture	9.00
Crude protein	54.51
Crude ash	18.03
Ether extract	2.86
Undetermined	15.60

21/ J. R. Manning, Value of Shrimp Meal, United States Bureau of Fisheries Memo., S-328 (1934).

At about the same time the above analysis was published, data on the chemical composition of meal manufactured from different species of fish were given as follows 22/:

TABLE V - 67.--CHEMICAL ANALYSIS
OF VARIOUS TYPES OF FISH MEAL

Item	Moisture	Protein	Ash	Oil
	Percent	Percent	Percent	Percent
Steam-dried menhaden	10.58	62.31	18.34	7.77
Flame-dried menhaden	9.25	61.25	20.56	7.14
Flame-dried whitefish	6.10	62.00	29.53	1.14
Vacuum-dried whitefish	12.52	67.88	19.20	1.90
California pilchard	5.94	61.88	20.89	3.54

A comparison of the protein values in the two tables shows that even under the old processing methods shrimp meal had a slightly lower protein content than meal prepared from other species. With the increased use of the new machinery in shrimp processing establishments the quality disadvantage of shrimp meal has become much more pronounced.

Prices (quoted on the basis of protein content) of shrimp meal are consistently below those obtaining for fish meal because of the quality differential. Recent quotations for shrimp meal at the cannery have been in the neighborhood of $60 per ton. At this price many canners, The Bureau of Business and Economic Research of the University of Miami reports, felt that the effort expended in readying the meal for the market exceeded the revenue derived from its sale.

During the 1930's there was an appreciable export trade with some of the western European countries in dried shrimp heads and hulls for subsequent grinding into meal for animal and poultry feeds. A part of the domestic production of shrimp meal was also exported to these countries. This market was lost during the war and has not been regained.

The lack of uniform standards for grade and quality appears to be another deterrent to an expanding market for shrimp meal. Fish meal and oil are the primary products of the herring fishery of Alaska and the menhaden fishery of the Atlantic and Gulf States. Shrimp meal, on the

22/ Source: Daniel, E. P., and McCollum, E. V., Studies of the Nutritive Value of Fish Meals, United States Fish and Wildlife Service, Investigational Report 2 (1931).

other hand, is a minor by-product of the shrimp fishery. Perhaps for this reason, fairly uniform standards of quality and grade are set and maintained in the fish meal industry, but are lacking in the production of shrimp meal.

Recent trends in shrimp meal production can be gauged from the following statistics:

TABLE V - 68.--UNITED STATES PRODUCTION AND VALUE OF SHRIMP MEAL, 1953 - 1956

Item	1953	1954	1955	1956
Number of processing establishments	38	37	29	22
Total production (in tons)	1,000	885	518	561
Value at the manufacturer's level	$80,036	$51,098	$34,470	$33,865

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INT.-DUP. SEC., WASH., D.C. 46948