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The Marine Shellfisheries of Louisiana.

Herbert Ryals Padgett

Louisiana State University and Agricultural & Mechanical College

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THE MARINE SHELLFISHERIES OF LOUISIANA

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

The Department of Geography and Anthropology

by

Herbert Ryals Padgett
B.A., Florida State University, 1950
M.A., Florida State University, 1951
June, 1960
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ABSTRACT

The Marine Shellfisheries of Louisiana

Geographers in general (and American geographers in particular) have given only slight attention to sea industries. The present study attempts in part to redress the imbalance by inquiring into a myriad of factors that have shaped the development of a specific sea industry—the marine shellfisheries of Louisiana.

Though comparatively few, those geographical studies that have dealt with sea industries are certainly not without merit. Such works as those by Bartz, Ackerman, Rostlund, and Morgan are outstanding in the field, and their influence on the present study is considerable. Yet traditional studies have frequently approached the subject from the viewpoint of one, or at best two or three, of the major factors, such as the economic history, or the market character and trends, or the simple economic-geographic relationships of the industry. The present study is grounded in a conviction that a serious inadequacy exists unless there is a thorough investigation into the interrelationships of the whole physical, historical, economic and cultural complex.
In addition to following an "interrelationships" approach, this study utilizes familiar lines of research. Close scrutiny has been made of several categories of literature pertaining to the sea: hydrographic principles, geology and composition of sea bottoms, marine biology, climate, history of fisheries, and State and Federal public documents. Thus, the work of specialists in several fields has been synthesized and then modified and supported by the author's own field observations. From this analysis of the Louisiana shellfisheries, several conclusions can be drawn.

The physical environment of the Louisiana Coast, due to the Mississippi drainage, has been a pervasive factor, both positively and negatively, in the development of shellfish industries. Sheer abundance of shellfish and ease of capture appear to account for Louisiana's preoccupation with and high productivity in the shellfish industries. Yet the deltaic character of the Louisiana Coast, while responsible for an abundant marine life, has yet been a deterrent to the centralization of ports and facilities, to the construction and employment of seaworthy vessels and gear, and to a well-populated coast zone.

The influence of New England fisheries on the entire southern region has been strong, and is especially apparent in gear, vessels, and methods of processing.

The varying degrees of commercial development of each of the three industries studied has been largely the result of the influence of economic and ethnic factors.
The revolutionary development of the shrimp industry in the 1920's and 1930's rests largely upon the joint advent of the gasoline motor and otter trawl. The stability since the turn of the century of the much older oyster industry results from ethnic factors which brought a transition from extractive reef harvesting to cultivation. Improved processing and packaging techniques occurring in the 1930's and an expanding national market for seafood are largely responsible for the commercial development of the number three industry--blue crab.

At least two cultural factors have been of major significance in accounting for retardation of southern fisheries, including those of Louisiana. These are the lesser degree of urbanization than occurs in some other sections of the nation, and an agricultural orientation of the entire southern region. These conditions are related, though indirectly, to a natural environment that originally favored an agricultural economy to the exclusion of almost any other.

The study of sea industries is a relatively new and promising field for geographic investigation. If the present study should serve as stimulus to future inquiries in this area, it will be more than justified.
CHAPTER I

INTRODUCTION-

Despite their apparent predilection toward a study of land-oriented industries, geographers have within recent years come to give increasing attention to fisheries. American geographers have contributed, but the most extensive and noteworthy work in this area has been conducted by German, British, and French geographers.

Among the foremost French geographers who have written on the subject of fisheries are Auguste Dupouy, Maurice Le Lannou, and Louis Papy. In Germany the principal contributor is Fritz Bartz, and in Italy it is Attilio Mori. From Britain have come worthy studies by Robert Morgan and R. L. Jones, while here in America monographs by Edward A. Ackerman and Erhard Rostlund and articles by Clifford Zierer and George W. Schlesselman are notable.

Yet despite this increased interest in fishing industries on the part of geographers, the studies thus far suffer from inadequacy; they are frequently either too narrow in scope or too loosely general. For example, Dupouy’s *La Pêche Maritime et le Pecheur en Mer*, is mainly sociological and very generalized. Although Dupouy treats at some length the fauna, the geographical conditions that are conducive to sea traditions, and the economic problems
of packaging and marketing fish, his main interest is the fishermen—their social and economic problems, their superstitions, job hazards, and the like. The physical aspects of the subject are mainly descriptive, and no attempt is made to relate fishing and abundant sea life to natural factors. The historical and cultural influences are also omitted. Similarly, Louis Papy's study—La Côte Atlantique de la Loire à la Gironde—is principally physical in nature, a description of the coastal morphology, climate, fauna, and flora, together with the habits and migrations of fish. Fishing as an industry of the area is not considered.

Ackerman's New England's Fishing Industry is an excellent regional description of a fishing industry. Despite its excellence, however, some important historical factors, as well as the diffusion of traits and techniques, receive scant attention. And although there is some good discussion of factors underlying the productivity of New England waters, the industry is not effectively related to the type of coastal zone or economic structure of the region.

Rostlund did not write about a fishing industry or region in the vein that most geographers have, but concentrated rather on the role of fish and fishing in the primitive economics of North America. His excellent monograph, Fish And Freshwater Fishing In Native North America, investigates fish as a natural resource in aboriginal North America, giving the characteristics of individual species and their distribution. Its principal purpose is twofold: to evaluate
the importance of fish and fishing economically, and to pre­sent evidence that might be useful in culture-historical problems. Cultural factors such as food preferences and aversions figure prominently in whether fish in general or just certain species were acceptable to certain tribes even though the resource may have been abundant. (It is interesting to note that such cultural factors as these figure prominently in modern America's consumption of fish.) Natural factors underlying fresh-water productivity he also considers. His summary statement is "that the importance of fish in the food economy of any North American tribe depended primarily on three factors: the kind of fish resource that was available to the tribe, the type of fishing equipment and degree of skill possessed by the tribe, and the attitude of the tribe toward fish as food." ¹ He views Indian fishing as a "complex formed in space by a process of hybridization, and this conception suggests the true nature of the diffusion process and of culture history." ² Some suggestions of Rostlund's approach will be found in the present study, which, however, differs greatly in time period, degree of emphasis, and the treatment of an organized modern industry as a four- or five-dimensional whole.

Robert Morgan's World Sea Fisheries is probably the best attempt of a geographer to show the relations between the physical environment and cultural factors of markets, gear and vessel designs. This ambitious work is very general, however, and is deficient in historical and ethnic influences
on fisheries. Nor does it examine any particular fishery in the light of all the forces that have come to bear upon it.

Probably no geographer has given more intensive and thorough attention to fishing industries than has Fritz Bartz. Though he has conducted several studies of fishing industries, one of his foremost is *Fischgründe und Fischereiwirtschaft an der Westküste Nordamerikas*. Touching on natural factors of coast configuration, nutrient and plankton conditions, and the different species of fish and their migrations, the study is primarily concerned, however, with economic factors. Factors closely related to modern economic development are the main points stressed—economic history (beginning with Indian fishing), markets and marketing problems, production statistics, and recent trends in economic development. Much less attention is devoted to physical conditions, diffusion of culture traits, impact of ethnic forces, and the influence of technology both within and without the industry itself. Nor is abundance of sea life effectively related to natural factors. The over-all impression one receives from Bartz's work is that the fishing industry is not conceived nor discussed in terms of a complex of several more or less important divisions, but that these divisions are treated only insofar as they may explain or clarify the economic aspects of the study. Bartz's approach does, however, come nearer to the one used in this study than that of any others known to the writer.
If fishery studies conducted by geographers tend to suffer from inadequacy or limited scope, it is even more true of those completed in the other academic disciplines, in economics, biology, conservation, oceanography, and the like. Most studies concerning fisheries and shellfisheries are principally economic—marketing problems and trends, the finance of vessels and gear, and technological developments that might result in a more marketable product. Many studies emphasize the conservation aspects of marine resources; still others are studies of the purely physical environment of specific fish and shellfish and of the manner in which these have influenced the scarcity or abundance of marine organisms. These studies are usually concerned with such factors as pollution, chemistry of the water, occurrences of toxic organisms, and predator control. Most fishery studies are nevertheless valuable in that they yield much-needed information regarding specific factors.

Since the scope of practically all fishery studies is narrow in the sense that only one or two aspects of the fishery are dealt with, there is need for a more comprehensive study which proposes to account for the variety of factors influencing the development of a particular fishery. For clear insight into the nature and development of a fishery, research must be conducted into the manifold factors to which the industry owes its character. Since natural, historical, and cultural factors are involved, these must be ascertained and their relationships explored.
The present study of the Louisiana shellfisheries is predicated on the assumption that seldom does an industry owe its full development to economic factors alone, or to physical and cultural factors peculiar to the area in which the industry is located.

Implicit in this study, then, is the assumption that the present character of the Louisiana marine shellfisheries can best be determined in the light of an inquiry into not only the physical and economic phenomena but into the historical and cultural implications as well; that, in short, the Louisiana shellfisheries are an outgrowth of a physical, historical, cultural, and economic complex.

Such an approach to the study of the Louisiana shellfisheries might well be called "contextual." It is essentially the approach which Frederick Jackson Turner applied to the study of history some years ago. In developing the thesis that the frontier constituted the most significant role in shaping American history, Turner claimed that the historian must understand all the forces which affect a given period—the political, economic, geographic, psychological, and scientific. Just as in history, so in a geographical study of marine shellfisheries, the "contextual" approach provides clearer insight into and a more balanced perspective of the character of an industry.

For the sake of clarity in discussing the manifold relationships that embrace the Louisiana shellfisheries and describing the fisheries in proper context, the presentation
of material in the following chapters is primarily from the general to the particular. Chapters II and III discuss physical elements of the sea and estuarine environments as they pertain to the character and abundance of sea life. In Chapter II the discussion is concerned with hydrographic principles and with marine environments in general. In addition, the physical character of the Gulf of Mexico is considered in some detail. Chapter III deals with the physical environment of the Louisiana coast.

Chapter IV inquires into the dominant role played by New England fisheries in the United States, and the diffusion of ideas and techniques into the south Atlantic and Gulf regions of North America. Without this discussion it would be difficult, if not impossible, to account for a large part of the technology, attitudes, and methods characterizing the Gulf and Louisiana fisheries to the nation as a whole.

In the remaining three chapters the physical and cultural nature of each of Louisiana's three shellfisheries is considered, and particular attention is given to the interrelationships of physical, historical, cultural, and economic factors that explain the industries as they exist in their present form. Together these three chapters form a study of the Louisiana marine shellfisheries, which comprise three divisions--shrimp, oyster, and crab industries. These industries will be analyzed in terms that are principally geographical in character--distribution of the resources
and the cultural phenomena involved in their utilization; natural conditions that favor or inhibit an abundance of shellfish and which consequently influence the extent and intensity of commercial development; and the relations between the natural character of the shellfish environment and the cultural factors influencing development of these industries.
PHYSICAL CHARACTERISTICS OF THE GULF OF MEXICO

Introduction—Physical Requirements for a Productive Fishery

The oceans and seas have their productive and non-productive areas just as the land does. Large concentrations of animal life in the sea are due to specific natural conditions. The basis for productivity is the presence of nutrients, which are composed of varying combinations of metallic and non-metallic minerals and organic substances in varying degrees of abundance throughout the water areas of the earth. Nutrients are directly utilized as food by microscopic plant forms known as phytoplankton, which are used in turn as food by microscopic and macroscopic animal forms known as zooplankton. Plankton itself is the basis for all higher forms of animal life in the sea. Certain species of fish are plankton feeders while other species are predators of the plankton eaters. All life in the sea is definitely interwoven into a food chain that begins initially with nutrients and plankton.¹

Since the utilization of nutrients by phytoplankton can occur only within the range of light penetration, there is a limited zone of utility ranging from the surface to several hundred feet, depending on latitude. Due to the vertical position of the sun in the tropics, the penetration
Footnotes


2. Ibid., p. 160.

of light there is several hundred feet, but only a few feet in polar regions where the sun is always low in the sky and completely absent for several months.

There are two principal physiographic sources of the life-giving nutrients. In one instance they are supplied by drainage from the land and distributed along the coastal areas either by currents which parallel the coast or by currents which flow offshore along the bottom. In some cases the nutrients are carried far out to sea. This condition can occur, for example, when a large river discharges into a quiet body of water in which coast-parallelizing currents are largely absent. Although there are few coasts that do not receive some land drainage and therefore support sea life, the coastal areas with the greatest amount and variety of animal life are those which receive a heavy drainage from the land. The type of animal life in any specific place is influenced by the particular kinds of minerals and sediments brought down by the streams.

The other source of nutrients is the sea floor. The accumulation of unconsolidated sediments on the sea bottom is a continuous process, but since there must be constant renewal of nutrients in the surface waters for initiation of the food chain, it is necessary that upwelling processes operate to distribute the nutrients vertically into the upper layers. There are a number of situations in which this upwelling may occur. For instance, it may occur in areas of contact between ocean currents flowing in opposite directions, usually a warm current meeting a cold current.
Vertical mixing and upwelling are violent and thorough over relatively large areas under these conditions. Some of the world’s most productive fishing grounds are located in such areas. These locations have a latitudinal conformation, generally between the latitudes of forty and sixty degrees, though similar conditions are found in other latitudes, under special conditions. In the tropical waters of the Pacific near the equator, diverging equatorial currents produce upwelling which replenishes the upper layers and supports a large plankton population. Plate I shows the distribution of the world’s principal commercial fisheries and zones of upwelling (Note the close correlation).

Another situation in which upwelling may occur is along coasts that have offshore winds and ocean currents which parallel the coast. The constant movement of surface water offshore by the prevailing winds is counterbalanced by upwelling. Such coasts are found on the western sides of land masses between ten and thirty degrees latitude, in a zone commonly known as the trade-wind and subtropical high-pressure belt. Coast-paralleling currents move waters chiefly horizontally, but there is also a considerable amount of vertical mixing at the same time, especially along the contact zone of currents and waters of different temperature and density.2

Chemically, most of the open ocean is a fairly stable, homogeneous medium. Its scanty supply of plankton is due in part to the persistent thermal stratification which prevents
PLATE I

THE WORLD'S PRINCIPAL AREAS OF UPWELLING AND THE MOST INTENSIVE COMMERCIAL FISHERIES ARE SHOWN HERE. NOTE THE CLOSE CORRELATION OF C AND U EXCEPT FOR THE GULF OF MEXICO AND THE MEDITERRANEAN SEA. IN THE AREAS WHERE UPWELLING IS PRESENT AND THERE IS AN ABSENCE OF COMMERCIAL FISHERIES, OTHER FACTORS (LARGELY CULTURAL) ARE RESPONSIBLE.
renewal of nutrients from the bottom to the surface layers. Rich plankton concentrations correlate with high PH content and show no apparent relation to salinity or temperature. In the tropics and warm-temperate latitudes a strong stratification of the water usually develops. This opposes any vertical mixing of the water so that a depletion of nutrients in the surface zone results. Thus, the tropical plankton of the open ocean is characteristically sparse as compared with that of the subpolar regions. However, certain regions of the tropical ocean may be the seat of greater productivity than are the subpolar areas.

It has been observed that much larger concentrations of phytoplankton occur in north-temperate and subpolar regions than in the tropics, and hence the conclusion that these waters are more productive than tropical waters. Marine biologists do not necessarily agree with this conclusion today, for recent studies have cast considerable doubt on its validity. The amount of plankton at a given time does not give a true measure of the rate of reproduction. The volume of phytoplankton is greatly affected by the grazing of marine herbivores and therefore at any time is merely a momentary balance between the processes of production and consumption. In the tropics, steady grazing by predators may keep the zooplankton at a lower level of abundance than is evident in higher latitudes where seasonal factors allow the plankton to "pulse" or bloom and thus increase much faster than the predators. The apparently low-standing
crop may be considerably counterbalanced by a high rate of turnover and nearly uniform production throughout the year. However, there is usually found a direct relation between concentrations of phytoplankton and zooplankton. Tuna-catch records and observations in the Pacific indicate quite definitely that areas of the greatest zooplankton abundance in the central Pacific are also areas of greatest tuna abundance.\(^5\)

Favorable conditions for phytoplankton are found more often in coastal waters than far offshore. Here the zone of decomposition (on the bottom) lies close to the productive zone (the surface), supplying nutrients in abundance.\(^6\)

In addition to the presence of plankton, a favorable topography and composition of the bottom are also of basic importance in determining the types of animal life and the degree of their concentration. The species of fish and shellfish that can be commercially exploited are the pelagic fishes (surface feeders) and those bottom feeders that can be reached by fishing gear in comparatively shallow areas contiguous to the coast or in shallow areas located at considerable distances offshore. The latter are known as "banks." Where conditions are normally good for abundant populations due to available nutrients, the suitability of those places for spawning enhances the concentration in local areas. In such places, tremendous numbers of both surface and bottom feeders are found. These areas are the most commercially exploited because of the enormous
aggregation and the ease with which fish can be taken by trawl and bottom lines. However, some of the world's most productive and commercially exploited fishing areas are along coasts with deep water close inshore. In the latter case, upwelling provides an abundant food resource base. Moreover, the fishery may be based in large measure on the taking of anadromous species, such as salmon, shad, and sturgeon; and since these fish spawn in the upper courses of rivers and spend their adult life as surface feeders in the seas, shallow zones contiguous to or near the coast are not necessary.

The composition of the bottom greatly influences the density of population and the species which are present. In general, a muddy bottom is rich in life, but mud mixed with sand is still more so. Coarse sand is poorer in animal life than is fine sand. The large amounts of organic materials constantly brought into the sea by rivers and also the detritus from a rich littoral vegetation sink slowly to the bottom where waves and currents are absent. The resulting mud affords a rich food supply. Vast numbers of minute forms—protozoans, nematodes, swarms of small crustaceans, ostracods, amphipods, and other forms—develop at the expense of the organic food supplies and create in turn a new source of food. The type of sea bottom is highly significant for larger forms of life, since the food supply is more abundant on certain bottoms. Shellfish of all kinds, shrimp, crabs, and oysters, are most abundant on mud bottoms
or mud-and-sand bottoms. Certain varieties of finfish appear to have no preference for bottom type since they are largely surface feeders, but such fish are usually more abundant in waters that have mud bottoms because their food supply is greater in such areas. Certain varieties of bottom-feeding fish prefer mud bottoms but others do not. The red snapper, for instance, is rarely taken on any bottom except sand or coral. Some shellfish, such as the pink shrimp (Penaeus duorarum) of the south Atlantic and Gulf of Mexico, are found only on coral or sand bottoms.

The topography of the bottom is of the utmost importance for the development of a commercial fishery. Certain areas which would otherwise have commercial possibilities are avoided by commercial fishermen because of bottom obstructions. The most common obstructions are large pebbles and boulders, patches of coral, shell heaps, conchs, and certain types of sponges. The waters of the tropics and subtropics appear to have more bottom obstructions than do temperate and subpolar seas, because they contain coral patches with razor-sharp edges, conchs, and sponges, in addition to shell heaps and rocky bottoms. The best prospects for fishery operations in the lower latitudes are areas offshore near river mouths, bays, and estuaries. In these places silt and fine sands have been deposited over the bottom and have created a soft, smooth surface for trawling and bottom-line fishing. There is an absence of coral, sponges, and conchs in most middle-latitude and
high-latitude fishing areas. Rock and shell bottom are here the major obstructions. Creation of the trawlable bottom in north temperate and subpolar waters is largely a result of glacial action. The glaciers moved tremendous amounts of moraine into coastal waters, and this drift was fairly evenly distributed over the bottoms. The scouring action of coastal glaciers had the effect of leveling and smoothing a bottom which otherwise might have been very rocky and irregular.

In addition to nutrient concentration, topography, and bottom composition, the configuration of the coastline is of significance in determining the type of marine life which can be supported. In general, an irregular or embayed coast has a richer and a greater variety of fauna than does a regular coast. Numerous shallow bays and estuaries provide spawning and nursery grounds for a large number of fish and shellfish. Bays are quiet bodies of water where sediments from the land accumulate and form a muddy bottom rich in nutrients. The food supply from the rich bottom and a dense growth of vegetation around the bay provide excellent ecological conditions for the fingerlings—a food supply and cover from enemies.

Still another factor affecting and regulating life in the sea is temperature, particularly as it affects spawning, migrations, and relative size of individuals of the same species. In temperate and subpolar latitudes spawning is initiated by a rise in temperature. Fish migrate out of
bays to the open water when temperatures drop in autumn, and return with rising temperatures in the spring. It is now recognized that individuals in polar and subpolar seas grow to a larger size than do the same species in temperate or tropical latitudes. It is also noted that animals in north temperate seas are larger than those of the same species in south temperate or tropical seas. For example, Gunter's study of marine fish in the Gulf of Mexico and middle Atlantic areas reveals that "of 26 comparable species from the two localities, for 18 of them the larger fishes were recorded from Chesapeake Bay." ^9

Delayed sexual maturity, longer life, slower growth, and greater final size are characteristics of animals in colder seas. The phenomenon seems to be dependent upon progressive retardation of growth by lowering temperatures poleward. Sexual maturity and growth are accelerated by high temperatures, but certain growth inhibitors operate at the time of sexual maturity to slow or stop growth. Therefore, the faster the growth, the less the final size. ^10

One final physical requirement for a productive fishery should be mentioned here, namely, the relative salinity of the water. Although most species are temporary inhabitants, coming to spawn or to escape higher or lower temperatures in the open water, many species spend their entire lives in the shallow bays and estuaries. The bays and littoral areas are, indeed, chiefly nursery areas, but they also provide a place of seasonal habitation for various
species that are sensitive to temperature and salinity changes. For example, in the Gulf of Mexico, the bays are not so fresh in summer as in winter, due to greater evaporation and less drainage from the land. The combination of higher salinity and higher temperatures thus attracts a greater population of salt-water forms in the summer.

The Physical Character of the Gulf of Mexico

Though a wide disparity among physical conditions throughout the Gulf of Mexico precludes its satisfying generally all the requirements for a productive fishery discussed above, certain areas are highly favorable to sustaining large concentrations of marine life. In general, the offshore waters are comparatively low in productivity whereas some of the coastal or shelf waters are quite productive. This is generally true for the northern Gulf coast and particularly true for the area around the delta of the Mississippi.

Located roughly between twenty and thirty degrees north latitude, with small portions extending above thirty degrees in the north and a small area between Mexico and the Yucatan Peninsula in the south extending below twenty degrees, the Gulf of Mexico itself is about a thousand miles long and approximately eight hundred miles wide. It is, in the main, an enclosed body of water, its only connection with the Atlantic being through the Florida Strait between Cuba and Florida. In form its floor resembles a huge amphitheater.
The Gulf Coast does not have many deep indentations, but has numerous small bays and estuaries surrounded by a gently sloping plain on all sides. This plain is narrowest in south Texas and Mexico. The specific character of the Gulf Coastal Plain can best be seen in the following description by Hedgpeth:

Structurally, the Gulf of Mexico does not begin at the shore line, but with the broad, gently sloping Gulf Coastal Plain. This Gulf Coastal Plain is continuous with the South Atlantic Plain. The Gulf Coastal Plain is indented by two great embayments, the Mississippi embayment, extending as far north as Cairo, Illinois, and the Rio Grande embayment, and two smaller embayments. This plain which slopes about 5 feet per mile, extends beneath the water at a gradient of 8-12 feet per mile to form a broad continental shelf. The shelf is 175 miles wide west of Florida, and 140 miles wide south of Louisiana.

The sediments on the continental shelf of the northern Gulf of Mexico obtain enormous thickness, especially in the vicinity of river mouths. The weight of these sediments has created what is known as the Gulf Coast Geosyncline. "The seaward margin of the northwestern Gulf Coastal Plain," writes Harold N. Fisk, "has long been known to be an active structural region. The effects of long, continued gulfward tilting and inland uplift of the region are apparent, and geological and geophysical evidence have been interpreted as indicating the presence of a huge downwarp of the earth's crust called the Gulf Coast Geosyncline." Concomitant with this downwarping has been the accumulation of some 40,000 feet of sediments, the base of which approaches a depth nearly four times greater than the
deepest part of the Gulf. Fisk notes also that the depressed area around the Mississippi trench may therefore "represent but a local and minor episode in the downwarping of the region," though he hastens to add that this local movement is "clearly associated with the area of deltaic sedimentation, however, and the relationship strongly suggests that downwarping in the geosyncline is most active in areas where the greatest quantity of sediment is being deposited."13

The sediments are principally a facies of coarse-textured sand, silty clay, and shell clay. The distribution pattern of sediments results principally from two conditions: (1) the great volumes of sediment derived from the Mississippi drainage system and several minor streams and (2) the movement of this sediment by a counter-clockwise prevailing current. The latter is responsible for the termination of the eastern Gulf calcareous area southwest of the Mississippi Delta, rather than directly south.14

From western Florida to the Florida Keys the shelf is drowned limestone or karst plateau with a comparatively thin veneer of unconsolidated sediments. This type of shelf is also found off the Yucatan Peninsula. The absence of large rivers along these coasts and the comparatively small sedimentary load of the lesser streams, together with underground drainage from the land, accounts for their non-depositional character. The peninsulas themselves are terraced limestone coastal plains. They have delivered a minimum of land-derived sediment to the shelves, so that,
under tropical climates, these latter abound in places and probably have long abounded in great coral reefs and some reef-like bars and sand keys of shell detritus. The continental shelf off the orogenic coasts of Mexico is narrow, the gradient convex, becoming steep, like that near the outer edge of the shelf in Texas and Louisiana; the grain sizes of the sediments decrease more regularly outward. The small size of the subaerial drainage basins where mountains stand near the coast restricts coastal sedimentation. The shelf is wide off the several sedimentary coasts, but narrow in front of the littoral mountains.

Barrier islands are found off the coast in parts of the northern Gulf area. These islands dominate the shorelines of the alluvial sectors of the coast. They are not caused by permanent or semi-permanent sea-level change, nor are they related to shorelines of submergence or emergence. The barriers occur where there is considerable longshore drift, the sand being supplied by the rivers and the retrograding shoreline. They may be built by strong onshore waves where longshore drift is absent. In the latter case the barrier is built of broken shells from the adjacent bottom.

The bottom character of the Gulf is determined largely by the drainage from the land. To begin with, the Recent and Tertiary sediments have strikingly similar patterns of distribution in the northern Gulf of Mexico region. Both are predominantly sandstone and shale in the west, and
limestone in the east. Little sediment goes to the Gulf from streams of the Florida Peninsula, and the shore deposits consist largely of calcium carbonate secreted by organisms. The area offshore from Alabama and the panhandle of Florida has detrital sediments which show the influence of the Appalachians. Most of the continental shelf west of Florida consists of hard rock, chiefly limestone, but a thin veneer of sediment is present in local areas and fills some of the shelf depressions. The sediments of the Mississippi delta region are arranged in leaf-like form, with the deposits of natural levees and channels forming the veins, while the marshes represent inter-vein areas. Subsidence and the shifting channels have, together with long-continued deposition, created a "pile-of-leaves" structure beneath the deltaic plain. Thick, elongated, finger-like deposits of sands and sandy silts underlie the distributaries, and huge clay wedges lie beneath the shallow basins between the distributaries. The delta platform is thus composed of these sedimentary units, together with an underlying, thin layer of pro-delta marine clay.

Shepard found that "most of the sediment surrounding the growing Mississippi Delta consists of silt and clay. The only clean sands are those that have been reworked from the levees and the bars of the delta front by the waves into spits and shoals along parts of the delta. The only major sand bodies have formed where delta-building is not now active."
The dominant sediment on the continental shelf along the Louisiana Coast west of the Mississippi is mud and sand. Near shore, fine sands derived from reworked delta deposits predominate along the beaches. Patches of coral are found on the shelf at considerable distances offshore. Plates II and III, respectively, show the sedimentary character of the Louisiana coastal zone and the bottoms of the Gulf.

There is not often found a regular gradation in texture from coarse to fine particles in an offshore direction, and in some instances the finer-grained deposits lie near the beach. Traverses in the northwestern Gulf reveal a patchy bottom with alternating silts and sands with irregular sorting. A narrow sandy strip shoreward seems to be continuous along the whole Texas-Louisiana coast. Seaward of the shelf's patchy bottom of sands, silts, and clays, there is a uniform cover of clay overlying the continental slope and the Sigsbee Deep. Sediments are somewhat different between Tampico and Vera Cruz, however, since volcanic rocks are found near shore. The coastal plain is narrow in this sector and the beach sands give way to near-shore patches of coral. Silt usually extends out on the shelf beyond the coral. The shelf of Yucatan is similar to that of West Florida. Coral is found close inshore next to the beach sands along the coast of Cuba.

In general, various types of muds occupy the basins of the Gulf of Mexico. In the deepest basins of the Gulf it is generally globigerina ooze, in the western Gulf blue
RECENT ENVIRONMENTS OF DEPOSITION IN NORTHWEST GULF REGION

PLATE III

mud predominates, and in the areas near the West Florida shelf and Cuba calcareous muds are found. Usually sands give way to mud as deposition proceeds seaward. However, this is not always the case. Off the coast of Louisiana and Texas, for example, sandy belts alternate with mud out to forty or fifty miles from shore. The sandy belts correspond almost exactly with those of currents. The silt is found in the slack-water region between the currents.

Currents in the Gulf of Mexico are largely responsible for sedimentation in specific areas. In general, the surface currents of the Gulf comprise a giant eddy. The main current passing northward through the Yucatan Channel splits off in three directions. One branch flows eastward through the Florida Strait and gives rise to the Gulf Stream. Another branch bends around the coast of Yucatan toward the west and parallels the Mexican and Texas coasts. A third branch continues northward toward the Mississippi delta, where, on approaching shore, it divides into two tongues which flow eastward and westward away from the delta. To describe the currents off the Mississippi's mouth, Scruton draws an interesting analogy. They can be compared, he says, "with currents in a large tank off a very small rubber hose. The large body of water flows first one way and then another and carries with it the minor volume of hose discharge. Currents due to hose discharge are relatively small swirls localized about the orifice." The regional gulf current pattern, according
to Scruton, "provides the background on which are superimposed local conditions off the delta. Regional or semi-permanent currents are produced both by winds blowing over the entire gulf and by regional density differences acted upon by gravity. Density differences are due to fresh-water input at many places and to gulf-wide evaporation, heating, and cooling."\textsuperscript{24}

A greater amount of the river's discharge is distributed westward rather than eastward due to the east-west component of local winds.

Because of this, data on average monthly winds and river discharges can be used to estimate river water and sediment distribution seaward in the gulf. About 55-65 per cent of the river water is distributed westward, about 25-35 per cent goes east, and the remainder (about 10 per cent) goes south. The river delivers a huge but still unknown amount of sediment to the gulf each year. Most of this load is carried during the high discharge months of late winter and spring when the winds are persistent easterlies, and because of this as much as 70-75 per cent of the Mississippi's suspended load may start westward in the gulf.\textsuperscript{25}

From the foregoing discussion it is evident that the inequality of sediment distribution has effects on coastline configuration. A large volume of the fine-grained sediment carried westward is driven into the marshes, and may partly explain, says Scruton, "why old delta surfaces at the west are emergent, while much of the St. Bernard Delta on the north has sunk below sea-level."\textsuperscript{26}

The salinity regime in the Gulf of Mexico varies more along the northern coasts. In the northern Gulf
some correlation exists between salinity and seasons. That is to say, salinities are higher in the summer. During this time the winds are southerly, pushing the oceanic waters through the channels into the bays and lagoons. Moreover, in the summer the evaporation rate is higher and there is less drainage from the land. These factors are responsible for the greater number of salt-water fauna inhabiting the bays and estuaries during the summer season. In general, however, salinities are governed more by the drainage than by climatic conditions. The drainage from the Mississippi River has a profound effect on lowering salinity for a large area around the mouth and for considerable distances east and west of the Delta. Since the northern Gulf coast receives far more drainage from the land than do the other coasts, salinities are lower and fluctuate more in the northern Gulf littoral. More streams draining into the northern Gulf area provide a different bottom sediment and a greater abundance of nutrients for a richer and different type of fauna.

The General Character of the Flora and Fauna of the Gulf

A discussion of the aqueous flora should begin with the smallest plant forms, which are, in the main, dinoflagellates and diatoms. These two plant families are the fundamental synthesizers of organic and inorganic material in the sea. They are grouped along with other similar forms and classed as phytoplankton.
Phytoplankton is found in varying concentrations in the neritic waters and in the open Gulf. In general, the open waters of the tropics and subtropics are poor in phytoplankton, except where special conditions cause upwelling. In the open Gulf waters there is a general paucity of all kinds of planktonic forms. The offshore waters of the Gulf are clear and blue, characteristic of tropical waters the world over. Surface temperatures are high, concentration of nutrients is low, and salinity is high throughout the year.27

The near-shore waters of the Gulf are much richer in plankton than are the open waters. The water is often of high temperature, with variable salinity and nutrient content, and highly turbid from wind mixing. The bays, bayous, and lagoons are also within this area. Tidal effects are strong in the neritic zone, and the physical and chemical conditions of the water vary greatly throughout the year.28

The northern Gulf waters are generally richer in plankton than are the southern waters. This is caused largely by the greater land drainage coming into the northern area. Heavy concentrations of nutrients and plankton occur off large river mouths, particularly in the waters surrounding the Mississippi mouth. Riley's research certainly supports this view:

The Mississippi releases a large quantity of phosphate into the Gulf. From two-thirds to nine-tenths of it is in soluble form, capable of being utilized by marine plants as soon as the river water becomes mixed with Gulf water. The amount of soluble phosphate per unit volume in the river
is approximately four times the mean amount found in the sea water of the surrounding region. Since the assumption is warranted that an increase of phosphorus content leads to greater phytoplankton productivity provided its growth is not limited or conditioned by other factors, the conclusion is that the zone of high phosphate, and consequently, the Mississippi itself, is an important factor in the productive area around the mouth of the river.29

The larger forms of vegetation around the perimeter of the Gulf of Mexico do not have such a direct relationship to the fishery resource base as phytoplankton. Nevertheless, they serve to provide organic material that can be transposed into food by plankton. This littoral vegetation is also of importance for cover when small fish and crustaceans are trying to survive. The larger forms of vegetation reflect the character of the bottom, salinity, turbidity, and other more basic factors connected with the ecology of sea life.

Four principal communities of flowering plants fringe the Gulf shores. One community is a characteristic strand flora found on sandy shores of barrier islands, large bays, and headlands. Another community is formed by submarine meadows or grass carpets that exist in shallow, quiet waters in practically all areas except the extreme north Gulf coast. Salt marsh, a third plant community, covers the shores of lagoons, bays, and estuaries along the northern Gulf coast. And finally, fringing the protected coasts of the central and southern Gulf regions are concentrations of mangrove swamps.30 The importance of these plant communities to fish life can be seen, for example, in the fact that the extensive salt
marshes of the northern Gulf coast provide excellent nursery grounds for small crustaceans (principally shrimp and crab) and minute organic substances from decaying marsh grasses constitute a principal food for oysters. The fauna of the Gulf of Mexico includes a great variety of species. The inshore fauna is denser and contains a greater number of species than the offshore fauna. This condition is due to the greater abundance of land-derived nutrients, organic food material from littoral vegetation, and the favorable nursery conditions provided by the shallow bays and estuaries. The fact that the Gulf is almost an enclosed body of water would seem to indicate the presence of a large number of endemic species. This is not, however, the case. As can be seen in the following excerpt from a fishery bulletin for 1954, Gulf fauna is largely a continuation of Caribbean fauna.

There is very slight amount of subspecific distinction between the fish faunas of the Gulf of Mexico and the Caribbean Sea, and a temperate Atlantic element is present in the Gulf but absent in the Caribbean region. On the other hand, there are several species which occur in the Caribbean region but not in the Gulf of Mexico, and there is no marked transition between the fish faunas of the Gulf and the Caribbean Sea or the Atlantic Ocean through the Yucatan Channel and the Straits of Florida, respectively.31

The reason for the paucity of endemic fauna in the Gulf of Mexico is fairly well understood. Though there is some disagreement among scholars as to the precise nature of the origin of the Gulf, the best geological evidence indicates that it was at one time a shallow basin.
"Previous to Middle Cretaceous time, it is believed," says Schuchert, "no such deep Gulf of Mexico as the present one was in existence, and the area now occupied by this sub-oceanic interior sea was a gentle sag or flat patchlike basin. With the Middle Cretaceous, the area commenced to subside and this downward tendency persisted until the Gulf reached its present great depth and extent."\(^{32}\) It is therefore assumed that shallow-water or shore faunas were the first to become established in the Gulf of Mexico and that they constitute the oldest element of its life communities. The shallow or shore fauna of the northern Gulf coast was a continuation of that along the Atlantic coast, being instituted before peninsular Florida was established as a barrier to many of the species during the Pleistocene. Since the emergence of peninsular Florida the passing of warm water from the Caribbean through the Florida Strait (Gulf Stream) has acted as a thermal barrier to the passage of temperate species between the Gulf and Atlantic. A connection with the Caribbean Sea was established during the Pliocene. Apparently the north Atlantic fauna became established before Caribbean species were able to come in through the Yucatan Channel. The deep-sea fauna has been established even more recently, having come from the adjacent oceanic areas.\(^{33}\) It can be stated, then, that the following factors have controlled the character of Gulf fauna: (1) the geologic recency of the Gulf basin, (2) the Pleistocene connection with the Atlantic through
present-day Florida, (3) the infusion of Caribbean and West Indian forms through the Yucatan Channel and the Florida Strait, respectively, and (4) the thermal barrier of the Gulf Current around South Florida, which has prevented any present or comparatively recent migrations of temperate species into or out of the Gulf.

Two general faunistic types, then, inhabit the Gulf of Mexico. Temperate forms dominate the northern fringe of the Gulf, and a tropical fauna prevails around the southern fringe, the offshore banks, and the open Gulf. Both areas, however, show some overlapping. A considerable number of tropical forms are found along the northern Gulf coast, and its bays and estuaries, during the summer. However, most of them migrate into the open water in winter. Certain species which are considered temperate fauna are found as far south as the Florida Strait and the Yucatan Channel, but they have never been reported from Cuba or elsewhere in the West Indies. At any rate, these species represent a small percentage of the total. Sheepshead (*Archosargus probatocephalus*), channel bass (*Sciaenops ocellatus*), and the common weakfish (*Cynoscion regalis*) are good examples of these species.34 The Gulf Stream is apparently a temperature barrier precluding the migration of these species to Cuba. Ecological conditions in extreme south Florida are common to northwestern Cuba, and it is to be supposed that these species would be found in both areas. On the West Florida coast, the transition between a dominantly temperate fauna
and a tropical fauna occurs between Cedar Keys and Tampa Bay. On the Texas coast, this transition occurs near the mouth of the Rio Grande. Cedar Keys' fauna is very similar to the Texas coast fauna, with the exception that more tropical elements are present at Cedar Keys.35

Shellfish seem to have a greater tolerance for temperature differences than do finfish. Many of the same varieties found along the mid-Atlantic coast and northern Gulf are also found in the southern Gulf waters of South Florida and Yucatan. The common American oyster (Crassostrea virginica) is found from the Gulf of St. Lawrence to the mangrove swamps of South Florida and around the northern Gulf, extending on down the coast of Mexico. The blue crab and many other species of crabs have the same distribution. The pink shrimp (Penaeus duorarum), which constitutes such an important fishery in the Gulf of Campeche, is taken in minor quantities as far north as North Carolina.36 Ecological conditions other than temperature, such as bottom type, littoral vegetation, and land drainage, appear to be vastly more important in determining shellfish distribution. Still, other types of shellfish are found on the mid-Atlantic coast and the northern Gulf coast but not in the southern Gulf or the Caribbean, and others are found in the southern Gulf and northern Gulf, but not along the Atlantic Coast.

It is significant that the most abundant fish along the Gulf Coast are plankton feeders. Anchovy heads the
list of plankton feeders, with mullet and menhaden following closely behind. Fourth place goes to the croaker \textit{(Micropogon undulatus)}, a member of the Sciaenidae family. According to Gunter:

The mullet is a mud and sand-eater, subsisting partly on miscellaneous organic matter, but largely on diatoms, one or more of which is found on every grain of sand. All three of the dominant species in mass, feed closely to the base of the marine food pyramid, the unicellular plants. The mullet is probably closest, since it feeds largely on diatoms, while the anchovy and menhaden feed chiefly on minute crustacea.\textsuperscript{37}

The family Sciaenidae contains by far the largest number of species of any group, both on the Gulf and the Atlantic coasts.\textsuperscript{38} Its several species are diverse in size and habits. Some are exceptionally abundant. The greatest percentage of the Gulf food fish belong to this group. Common names for some of the larger of these well-known species are red drum, black drum, redfish, sand trout, croaker, yellowtail, and whiting. The list includes many more food fish. Many of the sciaenids are of very small size and do not enter into the commercial catch.

The fauna and flora of Gulf and south Atlantic waters are exceedingly complex, varied, and interdependent. "In general terms," writes Hedgpeth, "this whole region from inner bay shores to perhaps 15-20 fathoms (or some possible shear zone between neritic and oceanic conditions) is occupied by what should be regarded as a single major ecosystem, which is similar to that on the Atlantic Coast, or the near shore waters of South Asia."\textsuperscript{39} Certain areas are
better endowed by nature than others for supporting an abundance of certain species, and this is how the Louisiana Coast figures so prominently in the fisheries of southern United States.
Footnotes

1. Several general works concerning sea resources have been quite liberally consulted for the preparation of this chapter.

2. Excellent discussions regarding the physical environment and the processes which provide nutrients are contained in the following publications:


23. Ibid., pp. 80-81.


25. Ibid., pp. 990-991.

26. Ibid., p. 1042.


28. Ibid., p. 223.


31. Ibid., p. 503.

32. C. Schuchert, Historical Geology of the Antillean-Caribbean Region, John Wiley & Sons, New York, 1935, p. 59. Weaver, who thinks that the great depth of the Gulf is due to downfaulting, observes that the "faulting is most intense along the outer margin of the continental shelf west of Florida and near Yucatan, but even the more gentle continental slopes are considered fault zones." (Paul Weaver, "Variations in History of Continental Shelves," Bulletin of American Association of Petroleum Geologists, Volume 34 (3), 1950, p. 359.) Eardley holds to the theory that "the Gulf of Mexico came into existence after the Appalachian orogeny by subsidence, and that much of the Gulf of Mexico is surrounded by the belt of late Paleozoic orogeny, with sediments in the marginal areas back to at least the Permian." (T. A. Eardley, "Tectonic Divisions of North America," Bulletin of American Association of Petroleum Geologists, Volume 35 (16), 1951, p. 2236.) Stetson's comment that "from
the overall picture of the whole area, one gets the impression that the bottom of the Gulf has foundered and that at least the continental slope is due to a normal fault" (H. C. Stetson, "Comment on Continental Slope Off Apalachicola River, Florida," Bulletin of American Association of Petroleum Geologists, Volume 35 (9), 1951, p. 1993.) belies the certain fact that a subsidence of the central Gulf basin has occurred.


34. For more information on the distribution of Gulf species of fish, it is suggested that the reader consult the work of L. R. Rivas, "Check List of the Florida Game and Commercial Marine Fishes Including Those of the Gulf of Mexico and the West Indies, with Approved Common Names," Ed. 4, Florida State Board of Conservation, Tallahassee, 39 pp.


37. Gordon Gunter, "Relative Numbers of Shallow Water Fishes of the Northern Gulf of Mexico, with Some Records of Rare Fishes from the Texas Coast," American Midland Naturalist, Volume 26, pp. 198-199.

38. Ibid., p. 199.

CHAPTER III

THE LOUISIANA COAST: ITS PHYSICAL CHARACTER
AND CONDUCIVENESS TO MARINE LIFE

I

The Physical Character

The Louisiana Coast extends from Pearl River in the east, westward to the Sabine River (Plate IV), an air-line distance of about two hundred and seventy miles. The coast is in a transitional zone between temperate and tropical climates, lying approximately along the parallel of thirty degrees north latitude. If a line were drawn through the Gulf of Mexico in a north-south direction, dividing the basin in half, about three-fourths of the Louisiana Coast would lie in the northwestern portion of the Gulf, rather than in a true northern location.

As noted earlier, except for the Mexican portion extending from the Rio Grande to the Gulf of Campeche, the coast of the Gulf of Mexico has many small bays, estuaries, and islands, but few large indentations or promontories interrupting the general outline. As viewed on an average-sized wall map, the coastline of the Gulf has a comparatively regular appearance. The Louisiana Coast, two-thirds of which is irregular, offers a sharp contrast. On the eastern border the coast juts out abruptly into the
Gulf, with a complex of bays, channels, and offshore islands, and then gradually withdraws in a northwestward direction toward the mouth of the Sabine River. Indeed, the very profile of the Louisiana Coast suggests that certain processes have been active here which are not found elsewhere on the Gulf Coast.

The Delta Complex

Virtually all of the Louisiana Coast, with its irregularities and numerous bays and islands, is deltaic plain and hence the result of Mississippi River alluviation. Note the vivid illustration in Plate IV of the effects of recent alluviation on the contours of the coast and the coastal zone. The large, bulge-like feature in the eastern sector is the present Mississippi delta. Deposition of river sediments has extended the coastline itself gulfward.

Former delta complexes of the Mississippi River have extended from Vermilion Bay in the west to the Chandeleur Island area east of New Orleans. The mouths of the present Mississippi delta extend southeast of New Orleans, forming a "bird's-foot" pattern. This particular pattern, according to Russell, is more an artifact of engineering efforts to stabilize the river channel for navigation than a result of natural processes. Given its way, the lower Mississippi River would diverge from its present channel and develop a new delta at the mouth of
the Atchafalaya.¹

A prograding shoreline exists in the active area where sedimentation is now in progress; elsewhere the shoreline is retrograding. The weight of the sedimentary load deposited into the delta area causes a downwarping of the underlying beds. Subsidence is most rapid at the mouth of the present river and decreases on the flanks. In addition to downwarping, subsidence is caused by local compaction of sediments and both processes operate simultaneously. These processes combined with wave attack result in submergence and deterioration of the deltaic surfaces in areas where sedimentation has ceased. The coasts marginal to the modern delta are being attacked by wave action and are eroding. The numerous islands and bays which are found on both the east and west sides of the present Mississippi mouth are the result of subsidence and destruction by wave attack. Much of the area not completely covered by water is a salt-marsh plain which is inundated during high-water periods. Other areas of slightly higher elevation, supporting trees and other non-halophytic vegetation, are natural levees, salt domes, and beach ridges.

The large shallow bays and lakes east of the present delta to the Mississippi state boundary and west to include Vermilion Bay are depressions and represent former depositional areas that are now deteriorating through subsidence and wave attack.
The straight and regular coastline extending from Vermilion Bay to the Sabine River is the result of coastal retreat. A series of former beach ridges or shorelines which parallel the coast are called "cheniers." The beach ridges represent halting stages in alluviation, when the Mississippi River changed its course and deposition was no longer taking place. With some exceptions this coast is presently in the process of retreat.

In addition to the deltaic irregularity, certain other features of the Louisiana Coast can be noted here. First, a comparatively wide continental shelf, with a gentle slope from the shoreline to about fifty fathoms where there is a rapid fall off toward the Sigsbee Deep, borders the Louisiana Coast. A distance from the western Louisiana coast to the edge of the continental shelf of about one hundred and forty miles gives Louisiana the second widest shelf found in the Gulf of Mexico, though it should be observed that the edge of the shelf does not lie very far off the present mouth of the Mississippi River where the delta extends into deep water.

Second, Kindle's early notice of ridge and trough features along the near-shore areas of the Louisiana Coast was augmented by later surveys that revealed ridges whose crests were as much as ten feet wide and separated by troughs sixty to ninety feet wide. Moreover, far out near the edge of the shelf the topography becomes quite irregular and hummocky. Attaining a relief that often approaches
several hundred feet, these hummocks are thought to be due to doming and many of them contain coral. 5

Bottom Types and Coastal Currents

Mud, silt, and sand typify the Louisiana Coast, both in the inner waters of the bays and lagoons and in the offshore waters. On the continental shelf along the Louisiana Coast west of the Mississippi delta the dominant sediment is mud and sand, whereas sand and shell prevail on and near the beaches. To either side of the Mississippi River, silt and mud are greatly in excess of sand, and westward from the delta lies a clay-silt zone with some sand and shells. The presence of dark gray to black mud in the quiet waters of the bays and the lagoons is due chiefly to a combination of decaying littoral vegetation and the vast amount of fine silt transported by the Mississippi River. 6

Offshore bottoms of other coasts around the Gulf of Mexico are either predominantly sand or a mixture of sand and mud. Along the beaches sands are dominant and grade into muds toward the edge of the continental shelf. In contrast, the beaches of the Louisiana Coast are composed predominantly of marsh-flat sediments, though fine sands can be found either mixed with marsh-flat sediments or forming a veneer over them.

Wave processes, bottom currents, and coast-parallel currents operate along all coasts to winnow the sands and
deposit them upon the beaches; fine silts are carried out to sea or moved to quieter, deeper waters contiguous to the coast. Yet, though such processes operate along the Louisiana Coast, the coarser sands and silts found nearest to the shoreline are principally the result of the reworking of deltaic deposits.

The effects of the Mississippi River on the bottom character of Louisiana waters are felt farther westward than eastward, a condition resulting from the nature of semi-permanent currents and local wind direction around the Mississippi mouth. For example, the predominantly mud bottoms in the neritic waters and bays to a considerable distance west of the Sabine River are largely of Mississippi origin. Mud and sand bottoms are found eastward in Mississippi Sound along most of the Mississippi Coast, but sand is overwhelmingly dominant from the Alabama Coast on eastward, except for areas around Mobile Bay.

In addition to the coastal currents, two other factors bear on the east-west extent of Mississippi sediments. The Mississippi mouth is located nearly as far east as it has ever been, while former deltas have extended since the last sea rise as far west as Vermilion Bay. Secondly, the Atchafalaya River, although smaller than the Mississippi, transports a considerable amount of sediment from the Mississippi, especially during high-water stages, and practically all of the Red River discharge. The material carried by the Atchafalaya, although different from the Mississippi to some degree in color of silt and mineral
constituency, is generally of the same character.

Aside from their importance in the deposition of sands upon the beaches, coastal currents act in several ways to strengthen the ecological base of marine fauna. Not only do they transport the larval forms of benthic animals to certain locations but they also carry and distribute the detrital materials that benthic animals utilize as food. Since certain bottoms may receive more of this material than may other regions, a greater abundance of bottom animals may be found in one region than in another. Wave energy may be sufficiently strong on some bottoms to erode the bottom and expose organisms to predators, and also remove the food material from the stirred-up sediments, thereby determining the chances of survival for larvae in a given region and whether or not there will be enough organic material to support an adult population.

Vegetation

The vegetation bordering the Louisiana Coast is primarily salt marsh. Still extant are remnant shorelines composed of accumulations of sand, mud, and shell that are representative of a period of long stability when there was sufficient time for wave action to remove a great deal of the fine materials and deposit coarser materials of sand and shell along the shoreline to form a beach ridge. The beach ridges have sufficient elevation to be above high
tide and support some non-halophytic vegetation such as live oaks, marsh elder, and hackberry. Areas fitting the above description are primarily in the vicinity of Grand Isle and include the "cheniers" in Vermilion and Cameron parishes. There is salt-water intrusion at high tide around or through breaks in these beach ridges and extensive areas of salt marsh extend inland.  

Natural levees along the Mississippi River, and its former distributaries that extend into the salt-marsh areas, are not subject to salt-water inundation and can therefore support non-halophytic vegetation.

Many varieties of salt-marsh grass withstand brackish water and extend inland around the brackish bays and lakes. Salt and brackish marsh grass gradually gives way to fresh-water species inward from the coast. There is a zone of transition in which both salt-water and fresh-water species are present. However, more species of salt-marsh grass can withstand brackish water than can fresh-water species, for they "live under most difficult conditions: high salt content in the soil solution, poor drainage, recurrent submersion and exposure, and full insolation." Therefore the halophytic forms predominate up to the fresh-water line.

Salt marsh exists primarily on surfaces that are near sea level and are frequently inundated. Very extensive flat surfaces of this nature are in areas of inter-levee depressions and are separated by lakes, estuaries,
bays, and lagoons. Practically the entire coastline of Louisiana exhibits this pattern, whereas it exists only in very limited areas elsewhere along the Gulf Coast. Louisiana possesses almost one-half the total salt-marsh acreage in the United States. Salt marsh plays a role in providing the distinctive environment of the Louisiana bays and neritic waters. The decaying marsh grass provides rich organic material that mixes with the silts of the bays to form a mud bottom. Such bottoms are richer in nutrients than are other types, and therefore support an abundant planktonic life and in turn a larger and richer benthic population.

Water Chemistry

Sea water contains in solution practically every mineral or element that occurs on land. Through various complicated distillation procedures practically all minerals can be recovered in some quantity from ordinary sea water. However, the degree of concentration of one or more of these elements or combination of elements varies greatly from one location to the next, and is dependent upon a variety of circumstances—from the mineral constituency of the lands drained by the rivers to such factors as coastal currents, presence or absence of upwelling, slope and topography of shelf, and climate.

The mineral constituency, or rather the degree of concentration of certain minerals, is of primary
importance to the sea life of estuarine and neritic waters. Bottom types are related to the degree of concentration and character of sediments brought by the land drainage. The presence or absence of even a trace of a certain mineral is critical in the ecology of some marine animals. For example, Prytherch has noted the vital role of copper in the setting or attachment of oyster larvae.

In concluding the analysis of numerous physical and chemical factors in respect to setting it has been found up to the present time that copper is the specific element that will induce this reaction and that its presence in the water in minute amount is necessary for attachment of the oyster larvae. Though river discharge is responsible for many fluctuations in the chemical composition of the water over the oyster beds, its continual contribution of minute amounts of copper is the factor of primary importance in setting of the oyster.10

The estuarine and neritic eco-systems11 vary greatly from season to season, month to month, and in some cases, daily, in their mineral constituency. These eco-systems contain a great number of marine animals that require brackish water during their larval stages and waters of higher salinity during adult life. Many salt-water forms that cannot tolerate waters of low salinity migrate into the estuarine waters during a seasonal shift when salinities are high.

This eco-system, which furnishes fresh water, brackish water, and salt water as necessary requirements for a large percentage of its animal inhabitants, is at maximum development along the Louisiana Coast. Just as
the bottom types, salt marshes, and the numerous bays are intricately related to the Mississippi River drainage and processes of alluviation, so the chemistry of Louisiana waters is related to the same conditions. As seen in the following comment by Hedgpeth, Louisiana bays, estuaries, and neritic waters vary more in their salinity composition and general mineral constituency than do other areas of the Gulf Coast.

The complex of bays, estuaries and inlets of the Texas and Louisiana coasts presents a wide range of environmental conditions, from shallow, lake-like bays to narrow sluggish bayous and channels which are thirty feet deep in places, with bottoms varying from hard sand to very soft mud. Salinities vary from nearly fresh water to oceanic concentrations, and temperatures from near freezing in winter to highs in excess of 31 degrees C. in summer.

If these tidal waters have one feature in common, it is their variability, both seasonally and from year to year. Such variation is characteristic of estuaries, but it is extreme on the northern Gulf coast, where floods may change salinity of a fairly large bay from 15 per cent to nearly fresh water in a few days, or periods of drought, accompanied by high temperatures, may raise salinities to hypersaline concentrations.

Louisiana waters are more subject to dilutions, and Texas waters, especially from Matagorda Bay south, to concentrations. Each system of bays, from the head of tidewater to the Gulf, is a separate hydrographic economy, which must be studied in detail to be understood. The hydrographic regime of such waters is the reflection of a complicated series of interactions between river drainages, climatic factors, and tides.12

Salinity conditions in Louisiana waters are less dependent on local climatic conditions than other areas of the Gulf Coast, since the drainage systems encompass a much larger area.
Geyer took average salinity values by months for September, 1948, through October, 1949, for several stations in Louisiana waters. His analysis shows that the varying discharge of the Mississippi River controls salinity characteristics of the offshore coastal waters. "A minimum average salinity of 22.6 per cent," Geyer reports, "is observed during March when the river is carrying off the melting snows and spring rains. The average monthly salinity then continues to increase throughout the remainder of the late spring and summer, reaching a maximum of 34.1 per cent in November. These changes correspond closely with the marked decrease in the discharge of the Mississippi River, reflecting summer rainfall and runoff conditions." In an analysis of salinity values from five stations, Geyer noted that those with the smallest daily and monthly variation in salinity were the ones situated so as to be least affected by the Mississippi discharge and the coastal currents.

South of Corpus Christi, Texas, because of the aridity of the climate, coastal salinities are usually higher than those of open sea water. One such large area, the Laguna Madre, is subject to high salinities because of inadequate land drainage. In summers, when the salinities of Laguna Madre are exceptionally high and accompanied with high temperatures, mass mortalities of fish have occurred.

The faunas of the bays and neritic waters are ordinarily subjected to wide variations in salinity, but
since their ecology requires a mixture of fresh and salt
water together with the nutrients brought in by the drainage, 
they therefore suffer no mortality except in unusual circum-
stances. Mortalities of sea life are often caused in the 
lower Texas coast by excessive salinity concentrations in 
the bays and lagoons, in the whole northern Gulf area by 
sudden freezes, along the west coast of south-central 
Florida by periodic occurrences of the "red tide," and 
in the bays and lagoons of Louisiana by excessive concen-
trations of fresh water.

Mortalities in the lower Mississippi delta complex 
of Louisiana were frequently the result of crevassing.17 
When a crevasse occurs, large areas are inundated and the 
silt-laden water drains off into the coastal bays and 
lagoons, causing a considerable loss of animal life through 
silting and low salinities. There appears to be a heavier 
mortality of oysters than of other forms of animal life 
because of the silting on the beds. One such crevasse 
which formerly poured Mississippi River water into Lake 
Pontchartrain, thereby causing heavy dilutions of the nor-
mally brackish water, is now continued intermittently in 
the Bonnet Carré Spillway. Crevassing probably does more 
good than harm to the animal life ultimately, for "spillway 
discharges always kill out oyster pests and predators and 
put thousands of tons of nutrient salts into the area. In 
1950 this amount was estimated at over 50,000 tons. Because 
of the nutrient salts brought in by the river water, a
greater abundance of shrimp and other marine life may normally be expected following the return to normal salinities.  

Crevassing has become less and less frequent since the early French period in Louisiana, although whenever it occurs, it is much more damaging. More and more control has been exerted over the Mississippi drainage within historic times and, except for a few disastrous breaks, artificial levees have kept the Mississippi confined to its channel. The almost complete control of the Mississippi’s discharge has had its noticeable effects on the ecological environment in the bays and lagoons flanking both sides of the river. Former distributaries have been closed off and former crevasse openings no longer function. As a consequence, the almost annual dilutions that formerly took place in the marshes and bays no longer occur. Within the memory of living persons, oysters spawned and grew naturally in Barataria Bay, but salinities are now too high for the spawning and setting of spat, so that Barataria Bay has ceased to function as an area producing oysters naturally. However, it has been discovered that young oysters obtained from natural reefs east of the river and transplanted in Barataria Bay are helped tremendously in flavor and the attainment of large marketable size by the higher salinity of the area, so that this region is one of the prime areas of Louisiana oyster culture. Also, it has been noted in the past several years that the older oyster reefs east of the river and in other areas as well have been destroyed by an
ever-increasing salinity, causing the region for successful growth of oysters to occur farther and farther landward nearer the supply of fresh water. Accompanying the higher salinities and causing further destruction is the principal oyster pest known as the oyster drill or conch (*Thais haemastoma*).

Mention has already been made of the large quantities of nutrient salts brought to the Gulf by the Mississippi drainage system. Riley has found the occurrence of phosphate in a zone around the Mississippi mouth to be four times the normal for the Gulf, with an accompanying high production of phytoplankton.

Climate

The Louisiana Coast lies within a broad climatic framework known as the humid subtropical. Humid-subtropical climates are generally located on the eastern sides of continents extending between twenty-five and forty degrees latitude. They are characterized by long, hot summers, and comparatively short, mild winters. There is no distinct seasonality in precipitation, although the autumn months generally receive less than the others. The growing season is comparatively long, ranging from almost twelve months in the southern limits to about six near the northern margins. Wind direction may be from any point on the compass but is generally northerly in winter and southerly in summer. The dominance of northerly winds in winter
is the result of the southward movement of recurrent high-pressure cells or cold continental air-masses, the duration and severity being dependent upon latitude and distance from large water bodies. These cold air-masses sometimes stop before reaching the Gulf Coast and are usually greatly modified when they do extend into the Gulf. However, low temperatures are not rare along the northwestern Gulf coast, and they are often accompanied by high mortalities of fish in the shallow bays, lagoons, and along the beaches. The dominance of southerly winds in summer is due chiefly to two factors: (1) The Bermuda high-pressure cell dominates the circulation over the Gulf, particularly during the spring and summer months. The southerly position of the Bermuda High leads to a dominance of southeasterly winds because clockwise circulation gives winds in the eastern portion of the cell a southeasterly or southerly direction. (2) There is a monsoon tendency on the eastern sides of continents in summer, with low pressures in the mid-continent. Heated continental air is then displaced by the cooler air of the surrounding seas. While more pronounced in southeastern Asia, it is strong enough to be effective in North America.

The Louisiana Coast, although lying within the boundaries of the humid-subtropical climate of the southeastern United States, is specifically located near its southern margin at approximately thirty degrees north latitude. Among the various components of the general
climatic regime of South Louisiana affecting the animal life and the activities of the fishermen are precipitation, water temperature, fog, the unusually but not rare occurrence of freezes in the winter period, and local storms and hurricanes in the summer season.

Precipitation values along the Louisiana Coast have an annual average from 52.91 inches at Cameron, which lies in the extreme west, to 59.72 inches at New Orleans. This precipitation is well distributed for every month in the year, but is lowest in October and highest in July. Local precipitation has the effect of lowering salinities in the bays and estuaries; however, this is a regular occurrence and is part of the ecological complex. Since the Louisiana bays and estuaries receive most of their land drainage from the Mississippi and its distributaries, they are governed more by the precipitation and run-off from the Mississippi's large drainage basin than by local precipitation. An excess of fresh water which may have damaging effects on the ecological base of the bays and estuaries occurs during times of Mississippi flood stages, particularly when crevasses allow a large volume of silt-laden river water to flow into the bays.

Although precipitation values in the winter months are not higher than in the summer months, rainfall is more effective because of greater run-off and the lower rate of evaporation. Along the Louisiana Coast salinities are much lower in winter and spring because of the greater flow from
the Mississippi River. The Mississippi discharges more water during this time because of the greater run-off from the melting snows in its upper drainage basin. Fewer salt-water forms of life are found in the bays and neritic waters during the winter and spring months, partly because of the greater influx of fresh water. As previously suggested, many life forms along the northern Gulf coast are types whose ecology requires both brackish water and salt water, if not for their entire life, at least for certain growth and spawning periods. Still, there are other forms that cannot withstand brackish water, and they enter into the bays and estuaries only during the summer and early autumn when salinities are sufficiently high. These forms are either pushed out through the passes connecting the bays and the Gulf during periods of sudden influx of fresh water or they suffer considerable mortality.

These alternations of high salinity and low salinity because of fresh-water dilutions are of considerable significance to the fisheries. For instance, several commercial species of fish are to be found in quantity only within certain salinity ranges, and a fishery fails sometimes because the normal environment of a particular bay or coastal section has been altered by drastically increased or reduced salinities. Certain oyster-producing areas which normally have a proper balance of fresh and salt water are sometimes damaged by a prolonged period of high salinity when the oyster drill or conch, which cannot
tolerate waters of low salinity, is able to invade the area and devour the oysters. Also, they may be destroyed if a crevasse develops suddenly and the bay undergoes a drastic reduction in salinity and silting over the beds. However, these occurrences are exceptional, and when they happen the damage is usually local. When conditions return to normal, the fauna begins to re-establish itself.

Temperature conditions are of more general importance in relation to the distribution of individual organisms and faunal complexes than are salinities. Temperatures govern the distribution of species and initiate spawning. More than any other factor, sudden drops in temperature are responsible for mass mortalities of sea life over the whole northern Gulf coast, although large mortalities are caused locally during the periodic outbreaks of the Red Tide, and the flooding of specific bays during the periods of excessive rainfall.

The Gulf of Mexico is a relatively warm body of water with a mean average of around 75.5 degrees Fahrenheit. Surface temperatures are coolest in the month of February with a mean of 67.4 degrees Fahrenheit, and they are warmest in August with a mean of 83.7 degrees Fahrenheit. The open Gulf, then, has a comparatively small seasonal range in temperature, and its temperature characteristics are suitable for tropical fauna the year round. However, the near-shore or shallow-water areas of the northern Gulf coast are subject to wide fluctuations.
"The inshore waters," writes Reid,

are more sensitive to atmospheric changes than offshore waters. The shallow water begins to cool about August, with the change toward lower temperatures being rather gradual during the first two or three months, after which cooling occurs rapidly. Short cold snaps are reflected in sudden drops in the water temperature, and these are, of course, stronger in the shallow area than in the deeper waters, although after the cold spell has passed the inshore waters warm up quickly. From July through December the shallow waters cool more rapidly and are generally two to three degrees colder than the surface waters 15 miles offshore. Warming in spring follows the same trend, in that the shallow water warms more rapidly than the offshore waters. Under such conditions, seasonal changes in the structure of the fish population might be expected. Such changes were apparent, and it appeared that temperature was one of the more critical factors in the environment.24

The northern Gulf coast experiences cold waves that bring about mass mortalities of fish and are of great significance to certain fisheries for a considerable period of time after the occurrence. As stated by Storey: "There were nine freezes along the west coast of Florida between 1886 and 1936, which killed fishes in large amounts."25

Fog occurs locally along the Louisiana Coast at certain times of the year. There is usually fog along the Mississippi River below New Orleans and in the vicinity of the river mouth from the beginning of winter till sometime in May. The reason for this is that average river-water temperatures are colder than the air temperature in this latitude, a condition favoring river fogs, especially when southerly winds prevail.26 Also, the lakes and bays near the coast modify temperatures and locally increase fogginess. Except for the almost continual fog around the mouth of the
river during the winter and spring months, fog is local and of short duration along the Louisiana Coast, seldom occurring in the summer and early fall. The presence of fog has no effect on the ecology of the sea life, but is a nuisance to the commercial ships which must pass through it and to the fishing vessels which operate in the vicinity.

The Gulf of Mexico is relatively and normally a quiet body of water from the standpoint of wave and tidal action. Tides on the Gulf Coast vary only about two feet and are even less in the bays. For many days each year, the weather conditions of the Gulf are fine and the waves are low; however, it can be a treacherous place to work, for it is subject to most severe, sudden, and spectacular wave action. It is necessary to build offshore oil-drilling platforms about thirty feet above the water, because there are periods of high waves and severe wind conditions resulting from hurricanes, line squalls, northerns, and storms of non-tropical origin developing in the Gulf. It is therefore necessary to plan daily activities along the Gulf with weather and wave conditions in mind.

Storms or weather disturbances that affect the Louisiana Coast are cyclonic disturbances that are associated with the passage of weather "fronts" over the Gulf, tropical disturbances that are spawned in the Caribbean and Gulf but are not of sufficient size and wind velocity to be classed as hurricanes, and West Indian hurricanes. All of the above-named storms occur in a seasonal pattern.
The storms with the greatest frequency and yet the least destructive element are the cyclonic storms of extratropical origin. These occur with the passage of fronts over the Gulf, usually from northwest to southeast. They occur most frequently in the winter and spring months with an occasional occurrence in the autumn and summer. They are accompanied by considerable rainfall; winds, however, are seldom strong enough to damage maritime vessels and coastal installations. However, since winds are sometimes locally severe and visibility is poor, small-craft warnings are issued. Because of the northerly or northwesterly winds which prevail during these storms, the water level of the bays and inlets is sometimes lowered three or four feet. This condition is sufficient to expose a considerable amount of the bay bottoms, and consequently some of the fauna, to the elements. Damage may be done to the ecological balance. Also, some of the passes connecting the bays with the open Gulf are sometimes very low or are sealed off temporarily, so that a freeze which may accompany the storm causes a considerable mortality of fish, which otherwise would have escaped into the open water.

The frequency of tropical storms that are not of hurricane intensity and West Indian hurricanes is about the same for the northern Gulf coast: an average of three or four every ten years. They may occur from June to November, but are most frequent in August and September. Such a storm is considered a hurricane if its winds have
a velocity of over seventy-five miles per hour, and many tropical disturbances miss this classification because the wind velocity is just under the hurricane figure. Both of these disturbances are very destructive to marine vessels and equipment and to shore installations. They also do considerable damage to transportation facilities and agriculture. High waters accompanying these disturbances may be as much as fifteen or sixteen feet above the normal water level of the bays and are a more destructive agent than winds. During these storms beaches are submerged and the water level of the bays and inlets rises and inundates much of the surrounding countryside. The waves and currents created by the wind cause considerable loss of sea life. However, most animal forms are able to withstand the wave action and turbidity caused by the disturbance, usually by seeking the deeper portions of the bays and neritic waters. Destruction of animal life is greatest in the more-shallow areas.

The loss of capital investments to the fisheries which follows the occurrence of a severe tropical disturbance runs into several million dollars. Fishing vessels are battered, sometimes overturned and sunk, and deck gear is often torn to shreds. Navigability through the passes to the open Gulf may be hampered by hurricane-created bars.

A series of aerial photographs taken at intervals of several years over the period 1934 to 1949 shows that a bar formed just below the intertidal zone off a new mouth of Brazos River remained submerged, until a hurricane had occurred, after which it
became a typical emergent cuspat e outline. A second bar then formed off a breach in the barrier, after which other hurricanes occurred before the second bar was, in turn, raised above sea to form a second line of emergent barriers. The inference is strong that in each case, a pre-existing submarine bar was built higher during a hurricane, so that during the storm it bore the same height relation to the elevated storm sea level as it had formerly borne to the normal level of the Gulf. The bars emerged as barrier islands after the subsidence of the temporarily high sea levels.

On October 3, 1948, a hurricane passed about 100 miles off the coast of southwestern Texas, causing a high sea level or storm tide of some 3 or 4 feet for two days or more along the barrier islands. A week later, the writer found that the summit of the beach, the beach ridge, in front of the shore dunes had been built up and remade by the storm and was slightly farther inland than its former alignment. The shift in position was evidenced by erosion of dune faces. The convexly rounded beach ridge then rested where the front part of the dunes had been.

These conditions can also occur on the Louisiana Coast. Sometimes a loss of several weeks' fishing occurs because it takes a considerable amount of time for the high water to subside and the turbidity to decrease so that normal fishing operations can be resumed. There is usually a domestic loss to the coast-dwellers, houses are in need of repair, and roads, wires, and many other items need attention.

Fishery industries have suffered greatly from hurricanes, sometimes almost beyond recovery. The September hurricane of 1915 almost completely ruined the diamond-back terrapin industry. One grower and dealer alone lost about 20,000 turtles of marketable size. The total value of his losses, including buildings, pens and equipment was probably between thirty-thousand and forty-thousand dollars.
Other growers and dealers also lost heavily. It is reported that many of the growers never resumed the business.

Earlier, in August of 1856, a hurricane completely demolished Last Island (Isle Derniere), at the gulfward margin of Caillou Bay. This island was an exclusive summer resort frequented mainly by wealthy Louisiana planters and merchants. The disaster was almost complete. Practically all of the cultural landscape was destroyed, hotels, cottages, and roads, and there was a heavy toll in human life. The island underwent physical changes as well; the shoreline was moved inland on the eastern section and shifted seaward on the western side. Culturally the island never recovered from the disaster and is rarely frequented today.

Channels and Passes

The condition of the channels and passes around the mouth of the Mississippi River, and those which connect the inside bays and lakes with the open Gulf, is significant to the maritime interests. Consider first of all the passes at the mouth of the Mississippi. Here shoaling is constant and requires dredging to keep the passes navigable. The reason for this condition is that the velocity of the river is sharply reduced as the river water reaches its base level—the surface of the Gulf of Mexico. Sediments carried by the river are deposited when the current slackens where river water encounters the Gulf. Only two of the
passes, South Pass and Southwest Pass, can be used by commercial vessels; and dredging of these passes is sometimes necessary to aid navigation. In South Pass the usual depth is about thirty feet, as compared to a usual depth of thirty-five feet in Southwest Pass. Of use only to small boats are Main Pass, with a depth of four feet over the bar at Gulf entrance; North Pass, with a depth of six feet at Gulf entrance; and Pass a Loutre, with a depth of about three feet.

Under constant attention it is difficult to keep a 30 foot channel across the bar at Southwest Pass, considerably less so at South Pass. Passes not maintained have a tendency toward depths of less than 14 feet under best conditions and at times shoal to less than three. Main Pass is difficult to enter in oyster or shrimp boats at times during high water, and many of the minor passes into Garden Island Bay are at times hardly deep enough for skiffs.

The channels of the silt-laden Mississippi and Atchafalaya rivers are deeper upstream than at their mouths. The deepest parts of the Mississippi channel are opposite New Orleans, Myrtle Grove, Point Michel, and Bolivar Point. The latter is only 19 miles above Head of Passes but had a depth of 195 feet on May 2, 1934. No depths of over 100 feet were found below Fort Jackson, a little over two miles below the hole at Bolivar Point, in fact soundings of more than 80 feet were few and sharply localized.

Of the passes that connect the inside bays to the open Gulf and the mouths of the various bayous which empty directly into lakes or the Gulf, many are so shallow that the smallest fishing boats cannot use them. Most of these passes average from two to four feet in depth. Most frequently used by fishing vessels and barges are the Rigolets.
(connecting Lakes Pontchartrain and Borgne, over seventy feet), Barataria Pass (connecting Barataria Bay with the Gulf, over seventy feet), and Bayou Lafourche (six feet at Gulf entrance; navigable to Thibodaux). Several passes with depths of six to thirteen feet connect Timbalier Bay and Terrebonne Bay with the Gulf. Bayou Terrebonne is navigable to a depth of five feet to Houma. 35

Practically all of the passes that are navigable and in general use by fishing boats and commercial vessels are dangerous to those not familiar with them.

From the delta of the Mississippi River to Sabine Pass, a distance of 250 miles, the off-lying waters from the beach is shoal for long distances, and except for the first 50 miles west of Southwest Pass, the 10-fathom curve is 20 to 35 miles offshore. Numerous shallow areas, irregular in outline, situated well out of sight of land, are serious menaces to the navigation of vessels of even moderate draft. With the exception of Barataria Pass, the numerous shallow passes to the eastward of Atchafalaya Bay are dangerous to enter except during good weather. The channels change frequently with storms and local knowledge is generally necessary. 36

It has already been shown that a bar sufficient to obstruct navigation can appear after a hurricane or some lesser disturbance. Some of the passes have old shipwrecks near the Gulf entrance; however, these are usually marked. Oyster reefs occur near the Gulf entrance of many of the passes, and familiarity with the area is essential in such cases.

The bays are also shallow. Many of them average less than five feet in depth and, with a high frequency of oyster reefs, constitute a real navigational hazard. Atchafalaya Bay is an excellent example. It is separated
from the Gulf of Mexico by the Pointeau Fer Shell Reef, which is an irregular mass of cemented oyster shells. The reef extends some eight miles in a northwesterly direction from Pointeau Fer and is partly exposed at low tide. It continues as an irregular, submerged ridge for about ten miles more. Thus, Atchafalaya Bay is partly enclosed by this barrier and averages a depth of six feet. Several natural and artificial channels, with depths ranging from seven to twenty feet, cut through the shoal ridges.

It is obvious that detailed local knowledge is necessary for the safe maneuvering of craft through the passes and inside the shallow bays and lakes of the Louisiana Coast. Ordinarily, the numerous bays and lakes are frequented by local fishermen and trappers who have a knowledge of their obstructions and peculiarities. An important consideration other than those concerning navigation in the passes should be noted here. The ecological complex of the bays and neritic waters is dependent on the condition of the passes which constitute the vital link between the two, since "it is through the passes that drainage waters must be discharged, and through them that the tides bring new supplies of sea water. They are also the highways by which fish, shrimp, and crabs migrate from the bays to the Gulf to spawn, and their young enter the bays to feed." If the passes are either blocked off or partially obstructed by bars so that there is a depth of less than two feet, it can seriously interfere with the
ecology of the animal life of the inside waters. This can happen particularly after a severe storm. Usually tidal scour will open the passes naturally, but this may take a considerable length of time, and in such cases artificial attention may be necessary.

II

Faunal Relationships to the Natural Environment of the Louisiana Coast

Although a full discussion of the ecology of the commercially important marine life of Louisiana is reserved for a later chapter, it is perhaps proper to adumbrate at this point the salient physical characteristics of the Louisiana Coast that favor a large concentration of fauna. An earlier chapter has shown that, from an ecological standpoint, the bays and neritic waters of the coast comprise a unit for most species of animal life. There are, however, a few species that spend their entire lives in the bays, and some tropical strays enter the bays during the summer when the temperature and salinity are sufficiently high. Moreover, adult forms of many species inhabit the bays during the warmer months only to leave for the warmer, more stable offshore waters of the Gulf with the first approach of cold weather. Yet, good nursery conditions within the bays draw the migration of larval forms of most species that have spawned in the open Gulf.
It has been shown also that a dominance of temperate-latitude fauna prevails in the shallow waters of the northern Gulf coast and that tropical species are dominant in the offshore waters. Such large concentrations of these particular species are due to favorable ecological conditions: a broad shallow continental shelf, many rivers that provide nutrients and fresh water, and a coast with numerous minor indentations, bays, and islands.

Though practically all types of sea life found in the northern Gulf of Mexico are common in Louisiana waters, the environment of the Louisiana Coast is particularly favorable for marine life, especially invertebrates (shellfish), because of the Mississippi drainage. The principal commercial species of sea life that inhabit Louisiana waters can be divided into two broad categories: finfish and shellfish. Gunter has found that the dominant species of finfish in the northern Gulf belong to the family Sciaenidae, and then menhaden, in that order. The sciaenids of commercial significance are the redfish (Sciaenops ocellata), black drum (Pogonias cromis), and whiting (Menticirrhus americanus). Other fish of commercial significance are two species of mullet, the striped mullet (Mugil cephalus) and the silver mullet (Querimana curema), sheepshead (Archosargus probatocephalus), speckled trout (Eriscion nebulosus), pompano (Trachinotus carolinus), and flounder (Paralichthys lethostigma). The shellfish that are of commercial significance are shrimp, two varieties: Penaeus setiferus and
Penaeus aztecus, the blue crab (*Callinectes sapidus*), and the oyster (*Crassostrea virginica*).

It is worth noting that certain species of commercially important sea life are present in Louisiana to an extent much greater than elsewhere along the Gulf Coast. The fact that Louisiana produces about half of the tonnage of shrimp marketed in the United States, and is the second largest producer of oysters and crabs (second only to the Chesapeake Bay region), is attributable to more than historical accident or the preference of Louisiana fishermen and consumers. Plate V, showing the distribution of the commercially significant shrimp and oyster grounds of the Gulf Coast, indicates Louisiana's favorable position. Though several small productive grounds lie off the mouths of the Texas rivers, only one other shrimping area east of the Louisiana and Mississippi grounds is of commercial importance, namely, the grounds lying off the mouth of the Apalachicola River in western Florida. The relationship of offshore shrimp grounds to the land drainage is fairly close. The distribution of the principal commercial oyster grounds follows the same pattern. Oysters occur all along the Atlantic and Gulf coasts, but are in commercial quantities only in areas which have considerable land drainage and inside waters where the mixing of fresh and salt water provides the proper balance. It is very significant, as in the case of the shrimp, that the only oyster area of commercial importance in the Gulf east of Mobile
AREAS OF SOUTH ATLANTIC AND GULF COASTS WHERE SHRIMP, OYSTERS, AND CRABS OCCUR IN COMMERCIAL QUANTITIES

NOTE THE CLOSE RELATION OF THE COMMERCIAL SHELLFISH GROUNDS WITH COAST ZONES RECEIVING HEAVY DRAINAGE FROM LAND. THE LOUISIANA COASTAL ZONE RECEIVES THE HEAVIEST CONCENTRATION OF LAND-DERIVED NUTRIENTS THROUGH THE MISSISSIPPI DRAINAGE COMPLEX, AND ITS PROPORTIONATELY GREATER CONCENTRATION OF SHELLFISH IS LARGELY A RESULT OF THIS FACTOR.

NOTE ALSO THAT THE HEAVIEST CONCENTRATION OF ALL THREE TYPES OF SHELLFISH TENDS TO BE IN THE SAME AREAS.
Bay is in the vicinity of the Apalachicola River mouth.

The importance of the Mississippi drainage system to the fisheries of Louisiana cannot be stressed enough. It is true that certain commercially important species of fish and shellfish appear to be about as numerous in other sectors of the Gulf Coast as they are in Louisiana. However, the Louisiana Coast environment is particularly favorable for a large number of marine and estuarine forms, among which are white and brown shrimp, oysters, and crabs. The ecology of these invertebrates requires inside bays which provide protection for the young and a rich mud bottom where organic detritus and nutrients have settled, thus providing food. An influx of fresh water, and the nutrients brought by it, are the ecological requirements of the oyster. Shrimp and crabs migrate through the passes to the offshore bottoms where they spend most of their adult life. The offshore bottoms of the Louisiana Coast are also composed mainly of mud with some sand, and receive organic and inorganic detritus from the land drainage.

The Mississippi River and its distributaries have been largely responsible for the mud bottoms that characterize the inside and neritic waters. Because of their greater inorganic and organic constituency, and consequent richer food base, these waters are preferred by shrimp, crabs, and other invertebrates, many of which are mud-ingesting forms. The physical processes connected with alluviation, such as the building of land seaward in areas
of active deposition, and the subsidence of former deltas or sub-deltas flanking the present delta, have created a very irregular coast which provides numerous bays and lagoons that connect with the open Gulf through small passes and that furnish excellent nursery conditions for the young of many species of fish and shellfish. The constant influx of fresh water into the bays provides the fresh and salt-water mixture which is vital to oyster ecology. The tidal marshes exist on muck deposits provided by the river system; the decaying vegetation adds further to the rich organic detritus in the bays and neritic waters.

The productive fisheries or fishing areas of Louisiana are practically coincident with that portion of the coastline which is actively influenced by the Mississippi drainage system. The areas regularly fished for shrimp, crabs, oysters, and even finfish, extend roughly from Lake Borgne on the east to Vermilion Bay in the west. This is also the area which has been most recently connected with the Mississippi discharge area. Although the area of active discharge from the Mississippi is small as compared to the coastal extent outlined above, this entire area is receiving nutrients and fresh water from either the present Mississippi discharge area or the Atchafalaya River, a distributary of the Mississippi carrying at high water stages a considerable portion of the drainage. Furthermore it is this part of the coast which has the numerous bays that are connected by passes
to the sea, all products of recent alluviation and hence constituting a necessary part of the eco-system of the northern Gulf.

For several reasons the coast from Vermilion Bay westward to the Sabine River is not favorable for the type of intensive fishery operations practiced east of there. First, the coastline is smooth, there being only a few breaks and these occurring where the drainage from the lakes behind the coast comes to the Gulf. Second, some of the lakes lying between Vermilion Bay and the Sabine River are fresh-water lakes and therefore have no function in the ecology of the commercially important marine fish and shellfish. Third, this area lies too far west to receive much benefit from the nutrients of the Mississippi drainage system. It must not be inferred, however, that the neritic waters along this coast are devoid of commercially important forms of sea life. The offshore waters are inhabited by most forms of sea life found throughout the northern Gulf coast. The bottoms are mostly of mud derived from former drainage in the area, and large invertebrate communities are found on them, though not to the degree of concentration found farther to the east. These offshore shrimp grounds are fished by vessels that are based farther to the east or in Texas. Most of the commercial fish, such as redfish, flounder, pompano, speckled trout, and sheepshead, are found along this coast. In short, significant factors explaining limited fishery
operations along this sector of the coast are the lesser abundance of individual species, the marked regularity of the coast, and the general absence of passes and shallow brackish bays.

Offshore shrimp grounds are practically continuous along the whole Louisiana Coast. However, the shrimp from the grounds lying offshore along the West Louisiana coast spend their nursery period either in the bays to the east of Vermilion or farther west in some of the Texas bays. Blue crabs are found all along the Gulf Coast, but the population is much less concentrated than in the waters nearer the present Mississippi and Atchafalaya discharge areas of completely fresh water.

Very little information is available concerning the areas of greatest concentration of such plankton feeders as anchovy, menhaden, and mullet. Nevertheless, these fish are found in abundance in Louisiana waters and menhaden catch statistics show that the most productive area in the whole Gulf and south Atlantic area is near the mouth of the Mississippi River. Riley has shown that the concentration of phosphate and plankton is four times as great in the vicinity of the Mississippi mouth as in other areas along the Gulf Coast. A plausible inference from this is that the plankton feeders are concentrated in larger numbers here than elsewhere. By the same token, it might be thought that the predatory species of fish are more abundant in this vicinity. But this theory is merely conjectural and awaits
further observation before it can be validated.

The present chapter has shown that the geomorphology of the Louisiana Coast and other physical conditions relating to nutrient concentration and vegetation are exceptionally favorable to marine life, especially shellfish. Thus the basic requirement for a commercial fishery, abundance of the resource, is present. Louisiana's well-developed shellfisheries certainly result, in part, from the excellent physical base. The other part, the cultural complex, becomes the subject for subsequent chapters.

It is possible that the very conditions that are conducive to a plentiful resource in nature happen to play a negative role in commercial development, and these must be overcome before significant exploitation is feasible. An illustration of what is implied here is the natural condition which enhances fertility in zonal soils. Low precipitation is in large part responsible for high mineral and organic concentration in soils of the semi-arid regions of the earth, but this very condition of low precipitation discourages agriculture, certainly on an intensive scale. Hence a technology and capital outlay which provide for large-scale irrigation projects are necessary to overcome the problem. It may well be that some components of the physical environment, even some that favor the resource, may have discouraged large-scale commercial development of Gulf and Louisiana fisheries, and these, along with historical and cultural factors, will be discussed below.
A fact well understood (certainly in professional circles) is that sheer abundance of a resource does not result in commercial development, but that other factors, sometimes fully as important, are also responsible. These factors are mainly cultural and usually involve, among other things, a general economic orientation of the hinterland or entire region, history and traditions of the local inhabitants, technological level, market demand, distance to markets, and transportation facilities.

It is also recognized generally that the culture of a society or an area can progress chiefly in two ways, by invention and by diffusion. This applies, of course, to a part of a culture such as an industry as well as to the culture whole. Of the two ways, diffusion is assigned the greater role for the acquiring of techniques and technology. The marine shellfisheries industry of Louisiana owes a part of its development to the profound influence upon the south Atlantic and Gulf areas from North America's prime fishery region—New England and the maritime provinces of Canada—to which influence the present inquiry now turns.
Footnotes


2. The early French settlers called these features cheniers because of the live oaks which grow on them.

3. Excellent discussions concerning the processes which have been significant in the geomorphology of Cameron and Vermilion parishes are contained in the following publications:


6. United States Department of the Interior, Fish and Wildlife Service, Bulletin 89, op. cit., pp. 80-81. Excellent discussions of bottom types are found in the following publications:


8. The following publications discuss salt-marsh vegetation and its role in the physical environment:


11. The writer first noted the use of the word "eco-system" in Joel W. Hedgpeth's Zoogeography of the Northwestern Gulf of Mexico. It is a term with a broad meaning, referring to the combination of neritic and estuarine waters as they form an ecological unit for shallow water or inshore fauna.


16. Red Tide is produced by the excess production of a species of phytoplankton, a dinoflagellate called Gymnodinium brevis. During these outbreaks the sea water is a dull reddish color. Huge numbers of Gymnodinium brevis produce a poison powerfully toxic to fish. The areas of red tide outbreak are those where normally a low plankton content is coupled with a low phosphorus count. However, at the time of outbreak, these areas have been found to have 2 ½ to 10 times the maximum total phosphorus concentration, both organic and inorganic, to be found normally in the Gulf. The source of this increased phosphorus is the main problem of the red-tide scientist. For further information on red tide, the reader should consult Fishery Bulletin 89, 1954, pp. 173-176.

17. A crevasse is a break in the natural levee, occurring at high water stages of the river.


20. Excellent sources which discuss the weather of the Gulf Coast and related areas are:


23. Harry F. Williams, op. cit., p. 239.

24. George K. Reid, op. cit., p. 9, 81-82.


28. The discussion concerning the classification and frequency of Louisiana coastal storms is largely derived from unpublished material possessed by the Coastal Studies Institute of Louisiana State University.

29. In his investigation of the oyster reefs of Mississippi Sound following the hurricane of 1947, James B. Engle found that large numbers of oysters in shallow-water areas and sandy bottoms had been destroyed. Many miles of reef along the north edge of Mississippi Sound were covered with mud by wave action. The area has shown no significant natural rehabilitation in the past eight years. The reference is:


30. C. C. Bates, Physical and Geological Aspects of Delta Formation, (dissertation), Department of Oceanography, Agricultural and Mechanical College of Texas, College Station, Texas, 250 pp, (no date).


34. Ibid., pp. 93-94.


36. Ibid., pp. 238-239.


39. In his "Ecological Study of Gulf of Mexico Fishes in the Vicinity of Cedar Key, Florida," George K. Reid found that temperate species were dominant from Cedar Key northward and around on the west side as far as the Rio Grande. Other writers have also recognized this dominance of temperate species in the northern Gulf.

40. Gordon Gunter, "Relative Numbers of Shallow Water Fishes of the Northern Gulf of Mexico, With Some Records of Rare Fishes from the Texas Coast," American Midland Naturalist, Volume 26, pp. 198-199.

41. Processes of active alluviation which were formerly present in this area have ceased, and processes of subsidence and wave action have through a long time period created a smooth coastline.
CHAPTER IV

INFLUENCE OF THE NEW ENGLAND FISHERIES ON THE SOUTH ATLANTIC AND GULF FISHERIES

The development of Louisiana fisheries owes much to the unique physical environment, yet other factors—equally important but not always so readily apparent—cannot be ignored. These factors stem from influences felt from outside the immediate area. In the development of the Louisiana fisheries, some of the strongest outside influences come from New England, America's oldest and foremost fisheries region. To trace the interconnections between the two fisheries is a complex task, since often the influences are only indirectly and obliquely registered.

Before there was any commerce between the Old and New World, fishermen from France, Spain, Portugal, and England frequented the banks off Newfoundland. Voyages of exploration and settlement to New England were prompted by reports of the valuable fishing grounds lying offshore between Cape Cod and Cape Sable. With the permanent settlement of New England, the fisheries became the chief industry of the people until some time after the Revolutionary War. Fish was the principal article of trade between the merchants of New England and those of the West Indies and Europe.
The New England environment is particularly suited for an abundant fish population. In a wide area lying offshore occurs a general mixing of warm and cold waters, which initiates upwelling, thereby providing an abundance of nutrients for a large plankton and fish population. Also, there are several large submarine shelves called "banks," which serve as spawning grounds for a great variety of fish. Ackerman emphasizes the excellent physical character of these waters:

The Gulf of Maine and adjacent waters, being in the boundary zone between the Atlantic-Arctic and Atlantic-Tropical water masses and subject to a wide seasonal range of atmospheric temperatures, show marked seasonal changes in temperature. Since every species of fish has its minimum, optimum, and lethal temperatures, distinct and often extended migrations take place in response to temperature fluctuations. Excepting the sessile forms, the character of the animal population of a given section of this sea therefore varies according to the season, few inhabitants of summer remaining through the winter, and vice versa.²

New England fishermen, then, have numerous species which keep them gainfully occupied throughout the year, and thus the highly successful fishery of this region is in direct relation to the abundance of sea life in all seasons of the year.

Traditionally, the principal species taken in New England waters are bottom-dwelling fish which are members of the cod family—cod, haddock, hake, cusk, and pollock. Of these species cod dominated the catch up until about 1900, when they began to be superseded by haddock, another
member of the same family. That cod assumed a position of first-rate importance can be attributed mainly to their sheer abundance, the ease with which they could be caught, and their adaptability to preserving. In contrast to the adaptability of cod to drying and salting, most species of southern fish, with their thin flesh and rapid decomposition, do not take well to such means of preserving.

To exploit these abundant fishing grounds required adequate fishing craft, and it is no surprise that New England pioneered in the development of fishing vessels. Though modern inventions have no doubt changed the face of New England fishing craft, several distinguishing features have traditionally marked the types of vessels employed through the many decades since the beginning of the New England fisheries. These distinguishing features can be defined in terms of three notable changes in vessel types.

With the first change, occurring early in the eighteenth century, the sloops with square topsails in vogue during colonial times gave way to the more-seaworthy schooner rig. Then, just before the middle of the nineteenth century, the blunt schooner was supplanted by the clipper schooner, largely in answer to the necessity for swift sailing vessels to engage in the mackerel fishery and in the rapidly developing oyster trade. The third change was the conversion to steamers in the latter half of the nineteenth century.
The influence of New England's pioneering development of fishing vessels was felt all along the south Atlantic and Gulf coasts. Indeed, because there was very little ship-building south of the New England and middle Atlantic ports until near the turn of the century, most seaworthy vessels in the southern states were manufactured in New England. Particularly numerous were the sharp-sterned, schooner-rig vessels. During the latter part of the nineteenth century, these vessels were used almost exclusively in the red-snapper fishery of Pensacola, the oyster and shrimp fisheries of Mississippi, and a few, even, in Louisiana. Although modifications have been made—diesel motors having replaced sails, for instance—quite a number of vessels of this initial design are still used in the red-snapper, oyster, and shrimp fisheries of the Gulf Coast.

In New England, however, these sleek, trim schooners began to lose ground with the emergence of trawling operations about 1905. The successor was the trawler, which must necessarily be designed differently from the schooner, since the tasks of each are quite singular. The trawler, requiring the dragging of a heavy load that puts a strain on the vessel, must be built as squat as possible and constructed of steel—in contrast to the wood construction of schooners built in the interest of economy.

The later emphasis on trawling in the south Atlantic and Gulf areas necessitated changes from the slim schooner
type, but this has not been quite so drastic as in the case of New England trawlers. South Atlantic and Gulf trawlers, with their hulls constructed of wood, are smaller than those fishing the offshore waters of New England. Nearshore trawling and calmer seas permit the use of these smaller, wooden vessels.

Today, schooners as well as trawlers visit the offshore banks of northern waters. The schooners are composed principally of holdovers from the sailing days, but they now have engines in them.

Until about 1850, the principal method of ground-fish capture in New England waters was by baited hook and hand-line, a method applied to both the inshore and offshore fisheries. This method continued to a limited extent down to 1860, but by 1880 it had practically given way to the use of dories. Before 1850, even schooling surface fish like mackerel were taken by hooks. About 1850, the trawl-line was introduced and this was the chief method of capture until shortly after 1900, when the otter trawl made its appearance. Although the greater portion of the New England catch is now taken by otter trawl and the purse seine, other methods of capture that produce large quantities of sea life are trawl-lines, hand-lines, pound nets and floating traps, gill nets, weirs, tongs, rakes, forks, lobster and crab eelpots, dredges, harpoons and spears, dip nets, haul seines, fyke nets, bag nets, and push nets.
From among these many and diverse methods, the south Atlantic and Gulf fisheries have come to adopt those most suitable to their own needs. The principal ones that are in use are the otter trawl, purse seine, trawl-line, gill net, haul seine, dip net, tong, and dredge. Those finding most extensive use—the otter trawl, purse seine, and dredge—are direct transfers from the North, having come within the last forty years. Though their origin and use probably antedates the oldest fisheries in North America, there is little doubt that the gill net, tong, trawl-line, and haul seine were first used extensively in the New England fisheries. Their use spread naturally enough to the south Atlantic and Gulf states.

But if an abundance of fish and the development of fishing vessels and gear were important to the rise of New England's fisheries, surely of no less consequence was the vigorous exploitation of available markets. The chief markets for New England fishery products in the earlier years of the industry were in Europe and the West Indies. In both areas salt fish was considered a cheap and suitable food for the lower classes, and especially so for the slaves in the West Indies. The fact that most of Europe was Catholic for the first two centuries following the discovery of the North American fishing grounds only added to the trade. At any rate, the European market was only partially supplied by European fisheries. The exchange of New England salt fish for rum and sugar of the West Indies was the basis
of a lively trade between those two areas. As the American colonies grew and large urban areas developed along the eastern seaboard, the well-established New England fisheries supplied most of the domestic needs. The New England fisheries continued to supply almost all the nation's seafood demands until about the close of the nineteenth century, when the Great Lakes and Pacific Coast fisheries began to offer competition. The continued development of the West Coast fisheries and the emergence of the Gulf of Mexico shellfisheries have broken the New England monopoly on this industry. However, the New England region still holds the dominant position in the United States' fisheries.

Since the fisheries of the northeastern states were the only ones of national significance up until the turn of the century, it is not surprising that fishermen from this area have been responsible for a great part of the development of fisheries elsewhere, and that their methods and techniques have diffused into other places. Northern fishermen were the entrepreneurs of the fishing industry, not only in the North, but in the southern states and the Pacific region as well. They had the most advanced technology, built better vessels and equipment, and were most knowledgeable concerning markets and marketing problems. Practically every fishery that rose to more than local importance is indebted to the enterprise of the northern fishermen.
The following discussion is concerned, therefore, with examples of New England influence on the fisheries of the south Atlantic and Gulf states. The discussion is by no means an exhaustive treatment of northern influence but is intended only to show some of the major introductions.

New England influence was being felt in the southern fisheries before the Civil War.

An important factor in the southern fisheries was the many northern fishermen employed in them. As early as 1834 a number of men from Connecticut resorted to the grounds near Savannah with gill nets, and took shad for shipment in sail vessels to the North. This fishery increased rapidly with the establishment of the first line of steamers between Savannah and New York. Also smack fishermen from New York and Connecticut would go to North Carolina, South Carolina, and Florida in the early fall and remain until the following May.\(^{10}\)

The commercial oyster industry of the Chesapeake region was first initiated by New Englanders. Oysters as a commercial product were first recognized in the North. Then, when the supply in northern beds began to fail, two oyster shippers came from Connecticut about the year 1836 and established packing houses in Baltimore, bringing with them northern methods of preserving, packing, and shipping oyster products.\(^{11}\) The oyster industry of the region grew rapidly after this, the output from Maryland increasing from 710,000 bushels in 1839 to 1,350,000 bushels in 1850 and 5,735,000 bushels in 1865.\(^{12}\)

A surprising number of New England traits and practices were introduced into North Carolina by a Mr. George N. Ives of New Haven, Connecticut. Mr. Ives came to
Beaufort to engage in the oyster trade, but finding that fresh fish of excellent quality were obtainable, he decided to establish an iced fresh-fish trade. Up until 1870 no fresh fish were shipped from North Carolina, and at that time only an occasional box was sent out in midwinter to some of the larger cities of the state. By 1874 Ives had inaugurated an iced-fish trade. From that date this trade grew rapidly. Ice had been used as a fish preservative in New England vessels since 1840. It was first used in cooling rooms where fish were to be stored, but by 1846 it became customary to crush the ice and mix it with the fish. By the time the method was introduced by Ives into North Carolina, the practice of carrying ice in vessels for preserving fresh fish had been greatly developed. Even before the iced-fish trade was introduced into North Carolina per se, northern fishing vessels were engaged in fishing for bluefish in North Carolina waters, and the catch was iced and carried back to northern markets.

Prior to 1866, bluefish were taken only by seines and gill nets, there being no vessels engaged in this fishery. At the close of the war Northern vessels began to visit the locality with nets and boats, carrying their catch in ice to Northern markets. They also bought a large part of the fish taken by the residents, and within a few years the business assumed important proportions. Between 1870 and 1876 the fishery reached its height, and about twelve sail of Northern vessels came yearly to catch and buy, while local dealers bought extensively for shipment to Northern markets.
Ives introduced in 1874 the New Haven or Connecticut "sharpie" into North Carolina. This boat proved to be swifter than local boats and able to withstand the worst gales. It soon replaced the local types in the sounds of North Carolina. The Carolina sharpies departed somewhat from those of New Haven, generally being wider in proportion to length and not so fast, but safer and stronger.

Ives is credited, too, with starting the scallop and oyster industries of North Carolina in the 1870's. Ives started the oyster business at Beaufort and Morehead in 1874. In those days the Baltimore dealers could not get enough oysters from Chesapeake Bay to supply the demand, and hence were looking elsewhere for their supply. Ives also started the blackfish (sea bass) industry in North Carolina. In 1903, he equipped a sharpie with a naptha motor and began fishing off New River. Other fishermen quickly followed suit.

The menhaden industry began in New England and spread southward to North Carolina, having been introduced successfully there in 1879. Since then, the industry has gradually spread into the south Atlantic and Gulf states. Within the last thirty years it has become an important industry in Louisiana and Texas.

In western Florida, the red-snapper fishery, centered in Pensacola, is another instance of New England promotion of a southern fishery. Fishing for red snappers on the west coast of Florida began some fifteen or twenty
years previous to the Civil War, but it was not until 1868 that the fishery began to assume importance, due to the enterprise of northern fishermen. At first, the fishery was conducted almost entirely by New Englanders, chiefly from Connecticut, who would fish the New England waters in summer and the Florida waters in winter. They would generally ship their fish through to New York, where their agents disposed of the catch. In 1871, the Pensacola Ice Company was formed, and local fishermen began to compete in the red-snapper fishery with the New Englanders, and from that time on the fishery has been operated on a year-round basis rather than seasonally. Captain Latham, one of the pioneers of the fishery from Noank, Connecticut, was the first to use ice in the Gulf for the purpose of preserving fresh fish aboard a vessel. Though the vessels employed in the red-snapper fishery were for the most part of northern build, and were about equally divided in type between the tight-bottom schooners in common use north of Cape Cod and the welled smacks of southern New England, it is significant that a few, of the smallest class, were built in Gulf ports.

Northern influence spread in another significant manner. Since most of the fishing gear was manufactured in the North, a surprisingly remarkable amount of standardization of equipment prevailed throughout the New England, mid-Atlantic, and Gulf coast areas. The principal equipment of capture, seines and gill nets, were
of northern origin. "The seines are made in Boston or New York and shipped by freight. The gill-nets are also made in the North."^{26}

New Englanders, then, were the first to use the more important and later widely adopted features employed in the fishery industries throughout the United States. They were the first to develop seaworthy vessels, to employ ice for preservation of fresh fish, to use steam vessels, and to use the otter trawl. They were largely instrumental in developing new fishing grounds and fisheries outside of New England, such as the oyster industry of the Chesapeake, the menhaden fisheries of North Carolina, and the red-snapper fishery of Florida. They were also the first to employ canning and the packaging of frozen fish.

Even in this cursory treatment, it is easy to see, then, the pervasive influence of the New England fisheries on the growth and development of the south Atlantic and Gulf coast fishing industries. Just why the New England fisheries have been able to exert such a strong influence may be seen by inquiring briefly into the relative status of southern fisheries before 1900.

Status of Southern Fisheries before 1900

It was roughly near the turn of the century before fisheries other than those of New England grew to more than local significance. Although the environment of the south Atlantic and Gulf areas is favorable for a relatively
large fish and shellfish population, it was, in several ways unfavorable for its commercial development. In contrast to the well-drained lands contiguous to the New England Coast, the coasts south of the Chesapeake region extending far into Texas, are bordered by marshes and swamps five to fifty miles wide. This condition was responsible for a very sparse settlement in areas adjoining the coast, and consequently, except for a few port cities, the areas acquiring a substantial population were located inland. Distance from the sea undoubtedly meant an unfamiliarity with seafood and methods of capture, with a resulting greater reliance on other foods. Although well supplied with many varieties of edible seafoods, this area did not have the large schooling populations of fish such as were very early noticed off the coasts of New England and the maritime provinces of Canada. There also were no large shallow banks to compare with those of New England waters. The last-named factors are most important in that they discouraged exploitation by northern and European fishermen. Europeans have fished the banks off the northeastern states and the maritime provinces of Canada for centuries. In a word, while the tremendous fishery resource of New England waters was recognized and exploited by European and American fishermen, the fishery resource of the south Atlantic and Gulf states remained practically unnoticed.

The fisheries of New England and the maritime provinces of Canada owed a great portion of their development
and markets to European nations. In addition, the location of the northern grounds was very important—they were much closer to Europe than south Atlantic and Gulf waters. While settlers of the southern regions were interested primarily in agriculture—carving out plantations for themselves—many of those settling in New England had come over for the express purpose of engaging in seafaring activities. Hence, there was no tradition of sea activities in the South.

Before 1900 the southern sea fisheries, with few exceptions, were of local importance only. Local fisheries were quite well established in the vicinity of the larger cities such as Wilmington, Charleston, Savannah, Pensacola, Tampa, Mobile, New Orleans, and Galveston. The fresh-fish trade was confined almost entirely to the port cities, whereas a considerable trade in salt fish was established with the interior. The most important fisheries were those for shad, sturgeon, mullet, squeteague (sea trout), oysters, striped bass, alewives, drum, and shrimp. For the entire area mullet was the most widely caught fish, especially in North Carolina and Florida. For certain areas along the south Atlantic coast, the catch of anadromous species such as shad, sturgeon, alewives, and striped bass, received the most attention, probably because of the ease of capture with gill nets during the seasonal migrations into the rivers. Shad and sturgeon were the dominant species in the catch of South Carolina, Georgia, and North Florida. Mullet dominated
the catch for Florida as a whole, but sea trout, drum, Spanish mackerel, and several other species were also important. Shellfish were the most important seafood of Mississippi and Louisiana, whereas redfish, bluefish, mullet, and sea trout were foremost in Texas.

Small boats were frequently used in the southern fisheries. Practically all of the boats were suited only for fishing in the bays, estuaries, and for a few miles offshore. Exceptions in the latter part of the 19th century were the Pensacola red-snapper fleet that fished the offshore banks of West Florida, and the Key West vessels that carried the greater part of their catch to the West Indies. Nearly all of the sea life taken in southern waters were those that frequented the neritic waters, bays, estuaries, and the anadromous species that migrated up the rivers to spawn. In contrast to the fisheries of the northern states, the capital invested in vessels and gear was small. One reason for the great attention paid to the anadromous species was that they could easily be taken with the simplest of gear—the gill net receiving the most use. Large haul seines were mostly employed in the capture of mullet, shrimp, crabs, turtles, and terrapins. Other types of gear used were lines, cast nets, dip nets, and tongs for oysters and clams. A few gear types such as the fyke net and pound net were significant in North Carolina, but not south of there.
The chief item of seafood reaching the interior portions of the South was salt fish (usually mullet) packed in wooden barrels. During the slavery period this cheap, unappetizing product formed one of the staples fed to slaves. Later, however, it was still of some importance, sold chiefly to the poorer classes. It was common practice among the plantation owners who lived within fifty or seventy-five miles of the coast to bring their slaves (and later their tenants and laborers) to the coast for a few weeks in the spring or summer for the purpose of acquiring a supply of salt fish for plantation use. The owners enjoyed some sport fishing while the workers were busy catching and preparing the salt fish. The barrels of salt fish would be loaded on several wagons which had been brought for the purpose.

With the coming of the railroads, a few port cities became important centers for the shipment of salt fish into the interior. Chief among these was Savannah. Savannah had good rail connections to the interior and became the most important center for the shipment of this product before 1900. A great portion of the fish cured in Florida for the interior market went first to Savannah by rail, where they were transshipped to various places. New Orleans was the largest single market for seafood on the Gulf Coast. Not only did it furnish the principal market for Louisiana's fisheries, but it also received a large part of the Mississippi catch, and even that of Alabama and West
Florida. Such fish as red snapper and grouper came by rail from Pensacola and Mobile packed with ice in hogsheads. Much of the catch in the region from Key West to Tampa was intended for the West Indian market. The fish were salted and dried along the coasts adjacent to where they were caught, and shipped to the West Indies a few weeks or months later.

Notable among the few fishery products of the South that found their way into northern markets were the red snapper and several species of turtles and terrapins. The latter were taken all along the south Atlantic coast and shipped to northern markets. An early concentration on this resource caused it to dwindle rapidly, and the fishery was of very minor importance at the close of the century. Red snappers were iced and sent by rail from Pensacola to various inland cities, and also carried back to New York and Boston by boat, either iced or in the wells of the vessels. This delicious fish with its attractive red color soon came into demand in the large northern cities and has been successfully marketed in the North up to the present time.²⁸

The last fifty years have witnessed the decline and even the disappearance of some fisheries in the southern states, and the rapid rise of others. Very important fisheries existed back in 1880 for shad, sturgeon, bluefish, and turtles. Today, shad are taken commercially in only a very few rivers and have disappeared entirely from other waters in which they formerly were numerous. Turtles are
still taken occasionally in the Chesapeake area, around Key West, and in Louisiana, but are of minor importance compared with other seafood. The fisheries for sturgeon and bluefish have disappeared entirely through the failure to employ conservation measures. Today, shrimp, oysters, crabs, and red snappers represent products that are of national importance, and a southern market now exists for various other seafoods from the local waters, the most notable of which are mullet, sea trout, pompano, redfish, and Spanish mackerel.

Large, modern seaworthy vessels are now employed in many of the southern fisheries, and use is made of the latest and most efficient gear. The growth and importance of the southern fisheries are a result of several factors, the most important of which are revolutionary methods of refrigeration and storage, the development of excellent transportation facilities, revolutionary developments in vessels and gear, and the trend toward urbanization throughout the South and the nation. Yet southern fisheries as a whole are poorly developed when compared to New England's, or those of the Pacific Coast.

Only in the shellfisheries, particularly shrimp, do the southern fisheries hold a position of prominence in the United States. Shellfisheries are most highly developed in Louisiana. And it is the complex of forces—physical, historical, economic, cultural—of which the well-developed
Louisiana shellfisheries are an outgrowth, that must now be considered at length.
Footnotes


5. Ackerman, *op. cit.*, pp. 74-75.


8. The difference between trawl-line and hook-and-line fishing is that the former is done with hooks connected in series. A trawl-line is composed of a heavy ground line that may be a quarter of a mile long, to which may be attached four- or five-hundred lighter short lines and hooks. The hooks are baited on shore or aboard and the line is coiled in a tub so that it may be put out quickly without entanglement. After setting, the trawl is anchored to the bottom and marked by a floating buoy. Usually it is let stand for several hours before checking, but if fishing is good, hauling will start as soon as the trawl is down.

9. Excellent descriptions of gear used for fish capture in American waters are contained in the following:


11. Ibid., pp. 267-274.

12. Loc. cit.


16. Flat-bottomed skiff-model boats over 20 feet in length were referred to as "sharpies." Not much attention was paid to rig. The Carolina sharpies gradually increased in size, up to forty or fifty feet in length, with cabins sometimes added. The boats were soon rigged as schooners and became very popular for oyster dredging in the Carolina sounds.


22. The red snapper is a fish that will keep an unusually long time in ice. It was packed with ice in barrels or boxes and sent all over the country, chiefly to Boston, Chicago, New York, and Denver. Nearby New Orleans also received its supply of red snapper in this manner.


27. In 1880, George Brown Goode, who was then Commissioner of Fish and Fisheries for the United States, and associates undertook to describe the fisheries industries and communities of the United States. The result of this well-organized project was an excellent account of all aspects of the fisheries of the United States at that time. Vessels, methods of capture, and gear were well described. The social aspects of the communities and the ethnic composition of the fishermen were recorded. An historical background of each fishery was often part of the report. Much more attention was given to New England, since it was the most important fishing area of the United States. However, there were excellent accounts on the status of the south Atlantic and Gulf fisheries. A large part of this discussion of the south Atlantic and Gulf fisheries was derived from Goode's work. The source is:


CHAPTER V

THE SHRIMP INDUSTRY OF LOUISIANA

Among the Gulf states Louisiana is first not only in the production of shrimp, oysters, and crabs but also in the total production of seafoods. Moreover, Louisiana is by a wide margin the largest producer of shrimp in the nation and, in the production of oysters and crabs, second only to the Chesapeake region. When these resources are fully exploited, Louisiana's catch may even surpass that of the Chesapeake.

Although many edible species of finfish inhabit Louisiana waters, they are of minor importance as compared to shellfish. The relatively unimportant catch of finfish is chiefly for local markets. Some fish, highly regarded in other areas, are practically unnoticed in Louisiana even though they are abundant. Mullet is an excellent example. This fish occurs abundantly in southern waters from North Carolina to Mexico. Highly esteemed as a food in North Carolina, Florida, and other states, it yet does not find favor in Louisiana. Indeed, some fish that are the basis of important fisheries in other states are of little consequence in Louisiana.

On the surface the development of certain fisheries and the neglect of others even when the resource is adequate,
is often inexplicable. Closer examination reveals, however, that a combination of the physical resource base with particular cultural circumstances and historical precedent is usually involved. Primary physical considerations are the ecological conditions that favor or discourage certain forms of animal life, and the conditions which facilitate or restrict the activities of fishermen in pursuit of the fishery. Of equal or even greater importance to a fishery are certain cultural factors such as the vessels and methods of capture employed by the fisherman, historical precedents of certain fisheries, attitudes and prejudices of fishermen and consumers in regard to certain kinds of seafood, and availability of markets.

As has already been observed, the physical character of coastal Louisiana is quite distinct from that of other sections of the Gulf Coast as a result of the Mississippi drainage and alluvial processes, with an environment particularly suited to a large concentration of shellfish, principally shrimp, oysters, and crabs.

The fisheries of Louisiana were comparatively undeveloped until the last three or four decades. Fishing was pursued chiefly for local markets, New Orleans in particular. Today, however, certain fishery products from Louisiana are marketed throughout the nation and even in some foreign countries. Of primary concern to this study is the origin of the important fisheries of Louisiana, the significant traits by which they are distinguished,
the influence of natural conditions, and notable adjuncts to the growth of these industries, viz., the introduction of revolutionary methods of capture, the use of more-seaworthy vessels, discovery of fishing grounds, the employment of improved methods of refrigeration, the advent of canning, and various aspects of the growth and expansion of markets.

The Shrimp Fishery

Foremost among the marine shellfisheries of Louisiana is the shrimp fishery. It is, indeed, the most valuable seafood resource on the south Atlantic and Gulf Coast. It furnishes more food, engages more fishermen, and, in general, supports a larger industry than any other fishery of these regions. It is today one of the most important fisheries in the United States both in volume and value, ranking next to the salmon, halibut, pilchard, tuna, and cod fisheries. Between 1921 and 1931 it grew rapidly, chiefly because of the introduction of a very efficient method of capture, the otter trawl (see p. 165). During the 1930's and 1940's the industry continued to grow. Some of this growth was due to a normal expansion of the industry, but no small part was due to the discovery of very productive offshore fishing grounds and the employment of larger and more seaworthy vessels. Compared to some other fisheries of the Gulf and south Atlantic states, the dominance of the shrimp industry is a comparatively recent phenomenon. In
1880, shad and sturgeon were the principal salt-water fishery products in South Carolina and Georgia, mullet in Florida, and oysters in Louisiana and Mississippi. Today, shrimp is the most important fishery product not only in each of the above-named states, but also in North Carolina (excepting menhaden), Alabama, and Texas. In Florida, shrimp have only recently come to occupy a dominant position—a result of high prices, expanding markets, and newly discovered shrimping grounds.

That shrimp production in Louisiana is greater than that in any other state may be seen from a glance at Tables 1 and 2. This has been true since the beginning of the industry. Since catch records have been kept, the production of shrimp in Louisiana has been greater almost every year than the combined catch of the south Atlantic states. Furthermore, the catch in most years has been nearly twice as large as the combined total catch for the remainder of the Gulf states, notwithstanding the fact that a great portion of the Mississippi catch was obtained in Louisiana waters. Since 1938, however, the catch from Mississippi vessels fishing in Louisiana waters has been recorded for Louisiana.

Ecology of the Commercial Forms of Louisiana Shrimp

Shrimp are crustaceans found in widely distributed coastal waters throughout the world. Though they range from subarctic to tropical waters, the forms that are
### TABLE 1

SHRIMP PRODUCTION FOR FIVE GULF STATES
1954 & 1955

<table>
<thead>
<tr>
<th>State</th>
<th>1954 Pounds</th>
<th>Per cent</th>
<th>1955 Pounds</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida</td>
<td>not available</td>
<td></td>
<td>13,203,000</td>
<td></td>
</tr>
<tr>
<td>Alabama</td>
<td>2,319,000</td>
<td></td>
<td>2,413,000</td>
<td></td>
</tr>
<tr>
<td>Mississippi</td>
<td>2,652,250</td>
<td></td>
<td>5,507,563</td>
<td></td>
</tr>
<tr>
<td>Texas</td>
<td>42,280,000</td>
<td></td>
<td>37,021,000</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>47,251,250</td>
<td>33.3</td>
<td>58,144,563</td>
<td>43.1</td>
</tr>
<tr>
<td>Louisiana</td>
<td>94,845,660</td>
<td>66.7</td>
<td>76,763,820</td>
<td>56.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>142,096,910</td>
<td>100.0</td>
<td>134,908,383</td>
<td>100.0</td>
</tr>
</tbody>
</table>


### TABLE 2

SELECTED SHRIMP PRODUCTION STATISTICS FOR SOUTHERN STATES--1890-1945

<table>
<thead>
<tr>
<th>Year</th>
<th>Louisiana</th>
<th>Mississippi</th>
<th>Texas</th>
<th>South Atlantic States</th>
</tr>
</thead>
<tbody>
<tr>
<td>1890</td>
<td>6,662,000 lbs.</td>
<td>614,000</td>
<td>176,000</td>
<td>743,000</td>
</tr>
<tr>
<td>1918</td>
<td>18,520,000</td>
<td>9,147,000*</td>
<td>164,000</td>
<td>18,906,000</td>
</tr>
<tr>
<td>1930</td>
<td>38,664,000</td>
<td>8,489,000</td>
<td>10,189,000</td>
<td>27,793,000</td>
</tr>
<tr>
<td>1945</td>
<td>116,914,000</td>
<td>6,595,000</td>
<td>15,722,000</td>
<td>45,364,000</td>
</tr>
</tbody>
</table>


* A large portion is caught in Louisiana waters.
commercially valued are found in greatest abundance in waters that have subtropical and tropical characteristics. There are many varieties of shrimp and shrimp-like creatures. Some are almost microscopic in size, others are too small to be of commercial value, and some large species inhabit waters too deep for commercial operations. Principally, five species enter into the catch of the southern United States, and all of them belong to the family Penaeidae. The most widely distributed species—that which has constituted over ninety per cent of the southern catch through all the years—is the common white shrimp, *Penaeus setiferus*. This shrimp is also called green shrimp, green-tailed shrimp, blue-tailed shrimp, and lake shrimp, depending on the locality.¹ Other species include *Penaeus brasiliensis*, *Penaeus aztecs* (also called brown, golden, or red shrimp), *Penaeus duorarum* (sometimes known as the pink, spotted, or channel shrimp), and a small shrimp, *Xyphopenaeus kroyeri* (known as the sea bob). Of the five species listed above, only *Penaeus setiferus*, *Penaeus aztecs*, and *Xyphopenaeus kroyeri* occur in commercial quantities in Louisiana waters. *Penaeus setiferus* is caught in Louisiana waters in far greater quantities than any other species, although each year a proportionately larger share of the catch is composed of *Penaeus aztecs*. The latter species has only recently (since 1938, when offshore grounds were discovered) entered into the catch. *Penaeus duorarum* (pink shrimp) does not occur in Louisiana waters west of the Mississippi,
Fig. 1. Life cycle and migration of shrimp belonging to the family Penaeidae. (Adapted from Idyll, "The Commercial Shrimp Industry of Florida," 1957).
but is found in limited quantities in Louisiana waters to the east, and is the most important species in the eastern Gulf and in the southern Gulf south of the Rio Grande. Bottom preference is the chief reason for the absence of *Penaeus duorarum* in Louisiana waters. The pink shrimp predominates on calcareous bottom, the brown and white shrimp on mud bottom.²

Although the several species of commercial shrimp in the south Atlantic and Gulf waters have their own distinct habits and preferences, their general ecology is similar. All are bottom feeders, and will eat any available organic material. All species spawn in the open sea, but require shallow estuarine waters for the juvenile period. Figure 1 illustrates the life cycle of shrimp belonging to the family Penaeidae. In many areas, all species occupy the same nursery grounds, but at different times of the year, so that only one species of shrimp in a nursery area is the dominant form at any particular time. Thus there is considerable overlapping of species in both the inshore nursery grounds and the offshore grounds, the exception being *Penaeus duorarum*, which is absent in areas with a pronounced mud bottom and low salinity. In the Gulf of Campeche all three species of commercial shrimp are found in contiguous areas, and although their ranges overlap, "their preferred environmental niches seem distinct enough to keep competition at a minimum."³
In regard to interspecific competition in the nursery grounds, Williams drew the following conclusions in a study of the life histories of commercial shrimp in North Carolina:

The three species all use approximately the same nursery areas, but the times of recruitment of young and the periods of occupation of these areas are apparently divided among the species so that at no time do large numbers of more than one species occur together...Concentrations of \textbf{P. setiferus} juveniles occur in regions of relatively low salinity. Wherever these concentrations occur, few individuals of other species are present.

The smallest juveniles of American shrimp occupy the fresher portions of the nursery grounds. As growth commences, progressively larger individuals are found near the sea. There is an apparent correlation between size of shrimp and salinity.

Most of the studies on shrimp ecology have been concerned with the common shrimp, \textit{Penaeus setiferus}. That this species should have received the most attention is only natural, since it was the only one known to exist in commercial quantities from the inception of the industry until recent years, and it still overwhelmingly dominates the catch. All of the commercial shrimp in southern waters show many similar traits: They are all spawned in the open sea; they find shallow estuaries with predominantly soft bottoms most attractive; they are all bottom feeders; they will eat any type of organic material; and they all migrate back to the sea when adulthood is approached. Since \textit{Penaeus setiferus} is by far the most important commercial species, both for the region as a whole and for Louisiana, its ecology warrants further consideration.
Penaeus setiferus seems to prefer areas that have inland brackish marsh connected by passes with a shallow offshore area with a predominantly mud or clay bottom. The adults prefer the offshore waters, while the pre-adults require brackish water, sometimes even water that is almost fresh. Female shrimp do not carry their eggs as crabs or crayfish do, but deposit them directly into the water. Spawning takes place in offshore waters, usually from April to August. The eggs and newly-hatched young drift shoreward with the tides and currents, and eventually reach the inside waters. A series of larval stages occurs after the egg is hatched, and by the time the larvae move into the estuarine areas they begin to assume the form of the adult shrimp. At this stage, about the time the larval life is completed, shrimp cease their planktonic existence, in which they have been at the mercy of the waves, tides, and currents, and become free-moving bottom dwellers. At first, the shrimp occupy the areas with the shallowest and freshest water, with mud or clay bottom, but as growth progresses they occupy more-brackish locations nearer the passes which lead to the sea. Within the nursery areas, certain factors modify population density:

Observations show that availability of cover is one of the most essential requirements for a satisfactory nursery area. The types of cover available vary somewhat with the substratum and the salinity as well as with the geographic position. In brackish creeks which run through marshes and have their headwaters in a well-forested area, there is a great quantity of forest litter scattered over the bottom. This material, in various stages of decomposition affords one type of favored habitat.
Another type cover is provided by living vegetation. Over such areas where there is marsh grass, the juvenile shrimp population is enormous. However, in the deeper parts of the bays or sounds where the ground lies bare, the population is almost non-existent.

Since the Louisiana coastal environment is very much like the favorable situation described above, it is readily seen that its abundant shrimp population results in large part from these conditions.

Shrimp spend a period of four to eight weeks in the nursery grounds. After this period they leave the shallow waters of the marshes for the deeper portions of the rivers and bays and then begin to become part of the inside fishery in June and July. At this time they average between two and three and one-half inches in length. The first to enter the "inside" fishery are spawned the earliest, and the population grows continually all summer from the later spawnings until by September the whole fishery is based on shrimp spawned the previous spring and summer. Rapid growth of shrimp is characteristic at this time, from three and one-half inches in July to five inches in August.

Growth slows after September, and by December they average only five and one-half inches. By the middle of December they begin to leave the colder waters of the bays and retire to the deeper, more stable waters offshore. The shallow areas may contain little or no shrimp at this time. The migration to the ocean is caused by the lowering temperatures in the inside waters rather than by maturity.
Many of the shrimp do not move far from the beaches, and some may re-enter the bays for short intervals.

With the warming of waters in spring, a second period of good shrimping occurs from about April to June or July on mature or maturing shrimp that re-enter the bays or move closer to shore. The catch is somewhat less in this period than during the August to December season which is on young shrimp. Offshore spawning takes place during the spring and early summer.6

That shrimp spawned only once and then died was once a widely held belief. The fact that large shrimp disappeared after they went offshore gave some verification to this idea. However, in 1938 large shrimp were found concentrated in deeper offshore waters of Louisiana. Recently, scientists have questioned the belief that shrimp die after one or two spawnings. Indeed, females that are ready to spawn show traces of previous spawning in early spring. Ripe leftover eggs from previous spawning, for instance, can frequently be found in female shrimp, and the remains of spermatophores are occasionally found attached to females. In general, however, the shrimp crop is an annual one, and most of the catch is composed of animals aged a few weeks to a little over a year.

The movement of shrimp is associated with spawning and temperature. In the northern Gulf of Mexico, shrimp move from estuarine to offshore waters. There is an offshore temperature gradient, and apparently the shrimp take
advantage of that. When the temperature drops during the
winter, the shrimp tend to move a little farther offshore;
and when in the spring the temperature rises, the tendency
is to move closer to shore. However, in winter, in some
localities, the movement becomes coastwise because of the
coastwise temperature gradient. In the northern Gulf
warmer winter waters are offshore in a belt which extends
between five and thirty fathoms. Because of the east-west
trend of the coastline, there is no marked coastwise tem­
perature gradient in this section. But along the western
Gulf coast there is a coastwise temperature gradient re­
sulting from the north-south trend of the coast, and it
appears that there is a southward movement of shrimp in
winter from central and southern Texas into Mexico. 7

The Shrimping Grounds

Shrimp are found in the coastal waters from North
Carolina to Texas, and occur in commercial quantities in
each state. Commercial shrimping grounds are not, however,
continuous over this whole area due to a general absence
of inside waters and nursery grounds along some sections
of the coast (see Plate V). Shrimping grounds occur in
the vicinity of Beaufort and Morehead City, North Carolina.
A relatively barren strip extends southward to Georgetown,
South Carolina. From Georgetown to New Smyrna, Florida,
the grounds are nearly continuous. A small shrimp area
extends south of Cape Canaveral, Florida, yet from this
point to Key West they are generally absent. A very recent shrimp fishery has been established just west of Key West on the Dry Tortugas Banks. Excellent grounds extend offshore from Apalachicola, Florida, but shrimp fishing is generally absent in other portions of Florida. Though the grounds are fairly continuous from Pensacola, Florida, to Mexico, the most productive and intensively fished grounds lie off the middle Louisiana Coast. Along the Mexican Coast shrimping grounds are small and scattered as far as the Gulf of Campeche, a condition resulting from the comparatively regular coastline and a small degree of land drainage. Lying off the northern coast of Yucatan in the Gulf of Campeche are some very productive pink, brown, and white shrimp grounds with considerable overlapping of range.

Most of the shrimping grounds now exploited are composed mainly of white shrimp (*Penaeus setiferus*). As can be observed in Plate VI, however, there are distinct areas along the coast and specific offshore grounds that are composed of either pink shrimp (*Penaeus duorarum*) or brown shrimp (*Penaeus aztecus*). The shrimp taken in the waters from North Carolina to Cape Canaveral, Florida, are largely white or common shrimp. Although shrimping is largely absent from Cape Canaveral to Key West, the coastal and offshore waters from Key West to Cedar Key contain pink shrimp. And from this small fishing village to the Mexican border white shrimp dominate. Located just off Southwest Pass, Louisiana, are very productive offshore grounds
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. (Adapted from Fishery Bulletin 89, Fish and Wildlife Service, U. S. Department of the Interior, 1954)
containing brown shrimp. This is also true of an area off the Colorado River and extending within thirty miles of Port Isabel, Texas; near Lobos Island, south of Cabo Projo, Mexico; and on the Obregon grounds in the Gulf of Campeche. Pink shrimp dominate on the Campeche grounds of Yucatan. Figure 2 illustrates the characteristics of each of the three commercial species.

Commercial shrimping is principally of two phases: that done on the inshore fishing grounds and that pursued on the offshore grounds. The inshore fishery is concentrated chiefly within six miles of the shore and includes the shrimping carried on in the partially enclosed sounds and bays; the offshore fishery extends as far as the thirty-fathom line (forty-five or fifty miles from shore in many places). Formerly the shrimp fishery was entirely inshore and has remained so on the Atlantic Coast. In the Gulf, however, an offshore fishery has been developing ever since the discovery of productive grounds off the middle Louisiana Coast in 1937. It is concentrated chiefly between the five-and fifteen-fathom lines. The inshore fishery is conducted mainly by small boats, whereas the offshore fishery is carried on by larger vessels which represent considerably more capital investment. It should be noted that in the Atlantic area large shrimp vessels do not go far from shore, although they do travel considerable distances along the coast following the migration of shrimp southward to warmer waters in the winter.
WHAT KIND OF SHRIMP DO YOU CATCH?

LOOK AT THE HEAD.

Is it grooved?

GROOVED HEAD

PENAEUS AZTECUS (BROWN SHRIMP)

OR

PENAEUS DUORARUM (BROWN-SPOTTED SHRIMP)

WITHOUT GROOVE

PENAEUS SETIFERUS (WHITE SHRIMP)

LOOK AT THE BODY.

Does it have a spot?

PENAEUS AZTECUS (BROWN SHRIMP)

1. SHORT HORN
2. SHORT FEELERS
3. GROOVED HEAD
4. NO SPOT

PENAEUS DUORARUM (BROWN-SPOTTED SHRIMP)

1. SHORT HORN
2. SHORT FEELERS
3. GROOVED HEAD
4. SPOT ON TAIL

PENAEUS SETIFERUS (WHITE SHRIMP)

1. LONG HORN
2. LONG FEELERS
3. NOT-GROOVED HEAD
4. NO SPOT

Fig. 2. The Three Principal Species of Commercial Shrimp. (Adapted from Idyll, "The Commercial Shrimp Industry of Florida," 1957.)
On the south Atlantic coast the winter fishery in Florida is for shrimp that have migrated from more northerly areas, and this fishery is so intensely pursued that the migratory population is practically exterminated.  

Along the northern Gulf coast both inshore and offshore grounds are fished from the same parts of the coast, despite the fact that offshore grounds lie, of course, farther seaward at greater depths. Frequently shrimping ports serve as the base of operations for both the inshore and offshore fleets; however, certain ports and landing stations are generally preferred by one or the other. In Louisiana, for example, the Morgan City-Berwick-Patterson area is the principal port of operations for the Louisiana offshore fleet, but vessels that fish offshore are found to some degree at all ports and places along the coast where shrimping is done.

Whether shrimp are present or absent from the waters along the south Atlantic and Gulf coasts depends on several factors. It has already been shown that for part of their life cycle shrimp require estuarine conditions where the availability of food and cover is a prime requisite. Shrimp also prefer mud or sand bottom, *Penaeus setiferus* and *Penaeus aztecus* in particular favoring bottom composed of mixtures of mud and sand, while *Penaeus duorarum* likes a sandy or calcareous bottom. Drainage from the land is chiefly responsible for the mud, clay, and sand bottoms preferred by shrimp both inshore and offshore and also
furnishes and constantly replenishes the organic detritus utilized for food and cover by the shrimp. Plate V which shows the distribution of shrimp grounds, clearly reveals the relationship between abundance of shrimp and areas with considerable land drainage, the poor or non-shrimping areas generally occurring along smooth stretches of the coast where inside waters are absent and where there is little drainage from the land. In areas where there are inside waters but an almost complete absence of land drainage, the shrimp resource is poor. The Laguna Madre area of south Texas is such a place. There the high salinity is another factor unfavorable for pre-adult shrimp. Hyper-saline bays and lagoons are definitely not favorable for shrimp. Inside waters of high salinity are restricted to only a few bays in South Florida and South Texas. Aridity of the south Texas coast and the accompanying absence of land drainage constitute the chief reason for hypersaline bays and lagoons, whereas the lack of land drainage alone is the main reason for similar conditions in parts of South Florida. Along the south Atlantic coast of Florida, three principal factors cause a poor shrimp resource: a lack of land drainage, a general absence of inside nursery areas, and the extreme narrowness of the continental shelf (the hundred fathom line lying within four miles of the coast in some places). Also, the coral bottoms make it extremely difficult to operate the otter trawl (p. 165), and thus commercial operations are impaired.
The absence of shrimping activities in an area does not necessarily mean, of course, that the shrimp resource is missing or is poor. Shrimp are known to exist in large quantities on some coral bottoms, but the grounds are ignored because trawling is difficult. From Cedar Key south to Key West, Florida, the bottom is largely coral and shell and little shrimping is done in this area. It appears that shrimp are not concentrated in commercial quantities, but this point is not certain. Due to the nature of the bottom little shrimping has been done here, yet it is known that shrimp are present to some degree and that they are chiefly of one species, Penaeus duorarum. This species is dominant because of the coral and sand composition of the bottom and the inside waters have higher salinities than are preferred by the other two commercial species, Penaeus setiferus and Penaeus aztecus. The new fishery in the Dry Tortugas grounds near Key West proves that valuable shrimp resources occur in these dangerous bottoms, and since suitable depths of fifteen to thirty fathoms occur northward of Dry Tortugas offshore from the west Florida coast, undoubtedly an expansion will occur to other Florida areas, following the success of the new fishery.10

Plate VII shows the seaward range of Penaeus setiferus on the offshore grounds extending much farther seaward along certain portions of the Louisiana Coast. The different species of shrimp are adjusted to different
bathymetric ranges, *Penaeus setiferus* generally occurring from shore to twelve fathoms and *Penaeus aztecus* from twelve to fifty fathoms (although most exploitation occurs on grounds from twelve to twenty-eight fathoms). *Penaeus duorarum* has the same general range as *Penaeus setiferus*, but there is little overlapping on the offshore grounds because bottom preferences are different. The wide, shallow area off the Louisiana Coast provides the largest offshore ground for *Penaeus setiferus* to be found anywhere. Although white shrimp have been recorded in forty-three fathoms of water off Louisiana, commercial trawling is concentrated inside twenty fathoms, and the bulk of the catch is made inside fourteen fathoms. One must travel as far as seventy miles south of Cameron, Louisiana, through *Penaeus setiferus* grounds before reaching at twenty fathoms the mid-depth grounds of the brown shrimp (*Penaeus aztecus*). This distance is reduced to two or three miles along parts of the Mexican Coast. The nearness of brown-shrimp grounds to the coast is proportionate to the offshore gradient and width of the continental shelf. A shallow and wide continental shelf does not, however, necessarily possess a greater abundance of shrimp than a narrow one, the shrimp population depending also on the existence of inshore nursery areas, degree of salinity of the inside waters, amount of land drainage, and bottom type.

According to Hildebrand, *Penaeus setiferus* and *Xyphopenaeus kroyeri* (sea bob) are the dominant species
from the shore to ten fathoms in the northwestern Gulf, while *Penaeus aztecus* is dominant in the twelve to twenty-five fathom zone. Hildebrand also points out the error of defining the distribution of the several species of shrimp as continuous bands between prescribed depth limits. "There are discrete fishing grounds for brown shrimp and the other species as well in the Gulf, which are related to the type of bottom and the inshore nursery grounds. Moreover, white shrimp, *Penaeus setiferus*, are often found in commercial quantities out to 25 fathoms off Louisiana, and it is rarely fished in depths greater than 16 fathoms in Texas waters." 12

The most productive grounds in United States waters are found in the inshore and offshore waters of Louisiana; moreover, statistics have indicated through the years that the intensity of shrimping operations is also greatest here. The reason for the high productivity is that Louisiana inshore and offshore waters possess practically every element essential to shrimp ecology--numerous, partially enclosed brackish bays and estuaries, predominantly mud bottom inshore and offshore, high degree of land drainage providing mineral and organic nutrients, a shallow, wide continental shelf, and a trawlable bottom. The latter element is of utmost importance to commercial shrimping operations. Much of the west Florida, Texas, and Mexican offshore bottoms that probably contain commercial quantities of shrimp is not trawlable without considerable risk to gear. The chief obstacles to trawling in Louisiana waters are the soft muds
and mud lumps in the vicinity of Southwest Pass and a few snapper banks that are found several miles offshore. In general, however, trawlable bottom is continuous from the mouth of the Mississippi to Freeport, Texas.

Shrimp exist offshore in commercial quantities along the entire extent of the Louisiana Coast, from Pearl River to the Sabine River. The most productive grounds and the greatest intensity of the offshore fishery occur, however, in Mississippi, Chandeleur, and Breton sounds to the east of the Mississippi from Southwest Pass to Vermilion Bay. Another area of intense fishing occurs offshore from the Sabine River mouth. The most productive grounds of all are the Ship and Trinity Shoal areas, lying roughly about ninety-one degrees and thirty minutes west longitude. Here the vessels sometimes work in from two to about thirty fathoms of water, though most fishing is done in five to fifteen fathoms.

Specific physical phenomena account for the greater concentration in certain areas. The abundance of shrimp on the offshore grounds is proportionate to the acreage of estuarine waters. A glance at the map of Louisiana shows that estuarine waters consisting principally of partially enclosed bays are practically continuous from Lake Pontchartrain to Vermilion Bay, and are virtually absent from Vermilion Bay to the Sabine mouth. A factor of further importance to the abundance of shrimp is that these inside waters are principal receivers of the rich mineral
and organic waters from the Mississippi and its distribu-
taries.

Along the comparatively regular coast from Vermilion
Bay to the Sabine River predominantly fresh-water lakes ex-
tend in a chain a few miles inland from the coast, with the
exception of the brackish Calcasieu and Sabine lakes.
Shrimp grounds do exist offshore, however, and are commer-
cially exploited. There are important reasons for this
fact. First, estuarine conditions are present to some
degree in the neritic or inshore waters due to the drainage
of the Mississippi and Atchafalaya rivers. Second, a por-
tion of the shrimp that have spent their pre-adult life in
the bays to the east migrate coastwise to these grounds.
With respect to the presence of estuarine conditions, a
large percentage of the Mississippi and Atchafalaya waters
is diverted westward immediately upon leaving the mouths
by a near-shore coastal current, and this tends to concen-
trate brackish or estuarine waters in a belt parallel to
the coast. Thus, along sections of the coast these condi-
tions are so pronounced that a certain percentage of the
pre-adult shrimp finds it unnecessary to migrate into the
inside bays for estuarine conditions in which to pass their
larval existence. It has been noted by fishermen and scien-
tists that in some years the shrimp population in the bays
is extremely small, and since the general offshore popula-
tion does not seem to be affected, it has been surmised
that the larval shrimp had found suitable estuarine
conditions in the coastal waters. Depending on the condition of the Mississippi River, salinities fluctuate greatly in Louisiana waters, and this fluctuation has a direct effect on the estuarine animal population. Figure 3 shows a shrimp vessel proceeding from Barataria Bay through a pass to the open sea. In Figure 4 shrimp vessels are at work in the shallow near-shore waters.

Inside or bay shrimping is done in practically all of the brackish bays of the coast, notably Lakes Pontchartrain and Borgne, Barataria, Timbalier, Terrebonne, Caillou, Atchafalaya, and Vermilion bays. The most intense bay shrimping is pursued in the Barataria Bay area. Some inside shrimping is also done in Calcasieu and Sabine lakes.

The shrimp caught in the inside waters are considerably smaller than those caught on the offshore grounds, since they migrate offshore as they approach maturity. Before scientific investigations in the 1930's determined the ecology of the shrimp, it was generally believed that the shrimp found in the bays and those found offshore were two different species, the former going by the name of "lake shrimp," and the latter called "prawns."

Economic Development of the Shrimp Industry

Favorable natural conditions, including a heavy concentration of nutrients, a large and complex system of inside waters providing excellent nursery conditions, a predominantly mud bottom, and a wide, shallow offshore
Fig. 3. East end of Grand Isle. The shrimp vessel is headed seaward through Barataria Pass, one of the principal passes from Barataria Bay to the Gulf of Mexico. Note the dark gray color of the beach sands, which indicates the high silt and organic content of the bottoms.

Fig. 4. A view of near-shore shrimping from the beach at Grand Isle.
zone—these conditions undeniably form an important dimension of the Louisiana shrimp industry and partially account for the state's high production of this particular shellfish. Yet, however important, resource abundance alone does not fully explain the development of the industry. Such economic considerations as technology, markets, and transportation must also be taken into account, and these considerations can be properly understood only insofar as they are seen in relation to historical and cultural factors that spawned a number of early changes and introductions within the industry.

The shrimp resource was recognized in Louisiana as early as 1718, when Bienville was establishing a French colony in the vicinity of New Orleans. Le Page Du Pratz, the historian who came to Louisiana later in 1718 and spent some sixteen years traveling in the territory, stated that "there is an incredible quantity of fishes in this country but the people were not experienced enough in the art of catching them." His only reference to shrimp, however, is in the following paragraph:

The Shrimps are diminutive crayfish; they are usually about three inches long, and of the size of the little finger. Although in other countries they are generally found in the sea only, yet in Louisiana you will meet great numbers of them more than an hundred leagues up the river. In the lake St. Louis [Pontchartrain], about two leagues from New Orleans, the waters of which, having a communication with the sea, are somewhat brackish, are found several sorts of sea fish, and freshwater fish. As the bottom of the lake is very level, they fish in it with large nets [seines] lately brought from France."
From Du Pratz' statement, brief as it is, can be deduced the notion that there was an early appreciation of the abundance and variety of the fish resource. Supporting evidence is found in the general European taste for seafood. The discussion of New England fisheries has shown the great attention given by the early French and other Europeans to the marine resources in that area. Judging from the abundance of marine life, particularly shellfish, and the relative ease with which the latter could be obtained, it is probable that the early French settlers relied upon this resource for a part of their food needs. Du Pratz mentioned nets—and they were undoubtedly of European design and manufacture and brought by the colonists in anticipation of their use.

Du Pratz' brief mention of southern seafoods is typical of the space allotted to this subject by writers and historians before 1860, and information is only slightly more available until after the turn of the century. The reason for this is obvious enough: Despite some use of seafoods in the vicinity of southern port cities, they rated so insignificantly in comparison to other industries in the South that they practically escaped documentation. In contrast, marine industries were among the foremost in the New England area and a considerable amount of historical literature about them is available.

However, this early lack of documentation is not so serious in light of the fact that these industries did
not arise to commercial importance until around the turn of the century. Several important and revolutionary changes occurred when commercial status became a reality. An industry may experience few or no changes for an extremely long period of time, particularly if it is largely subsistence in nature and localized. But when a certain importance or status is reached and the markets expand, introductions and changes may be quite rapid, and the industry may undergo a transformation that bears little resemblance to its former character. This has certainly been true for the shrimp and other shellfisheries of Louisiana and adjacent regions. Low production and quite primitive or inefficient techniques have marked these industries until shortly before the end of the nineteenth century. Very few if any important changes occurred from the time of Du Pratz until then.

Although it would be impossible to state exactly when the shrimp industry obtained true commercial importance, expansion was apparent during the last three decades of the nineteenth century. No single event was more important to shrimp and other fisheries than the widespread establishment of canning and packing houses. The advent of canning instantly meant the utilization of large quantities of raw products that would not otherwise find a market.

Although the canning of various products and sea-foods had been successfully instituted a number of years previously in the northeastern states, it was not until 1867 that the canning of shrimp was attempted. In this
year the firm of G. W. Dunbar and Sons of New Orleans carried out experiments with canning. However, it was not until 1875, after this concern devised the bag lining for cans, that it met with success. By 1880 this same company was producing one and one-half pound cans of shrimp at the rate of 234,000 per season. A second shrimp cannery was erected in Galveston, Texas, in 1879, and in the following year put up about 76,500 cans. In 1880 the first canning factory began operations in Biloxi, Mississippi. The Biloxi cannery was devised principally for oysters, but also canned shrimp. With these early beginnings as a nucleus, the canning of shrimp in Mississippi and Louisiana grew to attain the importance it has held in recent years and spread to include all of the states of the south Atlantic and Gulf from North Carolina to Texas. Figure 5 depicts one of the early shrimp-canning factories and Figure 6 shows the unloading of shrimp that are to be shipped by rail to New Orleans.

Before this revolutionary development, shrimping was a very minor industry, supplying only the coastal communities and New Orleans with fresh shrimp during the peak season. Although great production did not instantly follow the canning of shrimp, the stimulus for continued growth and expansion was then present, and from that time there has been a substantial increase in production and markets.

An additional impetus to the development of the shrimp industry of Louisiana was the institution of the
Fig. 5. Shrimp-canning factory at Caernarvon, Louisiana, in the year 1919. (Courtesy of Percy Viosca)

Fig. 6. Unloading shrimp at Empire, Louisiana, about 1919. They are to be shipped by train to New Orleans. This was the fastest possible means of getting fresh shrimp to New Orleans at this time. (Courtesy of Percy Viosca)
sun-dried shrimp factory in 1873. This industry was begun by Lee Yim, a Chinese immigrant who first settled in California, but later moved to Barataria Bay, Louisiana. Lee Yim built his first crude drying platform on the south side of the mouth of Grand Bayou at the northwest corner of the bay, a site later known as Cabinash. Dried foods had always been a staple article of commerce in China, so Yim was quick to visualize the commercial possibilities of dried fish and shellfish. His earliest efforts were with sun-dried oysters, but this venture did not turn out well and he soon turned to shrimp drying. Raw shrimp are boiled in brine for fifteen minutes in preparation for sun-drying and then are dipped from the vat and spread out on drying platforms. After making a commercial success of sun-dried shrimp, which found a ready market in China and in the Chinese colonies of the Pacific Coast, Lee Yim moved a few miles southward and built a larger drying platform at the mouth of Bayou Defon. The industry grew rapidly, with several platforms constructed between the Mississippi River and the western border of Terrebonne Parish. Most of them were destroyed by the tropical hurricane of 1915, but many were rebuilt and the number of platforms reached twenty-nine by the year 1927. Figures 7, 8, 9, 10, 11, and 12 illustrate the shrimp-drying operations.

The sun-dried shrimp industry has received a considerable amount of the catch ever since its beginning. It should be noted, however, that at the beginning of
Fig. 7. Unloading shrimp to the drying platform at Manila Village, Louisiana. This picture was taken in 1919. Note the old steam-powered, stern-wheel vessel. Shortly after this date these vessels were supplanted by gasoline-powered boats. (Courtesy of Percy Viosca)

Fig. 8. Shrimp-drying platform at Manila Village, Louisiana, 1919. Shrimp are raked and stirred for more effective drying. The workers are descendants of Chinese and Filipino immigrants. (Courtesy of Percy Viosca)
Fig. 9. At Manila Village the shrimp are covered with tarpaulins whenever there is a possibility of rain or high winds. (Courtesy of Percy Viosca)

Fig. 10. A small shrimp-drying platform on Lower Bayou Terrebonne. Lower Terrebonne Parish has had several of these small platforms since the beginning of the industry. Only a few are now in operation. This picture was taken in 1920. (Courtesy of Percy Viosca)
Fig. 11. Manila Village as it looks today. Its appearance is essentially unchanged from what it was in 1919. (Courtesy of Percy Viosca)

Fig. 12. The shrimp-drying process at Manila Village is about the same today as in 1919. (Courtesy of Percy Viosca)
World War II the percentage of the total catch of shrimp entering the sun-dried trade sharply declined and to this day has not regained its former prominence (see Table 3). This decline was due chiefly to loss of the Chinese market. Nevertheless, sun-drying of shrimp is still practiced at Manila Village in Barataria Bay and at a few platforms located in Terrebonne Parish.\(^{21}\)

The drying platforms utilize the smaller shrimp, for which there is less demand at the canneries. Even the little sea bob \((Xyphopenaeus kroyeri)\), which is always refused by the canners, will be taken for drying. Because of its small size (two to four inches), fishermen receive a much reduced price for this species.

### TABLE 3

PERCENTAGE OF LOUISIANA TOTAL SHRIMP CATCH USED IN DRYING FOR SELECTED YEARS

<table>
<thead>
<tr>
<th>Year</th>
<th>Per cent</th>
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<tr>
<td>1921</td>
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<tr>
<td>1924</td>
<td>.28</td>
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<td>1932</td>
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<td>1955</td>
<td>.05</td>
</tr>
<tr>
<td>1957</td>
<td>.04</td>
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*Source: Biennial Reports of the Louisiana Department of Conservation and Department of Wildlife and Fisheries.*
While the economic advance of the shrimp industry due to the advent of canning and drying was tremendous, the introduction of a revolutionary method of capture gave the shrimp industry another boost. This was the otter trawl, whose introduction in 1917 completely revolutionized shrimp fishing.

Whereas the old method (the haul seine) could be used only in shallow waters, required a large crew, and could be operated for only a limited time during the summer and fall months, the otter trawl was adaptable for use over a much greater range, could be operated with fewer men, yielded a greater production per man, and was a much more efficient type of gear. With its introduction, entirely new fishing grounds were opened up and a rapid expansion of the fishery followed. It took some three years for it to attain widespread use. In 1920 the total shrimp catch in Louisiana was 32,000,010 pounds, twice as great as it was for the preceding year.

The shrimp catch, then, practically doubled within the space of one or two years because of this new method of capture. Facilities for marketing increased accordingly and the industry became fairly stabilized for a span of about thirteen years, with annual production varying from 22,900,500 pounds in 1922 to a high of 44,106,930 pounds in 1929. Fluctuations in volume of catch during the thirteen-year period were due both to variation in the abundance of shrimp and to economic conditions. There
was a sharp decline in production during the economic depression years of 1930-33. From the 1929 figure of 41,106,930 pounds, the catch declined to 31,998,330 pounds in 1932. During the year 1934, as economic recovery became apparent, the shrimp catch soared sharply upward to a figure of 47,580,960 pounds. Also, the increased production and demand for shrimp in 1934 was due in part to an improved method of handling the product.

Prior to the year 1934 nearly all shrimp sold to outside markets were either canned or dried for the reason that to ship the same in its raw state required an express and re-icing charge that was prohibitive. Under the old method of shipping, the shrimp were packed in layers of ice alternating until the barrel was filled. This necessitated the paying of express charges on about 300 pounds gross when the eatable food contained in this barrel was only from 135 to 150 pounds.

When shrimp are shipped in their raw state these days, they are first de-headed, as the only food value of a shrimp is in the meat of the tail, and these tails are packed in paper cartons of 50 pounds each. After packing, these cartons are put in freezers, the contents are frozen and by this process remain fresh for an indefinite period.

Thus, in 1934 there was introduced into Louisiana a method of de-heading and quick-freezing raw shrimp. This new method of handling met with favor among the consumers and assured them a fresher and more sanitary product than could be offered when the shrimp were shipped and handled as "fresh-iced." Since the middle 1930's, continually more shrimp have appeared attractively packaged and frozen, and since 1946 this has been the chief method of marketing. It is today by far the most important
segment of the shrimp industry. Many improvements in the packaging and freezing of this product have been developed since its institution. The freezer facilities permit the accumulation of the product during the height of the season and its release during times of low production.

Another factor in the continued expansion of the shrimp and other fisheries of Louisiana has been the building since the middle 1930's of roads and toll-free canals. These served the fishermen's boats and trucks in the catching and quick delivering of their products to the central markets throughout the state and the nation. A considerable saving accrued to the Louisiana fisherman through the use of these state facilities, since he was obliged to follow the migrations of fish and shrimp from the east side of the Mississippi to the west side at certain times of the year. Before the purchase of existing canals by the Department of Conservation, small boats were compelled to pay as much as $20.00 to $24.00 per round trip. This saving especially benefitted the oysterman who obtains his seed oysters on the east side of the river and cultivates them on the west side.24

The most recent step in the economic development of the shrimp industry occurred in 1937 as the result of discoveries of offshore shrimp grounds south of the central Louisiana Coast. Previous to 1937, a few large or "jumbo" shrimp had been taken in the waters offshore from the mouth of the Atchafalaya River, but there was no
general shrimping in the area and the extent of the grounds and resource was not known. The offshore shrimp resource was discovered by the research vessel Pelican, of the United States Bureau of Fisheries. Grounds were also discovered off the Texas Coast. Today the Louisiana and Texas grounds provide the greater part of the Gulf states' catch. As previously stated, both Penaeus setiferus and Penaeus aztecus are taken on the offshore grounds of Louisiana and Texas; but they are adjusted to different bathymetric ranges, so overlapping of the two species on the grounds is slight.

Research work conducted aboard the Pelican during the years 1937 and 1938 established definitely that there was a large offshore migration of adult shrimp from the Louisiana Coast and that they were concentrated chiefly in a belt parallel to the shore between the five- and fifteen-fathom lines. The heaviest concentrations were found in the Ship Shoal and Trinity Shoal areas (Plate VII). Both Penaeus setiferus and Penaeus aztecus were abundant here, but within a different bathymetric range. Therefore, after the discovery of the offshore grounds, not only were larger individuals of Penaeus setiferus landed, but a new fishery for Penaeus aztecus was established.

Previously, very few individuals of the species Penaeus aztecus were caught. Plate VII shows the distribution of the Penaeus aztecus grounds. No important
Penaeus aztecus grounds have been discovered east of the Mississippi River. However, very large and productive Penaeus aztecus grounds have been discovered and exploited along the Texas and Mexican coasts. Today, a much larger share of the Texas catch is composed of Penaeus aztecus than is the case in Louisiana. However, there has been a steadily greater volume of Penaeus aztecus produced in Louisiana every year since the discovery of the offshore grounds. In many parts of Texas they are the principal species in the catch. Where the varieties were reported separately at major ports on a current basis, 1955 landings in Texas consisted of 7.7 per cent white and 92.3 per cent grooved shrimp (Penaeus aztecus).^5

The shrimp industry, both in Louisiana and other Gulf states, has expanded tremendously since 1937. A glance at the production table (Table 4) shows the phenomenal increase in the catch in the last twenty years. There were exceptionally heavy runs of shrimp in 1941 and 1944 and since then these high-catch figures have not been equalled in Louisiana. Also, wartime high prices stimulated production. However, the decline in the catch since 1946 was not the result of lowered prices, but rather of a decline in the abundance of shrimp. It was immediately thought that the industry was threatened, since there had been a large increase in the shrimp fleet and in fishing intensity. These fears were alleviated in 1953 and 1954 when the catch began to approach the high figures of the
peak war years. Anxiety gripped the industry again in 1955 when production fell back to 365,542 barrels. Marine scientists and officials connected with the shrimp industry attach little importance to the idea that the shrimp resource has been overexploited because of overfishing. Fluctuations in the catch are attributed mainly to natural causes of depletion. In certain years, the ecological balance in the nursery grounds is extremely unfavorable for a number of reasons, usually because of exceptionally high or low salinities, which may be attributed to high or low stages in the Mississippi River or to hurricanes and other tropical storms. Also, prices govern the intensity of shrimping operations. Many fishermen will terminate shrimp fishing when there is a sag in prices and temporarily turn to oystering, trapping, crabbing, or some other occupation. In other words, a very large number of the shrimpers work at whatever promises the most profit at the moment. This decline in shrimping intensity usually causes a price increase and in the following season the catch may be considerably higher.

No important discoveries of new shrimp grounds have been made in Louisiana since the years 1937 and 1938. The extent of the shrimp resource of Louisiana has been fairly well-known since that time. However, possibilities for expansion of the industry exist if gear is perfected that will permit exploitation of the brown shrimp on the grounds between twenty-eight and fifty fathoms and the red shrimp
(Hymenopenaeus robustus) that occur near the edge of the continental shelf at depths of fifty fathoms and over. The latter shrimp is extremely large, being as much as a foot long, weighing one-half pound. The general distribution of this shrimp is understood to be at great depths near the edge of the continental slope and a few have been taken, but as yet the true extent of the grounds is not known and there is no gear suitable for mass capture. Also, it is not known to what extent this shrimp will find favor in the markets. Large individuals of any species of fish or shellfish are usually tougher and less palatable than smaller ones. However, since this species appears to be much larger than the other known varieties, it may well be that the shrimp are palatable enough, and only extremely large individuals would be tough and lacking in delicate flavor.

What amounts to a revolution in gear development is apparently occurring at the present time. Many grounds with a heavy shrimp population have until recently been unexploitable because of bottom obstructions. The hazards are usually coral heads and reefs, and certain types of sponges. They are most common off the coasts of South and West Florida, Texas, and Mexico. Other important but less common obstructions are mud lumps occurring at the Mississippi River mouths in Louisiana, sunken logs off the mouths of the Brazos and other Texas rivers, and volcanic necks off the young orogenic coast of parts of
Mexico. However, despite some loss in gear, success has attended shrimping operations on the coral and calcareous grounds of the Dry Tortugas near Key West. Modifications have been made on the shrimp trawl. The bottom parts of the trawls used in dangerous bottoms now have chains and rollers attached, which permit them to ride or pass over some of the minor obstructions that would be disastrous for the conventional-type trawl. In all other respects this trawl resembles the standard or flat otter trawl. This modified trawl was brought by Atlantic Coast fishermen in 1949.27 The continued improvement of this trawl and its widespread use can certainly permit exploitation of many productive grounds along the Florida and Texas coasts. There is also the possibility of some expansion on Louisiana grounds, though Louisiana has less to gain from this important development, since most of the state's offshore grounds are now trawlable. Indeed, the ease of trawling on Louisiana grounds is no small advantage, and plays an important role in the intensity of shrimping.

Coincident with the discovery of important grounds offshore from Louisiana in 1937 and 1938, there was an addition of large shrimp trawlers capable of fishing these grounds. Previous to this discovery, there were only small shrimp vessels in Louisiana, which were designed for fishing in the inside bays and a few miles from the coast. However, larger and more seaworthy shrimp trawlers had been developed and employed on the south Atlantic shrimping
grounds from North Carolina to Florida. When news of the Louisiana shrimp resource was made public, there was an exodus of large diesel-powered trawlers to Louisiana. Morgan City, the nearest port to the grounds that could accommodate the large trawlers, quickly became the chief shrimping port for this fishery. Thus, the offshore fishery which began in 1938 was largely initiated by people who migrated from Florida and south Atlantic ports and settled in the Morgan City area. This area includes the grouped cities of Morgan City, Berwick, and Patterson. While this locality will probably continue to be the most important base for the new fishery because of its central location with respect to the best shrimping grounds, increasing numbers of large diesel-powered boats have been appearing in other sections of the state. Table 4 which contains the annual catch records for a number of years clearly shows the increase in the volume of shrimp since the beginning of the offshore fishery.

Here is a dramatic example of the important role of the diffusion of technology in the development of a resource. Despite the presence of the resource and the favorable bottom for trawling, Louisiana and the Gulf Coast did not possess the large trawlers necessary for exploitation. The nearness of such vessels and trained personnel on the south Atlantic coast was a distinct advantage for the Louisiana shrimping industry. Lacking such an abundance of shrimp on the south Atlantic coast, some
enterprising shrimp fishermen quickly shifted operations to a more-profitable area. Although there is little doubt that shrimp trawlers large and seaworthy enough to exploit the offshore grounds would eventually have been developed in Louisiana or the northern Gulf coast, it is not difficult to visualize the slowness of development had the nearest fish or shrimp trawlers capable of such operations been in Europe, the American Pacific Coast, or even New England.

Here also is an excellent illustration of the interrelationship of geography and culture. Larger, sturdier shrimp vessels on the south Atlantic coast were developed in response to rather poor bay shrimping, a rough and stormy sea, and the north-south coast-paralleling migrations of the shrimp. In contrast, the abundance of shrimp in the bays and just a short distance from the beaches of Louisiana, required only small craft, and so, until discovery of the offshore resource, there was no need of larger vessels. The calmness of the bays and near-shore Gulf waters generally also favored the use of small craft. After discovery of the offshore grounds, a rapid transfer of large shrimp trawlers from south Atlantic to Louisiana waters would not have been likely had there been unusual differences and difficulties to overcome. As it was, the environment, including the bottoms and climate, was very similar and the species was the same, therefore requiring no revolutionary changes in gear and general operations. In short, the adjustment was quickly and easily accomplished
Transportation and Disposal of Catch

Before the advent of gasoline motors for small vessels (around the close of World War I), shrimp destined to be marketed fresh or canned were transported from the fishing grounds to the chief local market, New Orleans, largely in steamboats or sailing vessels. The drying platforms of Jefferson and Terrebonne parishes were accessible to the small vessels, and shrimp were unloaded directly at these establishments. Many of the canneries were also within easy reach of the vessels. With the disappearance of sailboats, gasoline-powered vessels were used to take the catch to market.

Most shrimp vessels before the development of the offshore grounds in 1937 were small luggers, ranging in length from twenty-five to forty feet, that fished the inside waters (see Figures 18, 20, and 21). Whereas the large, modern shrimp trawlers carry their own ice for preserving the catch, most of the small luggers depend on an ice boat that serves a whole fleet of the small vessels. The ice boat buys the freshly caught shrimp from the luggers, promptly ices them, and heads for market. An excellent account by Kammer of the ice boat's function with the shrimp fleet deserves to be quoted at length:

There are several ways in which the fisherman can dispose of his catch. One way, perhaps the most common, is for the fisherman to sell his shrimp
to an ice boat. Ice boats are larger than the ordinary trawl boat and are used only for transporting shrimp from the fishing grounds to the nearest cannery or shipping point. Leaving port with their holds full of ice, they cruise around among the trawl boats and pick up the catch. When the holds are full of iced shrimp, or the ice begins to reach a dangerously low stage, they head back to the cannery or distributing point where the shrimp are unloaded. Among the fishermen of Bayou Barataria and Bayou Lafourche there is often an organization into fleets. Each boat in a fleet carries a distinctive flag at the mast and is served by the fleet ice boat, which carries the same identifying flag. Since most trawl boats look alike, at least from a distance, this flag enables the skipper of the ice boat to pick out boats of his fleet and the fishermen to pick out their ice boat. By being a member of such a fleet the fisherman is assured that there will always be an ice boat in his vicinity to pick up his catch. This is important because when the trawl boats are depending on an ice boat, they do not carry ice on board. Pouring water over the shrimp will keep them fresh for a time, but not indefinitely, so that it is imperative to get them iced as soon as possible. For performing this service the ice boat receives one dollar per barrel of shrimp for freight and fifty cents for the ice. To go back to the average price per barrel of shrimp—if the current price is $7.35, as represented by that average, the $1.50 for freight and ice is deducted from this price so that the fisherman receives $5.85 for each barrel of shrimp he catches, if he avails himself of the services of an ice boat.

This charge may seem high, but it has advantages. A 25-foot trawl boat, if it leaves port carrying ice, must have at least a ton in the hold to compensate for melting during the fishing trip. Carrying this load adds to the weight of the boat, consequently more gasoline and oil are consumed. The fisherman who depends on his own ice supply can trawl only as long as that supply lasts, usually two days at the most. The first day out he may not come upon any shrimp at all. On the second day, he may run into large schools, but he must return because his ice is melting fast and he must save what he has caught. By the time he goes back into port and returns to the fishing grounds, the shrimp may be gone. Or, a squall may come up and prevent fishing for two or three days and ice is a total loss. On the other hand, the fisherman who uses the services of an ice
boat is carrying no extra load on his way to the fishing grounds. He can stay out as long as he pleases because the ice boats usually carry an extra supply of gasoline and oil, besides ice, and even groceries, so that when the shrimp are "running good" he stops only to empty his hold before resuming trawling, and so is not obliged to come all the way back to port.

The fisherman who leaves port with his own ice may have secured it in one or two ways. The first is to buy for cash or on credit against his prospective catch. He will then get the full price of the shrimp at the unloading point. The second is to have the ice furnished by a wholesale shrimp dealer on condition that the fisherman return and sell his entire catch to him. Fishermen who use this latter plan sometimes speak of getting their ice "free," not realizing that the price received from the dealer is always sufficiently below the market price to cover the cost.

The ice boat has not entirely disappeared, but has certainly been on the wane since World War II. Large diesel-powered offshore trawlers with modern refrigeration equipment now catch the bulk of the shrimp in Louisiana waters. It is impractical for an ice boat to accompany them the great distances they may travel from shore. Also, in the inshore grounds more and more of the slow luggers are being replaced by fast-moving skiffs that are equipped to handle a small hand-operated trawl. These skiffs can quickly reach the shrimping grounds and return to port before there is any appreciable loss of ice or spoilage of shrimp.

Shipments of headless shrimp are made principally by freight, express, and truck. Within recent years, a steadily greater portion of the fresh-frozen, headless product is shipped by large trucks to various consumer areas.
Morgan City is headquarters for the shipment of shrimp by refrigerated, diesel-powered truck.

Summary of Economic Development

Although there had been some commercial trade in shrimp near the port cities and coastal communities for two centuries or more, true expansion of the industry began about 1867 when canning opened up new market horizons. Shortly afterward, in the 1870's, the drying of shrimp expanded the market considerably and caused a greater intensity of operations.

Despite the expanded market since the 1870's, shrimp capture was, until 1917, seasonal and done by the inefficient haul seine. At this time the otter trawl was introduced and quickly supplanted the other means of taking shrimp. Within two or three years the industry had doubled its production. Since that time shrimping has been conducted throughout the year rather than seasonally.

In 1934 the beheading of shrimp was initiated, creating a new fresh-shrimp market for export out of the state. It was found that by taking the heads off shrimp and icing the remainder, they could not only be shipped with less chance of spoilage, but that as the head constitutes forty per cent of the shrimp by weight, the express rates would be reduced by that amount.

In 1937 new shrimping grounds were discovered twenty miles offshore in the Trinity and Ship Shoals.
TABLE 4

SHRIMP PRODUCTION AND NUMBER OF TRAWLS AND/OR SEINES

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Number of Barrels (210 pounds)</th>
<th>Number of Seines</th>
<th>Number of Trawls</th>
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<tbody>
<tr>
<td>1880</td>
<td>2,543</td>
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<td></td>
</tr>
<tr>
<td>1887</td>
<td>32,429</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1888</td>
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<tr>
<td>1890</td>
<td>31,724</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1902</td>
<td>36,357</td>
<td></td>
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</tr>
<tr>
<td>1908</td>
<td>40,857</td>
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</tr>
<tr>
<td>1913</td>
<td>50,000</td>
<td>131</td>
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</tr>
<tr>
<td>1914</td>
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<td>1916</td>
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<td>109,050</td>
<td>111</td>
<td>699</td>
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<tr>
<td>1923</td>
<td>153,749</td>
<td>128</td>
<td>1,021</td>
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<td>150,624</td>
<td>143</td>
<td>905</td>
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<td>1925</td>
<td>154,722</td>
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<td>1926</td>
<td>123,967</td>
<td>143</td>
<td>692</td>
</tr>
<tr>
<td>1927</td>
<td>150,896</td>
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<tr>
<td>1928</td>
<td>195,303</td>
<td>261</td>
<td>1,454</td>
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<td>1929</td>
<td>210,033</td>
<td>125</td>
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<td>1930</td>
<td>197,550</td>
<td>172</td>
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<td>1931</td>
<td>178,815</td>
<td>126</td>
<td>1,131</td>
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<tr>
<td>1932</td>
<td>152,373</td>
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<tr>
<td>1933</td>
<td>166,058</td>
<td>67</td>
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<td>1934</td>
<td>226,576</td>
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<td>252,981</td>
<td>125</td>
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<td>286,749</td>
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<td>362,942</td>
<td>35</td>
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<td>1938</td>
<td>363,656</td>
<td>13</td>
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<td>1939</td>
<td>395,050</td>
<td>26</td>
<td>1,621</td>
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<td>1940</td>
<td>397,189</td>
<td>5</td>
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<tr>
<td>1941</td>
<td>554,354</td>
<td>5</td>
<td>3,028</td>
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<tr>
<td>1942</td>
<td>489,173</td>
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<td>2,380</td>
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<tr>
<td>1943</td>
<td>441,445</td>
<td>4</td>
<td>2,101</td>
</tr>
<tr>
<td>1944</td>
<td>544,378</td>
<td>4</td>
<td>1,866</td>
</tr>
<tr>
<td>1945</td>
<td>495,594</td>
<td>4</td>
<td>2,373</td>
</tr>
<tr>
<td>1946</td>
<td>464,981</td>
<td>4</td>
<td>3,030</td>
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<tr>
<td>1947</td>
<td>365,617</td>
<td>4</td>
<td>3,200</td>
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<tr>
<td>1948</td>
<td>376,605</td>
<td>4</td>
<td>3,408</td>
</tr>
<tr>
<td>1949</td>
<td>376,040</td>
<td>4</td>
<td>3,310</td>
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<tr>
<td>1950</td>
<td>361,365</td>
<td>3</td>
<td>2,819</td>
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<tr>
<td>1951</td>
<td>396,980</td>
<td>0</td>
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<tr>
<td>1952</td>
<td>398,952</td>
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<td>2,277</td>
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<tr>
<td>1953</td>
<td>437,340</td>
<td>10</td>
<td>3,543</td>
</tr>
<tr>
<td>1954</td>
<td>451,647</td>
<td>4</td>
<td>3,442</td>
</tr>
<tr>
<td>1955</td>
<td>365,542</td>
<td>5</td>
<td>3,276</td>
</tr>
<tr>
<td>1956</td>
<td>318,130</td>
<td>7</td>
<td>3,072</td>
</tr>
<tr>
<td>1957</td>
<td>181,061</td>
<td>9</td>
<td>2,419</td>
</tr>
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region. Larger boats were necessary to fish these offshore grounds successfully. Exploitation of the new grounds not only increased the number of boats in use but increased production until in 1940-41 the number of vessels and the production of shrimp had doubled.

Within the past twenty years newer methods of processing, quick freezing, packing, and rapid transportation have made fresh shrimp universally accepted and now the demand often exceeds the supply. Consider the fact that the value per barrel has gone from $3.00 in 1908 to as high as $140.00 or higher at the present time.

Until 1934, marketed shrimp were principally canned and dried. A small amount were sold fresh, principally to the New Orleans market. Changes in the preparation and marketing of shrimp since 1921 are contained in Table 5. At the present time shrimp are marketed in the following manner: fresh whole shrimp; fresh, frozen, headless shrimp in 100-pound boxes and one-to-five pound packages; fresh, raw, peeled shrimp (small quantity); cooked and peeled shrimp; dried shrimp; and shrimp meal for fertilizer and poultry-food concentrate. Fresh, frozen, headless shrimp is the chief form of preparation for market today, and has been since the middle 1930's.

The size and relative value of the shrimp industry of Louisiana can be appreciated by the following information: In 1949, 34,000 persons were supported by the industry, there being a total of 8500 shrimp fishermen, each averaging
<table>
<thead>
<tr>
<th>Year</th>
<th>Dried</th>
<th>Canned or Sold Fresh</th>
<th>Headless</th>
<th>Other</th>
<th>Cooked and Peeled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1921</td>
<td>6,775,072</td>
<td>27,467,370</td>
<td>750,000</td>
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<tr>
<td>1923</td>
<td>7,738,236</td>
<td>19,858,020</td>
<td></td>
<td>4,493,160</td>
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</tr>
<tr>
<td>1925</td>
<td>19,885,477</td>
<td>44,247,897</td>
<td></td>
<td>1,200,000</td>
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<tr>
<td>1927</td>
<td>9,396,538</td>
<td>19,495,350</td>
<td></td>
<td>2,796,360</td>
<td></td>
</tr>
<tr>
<td>1932</td>
<td>9,172,677</td>
<td>22,825,530</td>
<td></td>
<td></td>
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<tr>
<td>1938</td>
<td>15,446,820</td>
<td>35,772,415</td>
<td>25,148,585</td>
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<tr>
<td>1946</td>
<td>10,054,590</td>
<td>43,532,160</td>
<td>41,914,110</td>
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<td>2,144,730</td>
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<tr>
<td>1947</td>
<td>4,995,270</td>
<td>31,272,150</td>
<td>37,855,202</td>
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<td>2,656,920</td>
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<td>1948</td>
<td>10,329,690</td>
<td>28,521,150</td>
<td>35,675,010</td>
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<td>4,560,780</td>
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<td>1951</td>
<td>8,057,490</td>
<td>16,284,860</td>
<td>42,272,810</td>
<td></td>
<td>6,239,520</td>
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<tr>
<td>1953</td>
<td>5,673,990</td>
<td>29,864,100</td>
<td>52,569,300</td>
<td></td>
<td>3,733,800</td>
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<tr>
<td>1955</td>
<td>3,161,570</td>
<td>19,137,510</td>
<td>56,918,620</td>
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<td>2,556,330</td>
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<tr>
<td>1957</td>
<td>1,874,502</td>
<td>9,895,788</td>
<td>25,133,577</td>
<td></td>
<td>1,118,964</td>
</tr>
</tbody>
</table>

*Source: Biennial Reports of the Louisiana State Department of Conservation and Wildlife and Fisheries Commission.*
three dependents. There were 254 wholesale dealers and processors. There were also 3400 boats with a valuation ranging from two to seventy-five thousand dollars per boat. The investment in boats alone was estimated at thirty million dollars. There were 162 shrimp-processing plants, twenty-six of which were drying platforms. Processing plants, huge refrigerated trucks, and other equipment represent millions of dollars.30

The economic status and pattern of the shrimp industry have not changed materially since 1949. Annual production is approximately the same, and the methods of preparation and manner of marketing have not changed. There has, however, been an increase in large shrimp trawlers and a decrease in the smaller boats. Part of the decrease in smaller vessels is due to the discarding of them because of age and unseaworthiness. The small shrimp luggers are usually replaced by a shrimp trawler of larger design or by the all-purpose skiff.31

The Origin and Development of Shrimp Vessels and Gear

Despite increased market demand, and the advent of better methods of processing, only a limited expansion of the shrimp industry could occur until there were changes in vessels and gear. Usually, there is a lag in vessel and gear development after new markets and better processing have occurred. This is precisely what followed in the Louisiana shrimp fishery. Canning and drying increased
the markets and production, the latter resulting from a
greater and greater intensity of operations on long-proven
grounds. But production could go only so far, and was des­
tined to remain on a seasonal basis with the haul seine and
the small vessels not suitable for offshore shrimping. As
stated earlier, production of shrimp more than doubled
within three years after the advent of the otter trawl.
Without this introduction, it is very likely that present-
day production would not be noticeably higher than in 1917,
in spite of market possibilities, new forms of packaging
and shipping, and an improved transportation system. So
vital to the economic status of the shrimp industry, then,
are the innovations of vessels and gear, that a careful
inquiry into their origin and development is necessary.

It has been shown in a previous chapter that the
fisheries of the southern states were relatively retarded
and undeveloped until around the turn of the century.
Hence it may be expected that vessels and gear used in such
industries of strictly local importance were not too elabor­
ate and changed only slightly over long periods of time.
With the increasing commercial importance that has attended
shrimping and other fisheries of the Gulf states since
1900, there have been rapid and revolutionary changes in
fishing craft and equipment. These changes have been most
pronounced following the close of World War I, at which
time gasoline engines and the otter trawl were gaining
widespread acceptance.
From the most reliable information available, the earliest method for taking lake shrimp was with cast nets (these are small round nets with a lead line on the bottom, and are designed to be used by one person who wades in shallow water and throws the net when a school of shrimp or fish is within reach) and seines.32 A fresh-water species of shrimp known as river shrimp (*Macrobrachium ohionensis*), which are presently of very little commercial importance, once enjoyed local esteem. They were formerly, and are presently, caught chiefly by two methods. The oldest method, whose origin is not known, is the use of willow branches tied into bundles. The bundles are lowered into the water with the leaves downward. The shrimp gather among the bundles to feed upon the leaves and to protect themselves against enemies. At intervals a dip net is placed under each bundle as it is lifted from the water, and the bundle is shaken to release the shrimp into the net. River shrimp were also caught in traps set around partly submerged willow trees along the river front. The traps were made of wooden slats or discarded boxes, and were on the order of minnow traps, the slats spaced just far enough apart to allow the smaller shrimp to escape, but close enough to hold those of edible size. The traps were baited with corn meal. The original river-shrimp traps were willow basket work, possibly an inheritance from the Indians. The capture of river shrimp is discussed only from the standpoint of interest, since this study excludes
all fresh-water forms of shellfish.

The most reliable information on early methods of shrimping comes from some notes, based on personal observations, prepared by Percy Viosca around 1900:

Lake shrimp were taken in Lake Pontchartrain with cast nets and seines. The usual shrimp seines were under 200 feet long and had a half inch mesh. Most of the fishermen lived at the several villages which stood on pilings over the water: Bucktown, West End, Spanish Fort, Milneburg, and Little Woods. When not in use, the seines and cast nets could be seen hanging from the railings of the wharf to dry. The natural shrimping season on that lake lasted from late July until the end of October.

Two masted sailing schooners and smaller sailing vessels brought the shrimp up Bayou St. John to New Orleans. Some of the vessels stopped at the landing near Esplanade Street, whereas others proceeded through the Carondelet Canal, better known as the Old Basin Canal, to the landing near the present site of the New Orleans Municipal Auditorium. With favorable winds, the boats sailed up the waterway. When unfavorable, the crews were compelled to "pole" the vessels or to "walk" them in. Poling was done with long push poles which had a Y-shaped bottom to prevent their sticking in the mud. The pusher carried his pole to the bow of the vessel, placed the Y-end on the bottom and gave a steady push as he walked near the gunwale to the stern of the vessel. "Walking" was done with a long rope attached to a man or beast walking along the bank of the bayou. Smaller boats could be rowed in, and many times smaller vessels were observed towing the luggers. When the demand was sufficient, usually at certain hours, a small steam tug made up a tow and pulled the vessels to the landings for a fee. Such a tow comprised a motley group of vessels with such carried cargo as cord wood, charcoal, lumber, water melons, oysters, fish, and shrimp.

Horse or mule carts brought the shrimp from the landings to the French Market, or peddlers bought them from the boats and sold directly to the consumers. The standard shrimp measure at the market was a champagne basket which held 70 pounds of whole lake shrimp.33
Between the time of the observations of Mr. Viosca and the year Du Pratz left Louisiana (1734) there is a gap of 166 years. Much of this span can be accounted for through notes obtained from Mr. Viosca's father, Percy Viosca, Sr., and his father's uncle, Octave Viosca. Mr. Viosca's father preceded him by twenty-six years, and, according to information obtained from his father, shrimping was accomplished in the 1870's essentially in the same manner as around 1900. Also, from information obtained from his grand uncle, Octave Percy, Mr. Viosca reports that shrimping methods were no different around the middle of the nineteenth century from those of 1900.

Since it was near 1900 before shrimping began to develop commercially, it is only logical to assume that in all the preceding years this small local industry was pursued in about the same manner as it had been when the first French settlers were established in the New Orleans area. This assumption is even more tenable if the antiquity of the net and seine is taken into account. These items had been in existence at least since Mesolithic times and were probably in use in the Paleolithic period in Europe. They were well-known to all seafaring nations of southern and western Europe during the middle ages.\(^34\) During Roman times "the most ordinary fishing implements were the harpoon, the line, and different kinds of nets and seines."\(^35\)
Mr. Viosca has an interesting note concerning the use of ice as a seafood preservative around 1900:

Most people had ice chests here by the end of the century and the ice man made his rounds daily. Seafoods were considered highly perishable and consumed the day they were gathered, or the next. Fishermen in that day got up at about 2:00 A.M. Bait was gathered before dawn and fishing started at dawn for line fishing. Commercial seiners frequently caught their fish between midnight and morning in order to service hotel orders for the noon meal. Lake Pontchartrain fishermen who serviced New Orleans did not make use of ice, apparently because people had the impression ice was used because the seafood was not fresh, and the result was no sale. Broken ice was used by the markets, however, and the peddlers also used broken ice. Although oysters came in from the coast during "R" months, I do not believe fresh shrimp from the coast came in before 1910 when gasoline engines began to replace steam.

Boats used in the capture of shrimp vary considerably today, and around 1900 and the preceding years the variation was even greater. For those years boats used in shrimping operations varied from small rowboats to two-masted schooners (Figures 13 and 16), the latter carrying a fleet of small boats for the operation of the seine crews. All of the boats, including at times even small rowboats, were rigged with sails. Figures 13 and 14 show small boats that are rigged with sails. The motley array included small rowboats, launches (heavy open boats), schooner-rigged vessels, and the lugger. The origin of rowboats and launches is lost in antiquity. Schooner-rigged vessels were definitely copied from the world famous New England schooners which have been operating in Gulf waters since the middle of the nineteenth century. It is
Fig. 13. A sail-rigged launch. The men are throwing cast nets for shrimp. To the left are drying racks for haul seines. This photograph was taken in 1916, before the gasoline motor gained widespread use. (Courtesy of Percy Viosca)

Fig. 14. Sail-powered launch towing small rowboat. Since the World War I period, sails have been replaced with gasoline motors. (Courtesy of Percy Viosca)
Fig. 15. This photograph was taken in 1919 on Bayou St. John. The vessel is what might be termed an all-purpose boat. It was used for nearly every thing. (Courtesy of Percy Viosca)

Fig. 16. This picture, taken somewhere in the Louisiana marshes in 1919, shows a New England schooner-rig vessel in the distance. Quite a number of these vessels have been used in Gulf waters since the midpoint of the 19th century. (Courtesy of Percy Viosca)
not certain when the lugger first came into use, but it was employed in the latter half of the nineteenth century, and rapidly gained favor until 1937 when the large shrimp vessels from Florida were introduced.

Shrimp capture in Louisiana did not change greatly from the methods employed around 1900 and previous years until the introduction of the otter trawl in 1917 (see Figure 17). During this period the most notable change was the advent of gasoline motors in 1910. First used in launches, by 1917 they were being installed in luggers and other vessels. By 1920 the use of sails had greatly declined. With the use of gasoline motors, shrimp were more easily and quickly located and more extensive areas could be covered.

With the advent of the gasoline launch around 1910, the shrimp industry grew by leaps and bounds. With better icing methods and quicker transportation, many canning factories were established.36

Before the introduction of the gasoline motor, most of the shrimp caught in Louisiana were taken to drying platforms. The slowness of transportation from all areas except Lake Pontchartrain was conducive to spoilage of the product, even though ice was available at the shore stations.

From the very beginning of Gulf Coast shrimping until 1920, the haul seine was the principal means of capture. As the size of the catch over a long period was
in direct proportion to the size of the seine, large seines became very common, and some were as long as two thousand feet. It was common for seine crews to go out in large rowboats equipped with sails in case of favorable winds, and for large seines a crew of twenty men was often necessary. The crews searched the bottoms of the various lakes and bays and determined the presence of shrimp by means of small cast nets. When a school was found the size and extent would then easily be determined. The seine was laid out, and, if it were possible, the entire school would be surrounded and taken, only a small portion escaping.

Tressler gives an interesting account of haul-seine shrimping in Louisiana for the period shortly before 1920:

When the fishermen approach the fishing grounds, the throwing of the cast-net is begun. Two men usually stand on the stern, one on either side of the boat, each one constantly casting the net and hauling it in. The shore is usually rather closely followed because, whenever possible, the seine is always hauled to the beach.

As soon as the cast-nets indicate the presence of shrimp, the boat approaches the shore to a point where the water is waist deep, when, in the case of a crew of 12 men, 5 men jump overboard and hold the end of the seine. These men are said to be on "picket." The boat now steers a semi-circular course out to sea, two men standing on the stern and paying out the seine, one at the lead-line and the other at the cork line. As soon as the bag is thrown out, the boat again steers its course shoreward, so that when the seine is all paid out, the two ends are close inshore about 300 feet apart, and the seine lies out to sea in a half-moon shape. The boat is anchored and all hands abandon it. The two ends of the seine are first
closed up to within about 100 feet of each other, and about three-fourths of the seine is hauled in, after which the seine is entirely closed up, and the hauling continues until the bag is reached. During the hauling process, one man at each end stands with his foot over the lead-line, so that throughout the entire haul the lead-line may closely follow the bottom of the bay and prevent the escape of the shrimp. Each lead-line man stands facing the webbing of the seine, with the toe of one foot placed over the lead-line. The haulers stand within about 3 feet of the lead-line men. As the seine is hauled in, the slack is passed into the water behind the fishermen. Toward the end of the hauling-in process, the two lead men stand very close together, sometimes almost back to back, to prevent the escape of the shrimp.

When the seine is all hauled in and the shrimp crowded into the bag, the bag is closed up by throwing the lead-line over the cork-line, and, while the rest of the crew hold the bag shut, one of the fishermen brings the boat alongside, steering it directly across the bag, and the shore. Another fisherman now gets into the boat and two anchors are thrown out, one from the bow and the other from the stern. The cork-line of the bag is hooked over the oar pins of the boat. The ten men remaining in the water hold the mouth of the bag up at the lead-line and begin to turn the bag inside out, until all the slack is turned in. The two men in the boat commence to dip the shrimp out of the bag with dip nets.

Haul seines gradually declined as a means of shrimp capture after 1920. They were supplanted by the highly efficient otter trawl. However, the haul seine is common until the year 1936, at which time the number was reduced from 125 the previous year to 30 in 1936. Table 4 shows the number of seines and trawls in use in Louisiana waters from the year 1913 to 1957. Three haul seines were in use as late as 1951, but none was reported for the year 1952. However, in 1953, ten seines were in use and a few have been in use until the present time. This recent use of the
haul seine probably reflects the intensity at which shrimp­
ing was pursued during the 1953-54 period when production skyrocketed over that of previous years.

Development and use of the otter trawl had to await
the introduction of the power boat. They are in associa­
tion, then, since the otter trawl can only be pulled by a
vessel which has a steady source of power. The trawl would
not have had any practical use in Louisiana without the
gasoline-powered boats. As so often happens in an indus­
try, a revolutionary change in method or production results
from the introduction of two elements which are in asso­
ciation. The gasoline-powered boat was by itself of value
in providing rapid transportation and therefore expediting
the operations and to some extent causing an increase in
production, but the trawl was necessary before any sub­
stantial difference in production could be effected.

Extensive use of the haul seine and the otter trawl
in Louisiana are particularly related to the favorable
geography of the region--extensive, shallow bays and
estuarine waters with smooth mud bottoms are admirably
suited for the use of this gear. Since they are the most
practical gear known for shrimp capture, it can readily
be seen that Louisiana possesses a distinct advantage for
the industry. The physical geography of other Gulf and
south Atlantic states, although similar in some degree to
that of Louisiana, is less in favor of such operations.
Although the number of haul seines in operation declined gradually following the introduction of the otter trawl in Louisiana during the year 1917, the number of trawls increased sharply beginning with the year 1920, and from that year to the present they have accounted for the bulk of the shrimp caught in Louisiana.

The otter trawl is a long, funnel-shaped net with wings extending out from the open end on both sides (see Figure 17). The wings have a lead-line at the bottom and a cork-line at the top. The average wing-spread of a trawl is from fifty to sixty feet, but the wing may range from twenty to one hundred feet. The wings are tied to heavy wooden boards with strap-iron runners along the bottom edge. The boards are attached by four chains, like strings of a kite, to ropes leading to the boat, so that the boards are pulled downward and outward when the boat moves ahead. The trawl is thus kept on the bottom and the wings spread open by the pressure of the water. One line from each board runs to a winch powered by the boat engine. The back of the trawl is open and tied with a rope when in operation.

The nets are commonly made with one-and-one-half to two-inch stretched mesh. Molded leads are attached to the lower or lead-line at intervals of from four to twenty inches, becoming more frequent toward the otter-boards. Corks of about three to four inches in diameter are spaced at from two to eight feet along the top or cork-line. Both
Fig. 17. Sketches of the otter trawl. The otter boards which control the opening of the trawl mouth are forced apart by the water pressure when the vessel is in motion. The catch is forced into the rear of the trawl where they remain until it is hauled aboard. (Adapted from Commercial Fisheries Review, Fish and Wildlife Service, United States Department of the Interior)
cork and lead-lines are made from one-half to one-inch rope.

The otter-boards vary from three and one-half to eight feet in length and are usually constructed from one-inch planks, the lower front corners rounded to facilitate movement over obstructions on bay or ocean bottoms.

In searching for shrimp, fishermen use a small net called a try-net, which in reality is a miniature otter trawl. Since it is much easier to operate, it is used first to determine whether shrimp are on the bottom. If after a few minutes drag a try-net contains ten to twelve shrimp or more, the boat owner concludes that he has a chance to make a fair catch and so puts his trawl overboard. If shrimp are not caught in the try-net, the boat operator hunts another place.

Before throwing out the trawl, the fishermen secure a buoy with line to the tail of the bag portion of the net to insure its recovery in case the tow line should become disengaged. The net is then allowed to run out over the stern as the boat proceeds slowly. The speed of the boat while dragging is two to five miles per hour and the time for the drag may last from thirty minutes to over three hours, depending on the abundance of shrimp. Fishermen can tell by the pull of the trawl when they have a load. When the drag has been completed, the boat is stopped and the net hauled on board either by power winches or by hand.38 Today, a few luggers and skiffs in Louisiana
waters have hand winches, but the new and larger shrimp vessels have power winches. 39

When the bag is brought on board it is emptied by untying the rope at the back end of the bag, or if the catch is large, it is pulled to the side of the boat and emptied by dip nets made for the purpose. The shrimp are then separated from the fish and the latter thrown overboard. The usual crew of the otter-trawl vessel is two men, although frequently a third man is employed to aid in culling the shrimp.

In the Gulf of Mexico trawling is not often carried on in water over ten fathoms deep. At this depth the trawl is paid out on a little over three-hundred feet of line. Thus a customary ratio of five to one is used between the length of line and depth.

The otter trawl apparently was invented somewhere in Europe during the latter half of the nineteenth century. Steamers known as beam trawlers were operating in Europe during the last few years of the nineteenth century. However, it was not until 1905 that the first steam otter-trawler sailed from Boston on its first voyage. This vessel made profitable trips and soon led to the construction of others; by 1913 six steam trawlers were fishing out of Boston. 40 By about 1920 gasoline and diesel engines had become reasonably inexpensive and dependable and the otter trawl was thus made available to any fisherman who could afford to build and operate a small or medium-size
The otter trawl was introduced into the waters of the Southern states sometime between 1912 and 1915. At about that time, the Bureau of Fisheries, at its station in Beaufort, North Carolina, was using a small otter trawl for collecting marine forms. Fishermen, noting that shrimp were being taken by these nets, adopted the idea, and larger trawls were constructed for commercial use in the shrimp fishery. The first shrimp trawling took place at Fernandina, on Florida's northeast coast. The use of the trawl spread rapidly throughout the south Atlantic and Gulf regions, and soon became the standard gear. In 1917 it was introduced into Louisiana.

With the development and widespread use of the trawl, the haul seine gradually disappeared. Louisiana was the last locality in which the latter gear or method was employed. It appears that certain natural and economic conditions are responsible for the gradual disappearance of the haul seine from Louisiana waters. Louisiana has considerably more shallow bays and brackish lakes which are more suitable for haul-seine operations. Also, the abundance of shrimp on Louisiana's mud bottoms was favorable to haul-seine operations. From an economic standpoint, a relatively greater investment had been made in haul seines in Louisiana than elsewhere because of the greater area fished and the intensity of operations. In addition, a relatively smaller capital investment existed
in vessels and gear per unit in Louisiana than in the large-scale shrimping operations in Florida and the south Atlantic states. Another factor is the later appearance of the otter trawl in Louisiana than in neighboring states—it began in New England and spread down the Atlantic Coast and eventually into the Gulf of Mexico and Louisiana.

Before 1949 practically all of the shrimping vessels were using the flat trawl, and most Louisiana vessels still use it. The flat trawl has leads on the bottom line and both the cork and lead-lines are tied close to the trawl doors. This type of net digs into the bottom when it is dragged, a procedure adapted to the smooth mud bottoms of Louisiana waters. However, on the coral bottoms of Florida waters, fishermen soon discovered they had to replace the bottom of the net frequently because of wear. Siebenaler has aptly described the disappearance of the flat trawl in Florida waters.

Soon after the Tortugas shrimping grounds were discovered in late 1949, Atlantic Coast fishermen brought the balloon trawl to Florida. This trawl is hung with chain on the bottom line, fifteen inches of chain may be tied every eleven inches along the foot rope. The float and the bottom lines extend for about twenty feet from the wings of the trawl to the doors. This allows the top of the net to ride six to nine feet above the bottom of the net. This type of net is said to ride over the bottom, rather than digging in, and picks up fewer bottom organisms and less trash. Since there are a great many shells and crabs on the Tortugas grounds the flat trawls were quickly abandoned in favor of the new gear.42
Shrimp Vessels

There are three principal types of shrimp vessels in general use in Louisiana today. They are the Louisiana "lugger," the Biloxi-type, and the Florida-type. The last is a comparatively recent introduction, whereas the other two have accompanied the growth of the shrimp industry since the turn of the century or shortly before.

Until about 1938, when Florida-type trawlers were introduced into Louisiana for the new offshore fishery, the type of vessel in general use in Louisiana was the lugger, often called the "Louisiana lugger." These vessels, ranging in length from twenty-five to fifty feet, are of shallow draft and are designed for the shallow inside waters (see Figures 18, 20, 21, 22, 23, 25, 28, and 29). Consequently, they are not well suited for the open Gulf, particularly when the weather is unfavorable. 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 fish hold forward. This is the most distinguishing feature of the luggers used in Louisiana.

When the trawl appeared, luggers were easily adapted to its use—the only additions needed were a set of towlines and a trawl. Up until the late 1930's, few of these vessels carried power-driven machinery for putting out or taking in trawls. At present, many of the
Fig. 18. Rear view of the Louisiana lugger. The shrimper spends a great portion of his time aboard the vessel. He cooks, eats, and sleeps on it.

Fig. 19. A large, Florida-type shrimp vessel moored behind the home of a shrimper on Bayou Barataria. A neighbor may possess only a small Louisiana lugger for inside bay shrimping or a skiff for crabbing and trapping. This community is one of contrasts—culturally, economically, and in ethnic constituency.
Figs. 20 and 21. The Louisiana lugger. It is suited only for shrimping in the inside waters of the bays and brackish lakes. The locality is Bayou Barataria. Here, shrimpers, crabbers, and trappers live along the bayou and have their vessels moored directly to the domicile.
Figs. 22 and 23. Shrimp lugger on lower Bayou Terrebonne. These pictures were taken in 1919. Note how little change has occurred in design of these vessels in the past thirty-nine years. (Courtesy of Percy Viosca)
Fig. 24. View of the shrimp fleet at Grand Isle, Louisiana. Nearly all of these are large seaworthy vessels of the Florida-type with cabin in front and the hold in the stern.

Fig. 25. On the left is a typical Louisiana-type shrimp lugger with cabin in the stern, but on the right is the Florida-type shrimp vessel with cabin in the front. They are often seen together in the Louisiana marshes. The Florida-type vessel appears to be gradually replacing the Louisiana lugger.
Fig. 26. Photograph of Biloxi-type lugger taken in 1919. It is used as a shrimp vessel and for oyster work in the lower delta. Its shallow draft and long deck space make it ideal for oystering. Note that it is sail-equipped. Such vessels are now equipped with diesel or gasoline motors. The large fish is a sturgeon. (Courtesy of Percy Viosca)
Fig. 27. This picture was taken in 1956 (of a Biloxi-type lugger). Although most commonly used in oyster work, some of this type have been modified for use as shrimp trawlers. Note the close resemblance to the lugger in Figure 26, the chief difference being that this one (Figure 27) is powered by a diesel engine.
Figs. 28 and 29. Small Louisiana-type luggers trawling for shrimp in Barataria Bay. (Courtesy of Percy Viosca)
better-equipped and more-recently constructed luggers employ a hoist, but in a number of the older boats the gear is still operated by hand. For nearly two decades following 1920, most luggers were powered by gasoline motors, but in recent years there has been a trend to install diesel engines, especially on the larger vessels. The Louisiana-style luggers operate chiefly in the inside waters and the Gulf waters close inshore.

A lugger is technically a vessel with lugsails, that is, quadrilateral sails bent upon a yard that crosses the mast obliquely. The Louisiana lugger appears to have certain features that were borrowed from luggers operating in the Mediterranean, and they received their name of lugger because of their Mediterranean rig. This is understandable in view of the fact that so many of the fishermen and boatmen of the lower Mississippi delta are of Mediterranean extraction. In 1880 a report on the fisheries of New Orleans and vicinity indicated that the "men who are employed in this fishery, and also the sailors who own the luggers, are almost altogether Italians and Sicilians. Their swarthy faces, long, curly hair, unfamiliar speech, and barbaric love of bright colors in their clothing and boats, give a perfectly foreign air to the markets. There is not an American style of rig seen, nor hardly a word of English is spoken." 43

The lugger of Louisiana does not necessarily resemble vessels of the Mediterranean in other respects.
The extremely shallow draft appears to be a feature especially designed for threading the shallow bays and bayous of Louisiana waters.

The Louisiana lugger has diffused only slightly, if any, from its area of apparent origin—the inside waters of Louisiana. It is not known in Florida or Texas, and is quite uncommon in Mississippi and Alabama waters. The lugger was designed to draw from one and one-half to three and one-half feet, which would enable it to move from one bay to another. It appears, then, that this boat is the result of conscious efforts of Louisiana fishermen to design a craft especially suited for use in the shallow bays and bayous. The lugger came into widespread use in Louisiana waters during the latter part of the nineteenth century. However, other-style vessels were also in use at that time. Some other vessels used in Louisiana before 1900 were sail-rigged, schooner-designed vessels (Figure 16); steam operated stern-wheelers (Figure 7); and large open launches (sometimes sail-rigged) (Figures 13 and 14). The lugger, however, apparently was the most practical craft for the shrimper and oysterman to employ when the industry began to expand so rapidly.\footnote{44}

The Biloxi-type boat resembles the lugger in that the cabin and engine room are in the stern, but forward it is much like conventional vessels used in Florida and the Atlantic states (Figures 26 and 27). It is larger and more seaworthy than the lugger, commonly measuring...
from forty to fifty feet in length, which approaches the maximum size of luggers. As its name implies, the Biloxi-type vessel originated in Mississippi. It was first used by the oystermen of Mississippi who worked the Louisiana marshes east of the delta, and was soon used by fishermen of Louisiana as an oyster and shrimp vessel. The Biloxi-type vessel is not so common in Louisiana waters as the lugger and Florida-type vessels. It is most common in the oyster waters of the delta and the immediate vicinity.

A shrimp trawler originally designed for use in Atlantic waters, the Florida-type vessel (Figures 19, 24, and 25) gradually spread northward to the Georgia and Carolina fisheries. Because of its seaworthiness it was suddenly introduced into Louisiana in 1938 for use in the new offshore fishery which was developing in the waters south of Morgan City. From Louisiana the vessel spread rapidly into Alabama and Texas waters.

The Florida shrimper ranges in length from fifty to sixty feet and may reach eighty-five feet. Unlike the common Louisiana lugger or the Biloxi-boat, the engine room is forward and the hold is in the stern. It stands high out of the water; the bow is about six feet while the stern is about four feet above the water. It draws about four feet of water and has a diesel-powered engine. It is capable of a wide range of activity, commonly making trips of ten or twelve days' duration (which is about the limit of time ice will last or the catch can be safely
Fig. 30. View of winch on Louisiana-type shrimp lugger. Note the shovel and boots which are so necessary in sorting and placing the shrimp in the vessel's hold.

Fig. 31. The all-purpose skiff which is replacing the small shrimp luggers throughout the coastal zone. It is suitable for bay shrimping. It is also a favorite of the crab fishermen and trappers. Its speed and maneuverability are the obvious advantages.
held), and is equipped with ship-to-shore radio which is used to keep close contact with the owner for information and orders.

The Florida vessel has succeeded not only in complementing the lugger but in actually replacing it in many areas of the coast. However, it is used chiefly for offshore operations. It is the most efficient shrimp vessel in American waters, having been primarily designed as a shrimp trawler.

Skiffs, either powered by oars or sails, have been used in Louisiana waters ever since white settlement of the region (see Figure 31). Usually they are employed in conjunction with oystering, or for crabbing and lesser activities in the bayous. However, within the past ten years, a gasoline-powered skiff which is manufactured in Gulf shipyards has gained great favor in the delta area, particularly in the vicinity of Barataria Bay. It serves well as an all-purpose boat for the small operator who shrimps in the inside waters part of the season and pursues crabbing and other marsh activities during other times of the year. It is used also for crab fishing, hand-line fishing, and for use as a speedy means of transportation to and from fishing and hunting camps located in the marshes. The skiffs vary in size from twenty to twenty-six feet in length, have a beam of from six to nine feet and a draft of eighteen to twenty-four inches. A very few may have cabins or half-cabins built on them.
Most of them are powered by 85 or 115-horsepower marine gasoline engines.

When trawling gear is used in the skiffs, it is handled entirely by hand. The platform at the stern has space enough for paying out the trawl as well as hauling it aboard. The crew consists generally of one man. The cruising speed of the skiffs is from eighteen to twenty-two miles per hour, with a maximum speed of thirty miles per hour. Cypress is used in the hull construction of practically all of them. The development of this type craft has been a gradual process over a period of years—from the old flat-bottom boat toward the design of larger shrimp trawlers. The skiff has the advantages of speed and maneuverability over the small Louisiana-style lugger, and appears to be rapidly replacing it as a vessel for use in the inside waters, although at the present time it is used principally in the Lafitte-Barataria region.

Ethnic Character of the Coastal Zone and Cultural Influences on the Louisiana Shrimp Industry

No inquiry into the character and development of the Louisiana shrimp industry would be complete which did not take into account the special, often subtle, influences exerted by various ethnic groups. Couched in traditions and attitudes, these influences can perhaps best be seen by treating them in an historical frame of reference.
Remarkable similarity and uniformity of traditions and industries are found throughout the United States due to the overwhelming Anglo-Saxon population and influence which prevails nearly everywhere. This is particularly true for the southern states, which have never received significant additions of any group (except Negro) other than those of Anglo-Saxon stock. However, coastal Louisiana is an exception to the general rule. Here, in many portions of the coast, Anglo-Saxons are in the minority, and the customs, practices, and industries are in striking contrast to those found elsewhere in the South. This condition was more profound in the past than it is today, since improved transportation, the establishment of other industries in the coastal zone, and technology in general, are bringing about more uniformity of culture and standardization within specific industries and life in general.

The shrimp fishermen of Louisiana are descendants of peoples of various ethnic stock and nationality. Some of the various national and ethnic strains present are French, Slav, Spanish, Italian, Greek, Portuguese, Sicilian, Malayan, Chinese, Scandinavian, and Anglo-Saxon. However, a roll of the names would contain a majority that are French. The composition is more varied today than in the years past, since recent developments in the shrimping industry have attracted people from a number of southern states. In 1887, G. B. Goode discussed the ethnic and national composition, as well as some of the
traits, of fishermen in the New Orleans vicinity:

The New Orleans fishermen and oystermen are nearly all descendants of the Mediterranean coast fishermen and sailors, who came to this country years ago to engage in the fishing or fruit trade.

Frenchmen, Spaniards, and Minorcans are probably in the majority, the balance being made up of Italians, Portuguese, Sicilians, Corsicans, Greeks, and there are even a good many Malayans in their numbers. In nearly every case the fathers and forefathers were fishermen or sailors, and these men follow in their footsteps as nearly as they can in a country so different from that of their ancestors.

The old and middle-aged men, as a rule are very ignorant of anything outside of their profession, and it is quite rare to find one who can read or write. The French are generally more intelligent than the others, having been longer in this country, and seem to gain knowledge more rapidly than the Spanish and Italian creoles. The Malayans are also noticeable for their industry and promptness in business matters, and for their quickness to learn. They all retain much of the superstitiousness of their ancestors, which often influences them to their loss. The clouds, the sky, the wind, etc., have each their peculiar significance to them at times, and they run no risk when the signs are unfavorable; not that there can be any great risk of their lives, but they seem to fear invisible objects, that, if the signs are this way or that, they are sure to catch no fish, and therefore do not try...

...On their boats or at fishing camps they live quite comfortably, but in rather a peculiar way in comparison with other American fishermen. There seems to be no regular time for anything, either work or recreation. They work part of the night and sleep part of the day, and have their meals thrown in at any and all times.46

Although fishermen of French descent are found in considerable numbers throughout the Louisiana Coast, they are heavily concentrated in certain areas. The area of greatest dominance extends from Bayou Lafourche to
Vermilion Bay. This area includes the chief shrimping ports of Louisiana such as Grand Isle, Golden Meadow, Cocodrie, Dulac, Theriot, Houma, and the tri-city area of Morgan City, Berwick, and Patterson. The Bayou Lafourche region is more overwhelmingly French than any of the others. Most of these French-speaking natives are descendants of the Acadian settlers who moved into the Bayou Lafourche and Teche regions as farmers. Many later left the farms to engage in fishing, shrimping, crabbing, and trapping.

The most polyglot or cosmopolitan area, as far as ethnic strain and nationality are concerned, extends along both banks of the Mississippi River from New Orleans to Venice, and also includes the settlements of Barataria and Lafitte. The latter settlements were originally French, but Chinese, Malayans, and Filipinos moved into the area to engage in the shrimp-drying industry. Also, many Negroes have lived in the area since early times when sugar plantations were operating there. Considerable mixing has occurred through marriage and non-marital relations and this has produced many individuals who are mixed negroid, mongoloid, and caucasoid. From Myrtle Grove to Venice on both banks of the Mississippi the dominant people are a strain of Slavs, sometimes called Dalmatians, after the coast of Dalmatia in Yugoslavia from which so many families come. These Dalmatians were oyster farmers in their original homeland and were attracted to the lower
delta area because of its excellent possibilities for oyster cultivation. Until recently, few of them ever left the oyster trade to engage in shrimping. The shrimping in this area is pursued mainly by peoples of French, Anglo-Saxon, Spanish, or some other Mediterranean strain. This area also received in the past an enrichment of various nationalities and races, due to sailors and stowaways jumping ship. Once a person fled his ship for the marshes of the lower delta, the time and effort necessary to recapture him were considered not worth the trouble. 47

In St. Bernard Parish to the east of the Mississippi River is a considerable number of people of Spanish ancestry or, more accurately, Canary Islanders. They are most concentrated along Bayou Terre aux Boeufs and in the settlement of De la Croix. These people have held tenaciously to their language and cultural patterns but presently are showing signs of becoming absorbed. They have been active mostly in trapping and fishing since their arrival in this area in the latter part of the eighteenth century. A few are shrimp fishermen and practically none of them is in the oyster trade. A note on their origin is furnished by Kammer:

The history of St. Bernard Parish is closely connected with that of New Orleans. Shortly after the founding of that settlement plantations were established along the river and along Bayou Terre-aux-Boeufs. Following the cession of Louisiana to Spain, intensive colonization was inaugurated by the Governor, Bernardo de Galvez. In 1778 the province was reviving under the healthful influence of the extension of its
commercial franchises, when it received a considerable accession to its population by the arrival of a number of families transported to Louisiana from the Canary Islands, at the king's expense. Some of them, under the command of Marigny de Mandeville, settled at Terre-aux-Boeufs, on a tract of land now included in the parish of St. Bernard. 48

The area with the greatest percentage of persons with Anglo-Saxon ancestry is the area around Calcasieu and Cameron parishes. This area is not part of French Louisiana, although a considerable number of French families have moved there in connection with shrimping and other marine resources. The hinterland of this section of Louisiana was settled originally by peoples of Anglo-Saxon stock and the fishery industries of the area have largely been pursued by persons of that ethnic composition, which is true also for neighboring Texas.

Since 1938, when the tri-city area of Morgan City, Berwick, and Patterson, became the center of Louisiana's rapidly developing offshore shrimp fishery, a large number of outsiders from Florida and various places along the south Atlantic coast have arrived and settled there. The greatest percentage of the families settling recently in the Morgan City vicinity for the purpose of participating in the offshore shrimp fishery trade are of Anglo-Saxon or Scandinavian ancestry. The bulk of them came from east-coast ports of Florida, but some came from shrimp ports in Georgia and the Carolinas.
People of Acadian French ancestry had been shrimping in the inside waters near Morgan City for a long time and are still present in considerable numbers today. Many of the French shrimpers soon invested in larger more-seaworthy craft in order to pursue the lucrative offshore fishery, but it was largely the outsiders who developed it.

A roll call of shrimp-boat captains in this area today would include a liberal assortment of names such as Anderson, Breaux, Thompson, Larsen, Pacetti, Palmer, Boudreaux, Casso, Adams, Hanson, Ledoux, Varnum, Gorsha, Schultz, Thibodaux, Daigle, Olsen, Wiggins, Andrews, Aucoin, Callahan, Authement, Vidos, and many others that reveal the diverse ethnic strains which are represented.

Although economic trends and technological developments are mostly responsible for development of the Louisiana shrimp industry into its present form, some cultural influences resulting from the diverse ethnic strains found in the coastal zone have also been significant. It has already been shown how profoundly the cultural influences affect an industry. For example, the coming of Lee Yim, the Chinaman, greatly affected the character and status of the shrimp industry. It is very likely that the colorful and important shrimp-drying trade would never have been introduced into Louisiana unless someone of Chinese ancestry moved into the area. In 1938 a revolutionary change occurred within the shrimp industry when families of Anglo-Saxon and Scandinavian
ancestry came to Louisiana. These people, with their larger vessels and far greater experience with the open sea, freed the fishery interests of Louisiana from dependence on the inside and near-shore waters. From this time to the present there has also been a trend toward larger vessels and equipment.
Footnotes


3. Ibid., pp. 226-227.


5. Ibid., p. 141.


9. Ibid., p. 91.

10. Idyll, op. cit., p. 15.


12. Ibid., pp. 325-326.

13. Some of this information was obtained in a field interview with Louisiana's fishery biologist, Mr. Percy Viosca.

15. Ibid., p. 277.


17. Most of the canneries of this period canned both oysters and shrimp, and even a few crabs and other things. Virtually the same equipment could be used for both products and this factor was of paramount importance to the economic feasibility of establishing the canneries. The firm of Dunbar also canned many kinds of fruit in their appropriate season.

18. Excellent descriptions of shrimp-canning operations are given in the following sources:


19. Excellent accounts of the shrimp-drying process are contained in the following:


(2) Tressler, op. cit., pp. 558-560.

(3) Lindner, op. cit., pp. 40-43.

20. Much of the information regarding the sun-dried shrimp industry was obtained from interviews with and records of Percy Viosca, the Louisiana State Biologist.

21. These statistics were taken from the Biennial Reports of the Louisiana State Department of Conservation and the Department of Wildlife and Fisheries.
22. Various persons familiar with the shrimp industry report that shrimp were as abundant during the depression years as they were in 1929, but the price was so low that shrimping was not very profitable, hence the decline in the catch.


24. Ibid., pp. 110-111.


26. Much of the information in this paragraph is a result of interviews with persons connected with the shrimp industry.


30. Ibid., pp. 52, 62, 64-65.

31. Skiffs are being increasingly used in much of the bay and coastal waters of Louisiana as a replacement for the slower, clumsier, Louisiana-type lugger. The skiffs are streamlined, fast, easy to maneuver, and are better suited for an all-purpose type of fishing than the luggers.

32. "Lake shrimp" (*Penaeus setiferus*) is a term formerly in common usage for the small sizes of *Penaeus setiferus* which spends its pre-adult and early adult life in the brackish lakes, bays, and coastal waters. It has been scientifically established only within comparatively recent years that the small lake shrimp and the larger sea shrimp are the same species, and only since the introduction of power-driven vessels and the otter trawl that the larger sizes have been commercially exploited.

33. This information comes from the personal notes of Percy Viosca, the Louisiana State Biologist.


38. The operation of the winch by hand was common twenty to twenty-five years ago, but it is not very common today. Occasionally some of the very small luggers have a hand-operated winch.


40. The Ocean Fishery—Massachusetts' Oldest Industry, Massachusetts Department of Natural Resources, Boston, (no date of publication), p. 11.


42. Siebenaler, *op. cit.*, pp. 32-33.


44. These conclusions are supported by field observations. Library research failed to yield any exact information as to the time or place of origin.


In addition to field notes, this information has also been verified by Mr. O'Connell, the chief of the Oyster Division for the state of Louisiana. Mr. O'Connell has been connected with the Oyster Division for over thirty years and is familiar with practically every mile of territory in the lower delta and vicinity.

Kammer, op. cit., p. 16.
CHAPTER VI

THE LOUISIANA OYSTER INDUSTRY

Ecology of the Oyster

The common North American oyster, *Crassostrea virginica*, is a bivalve whose habitat extends from Prince Edward Island in the Gulf of St. Lawrence to a considerable distance along the coast of Mexico. Growth conditions are ideal along certain sections of the middle Atlantic coast and the northern coast of the Gulf of Mexico, particularly in Louisiana. Today it is economically the second most important shellfish resource of Louisiana and is also the oldest one of commercial significance. Many species of oysters exist throughout the world, but the one important in Louisiana is *Crassostrea virginica*.

Oysters occur in quantity in temperate, subtropical, and brackish waters wherever streams discharge enough nutrients and fresh water to fulfill their ecological requirements. Hence, there are vast stretches of coast where oysters rarely occur, if at all, and other areas where they grow in abundance. Oysters are brackish-water shellfish. Their habitat is close to shoreline where waters are fresher than in the open sea. It is true that if certain other conditions are favorable oysters can exist in waters of
comparatively high salinity, but there they grow little and do not reproduce. The Louisiana coastal waters have favorable ecological conditions for *Crassostrea virginica*, and Louisiana is a heavy commercial producer of oysters.

An oyster is composed of two distinctly different parts. The soft body mass is vital, energetic, and carries on the activities of a living organism; it takes in food, grows, breathes, and provides for reproduction. The shell is non-living and is essentially calcium carbonate which has been deposited by the mantle, the outermost layer of tissue of the body. The shell itself is in two halves or valves held together at one end by a tough, elastic hinge-ligament (Figure 32). This ligament acts as a string, tending to force the valves apart. The muscle of the body, however, is attached to both valves and, by contracting, tends to pull the valves together.

When the shell of the oyster is open, millions of tiny, hair-like structures on the gills beat back and forth, pumping water in one side and out the other. Dissolved or suspended in the water are oxygen, mineral salts, and microscopic floating plants. The floating plants (diatoms), other microscopic organisms, and the mineral salts are taken in as the principal foods; the oxygen is necessary for respiration. When the oyster closes its shell, an efficient armor surrounds the soft inner parts and it becomes resistant to its natural enemies or to unfavorable changes in the water about it. Oysters live best in a mixture of
fresh and salt water, ranging from 20 per cent to 75 per cent of the salinity of ocean water. When the water becomes either too fresh or too salty, the oyster closes its shell until a more favorable salt concentration prevails.

Oysters in Louisiana breed from April until October and in isolated cases even during the winter months. Breeding oysters are called "milky" because of the milky-looking fluid with which the gonads are filled. The milk of the female contains millions of minute eggs, that of the male, an incalculable number of extremely small spermatozoa. The milk is cast out into the water, where there is a chance intermingling of sperms and eggs. The fertilized egg divides again and again, forming a ball of many tiny cells. In the course of a few hours small vibrating hairs, known as cilia, appear on the developing young oyster. With these cilia it keeps itself suspended while moving about at the mercy of currents. Within three days, the embryo develops a pair of tiny shells which become larger and larger as the larval oyster grows. Soon the larva seeks a hard, clean surface on which to attach itself. If it cannot find a suitable surface for attachment, the larva falls into the mud and is smothered. If it succeeds in finding a suitable surface, the larva cements itself to that surface, loses all organs of locomotion, and remains stationary for the rest of its life. The young oyster grows rapidly, and in the course of a few months becomes a tiny male. For the next year's spawning season, it usually
changes to female, and from then on its sex may or may not be stable. It may remain female for years, or it may change back and forth very frequently.¹

Experiments made many years ago in North Carolina and the Chesapeake indicate that reproduction practically ceases when the temperature during the breeding season falls below 60 degrees F., and that the swimming stage is rarely reached when the water is warmer than 80 degrees F. The minimum temperature at which reproduction is possible is probably nearer 70 degrees F., than 60 degrees F., and it takes place in water above 80 degrees F. in certain parts of the Gulf of Mexico.

Bottom character is of great importance to oyster ecology. Where the bottoms are composed of very deep muds and there are few obstructions, the situation is unfavorable for the successful attachment of spat (very young oysters). To quote Kellogg:

Over the greater part of the oyster territory bottoms are more or less muddy, and the nature of this mud must be determined. On many of the best northern grounds there is but a thin surface layer of it covering a firmer foundation. This, without any preparation, is found to afford a secure resting place for planted oysters. In many parts of the Gulf of Mexico, however, the bottom is composed of mud so soft and oozy that a pole may be driven into it, by force of hand alone, to a depth of several feet. It is very generally believed that such conditions cannot be overcome, the assumption being that any kind of pavement placed on it would sink below the surface. That such is not true, has been shown by successful plantings in Louisiana. In parts of Long Island Sound, where mud is deep but not so soft as in the Gulf, bottoms have been successfully prepared by paving with shells or with sand and gravel. Bottoms naturally sandy are
also often selected by the oyster farmer, but under shallow water, where they may be shifted by wave action, they are unsafe. It is especially desirable that the bottom should be firm, to withstand wave or tide action where spat is to be gathered on collectors, for the young are quickly smothered in a quantity of mud that would not seriously affect mature oysters.

In the Gulf of Mexico it is found that oysters often thrive and reproduce in localities where, much of the time the water is very muddy. But it is also true that currents in such places are too rapid to deposit much of their silt. In more quiet waters, where mud slowly collects on the bottom, mature oysters may be able to exist, but even a slight deposition is fatal to newly attached spat. Finally, there are many places where mud collects so rapidly on the bottom that oyster life is impossible.2

The amount of food over a given area depends largely on currents. Where there is no current, oysters quickly exhaust the surrounding water of its food. A current continually replenishes the supply. Up to a certain point, the more rapid the current, the greater the amount of available food. But one current bears more food than another. Salt water that flows out from shallow marshes during the ebb tide, for example, usually bears great numbers of diatoms because the marshes are warmer than the sea waters outside, and the higher temperature stimulates a rapid multiplication of these organisms. Food is sometimes so abundant that a rapid current is not necessary. These latter conditions exist along much of Louisiana's embayed marsh coast where oysters thrive.

The chemical and physical conditions governing oyster propagation are, to say the least, extremely complex. There is, for example, the important role played by copper
in the successful attachment of spat. In other respects, areas suitable for oyster growth are dependent upon such natural occurrences as crevasses in the natural levees, long-term or short-term fluctuations in stream discharge, and the artificial works of man. The natural oyster grounds of Louisiana have been affected by these conditioning factors.

For the past seventy years or so, the principal oyster grounds or reefs of Louisiana have been east of the Mississippi delta, whereas the areas most suitable for artificial planting lie just to the west of the Mississippi discharge area (the distribution of Louisiana oyster grounds is shown on Plate VIII). However, in the years before the annual overflows of the Mississippi were checked by high artificial levees, enough fresh water was discharged on the west side of the river to permit the natural growth of oysters. At the present time, for example, it is not possible for oysters to reproduce naturally on the immediate west side of the river in the vicinity of Barataria Bay due to high salinities. Yet some can remember when oysters grew naturally in this area. Gunter has supplied excellent information regarding changes in the oyster environment of the Louisiana marshes:

Oysters can live at salinities lower than 6 per mille for a long time and field observations indicate that the critical point is even lower. Since the flow of fresh water from land fluctuates, the oyster is often subjected to too much fresh water. This problem has confronted the oyster industry around the lower Mississippi River for many years.
Since historic times and long before, oyster beds existed in the Louisiana Marsh and Mississippi Sound. Before the white man settled Louisiana, the Mississippi River overflowed its banks every spring and flood waters entered the bays and sounds over a wide area extending from Terrebonne Bay on the west to Lake Pontchartrain on the east. This subjected the oyster reefs of Louisiana and Mississippi to an annual or seasonal decrease in salinity during the first half of the year. Leveeing of the river was started by the French Colonials in 1717 and was begun in earnest in 1735. As the levee system grew and the distributaries of the river were cut off, the water was funneled out to the river's mouth in greater volume. The gradual seasonal fall in salinity gave way in most bays to less annual change, interspersed with more violent fluctuations in some years when the levees broke, as they did quite often in the early days. Detailed effects of this historical change are unknown because no survey of the conditions of the early history of levees and crevasses is not good. However, there is considerable evidence of gradual historical increase of salinity in some oyster producing areas. There is some indication that the region for oyster growth has slowly moved landward, with the increase in levees, and now lies closer to land than formerly. Oysters formerly grew around the Chandeleur Islands (Russell, 1936) and large dead reefs are present far out in Breton Sound where oysters no longer live.

Historically, the flow of fresh water from the Mississippi onto oyster bottoms may be divided into three stages. The first was a period of unrestricted flow extending from times unknown to the period of extensive levee construction. It can be called the "prehistoric period." The second, which extended from about 1750 to 1927, can be called the "crevasse period." During this time any crevasse or break in levees on the east bank of the river from Baton Rouge to Caernarvon, Louisiana, let flood water through Lakes Pontchartrain or Borgne into Mississippi Sound. Breaks farther down the east bank let water flow into Breton Sound. Flood waters flowed through crevasses on the west bank into Barataria Bay. As the levee system grew in length and height the crevasses became more violent.

The third stage may be called the "stable levee" period. After the great flood of 1927 all flood control was placed in the hands of the Corps of Engineers and the Mississippi River Commission.
Vast projects have brought a virtual end to crevasses and, although the conquest is never certain or final, some ascendancy over the river has been gained and its destructive might has been curbed.\(^3\)

The Bonnet Carré Spillway has played a major role as conditioner of the oyster environment of Mississippi Sound. The spillway lies in an old crevasse area and connects Lakes Pontchartrain and Borgne with the Mississippi River. As much as one hundred per cent of the oysters in Mississippi Sound west of Bay St. Louis may be destroyed in years of heavy spillway discharge. Discharge records indicate that somewhere between 12,500,000 and 24,500,000 acre-feet of water there is a critical point where flood waters from the spillway cause extensive damage to oyster beds lying between Bay St. Louis and Cat Island and the Louisiana beds in the marshes. Mortality of oysters will not result, however, if the spillway discharge is fast and remains on the beds for only a short period. Also, if spillway waters come early in the season when conditions of the oysters are good and temperatures are low, mortality is less than in later months. When the Pearl River discharge is high, the combined flow of it and spillway discharge is quite disastrous, but if previous to the spillway openings, the Pearl River discharge is low, there will be a low mortality.\(^4\)

There is some compensation to spillway discharges, even when very heavy. Gunter states that "spillway discharges always kill out oyster pests and predators and put
thousands of tons of nutrient salts into the area. Because of the nutrient salts brought in by the river water a greater abundance of shrimp and other marine life may normally be expected following the return to normal salinity.**

The typical oyster reef on the Gulf Coast is, in cross-section, a low mound with a high center or "hogback," which is occupied by dead shells, with the live oysters on the sloping shoulders. These reefs occur on muddy bottoms widely distributed on bays of lower salinities, but more or less restricted to the upper ends of bays subject to the invasion of higher salinities from the Gulf during periods of low rainfall. Hedgpeth states:

Oysters are not only formers of reefs, they are dominant members of a natural community of organisms. *Crassostrea virginica* is an organism which is capable of providing in the form of reefs its own substrates, and which provides, especially on the Gulf Coast, where there are no rocks, the only available natural hard substrate for many of the sessile invertebrates occurring in the bays. If not a major benthic division, the oyster reef is certainly an important subdivision of the bay environment. Where it builds actual islands it is a terminal, or climax, formation. The actual structure is therefore the end product of a natural process which can only be reversed by physiographic changes. The mudshell deposits of the bays, which are actually buried reefs, are evidence that such physiographic changes are part of the long-term fluctuation in the environment of the Gulf Coast.***

It has been observed that the ecology of the Louisiana oyster is not exactly the same as that of the middle Atlantic coast oyster. According to the results obtained by workers in northern waters, the lack of great temperature changes, the absence of winter ice, the high
temperatures of summer, and the great variations in salinity, all make seasonal changes in the Louisiana marsh difficult to interpret. Burkenroad has recorded some significant differences in feeding and spawning of the Louisiana oyster:

Since the temperature of Louisiana waters is usually well above the critical point below which ciliary action (and therefore feeding) ceases in Northern oysters, and since all oysters observed have been feeding, except in certain cases where the water had become and remained fresh through river discharges, it seems possible that salinity is the important factor here, directly, and indirectly, in the growth and fatness of the oyster.

Oysters have not been observed to be feeding on the abundant animal plankton nor on debris, as northern oysters were found doing. In this connection it may be noted that the most abundant debris in Louisiana waters is derived from marsh grass, which northern oysters, in feeding experiments, refused.

It has been stated that *Crassostrea virginica* in all parts of its range, spawns after the water temperature reaches twenty degrees C., and that subsequent spawnings occur only after a two degree increase in temperature has occurred. It seems possible to the writer that spawning in Louisiana occurs at the time of change from lesser to greater salinity, and that this change may provide the reproduction stimulus rather than temperature increase. The individual peculiarities of the various bodies of water: their shape, proximity to river discharges, accessibility to tides, etc., may, by the difference in the salinity of their waters, produce the long spawning season which occupies the whole summer. In this connection, it has been noted that water temperatures throughout the marsh are quite uniform, at the same air temperatures, so that all parts of the marsh will probably reach twenty degrees at the same time, while oysters of different parts spawn at different times.

The life of the Louisiana oyster is not only dependent upon the vagaries of the Mississippi drainage system,
the artificial works of man, and the weather, but also on the presence or absence of oyster pests and fungus diseases.

The most important oyster predators or diseases, as far as the Gulf Coast is concerned, are the fungus, *Dermocystidium marinum*; such parasites as the gregarine, *Nematopsis*, whose alternate hosts include various crabs of the family Xanthidae; and the tremadode, *Bycephalus*, which is carried by some unidentified species of fish; and such active predators as the polyclad, *Stylochus*, the large active crabs, *Callinectes sapidus* and *Menippe mercenaria*, and the predaceous gastropod, *Thais haemastoma*. Another group of organisms infests the shell of the oyster, weakening it or causing the oyster to devote its energies to repairing the damage by building layers of shell over the irritating invaders. These include the boring sponge, *Cliona*, the boring clam, *Martesia*, and the polychaete worm, *Polydora*.

Several organisms which are important pests in other parts of the world are missing from Gulf waters. Texas and Louisiana bays are remarkable, as far as the oyster is concerned, for a lack of predaceous starfish. The oyster drill, *Urosalpinx*, is also absent, although there is a similar snail, *Cantharus cancellaria*, which probably has been mistaken at times for *Urosalpinx*. It may attack oysters, but by far the worst predator is *Thais haemastoma*. The predations of *Thais haemastoma*
are greatest when the salinities are highest. In recent years, oyster mortalities from this predator have been greater than in the past, due to higher salinities in the bedding grounds and the cultivated fields.

Unusual mortalities in Louisiana oysters have occurred within the past fifteen years and appear to be related to a general increase in salinity. A scientific investigation revealed the following conclusions: 1. Industrial wastes are detrimental to oysters in concentrations above 1 per cent. 2. The lack of river water during periods of high temperature has reduced the steady production of oysters west of the Mississippi River.

Gulf encroachment, flood control along the lower Mississippi River, and industrial and navigational needs for canals have apparently resulted in an increase in the mean salinity over much of the Louisiana Coast during the past twenty years. Increased salinities have in turn resulted in changes detrimental to the oyster industry. These include: 1. Increased predation of the seed grounds and bedding areas; 2. Apparent reduction of spatfall in important seed areas; and 3. A possible decrease in fertility due to lack of minerals in certain areas where the fresh-water supply is reduced.

The apparent answer to these problems is fresh water. It is generally agreed that from an engineering standpoint fresh water can be supplied. Such an undertaking would necessarily involve the following
considerations: 1. Locating sites to tap the fresh water. 2. Determining the volume of fresh water needed and the proper method of control. 3. Financing such projects.

History and Economic Development of the Louisiana Oyster Industry

The Louisiana oyster industry is the oldest of the commercial seafood industries. A profitable trade in oysters was well established long before shrimp, crabs, or other seafoods became commercially significant. Since 1925 the oyster industry has been surpassed by the shrimp industry in monetary value, and in recent years the shrimp industry has been worth several times that of the oyster trade. However, the value of the industry to the state in terms of dollars and employment is considerable.

The early establishment of the oyster trade and its relatively stable production and value are interesting aspects of the industry. Although ranking ahead of shrimp commercially until 1925, the gap between the two industries had been growing steadily narrower since 1890. In 1923 the value of the oyster industry was $7,633,325, and of the shrimp industry, $6,620,023. By 1927, the wholesale value of shrimp was $3,500,000, and of oysters, $2,000,000. Shrimp have outdistanced oysters in value by an increasingly wider margin in the years succeeding 1927. No simple explanation will clarify the difference in the commercial record of the two industries. However, an important
factor involves a profound difference in ecology, abundance of the resource, and its distribution. Oysters are much more limited by their environment—the areas where they will thrive naturally and artificially are much smaller than the shrimp grounds. Since the oyster resource is more or less permanently fixed in a definite location, the extent of the resource was known and understood at a much earlier date than that of mobile forms of shellfish such as shrimp and crabs. The stationary character of the oyster reefs permitted an easy harvesting and exploitation, and this factor, no doubt, accounts in part for the early commercial status of the oyster industry as compared to a much later development of the shrimp and crab industries (a similar situation also occurred on the Atlantic Coast). The continued rise in shrimp production has been due chiefly to research that revealed new grounds, and innovations in vessels and gear that permitted a more efficient exploitation. In this connection, however, it is interesting to note that although shrimp production has varied in the last fifteen years it has not significantly increased since the early 1940's when the true extent of the grounds was known and exploited.

Thus, the earlier establishment of the oyster trade and its stability through the years reflect the ease of recognition and harvesting of the resource, and the inability to greatly expand the productive zone. It appears that the shrimp industry has now entered into such a stable
phase, at least for the well-known commercial species that are marketed today. Other factors accounting for differences in the two industries have to do with technical matters of exploitation and production, and the rising cost of labor. These are discussed elsewhere.

Mention of oysters is made by writers on economic subjects in colonial times and during the early part of the nineteenth century, but the impression conveyed is that oysters constituted one of the natural luxuries to be had almost for the asking. The supply of oysters on the natural beds was everywhere so much greater than the local demand and they were so easily attainable, that the price remained too low to induce landsmen to take up oystering as an occupation or to stimulate the demand.

The value of oysters as an article for general commerce seems to have been recognized first in the New England states and in the vicinity of Long Island Sound. However, due to the extractive methods of harvesting, the supply on northern beds began to fail. Previously there was mention of New Englanders coming into the Chesapeake region and establishing packing houses as early as 1836, and also bringing their methods of preserving, packing, and shipping oysters. After the period shortly before the Civil War the industry in the Chesapeake region developed rapidly, and by the close of the Civil War the supply from this area was more than sufficient to satisfy the demands of the trade, including seed oysters for the
northern grounds.\textsuperscript{11}

Around the middle of the nineteenth century the only other area that was producing oysters in significant commercial quantities was the lower Mississippi delta region south of New Orleans. It is likely that a commercial trade in oysters existed in the New Orleans area for many years before the middle of the nineteenth century, but very little information exists to verify this assumption. New Orleans has been a prime market for seafoods ever since the French established the city. Several explanations might account for the fact that residents of New Orleans have always been large consumers of seafood. One reason is the abundance of seafood in the vicinity and the relative ease with which it can be harvested. Another factor that probably has some bearing is the strongly Catholic population of New Orleans. Still another reason could be the early French settlers' familiarity with seafoods. Oyster culture and appreciation for oysters had been established in France before America was discovered, and many of the French settlers and fishermen of the New World originated in the maritime provinces of Normandy and Brittany.\textsuperscript{12}

One of the earliest references to the importance of the oyster industry in Louisiana occurs in \textit{DeBows' Review} for 1847:

\textit{In Plaquemines Parish, upwards of 500 men are engaged in the oyster trade, 150 of which number fish the oysters from the bays, the rest are employed in conveying them to New Orleans. For this purpose 170 small luggers, sloops, and}
schooners of from 5 to 15 tons capacity, are in use for five months of the year. During the summer months they find employment in carrying shells from the islands to the forts and the city. For public works in progress of erection, the city streets, and ornamental walks at private residences, the demand for shells affords good summer employment for this class of persons. From the best information to be had on the subject, the parish of Plaquemines sends a weekly supply to the city of New Orleans of at least 4,000 barrels of oysters, amounting during the season to about $100,000.

Until 1908, Louisiana's oyster industry was an extractive one that merely supplied the local markets, but since that date it has passed into a stage of increasing production and permanence because of the shift to oyster cultivation. Seferovich has classed the development of the industry into three significant epochs: from earliest times to 1896, 1896 to 1908, and 1908 to the present time.

During the seventies and eighties Louisiana was not a large producer, oysters being fished merely to supply the local market. There were no important planting interests, and the potentialities of the industry were realized. Until 1902 the administration of the oyster bottoms was under the jurisdiction of the police juries of each parish. In 1896, the legislature requested the United States Fish Commission to investigate the industry. As a result, a comprehensive oyster law was enacted in 1902. Another investigation conducted by the United States Bureau of Fisheries in 1908 resulted in laws more conducive to scientific culture. The industry changed from the extractive type to the genetic type in 1908, because of the new laws and the administration of the oyster commission. The oyster laws have been amended from time to time; at the present, Act 67 of 1932 governs this industry. Its essential features are to permit state owned bottoms to be leased at $1.00 an acre for a fifteen year period renewable for ten years. In addition, the act prescribes the method of dredging, sets the dates of the dredging season and provides for the issuance of licenses and the collection of privilege and severance taxes.
The extractive nature of the oyster industry before 1908 and poor administration led to investigations that resulted in the passage of the oyster laws. The investigations revealed that the waters of the state were subject to change, and that the ideal producing areas changed with the environment. The principal feature of the oyster laws was to remove jurisdiction over the oyster bottoms from the ineffective and contradictory police juries of the several coastal parishes, and to place it under a state oyster commission which would have sole authority over the entire coast, insuring consistency and uniformity of administration, and police powers to enforce the laws. It appears that a valuable resource was saved by some creditable legislation. Other states with an oyster resource have not followed suit, their fishery remaining a poorly administered extractive gathering of reef oysters with little provision for permanent maintenance.

The economic potentialities of the oyster resource of Louisiana did not get much impetus until the 1880's and 1890's. It was helped along by several factors: 1. The development of the canning process in the 1880's; 2. The immigration of Dalmatians technically trained in ostreiculture; 3. The practice of transplanting seed oysters from the numerous natural reefs east of the delta to the more-saline waters west of the delta; and 4. The enactment of favorable legislation following the oyster investigations around the turn of the century.
The market for oysters taken in Louisiana waters by citizens of Louisiana prior to 1880 was New Orleans, together with a small consumption in the villages and settlements near the reefs. In 1880 the wholesale trade was started at Morgan City and several years later several shucking houses were established at Houma. These developments were for the shipping of oysters to distant points.

From the standpoint of production, the Louisiana oyster industry has been fairly stable. Considerable fluctuation has occurred from year to year due to natural changes in the environment, but in general production has not varied greatly in the last fifty years. This stability is counter to the production figures for Louisiana's other two outstanding shellfish resources, shrimp and crabs, which have been upward. Oyster production for selected years is as follows: 1897, 295,135 barrels; 1920, 573,108; 1928, 645,764; 1932, 616,816; 1937, 1,087,176; 1950, 470,600; 1952, 793,074; 1955, 739,517; and 1957, 485,232 barrels.

Although production has not varied greatly over the last half century, there has been a shift in the source of the oysters. In 1880, most of the oysters taken in Louisiana waters were from naturally growing, uncultivated reefs, whereas today the greater portion of the oysters marketed in Louisiana comes from cultivated and privately leased bottoms.
Oyster Cultivation

At this point it seems timely to describe the different grades of oysters and oyster cultivation in the Louisiana area. In order to change an extractive industry into one in which the resource is renewable, and to answer market demands for a finer product, oyster cultivation was instituted. It originated first in Europe, and later was practiced in southern New England and the middle Atlantic states when it became apparent that natural reefs would soon become exhausted and destroyed by wasteful and unrestricted methods of harvesting. Toward the latter part of the nineteenth century oyster cultivation was initiated in Louisiana. Favorable legislation for protecting the oyster resource followed around the turn of the present century and has enabled Louisiana to remain at a comparatively high and stable level of production. Because natural reef or "coon" oysters tend to be small, difficult to separate from the very young growth, sharp-edged, not of particularly good flavor, and not generally suited for anything except steam canning, oyster cultivation was instituted. Cultivated oysters generally are larger, of a rounder, better shape, and possess a flavor superior to that of natural reef oysters.

Salinity and temperature conditions are ideal for the reproduction and setting of oysters on the east side of the Mississippi delta and in certain areas in Lake Barre, Timbalier Bay, and Calcasieu Lake on the west side, but
most of the area immediately to the west side of the delta is too high in salinity for normal reproduction. The latter area is, however, excellent for oyster cultivation, that is, for the fattening and flavoring of oysters. It appears that the same conditions that are so favorable for reproduction and setting of oyster spat are not usually good for the growth of large, well-shaped, tasteful, mature oysters. Oysters in the zones of ideal condition for reproduction fasten on the available cultch in such enormous numbers that they overcrowd and compete for the available nutrients. The result is enormous numbers of small, sharp-edged, ill-shaped oysters. The Louisiana Coast, then, affords excellent conditions for both natural-reef and cultivated oysters. Large areas immediately west of the Mississippi delta and extending to Atchafalaya Bay have salinities that are too high for the normal reproduction and spat setting, but they are excellent for fattening and flavoring.

All oysters taken from Louisiana waters may be classed into three groups: 1. Steam-canning oysters; 2. Raw-shop oysters; and 3. Counter-stock oysters.

The steam-canned oysters are usually taken from the natural reefs east of the mouth of the Mississippi River where the oysters run to small sizes. The area here is extremely productive, often so productive that there may be a food shortage. Steam-canning, then, is the method used to process and market the small, ill-shaped,
less-tasteful, natural-reef oysters. In addition to a harvesting of the natural-reef oysters, oysters for steam-canning may be provided for by shell planting, which is conducted by the canning factories under the direction of the Louisiana Conservation Department. Factories are required by Louisiana law to bed specified numbers of barrels of shells. The shells provide a natural base for attachment by young oysters and in about two years the oysters are large enough to be harvested. In the factories these oysters are opened by steam, the meats removed, placed in cans, and processed.

A great deal of cultivation is required to produce oysters for the raw-shop trade (see Figures 33, 34, 35, 36, and 37). These oysters are usually taken from natural reefs, cleaned and separated, and placed on bedding grounds leased from the state. Here they become larger, better shaped, fatter, and more palatable. After twelve to eighteen months on the bedding grounds, they are harvested and brought to the packing houses where they are opened, removed from the shells, and shipped in containers ranging in size from six ounces to several gallons. They are under constant refrigeration during shipment to the markets all over the United States.

The counter-stock oysters are the highest grade and the most carefully cultivated. Like the raw-shop oysters, they are usually taken from the natural reefs east of the Mississippi River or from some other natural oyster area.
Fig. 33. Oyster farmers depositing oyster shells over a cultivated ground. Seed oysters will be brought in and spat will attach itself to the re-bedded shells. Much hard work and handling is involved in the cultivation phase of the industry. The beds are outlined by stakes driven into the mud. (Courtesy of Percy Viosca)

Fig. 34. Tonging for oysters. Note oystermen’s houses in background. (Courtesy of Percy Viosca)
Fig. 35. Crewmen of an oyster lugger throwing back the oyster shells which will serve for attachment by future young oysters. There is so little natural attachment in the soft muds of Louisiana that re-bedding of shells is necessary. (Courtesy of Percy Viosca)

Fig. 36. Oysterman holding stake which is used for designating the area of bedded oysters. Oystermen tend their grounds in small luggers such as this one. Some use motorized launches or skiffs.
Fig. 37. Oyster lugger loaded with shells. The men are throwing the shells back to serve as cultch for young oysters. (Courtesy of Percy Viosca)

Fig. 38. Small oyster luggers gathering natural reef oysters. The reef can be seen in the right side of the photograph. (Courtesy of Percy Viosca)
and transferred to leased bedding grounds, usually west of the Mississippi. After remaining on the first bedding ground for several months they are then transferred or re-bedded on a "fattening ground." Two weeks to three months later these fat, flavorful oysters are taken up and sacked, and sent to the cities where they go to restaurants, hotels, and oyster bars. These oysters are usually served on the half-shell.

Disposal of Oysters

The methods of handling oysters and their marketing have changed surprisingly little since oysters first became commercially important in the latter part of the nineteenth century (see Figures 39 and 40). Some aspects of marketing and transportation have been made vastly more dependable and efficient within recent years, but the methods of handling and the types of vessels and gear employed in the oyster trade have experienced little modification. The most notable difference in transportation has been the switch from steam and sail-powered luggers to gasoline and diesel-powered vessels. Zacharie describes the methods of transport and the market conditions near the close of the nineteenth century:

When the planter finds that his crop is sufficiently matured and fat, ready for market, say six or eight months after being transplanted, he bargains and sells to the "luggerman" on the ground. A few planters own or have their luggers and ship for their own account. The "luggermen" transport their purchase to market, generally to
Fig. 39. Sacked oysters on the deck of an oyster lugger at Venice. These are large counter-stock oysters destined for some oyster bar where they will be served on the half-shell.

Fig. 40. A typical oyster lugger enroute to market with a load of sacked oysters.
New Orleans. The trip to the city usually takes from two to three days, a part of the journey consisting in threading narrow, shallow, and tortuous bayous. Adverse head winds sometimes delay the passage so long that the cargoes are unmarketable on reaching their destination. Sometimes, where practicable, "cordelling," or hauling the luggers by horse or man power, is resorted to, and at times steam towage, when accessible, is employed.

Arrived at New Orleans, the luggerman disposes of his load to the dealers, who supply the local trade and ship to neighboring cities. Favorable winds may serve to bring in on the same day a large fleet of oyster-laden craft to "Lugger Bay," as their landing opposite the French Market is called. The market consequently becomes overstocked and glutted. If to this is added simultaneously a sudden change of weather from cold to warm, a not unusual thing in this climate, the luggerman is forced to sell at a very heavy loss or unload his cargo into the river. Besides these adverse contingencies, there are the ordinary accidents of navigation such as grounding and remaining so for several days' duration. Then, too, the cargo is in considerable risk of being killed while in transit. A violent collision with the bank or another vessel, a violent hammering on the deck, and even heavy peals of thunder, have been known to "deaden" the whole cargo, and if the weather be warm and the market not close at hand there ensues a complete loss.21

Seferovich describes marketing conditions and methods of handling oysters in 1938:

The oysters are transported from the beds to the city in power-driven luggers. The luggers are either owned by the planters or operated as common carriers.

Unlike the methods employed in Maryland, the oysters are sacked at the point of production and are not shipped loose in the hold of the lugger. The sacks are carried from the hold of the lugger and stacked on the wharf, from where they are removed to the trucks of wholesalers and then distributed to retailers or shucking houses. Unlike the scenes at the oyster wharves in Maryland, there is neither haggling nor the rush and bustle of buyers and sellers. The boats operate on regular schedules and the shipments from different
planters arrive at scheduled times during the week. The large wholesalers own oyster sacks with the firm's name stencilled in purple, red, or green ink. The wholesaler places his order with the luggerman by delivering to him the number of sacks which he wishes filled and a requisition for various sizes. The luggerman upon returning to the beds delivers the sacks to the proper planter who fills the order and ships it on the next sailing. During the season planters ship about twice a week.

Each wholesaler has an assigned portion of the wharf where the sacks bearing his firm's name are stacked in rows three sacks high. Each sack has a tag attached bearing the names of the planter, the lugger, and the consignee; the number of sacks in the order; and the size of the oysters contained in them. The wholesaler trucks them to his shucking plant where he fills orders for both shell and shucked oysters. 22

Most of the perils of transportation and the uncertainties of marketing have been corrected since Zacharie's report. Canals have been dug, bayous canalized; market conditions are now fairly stable and vessels move rapidly from the point of production to market, only a few hours from the grounds to New Orleans. Present conditions surrounding the handling, transportation, and marketing of oysters are essentially unchanged from those described by Seferovich in 1938.

Gear and Vessels Used in the Louisiana Oyster Industry

Just as the handling and disposing of oysters have undergone but slight changes since the latter part of the nineteenth century, so has the type of gear and vessels employed within the industry remained fairly stable. Some notable changes in harvesting oysters and
in transportation have occurred, but, in general, changes and developments have been slight. In the light of a relatively long established industry, however, this is not surprising. Most changes in technology occur when the status of a resource is altered from that of subsistence or local importance to commercial proportions. In the Louisiana oyster industry there has been considerable time for development of gear and equipment, and thus the old, long-established methods are generally in use today.

Bakes, scoop nets, and various implements have been used to take oysters from the water, but dredges and tongs are the important implements.\(^2\) Tongs date back to ancient Rome and later were employed in other parts of Europe for several centuries. Although dredges have been employed to an ever greater extent within recent years, tongs are still an important tool, especially in the cultivation aspect of the industry where great care is given the oysters. Dredges are employed especially for harvesting oysters from the natural reefs and the artificial shell beds where the catch is destined to be steam-canned, and also in the cultivated beds where previous examination has shown them to be of uniform size and ready for market. Dredges have become important since the World War I period, when power-driven vessels and machinery began to gain prominence. Oyster corporations and canneries find the dredge especially suitable for their large-scale operations.
Skiffs and luggers are the principal vessels employed in the industry, although vessels of many designs have been used on occasion, especially in transporting the product to market. Skiffs and luggers were used in the latter part of the nineteenth century and are in present use with no significant change in size or design. There has, of course, been a switch from sails to gasoline and diesel engines. While the shrimp industry has undergone a revolutionary change in size and design of vessels within recent years, this is not true for the oyster industry. The change in shrimp vessels has been due largely to the development of the offshore shrimping grounds and hence a shift in location of the resource. The oyster industry, however, has not undergone change in the principal distribution of the resource nor a consequent revolution in methods and gear. The methods employed in the latter portion of the nineteenth century have proven to be, in most instances, satisfactory for the present prosecution of the industry.

The oyster luggers most commonly used in Louisiana waters resemble shrimp luggers, but with some notable differences. Figures 36, 37, 41, and 42 illustrate some of the differences. The typical oyster lugger, aside from the shrimp vessels used in oystering, has a shallower draft than that used in shrimping and is usually longer, with more deck space for stacking oysters. The slight draft is necessary for use in the very shallow bays. The
Fig. 41. Biloxi-style oyster lugger loaded with shells. Note the long deck space forward for stacking oysters. (Courtesy of Percy Viosca)

Fig. 42. Biloxi-style oyster lugger at Venice, Louisiana. Note the old hull design. A new deck house has been added. Oysters are stacked forward where considerable space is available. This boat doubles as a shrimp trawler, a not uncommon practice in the lower delta.
oyster lugger in greatest use in the lower delta area of the Mississippi may be termed the Biloxi-type lugger, a vessel described in an earlier chapter (see Figures 36, 37, 41, and 42).

Skiffs are small open boats that can be rowed by one person. These boats are used especially in the detailed work of ostreiculture. Oysters are usually tonged into a skiff and then removed to a lugger (see Figures 33, 34, and 40), if transportation for any distance is anticipated. The oyster farmer nearly always owns his skiff or skiffs, whereas he may rely on someone else for the use of a lugger in transferring his seed oysters to the bedding grounds or in shipping mature oysters to market. It is well at this point to note the steps involved in producing high quality oysters, usually counter oysters. The fisherman buys his shells from either a raw-shop or factory and loads them on his oyster lugger. The lugger transfers them to a bedding ground in a locality where the correct mixture of salt and fresh water is found, making it possible for the young oyster spat to set and live. At this point, the shells are transferred from the lugger to a larger skiff. From the skiff they are carefully scattered on the bedding ground in such a manner as to prevent overcrowding. These shells are then left for a period of approximately two years, at which time they will have accumulated the "set" from two seasons. Again they are tonged up from the bedding ground into a skiff.
The oysters are now carefully culled by the fisherman, who separates the various sizes with a small hatchet used for that purpose, the small oysters being re-bedded. The large oysters are transferred from the skiff to the lugger and are now carried to a bedding ground nearer the sea where they may develop choice flavor. At this point they are shovelled from the lugger into the skiff. From the skiff they are again scattered on the bedding ground, care being taken to give them a proper spread, and are allowed to remain from one week to two months, dependent upon conditions. On the several days preceding shipments, the oysters are tonged into a skiff and taken to the "clean" bedding ground, usually located near the fisherman's camp. These are the oysters which, by careful selection, are found to be ready for the market and are re-bedded very thickly so as to permit rapid loading for shipment. Several hours before the freight boat arrives they are tonged again into the skiff. They are now carefully measured into a standard metal basket containing one and one-half bushels and from this basket are dumped into the familiar oyster sack. These sacks are carried onto the freight boats and transported to the city. From the freight boat the sacks are carried and stacked on the wharf to await distribution. Sacks are loaded onto a truck and brought to the various oyster counters, raw-shops, and restaurants scattered over the city.
From the above description it is apparent that there is much laborious work and a great number of steps involved in the production of cultivated oysters.

The Oyster Fishermen

Though peoples of various racial strain and nationality are found working in the oyster trade in Louisiana, families of Anglo-Saxon, French, and Slavic origin are the principal ones. Families of Slavic descent, frequently referred to as Dalmatians, dominate the industry and especially control the phase which practices cultivation. They were the pioneers that developed oystering from a haphazard, part-time, extractive industry to a highly organized and year-round occupation. Members of this group are also responsible for most of the tools, and gear that are connected with oystering in Louisiana.

The Dalmatians are not distributed evenly throughout the area of the coast where the environment is favorable for oysters, but are concentrated in a single geographical area. They dominate the oyster industry on both sides of the lower delta, from Myrtle Grove to Venice. They are especially concentrated on the side tangent to the west bank of the Mississippi, in the area where oysters do not thrive naturally but must be cultivated; and this is also the phase of the industry with which they are most vitally concerned.
People of French extraction dominate oystering from Barataria Bay westward to Vermilion Bay. They are most numerous in the lower part of Lafourche Parish. The French are found, however, in all the areas of the coast where oystering, shrimping, and fishing are pursued. They do not form as closely knit a group as do Dalmatians, either in geographical distribution or in economic occupation. They were the first people to gather oysters along the Louisiana Coast, but to them it was strictly a part-time occupation, and was extractive in nature. When they had exhausted the oysters in one vicinity, they moved to another, concerning themselves very little with the conservation of the resource. It remained for the Dalmatians to institute oyster culture. Some French families are now engaged in oyster culture, but they learned the technique from the Slavs.

Since the Dalmatians are the distinctive group that dominates oystering in Louisiana, their origin, culture, and living habits are worth noting. The Dalmatians, also referred to as Slavs, Slavonians, and Austrians, immigrated to Louisiana from the Dalmatian coast, presently the part of Yugoslavia bordering the Adriatic Sea. This coast was part of the Austrian Empire before World War I, and was referred to as the Slavonic provinces. The people there were Slavic in language and culture. Many of the inhabitants of the Dalmatian coast were fishermen and oystermen, and some of these hardy individuals
spent a part of their lives as sailors and visited many foreign shores. Such travel led them to discover the lower delta of Louisiana and its abundant seafood resources. A few of these sailors were quick to recognize in Louisiana the economic possibilities of oystering—something familiar to them in their homeland.

The Slavonians did not come in great numbers within a short span of years; on the contrary, their immigration extended over nearly a half century from the middle of the nineteenth century until the years approaching World War I. Kammer has this to say about them:

It is not definitely known when the first Slavonian immigrants came to Louisiana. The first Baptisms in the parish of Our Lady of Good Harbor at Buras were conferred December 4, 1864, on Louise Buras and Josephine Zibilich. Other Slavonian names appear in subsequent entries in 1864 and 1865. Consequently, there was at least a small group in Plaquemines Parish at that time. Although living in a distinctively French culture, the Slavonians have maintained their own cultural patterns.

At first, only men came into the delta where they lived singly under primitive conditions for ten or fifteen years, and when they had amassed what they considered a tidy fortune by standards in their homeland, they returned to Dalmatia to pick a bride and perhaps return to Louisiana or remain in their native land. Gradually, however, more and more of them became attracted through the stories of their compatriots to the oyster coast of Louisiana, and began taking their women with them. Finally, the trickle back to Dalmatia ceased entirely and the immigrants
set about the task of becoming permanent residents engaged in a year-round occupation to which they had elevated the oyster industry.

The Slavs have retained their cultural patterns to a surprising degree in the midst of a polyglot delta community. Most of them who still live in the delta are bilingual, and they still observe Slavic holidays and festive occasions, as well as subscribing to Slavic literature. They also brought and have maintained Slavic work habits, which, compared to French standards, are unbearably and unnecessarily stringent. Their belief in and willingness to do hard, laborious work have probably been the factors which have developed the oyster industry into what it is today.

In contrast to the shrimp fishermen's manner of settlement, whereby a village is extended for perhaps several miles along the natural levee of a bayou and consists of houses of various design from crude shacks to brightly painted, spacious bungalows, the oystermen typically live widely dispersed and comparatively isolated in little cabins erected on piling to protect them from high tides (see Figure 41). In this respect their mode of habitation and settlement has not changed much in the last fifty years. Naturally, certain modern conveniences have been accepted, such as gasoline-powered craft, radios, and kitchen utensils, but their homes are still small and barren as compared to those of other marsh inhabitants.
Fig. 43. View of an oysterman's house. It is a small one-or two-room construction that is raised on stilts to protect it from hurricanes and wind tides. Also it is much drier and cooler than if it rested on the moist ground of the marsh. It is a lonely existence, one that most marshdwellers have avoided, excepting the Slavs and their descendants. Financial returns have made it worthwhile to the Slavs. (Courtesy of Percy Viosca)
The oysterman's house is a small box consisting usually of not more than one or two rooms, often with an attic for storage. It is erected on cypress poles and usually has cypress shingles on the roof.

The oysterman has found it necessary to live either in this house the year round or certainly somewhere in the vicinity of his operations, if he would realize a profit. The cultivation phase of the industry requires constant attention: Oysters must constantly be examined for size and quality since they may be in different stages of growth; they must be taken up occasionally to prevent overcrowding; predators must be controlled; and they must be protected against theft, which frequently occurs when the beds are left unguarded. Thus, it can be seen in this instance how much the physical environment and occupational requirements affect house type and general living conditions.

Not all of the people in the delta of Slavic descent are oyster farmers. The percentage of them engaged in oystering would be considerably less than half. The remainder are employed in the citrus industry near Buras, and others are in various occupations connected with retailing and servicing. Still, many others have recently left the area for opportunities in New Orleans and other cities of the region.

Just as they developed the oyster industry into one of permanence and significance, so the industrious
Slavonians also initiated a citrus industry in the lower delta. Again, just as they were familiar with oystering in their native land, so they were also familiar with citrus culture, and they quickly recognized that the climate of the lower delta would permit this industry. They specialize in orange wine, and the lower delta is one of the few places in the United States where orange wine is commercially manufactured. The fact that the Slavs are traditionally great wine drinkers doubtless led to the initiation of this industry.

Thus, it is readily apparent how much the character and status of an industry owes to a particular ethnic group. Oyster culture in Louisiana is a specific introduction of the immigrant Slavs, and in spite of the favorable oyster environment, it is very possible that it still might be of little or no importance had the Dalmatians not come to Louisiana. The continued dominance of the industry by the Slavs, and the hesitation with which others have entered into the cultivation phase of this occupation, tend to support this observation. Although there are no other southern states south of the Chesapeake region with an oyster resource comparable to that of Louisiana, some, nevertheless, have possibilities for oyster culture but have failed significantly to realize them. It is perhaps noteworthy in this connection, that only Louisiana received a sizeable immigration of Dalmatians.
The comparatively early rise of the oyster trade in Louisiana at a time when other seafood industries had little or no commercial importance reflects the early familiarity of Americans with the product, the comparative ease of harvesting natural reef oysters, the long-established and simple types of gear, the presence of an unusually large urban market (New Orleans), and the immigration of the Slavs.

Comparatively stable production through the years is a result of early recognition and development of the oyster grounds, and of the fact that they have not been or cannot be greatly expanded, meaning, therefore, that no great increase in production could have been effected. Also, the rise of the shrimp and crab industries has constantly received more and more attention from the coast-dwellers. Some foresee a danger to the oyster industry because the thriving shrimp and crab industries require less labor, time, and are probably more rewarding financially. For this reason, many of the Dalmatians of the present generation are not following the pursuit of their fathers.
Footnotes


4. Ibid., pp. 52-54.

5. Ibid., pp. 52-54.


10. These statistics were obtained from the Louisiana Department of Conservation Biennial Reports. The sixth and eighth Biennial Reports were used for the years 1922-23, and 1926-27, respectively.


15. Fleets of schooner-rigged vessels from Mississippi had been gathering oysters from the natural reefs of Louisiana east of the delta for decades. Mississippi vessels still come to these waters, but must pay a severance tax on the quantity taken.


17. The figures of production were taken from the Biennial Reports of the State of Louisiana, with the exception of the first figure which was obtained from the U. S. Fish Commission Report for 1899.


20. "Coon" oysters were so-named because raccoons have been observed feeding upon them at low tide.


25. Oysters require considerable year-round labor and continuous watching to prevent poaching, therefore the oysterman and his family or employees will live
in the camp or visit it frequently. Boats and other equipment are kept at the camp the year round and the elevated house serves to protect against the summer sun and provides a place to work. Oyster habitat occupies the zone of the marshes known as salt-marsh located on the outer perimeter of the coast and subjected to every hurricane that may occur. Seldom does a year pass that four- to five-foot storm tides do not sweep such areas at least once during the hurricane season.

Trappers' camps, on the other hand, are established with less permanence in mind. Trapping leases are usually made on short terms as animal populations are continually shifting. The trapping grounds are afforded some protection from hurricanes by their position further inland where bayou banks and man-made levees usually provide a higher elevation. The trapper maintains his camp and equipment only during the winter months, the season without tropical storms. His gear is moved in when he moves in and out when he leaves. The cheaper construction with house flat to the ground can be kept warmer in the winter than if located on piling. During the off-season or periods when animal populations are not sufficient for commercial trapping, the camp must remain unattended for long periods, subjecting the houses to the hazards of marsh fires and vandalism. Lightning often times sets dry marsh grass afire in the trapping zone, whereas the salt-saturated vegetation in the oyster zone will seldom burn.
Crabs constitute the third important shellfish of Louisiana. Crabs rank third in nearly every comparison with shrimp and oysters: in monetary value, number of people engaged in the industry, and as the last of the three to gain commercial significance. However, crabs are not necessarily last in abundance and potential. Although the commercial phase of the industry is well underway, there are still good possibilities for increased exploitation of the resource. Intensification of the industry will necessarily await such things as market expansion, improved methods of handling, various new preparations of the meat for consumption, and perhaps a rise in price for the raw and finished products. Nevertheless, the growth in importance and production of crabs within the last twenty years has been nothing short of revolutionary.

The common blue crab, *Callinectes sapidus*, is the species which is commercially important in Louisiana, just as it is in the remainder of the Gulf states and the south and middle Atlantic states. It ranges from Massachusetts to Texas, occurring most abundantly in the
Chesapeake area, the south Atlantic, and the northern Gulf coast. It is taken commercially in all coastal states south of New York, but production is greatest in the Chesapeake region and Louisiana. It is also one of the best known crustaceans in the world because it is so widespread.

The environment which is suitable for shrimp and oysters is also excellent for blue crabs. The particularly favorable environment afforded by the Louisiana Coast for shellfish has already been described in considerable detail and will not be discussed further. It should be sufficient at this point to state that blue crabs are euryhaline animals tolerant of a wide salinity range, and though differing tremendously from oysters and shrimp in their biological nature, their welfare and abundance are, in a general sense, largely dependent upon a similar environment. Pertinent facts regarding the special biology of the blue crab and its living habits are outlined in the following paragraphs.

The blue crab is only occasionally found in the open sea, except for a narrow, shallow zone bordering the beaches. It prefers bays, sounds, and the mouths of rivers, where it lives in waters ranging from true ocean saltiness to almost completely fresh water. Although found and taken commercially in fresh water at times, the chief commercial fisheries are in the bays and sounds. Obviously, then, a coastal environment which
is a complex of bays, sounds, and brackish streams will have a particularly abundant crab population, one that will have great commercial potentiality. Louisiana has such a coast and is also one of the leading commercial producers of crabs.

Although thriving in the environment that is suitable for oysters and shrimp, the ecology of the blue crab is less exacting than that of the other two species of shellfish. Crabs are more evenly distributed in their range than shrimp and oysters, but show definitely greater abundance in the same areas where shrimp and oysters are found in quantity. The reasons for this probably rest upon the crab's special biological equipment, its larger size, and feeding habits. Crabs are very mobile creatures, their shell affords good protection from enemies, and they are scavengers (although they prefer fresh food to carrion or food that is undergoing decay).

Crabs are found nearly everywhere in the shallow waters of the Gulf and in the tidal bays, lakes, and estuaries. During the warm season they are abundant in shallow water, but migrate to deeper water for the winter where they either bury themselves in the mud or sand or live quiescently on the bottom. Crabs are hatched from an egg about the size of a pen point. The unhatched eggs are carried in a sponge-like mass under the abdomen of the female. This mass may contain over two million eggs. Upon hatching young crabs swim off and are dispersed by
waves and currents. Crabs enter three principal stages of development, the "zoea" stage, the megalops (large-eye) state, and the third stage in which they finally resemble their parents. In the "zoea" stage they are like small spiny lobsters and swim freely in the open sea feeding upon tiny plants and animals. In the megalops stage crabs resemble a little crawfish with large bulging eyes. Also, in this stage they cease swimming and attach themselves to jelly-fish, seaweed, or driftwood. During the third stage when they begin to resemble adults, young crabs enter the inside waters where they receive more protection from enemies than in the open sea and hence gain a better chance for survival.

Crabs can increase in size only at the time of shedding their shell. Fat and flesh accumulate under the old shell and internal pressure literally cracks it open along predetermined lines. At this stage they are known as "busters." When the old shell is completely cast off, a new soft shell takes shape almost immediately and during this period they are referred to as "soft-shells." Growth is apparently remarkable at this time, a buster crab three and one-half inches across the shell may be as much as four and one-half inches a few minutes after shedding its shell.

Since the soft-shell crab has no protection from its enemies or even other crabs, it immediately seeks cover or buries itself in the mud behind the old shell.
It cannot feed for three or four days until its shell becomes hard, but subsists in the meantime on a stored-up fat reserve. A crab may go through fifteen or more molts before attaining maturity, at which time it can no longer shed its shell. Adult males are usually about eight inches across the shell, while females are slightly smaller. A crab can mature in about six months; one hatched in March may be mature by the end of summer. However, growth is slow in winter, and a crab hatched in September will not attain maturity until the next summer. Mating occurs when the female is approaching the final molt.

Females mate only once; when the mating is over a female separates from her mate and lives a solitary existence in the shallow water of the open sea for the remainder of her life. It is not known whether male crabs mate more than once. The food of crabs is highly variable and may be both animal and vegetable. Crabs are pre-eminently scavengers but can seek and capture their own food. The large pincer claws enable a crab to hold and crush its prey which may include oysters, mussels, other sessile organisms, small fish, and even their own kind.²

Development of the Louisiana Blue Crab Fishery

Crabs have been taken and used as food by the
coastal inhabitants of Louisiana ever since settlement of the region. Also, considerable quantities have always been marketed in New Orleans and smaller coastal cities. Other than this relatively minor local consumption of crabs, there has been no significant commercial development of the resource until comparatively recent times.

Commercial development of the crab industry first occurred in the middle Atlantic states, principally in the Chesapeake region. Nearly every seafood resource which is common to both the Gulf and middle Atlantic area was first developed in the latter region. A previous section of this paper has traced the early development of fisheries in the New England and middle Atlantic states and the diffusion of methods, gear, and vessels into the south Atlantic and Gulf states. The crab industry is no exception to this general pattern, and most of the methods of handling, gear, and other equipment employed in Louisiana were first used in the middle Atlantic states.

In the 1880's crabs were commercially important in some sections of the middle Atlantic states, but were of no significance from North Carolina southward, except in the vicinity of relatively large cities such as Wilmington, Charleston, Savannah, Mobile, New Orleans, and Galveston.

During the 1880's the crab industry of the middle Atlantic states was a seasonal industry employing
more people in the summer and attracted mostly women and children. The actual canning of hard crabs began in the year 1878 at Hampton, Virginia, under the direction of a Mr. James McMenamin. The financial success which resulted from the lobster canneries of New England led to the idea that crabs could also be profitably canned elsewhere.  

The oyster resource of Louisiana was being developed during the latter years of the nineteenth century and the shrimp industry was born shortly afterwards. It was, however, not until the early 1930's that the crab resource of Louisiana began to assume commercial significance. Reference to the growth of the crab industry at this time is given in the 1930-31 Biennial Report of the Louisiana Department of Conservation:

Of great importance to the fisheries of Louisiana is the new industry of crab-meat packing, now being developed. Within the short period of one year, the crab-meat industry of this State has grown from almost nothing to a position of real importance. Over a score of firms and hundreds of workers are now engaged in the business of catching, picking, packing, and processing crabs into cans. These new plants are packing crab-meat on an average of 75,000 crabs daily, having a combined output of 5000 to 6000 pounds of crab-meat per day. This new industry provides work for countless people, as it requires two crab fishermen for each person employed in the plant, busy picking and packing the crabs, which means thousands of fishermen busily engaged in the catching of crabs.

Further accounts of the early commercial development of the crab industry in Louisiana are furnished by N. E. Simoneaux, quoting Mr. Joseph L. Fisher, a crab-
meat packer of Morgan City:

Crab-meat is the industry that promises to be the major one in this section in the near future. The first establishment was opened here a few years ago in a small way by a New Orleans distributor who has gradually enlarged his plant and increased his number of workers, until now he owns about eight such concerns in Morgan City and Berwick, providing employment for six hundred people.

Some doubt was expressed for a time whether there would be enough crabs to maintain the plants in continuous operation, but this doubt has now been eliminated by the string of boats on the Gulf coast fishing in salt water for crabs. Perhaps a hundred men are now employed fishing crabs in the outside waters, mixing the salt water crabs with the fresh water catch.5

Except for the discovery of the offshore shrimp grounds in this vicinity and their consequent exploitation, Mr. Fisher's prediction that crabs might be the major industry of the Morgan City area could well have been true. It is today the center of the industry in Louisiana.

Since the early 1930's crab production has steadily increased. It has been due chiefly to the establishment of crab-meat packing and canning factories, a gradual expansion of markets, a general economic improvement within the nation as a whole, and also some improvement in methods of capture, although most devices employed for crab capture in Louisiana have been in existence for over half a century. The 1950-51 Biennial Report of the Louisiana Department of Wildlife and Fisheries states that crab production has risen within a period of fifty years from one-half million to over
ten-million pounds per annum. Production figures for selected years attesting to the steady growth of the crab industry are: 1932, 1,041,091 lbs.; 1933, 1,813,508 lbs.; 1936, 4,000,000 lbs.; 1950, 10,854,669 lbs.; 1954, 14,112,177 lbs. The commercial production of crabs before 1930 was extremely low, apparently so slight in importance that production figures were not listed in the Biennial Reports of the Department of Conservation.

Although the Chesapeake Bay section has always led in crab production, the yield from southern areas has been growing steadily. In 1944, Rachel Carson stated that the state of Louisiana produced almost half as many crabs as are taken in the Chesapeake. Louisiana far surpasses any other southern state in production. Compared with fourteen million pounds produced in Louisiana, North Carolina and South Carolina produce about four million each, Florida about six million, Georgia, Alabama, and Mississippi one to two million each, and Texas only about 250,000 pounds. It is believed that crab production in the Chesapeake has about reached its maximum development, whereas in Louisiana it has just gotten well underway.

It is not simple or easy to account for the retardation in development of one resource while similar resources developed earlier. A great part in the development of a resource is played by strictly cultural phenomena such as attitudes and prejudices of people, unfamiliarity with the species, technological problems
in production and processing, transportation, and the preservation of the meat. It appears, however, that the following features are largely responsible for the late development of the crab industry as compared to an earlier development of oysters and shrimp: 1. The technological difficulties connected with preservation, processing, and the picking of crab-meat from its shell. 2. The seasonal nature of crabbing until vessels began taking them in the outside waters. 3. A general unfamiliarity with the blue crab, except along the Atlantic Coast.

A retarding factor of unusual proportions has been the difficulty of preparation and preservation of crab-meat. Very few fish or shellfish decompose as rapidly after death as crabs. If a crab has been dead no longer than a few hours, the meat is usually considered unsafe for consumption. Crabs, then, cannot withstand the delays and long periods in a semi-frozen state which formerly characterized the handling of seafoods. They must be kept alive after capture and transported as quickly as possible to the canneries and packing houses. Obviously, few commercial possibilities existed for this resource until canning and quick-freezing became widespread.

Add to the difficulty of preservation the time and painstaking labor necessary to remove crab meat from the shell, and it is small wonder that crab production
has not been of long commercial standing. Before modern steam canneries and the quick-freezing process, the cost of labor, together with poor transportation and the slight demand for crab meat (except for certain Atlantic Coast districts), barred any extensive commercial operations. Also, unlike shrimp and oysters, the edible portion of crabs is small in proportion to the whole crab, and this has been a disadvantage in the development of the industry.

There are undoubtedly more factors involved than the ones offered; however, the ones named appear to be significant. As the nation is gradually becoming familiar with blue crab-meat, it can be assumed that production will continue to rise until there is a noticeable dwindling of the resource. Oystering was once a seasonal occupation, and the same was true for shrimp. Oyster cultivation changed that industry from a haphazard seasonal industry to one of year-round occupation. The advent of the otter trawl revolutionized shrimping and permitted production to increase tremendously. Also, the discovery of the offshore shrimping grounds permitted year-round exploitation of this resource. The establishment of outside markets for Louisiana canned and packed crab-meat and improved packing and handling of live whole crabs gave economic birth to this industry. The desire for a continuous production of crabs for the canning and packing plants led crabbers to exploit the
salt-water crabs, and thus commercial crabbing could, with extra investment, be pursued for practically the whole year. However, except for an area near Morgan City where crabbing is pursued in the outside waters, it is still principally a seasonal occupation with most of the marsh inhabitants.

Intense year-round harvesting of crabs is probably not possible over a large area for both natural and cultural reasons. Natural obstacles could be that this type of exploitation might upset the ecology—too many of the young might be taken or destroyed, and the spawning area might be disturbed. Also, in the cultural sense, too much time and investment on the part of the crabber and too little reward in price will perhaps discourage anything more than seasonal participation. Crabbing is seldom anything more than a summer occupation with most people. It fits nicely into the occupational pattern of the marshdweller, who traps muskrat and nutria during the winter months, and devotes a part of spring, summer, and fall to crabbing. He may also do some shrimping during the peak season. Although largely a seasonal occupation, a tremendous quantity of crabs can be taken during the summer period, as practically every stream and lake in the marshes contain great numbers of them. Production has intensified in the last twenty years and, apparently, the resource can withstand even greater demands.
Although crabs are found plentifully throughout the brackish waters of the coast, commercial production is concentrated in certain areas. These areas, by their special natural characteristics, are exceptionally endowed for an abundant crab population. Three principal areas can be designated as centers of crab production in Louisiana. They are, in their order of importance, the Morgan City area, the Barataria-Lake Salvador region, and Lakes Pontchartrain and Maurepas. With the knowledge that crabs are euryhaline animals, a glance at a map of coastal Louisiana is sufficient explanation as to why these areas are crab-production centers. First of all, they have an unusual concentration of brackish lakes and inter-connecting bayous. Secondly, they are accessible and relatively near New Orleans, the traditional market and transportation center of the whole region, and thirdly, these areas, previous to commercial crabbing, were already centers of shrimping, oystering, or trapping, which facilitated participation in crab exploitation. (See Plate VIII for the location of the principal crabbing areas.)

Although crabs taken in all of these areas may enter the market as whole hard and soft-shell crabs or canned crab-meat, there is particular emphasis in each area on a certain preparation for market. The Morgan City-Berwick area is the center for canned and frozen-packed crab-meat, the first crab cannery in Louisiana
LEGEND

- **Principal Oyster Bottoms**
- **Principal Crabbing Areas**
- **Shrimp Ports**

THE COASTAL ZONE

INTRACOASTAL
CALCASIEU LAKE
SABINE LAKE
WATERWAY
GRAND LAKE
CAMERON
having started here around 1930. Production from the other two areas is composed largely of live or frozen whole, hard and soft-shell crabs. The latter areas supplied New Orleans with crabs long before the resource attained its present importance, and probably half of their present production is consumed in New Orleans. However, fast transportation and improved preservation now permit whole hard and soft-shell crabs to be transported in good condition to large city markets all over the country, but most of these crabs are sent to cities along the Atlantic seaboard, where there is familiarity with and a heavy demand for whole crabs. Carson states:

At the present time the most important markets for fresh crab are the cities of the Atlantic seaboard, which have long been familiar with this perishable product and know how to give it the special handling it requires. On the other hand, few mid-western cities know the blue crab as well, and as a result the interior markets to which the Gulf coast product could most profitably be shipped have not been fully developed. This lack of near-by markets for fresh crab has been an important factor in holding back the development of a large fishery in the Gulf.

Crabs may enter the market in various ways, but usually as live hard or soft-shell crabs, and as canned or packed, frozen crab-meat. In Louisiana, soft-shell crabs are packed in Spanish moss, usually in baskets. After grading, they go into refrigeration instantly. They are rushed to New Orleans daily by motor trucks, packed in ice. Markets and restaurants take many, while others are shipped to distant points: Chicago, New York,
California. Other crabs go into cold storage, to be frozen and kept indefinitely. Hard-shell crabs do not require such careful handling as soft-shell crabs; they may be shipped in barrels, baskets, or some other container moist, because as long as the gills of the crab are moist they will stay alive for days or even weeks.

In the packing or canning plants, crabs are boiled alive, and in about twenty minutes are ready for dissection. A considerable number of people (usually women) are employed as "pickers." They dissect the crab, segregating the dark meat of the claw from the white meat of the body. The meat is packed in different containers, being designated as dark (claw) meat or white (body) meat. The white meat brings a higher price in the market but some people actually prefer the dark meat. Crabs may be brought and sold at the docks of the packing and canning plants in quantities ranging from a small sackful to several tons.

Crab Gear Development

Crabs are captured in various ways, with baited lines, dip nets, hoop nets, crab pots, gill nets, fish seines, fish hooks, scrapers, oyster tongs and, in Louisiana, with the "bush" method. With few exceptions, the methods for taking crabs have changed very little since the latter part of the nineteenth century. Most
Fig. 44. Trotline. This semidiagrammatic sketch of a trotline being fished shows the anchored and buoyed line, baits in place, passing over the roller on the side of the boat. The fisherman nets the crabs as they are brought to the surface. (After Cargo, Maryland Commercial Fishing Gears III. The Crab Gears, 1954)
methods of capture are common to both Louisiana and the Chesapeake region, although there are some notable exceptions. For 1880 Rathbun lists all of the above-named methods, with the exception of the crab pot and "bush" method.\textsuperscript{10}

Several of the methods of capture listed in the above paragraph are unimportant for commercial crabbing—gill nets, fish seines, fish hooks, and oyster tongs. The most important device of capture for commercial purposes is the baited line, sometimes called a trotline. (Figure 44 illustrates this method.) The baited line is one of the oldest and most widely used methods of capture. It ranks first in importance not only in Louisiana but also in the Chesapeake region and other crabbing areas.\textsuperscript{11} At the present time, however, the crab pot is seriously competing with the baited line as a preferred means of capture in the Chesapeake area.

The baited line is the chief method of catching hard-shell crabs, as soft-shell crabs will not take bait for fear of exposure and attack by their enemies. The baited line is a long line, usually over a thousand feet, to which are attached shorter lines holding the bait. The bait is usually something tough and rubbery, like a cow's nose, ear, or lip. The lines are set in the water of lakes, bays, and bayous, and along the beach. They are tied at each end to stakes. The fisherman, in a skiff or pirogue, pulls himself along with the heavy
Fig. 45. Roller and Bracket. Sketch of a roller and bracket attached to side of boat. The trotline is shown passing over the roller, an operation that lifts the feeding crabs to the surface to be taken in a dip net. (After Cargo, *Maryland Commercial Fishing Gears III. The Crab Gears*, 1954).
Fig. 46. Patent Dip Net. Note the bracket and roller on the nearer bow which is fastened to the boat. The trotline runs over the roller and the crabs drop into the net which is fished, that is, emptied, according to the abundance of crabs in the catch. (After Cargo, Maryland Commercial Fishing Gears III. The Crab Gears, 1954)
line and catches the crabs hanging onto the bait with a dip or scoop net. The crabs are kept alive in baskets covered with wet Spanish moss. In the Morgan City area of Louisiana where crabs are captured in salt water practically the year round, extremely long lines of several thousand feet may be used. The baited line is constructed after the pattern of the trotline used in ordinary fishing, but without hooks.

A recent modification in the baited-line method of capture, and one that is being widely adopted by commercial crab fishermen from New Jersey to Texas, is addition of a roller (see Figures 45 and 46). A roller is fastened onto the boat, and over it the crab line runs. The motor of the boat is idled to the point where it slowly pushes the boat along the line. Then, with the use of a small dip net, the crabs are scooped from the bait into the boat just before the bait is raised from the water by the roller. Another automatic feature often used is a basket-like net just below and behind the rollers. The basket is placed just at water level (Figure 46). As the line passes between the rollers the crabs are knocked off the bait and swept back into the net by the forward motion of the boat. The roller method has been only in very recent use in Louisiana, probably no earlier than 1951. Kammer, in 1941, describes the baited-line method of crab fishing, but makes no mention of the roller modification. Percy Viosca
stated in 1953 that the roller method was a very recent innovation. Actually the method must have been introduced into Louisiana shortly after 1951, probably in 1952, because Gowanloch wrote an article in the 1950-51 Department of Wildlife and Fisheries Biennial Report, describing efficient crab gears, the roller method among them, that were unknown in Louisiana waters. The roller method originated in the Chesapeake region within recent years. Cargo gives a very detailed explanation of its use and construction in his report on crab gears of the Chesapeake.

The dip or scoop net is used mainly in conjunction with the baited-line method, but may be employed alone for crabbing in very shallow water. The latter manner of capture is, however, relatively unimportant; the main use of the dip net is for landing crabs once they have been enticed by bait.

A favorite device for taking hard-shell crabs in some areas of Louisiana, especially Lakes Pontchartrain and Maurepas, is the hoop net (see Figures 47 and 48). This is simply a piece of twine netting tied to a hoop (usually a barrel hoop). It is weighted in the center and, after being baited with a piece of meat, is lowered to the bottom if the water is shallow, but otherwise to a few feet under the surface in deep water. When it is lifted by a long hook, by hand, or by strings attached to a stake or float, the net closes, with the crab and
Fig. 47. The hoop net sags in this manner with a piece of meat in the center. The net is held near the surface by a small float. Circulating crabbers raise the net and dump the crab into their boat.

Fig. 48. Inside the shelter of a small dock. Note the hoop nets. This is a favorite method of capture in the Lakes Pontchartrain-Maurepas region.
Fig. 49. Sketch of Crab Pot (description in text).
(After Cargo, Maryland Commercial Fishing Gears III. The Crab Gears, 1954)
bait enclosed in the center of the net. A favorite way of using hoop nets in Lakes Pontchartrain and Maurepas is to set them in a certain section of the lake attached to a float or buoy that may or may not be connected with the bottom. Oftentimes a series of hoop nets with floats is connected together by a long line that is fastened to stakes driven in the bottom. The crab fisherman, usually in a motor-powered skiff or rowboat, will make periodic visits to examine his hoop nets. The hoop net apparently has never been an important device of capture in the Chesapeake. Cargo does not even mention it in his description of crab gears in Chesapeake waters. However, this method is not of recent origin. In 1880, Rathbun lists the hoop net as an important means of capture on the coast of Georgia. It is also commonly used in certain sections of the Pacific coast.

The crab pot is an efficient method of capture for hard-shell crabs (see Figures 49 and 50). It compares favorably with the baited line as a means of capture, and some sources state that more crabs can be harvested in a given period by this method than with the baited line. The crab pot is a fairly recent innovation, patented in 1938 by B. F. Lewis of Virginia. Cargo furnishes an excellent description of the crab pot:

The pot affords an easy entrance for the crabs through funnels, but escape is difficult. It is cube shaped and generally constructed of one to one-half inch chicken wire with heavy wire or
iron rod bracing. It is usually twenty-four inches on each side. It is divided horizontally into two parts by an odd-shaped partition. The lower part has two or four funnels on the sides and contains a cylindrical compartment which is closed at the bottom by a metal plate. The partition is raised in the center and has two slits cut in it to permit the crabs to move to the upper chamber after entering the pot. This feature tends to draw the crabs away from the bait so that the pot will continue to lure crabs. The wire on top of the pot is left free on one edge to provide for the removal of the catch when the gear is fished. This opening is closed and held that way by a wire catch. The gear is completed by the attachment of a fiber rope with a small buoy or float, usually bottles or cans, to mark the position of the pot. Most pots are weighted to hold them in place when water movements become heavy. Generally, handfuls of cement are placed in the bottom of the pot. It is baited with fresh fish of the least used kinds, the so-called trash fish. Contrary to general belief, fresh bait attracts more crabs to the pot than does spoiled bait.20

Although there has been a rapid expansion of crab-pot use in the Chesapeake region, its employment is just beginning in Louisiana. In the fourth Biennial Report of the Department of Wildlife and Fisheries for the State of Louisiana, the chief biologist, Nelson Gowanloch, had this to say:

The crab pot is essentially the modification of the traditional lobster pot used for centuries in capturing the northern lobster. It has been used with extreme success on the East Coast, where it is standard gear, but has never been used in any other than an experimental manner in Louisiana waters, although it is, in the writer's opinion, one of the most efficient methods that could be used by a small operator. It has the commendation of conservation authorities wherever it is employed, since it holds the captured crabs without harm and permits the release of undersized individuals. It has the further merit of being inexpensive and capable of inexpensive maintenance care.21
Gowanloch wrote the above article on the crab industry of Louisiana in part for the purpose of acquainting Louisiana crab fishermen with efficient means of capture that were highly successful elsewhere. Apparently, the efforts of Gowanloch and others were partially successful, because the crab pot and some other methods previously unknown to Louisiana fishermen are now used. However, in the case of the crab pot, it has not yet gained wide acceptance throughout the crabbing areas of Louisiana. As late as the spring of 1956, it was practically unknown in the Lakes Pontchartrain and Maurepas area. In this area a few crab pots were observed lying outside of a crab dealer's establishment, but local crabbers said they had just been left there for experimentation by a crab dealer of the Barataria region (see Figure 50). Crab pots had been used for some time in the latter section with great success. Crabbers in the Pontchartrain and Maurepas area were definitely not familiar with the crab pot at that time. It appears, however, that this device will rapidly gain favor with the crab fishermen.

The previous discussion is concerned with the principal methods employed in capturing hard-shell crabs. There are two important methods employed chiefly for the taking of soft-shell crabs. They are the crab scraper and the "bush" method. The former is an important device used in the Chesapeake region, but not yet extensively employed in Louisiana. The use of the latter method is confined
Fig. 50. Crab pots lying in the foreground near a crabber's house. The crab pot is a very efficient means of capture but has only recently been introduced into Louisiana, and is still not in general use throughout the crabbing areas.

Fig. 51. "Seria" branches. They are used in crab capture. "Buster" crabs find the submerged branches ideal as a hiding place from their enemies, which are mainly other crabs. (Courtesy of Percy Viosca)
Fig. 52. Cutting some "seria" branches near Barataria. Their use is the favorite manner of obtaining soft-shell crabs in the Barataria-Lafitte region of Louisiana. (Courtesy of Percy Viosca)
Fig. 53. "Buster" crabs clinging to "seria" branches. (Courtesy of Percy Viosca)

Fig. 54. As the "seria" branches are pulled from the water, a dip net is placed under them to catch the crabs as they let go of the branches. (Courtesy of Percy Viosca)
almost entirely to a limited section of Louisiana.

An excellent description of the crab scraper and its use is given by Cargo:

The scraper is the gear most often used in areas where peelers and soft crabs are abundant, that is, on grass covered areas and shallows. The catch from this gear is made up principally of peeler crabs which seek grassy flats for protection when about to shed. Some hard crabs are caught in this gear but the number is not large.

The scraper is a dredge-like device which is dragged over the bottom behind a small power boat. Generally, two scrapers are operated, that is, one from each side of the boat. Upon hauling a scraper from the bottom and on to a culling box on the side of the boat, the crabs are sorted from the grass. The residue of grass mixture and other material is then pushed overboard. The yield from scrapers varies from day to day, generally, however, it averages about four hundred peelers per day per man.

Gowanloch stated in 1951 that the crab scraper was a more productive method of harvesting soft-shell crabs that the usual methods employed in most localities of Louisiana:

The use of the crab scraper has the tremendous advantage of, first, its efficiency in capturing crabs; second, lack of damage to the crabs themselves since by its operation they are rolled up in the turtle grass and the undersized individuals can be released unharmed; and, third, the fact that the scraper in passing over the beds of vegetation automatically removes the dead plants and thus cultivates the beds.

Although the scraper is now used to some extent in the Barataria region and the Morgan City area of Louisiana, the most important method of capturing soft-shell crabs is the "bush" method. This method is used almost exclusively in the Barataria region of Louisiana, which is also the
Fig. 55. The boys are holding some "buster" crabs. Hard-shell crabs could not be held in this manner for they would inflict nasty wounds with their pincer claws.
area of greatest soft-shell crab production. This also appears to be the area of maximum abundance.

The "bush" method of capture is a fairly recent method which was devised or discovered by some inhabitants of the Barataria-Lafitte section of Louisiana (see Figures 51, 52, 53, and 54). Credit for discovery goes to Mrs. Frank Burgess and Mrs. Louis Martin, who in 1931 pulled a bush out of Bayou Pirogue and discovered that it contained several dozen soft-shell crabs. Frost gives an account of this discovery and the conditions which led to it:

The tiny shrimp known as "river shrimp" inhabit the brackish bayou waters. They flee from their natural enemies by hiding in any thick, submerged growth. These shrimp are excellent for fish bait, especially catfish, so that when a mess of these shrimp are desired for bait, a bunch of "seria" branches are chopped, tied together, and sunk in a bayou. The next day the bunch is hauled into the skiff or over a big scoop-net, and out fall the river shrimp.

In 1931 when Mrs. Burgess and Mrs. Martin hauled up their seria bunch out of Bayou Pirogue, they found in it besides river shrimp, more than three dozen of the finest soft-shell crabs. They carried the news to their husbands and neighbors, and from that time on this method has been the most popular one for the capture of soft shell crabs in the Lake Salvador-Barataria region of Louisiana.

The common method of bush crabbing is to stretch long lines from poles protruding above the surface. From the long lines hang shorter lines, each with its "seria" bunch. Daily the fisherman, oftentimes in a motorized skiff, works down the lines, slips a scoop net under the bunches, and catches the crabs as they tumble out. Men and women work at this operation.
The "bush" method for the capture of river shrimp had been employed for over a century, especially along the Mississippi River, but it was only by chance that someone discovered that crabs about ready to shed their shells could also be captured by this means.

"Seria," as nearly as can be determined, is a colloquialism for the French cerisier, or cherry tree. The plant grows as a short, bushy shrub throughout the low-lands of South Louisiana, gaining sometimes a height of twenty feet. It is also called the wild cherry, myrtle, and wax myrtle (Myrica cerifera). There is nothing especially attractive about the "seria" bunches to river shrimp or soft-shell crabs except that the leaves are thick and tough and make a fine hiding place. Fishermen like it because it stays under water longer than any other such clump of branches without the twigs and leaves falling apart.

The "bush" method of crabbing is confined almost entirely to the Barataria-Lake Salvador region. It has, however, been tried in other areas of Louisiana, but without too much success or favor. Crab fishermen in the Lakes Pontchartrain-Maurepas region have heard of it, and a few have tried it, but it is not in general use. It appears that crabs which are about ready to shed their shells gather in great numbers in the shallow, grassy lakes and bayous of the Barataria-Salvador region and that this might be a factor in the great success and popularity of the
"bush" method for that area. The "bush" method is, then, the chief means of capture in Louisiana's prime area for soft-shell crabs; however, the crab scraper is now being used in the area and is meeting with some success.

For those who actively pursue soft-shell crabbing, especially in the Barataria-Salvador region, the business practically amounts to what might be termed "crab cultivation." In this phase of the industry, floats, pens, boxes, or "cars" are kept by the fishermen and he separates the crab catch according to the stage of shedding (see Figure 56). Crabs taken by the "bush" method are either in the process of shedding their shell (busters) or are about to undergo shedding within a few days. "Buster" crabs will shed within two days and will not eat anything during the period. "Green" crabs will shed within about four days. A crab fisherman can ascertain whether a crab is a hard shell or one that is to become a soft shell, by observing if there are cracks in the shell or by feeling the shell to see if it is becoming soft and loose. The soft-shell crab fisherman will usually have at least two floats, one for the "green" crabs and one for the "busters." The crabs must be kept in separate pens since the "busters" are unable to defend themselves and will be eaten by the green crabs.

Soft-shell crabs will expand to about 20 per cent greater size within a few minutes after shedding. As soon as expansion takes place they are taken out of the float
and placed in a refrigerator or freezer; otherwise the soft shell will harden into a "paper shell" in a few hours. Since only three to four hours elapse between the soft-shell and the paper-shell stages, the floats are inspected about every three hours. The fisherman takes his refrigerated soft-shell crabs to a crab dealer or wholesaler. Refrigerated trucks make regular calls on the dealer and carry the crabs to New Orleans, Morgan City, or Baton Rouge. Many soft-shell crabs are sold directly to restaurant owners and individual consumers.

The principal areas where crabbing is pursued and the principal methods employed have been previously described. However, the different areas tend to employ different methods of capture and tend to concentrate on a different phase of the industry.

The most intensely commercialized crabbing occurs in the Morgan City area, where the concentration is mainly for hard-shell crabs to supply the crab-meat canning and packing houses. Here the baited-line method is employed chiefly, but crab pots are being used. Crabbing is somewhat more than a seasonal occupation in this area, since there is a need for the packers and canners to be kept in continuous operation. However, production falls off very drastically during the winter months, and the supply is furnished mainly by a few crabbers who operate in the outside waters.
In an area extending generally from Lake Salvador to the head of Barataria Bay, the emphasis is chiefly on soft-shell crabbing and the chief means of capture is the "bush" method. Experimental crabbing for soft shells has been successfully tried with the crab scraper, and some limited use is now made of this device. Considerable numbers of hard-shell crabs are also taken in this area, chiefly by the baited-line method, and these find their way to the restaurants, crab canners, packers, and individual consumers who purchase crabs directly from the crab fishermen or dealers.

In the region of Lakes Pontchartrain and Maurepas, the hoop method of capture is the most extensively used. Here the emphasis is chiefly on the capture of hard-shell crabs. The industry here appears to be more poorly organized than in the other two areas. A great number of the inhabitants who live near the edge of these two lakes take crabs in the crabbing season and keep them in floating pens until the trucks of wholesalers collect them and take them to New Orleans.

Even though the emphasis on crab production may be for hard shells or soft shells in the different areas, both types of crabs are important in all of the areas. Some individuals prefer to concentrate on soft-shell crabs and others in hard-shell crabbing. Soft-shell crabs bring a considerably higher price, but this phase of the industry requires much more labor and care, so that the advantage
of a higher price is probably cancelled and both phases of the industry are about equal in financial return to the crabber. In the different areas of production, concentration on one or the other two marketable phases of crabs is principally a matter of degree.

As indicated earlier in this chapter, crabs occur in all the near-coastal lakes, bays, and streams of Louisiana and the northern Gulf coast. To a slight extent, crabs are taken throughout coastal Louisiana and the northern Gulf coast, both for home consumption and for market. A minor trade in crabs occurs also in the Cameron area of Louisiana and in the adjacent portion of Texas.

The Crab Fishermen

There is little conformity of race, ethnology, living quarters, or habits among the crab fishermen. Crabbing is important in the same areas where shrimping, oystering, and trapping are important industries. The crab fishermen may be of French, Anglo-Saxon, Slavic (rarely), Spanish, Malayan extraction, or even Mulatto, since all of these peoples inhabit the coastal marshes of Louisiana, with somewhat greater concentration of each group in one area than in the others.

Usually, the crab fisherman and his household are not distinguishable from a shrimper, except for the absence of a shrimp vessel in the bayou adjacent to his house, from a trapper, or from some other resident of the marshes.
Actually, few marshdwellers spend all, or most of their time crabbing, even during the season. In the Morgan City area some few-hundred families pursue the industry intensively throughout the season, and some even in the winter months, but in most of the crabbing areas the occupation is considered to be a seasonal one. In other times of the year the crab fisherman may be a trapper or even a shrimp fisherman. Many may work as laborers in the oil fields or in some other occupation during part of the time. Oftentimes, the head of the family works entirely at another occupation, such as shrimping, construction work, or small merchandising, leaving the crabbing chiefly to the wife and children. This practice is very common in all the crabbing areas of Louisiana.

Summary Statement

Although crabs are abundant in Louisiana, little commercial importance was realized until the 1930's, at which time a combination of circumstances favored growth of the industry--advent of quick freezing, quicker and better transportation from grounds to wholesalers, an increasing population and market for seafoods, solution of technical difficulties of canning and extraction of the meat from the shell, and improved economic conditions within the country which made crabbing profitable.

The crab industry has had to overcome the disadvantage of a late beginning as compared to oysters and shrimp.
However, considering the consumer resistance due to ignorance and the competition from other seafoods, the industry has made remarkable strides since the early 1930's. A factor of no small importance aiding rapid growth is the excellence and richness of crab-meat. In most preparations it would rank as a delicacy compared to other seafoods, especially finfish. Robust growth is still with the industry as indicated by the greatly increased catch every year since its inception as an industry. The potential production is still considered good, when compared with that of oysters and shrimp whose production has been fairly stable for a number of years.

Unlike the shrimp industry whose development was so greatly enhanced by revolutionary developments in gear and vessels and the discovery of new grounds, and the oyster industry which owed so much of its character and status to an ethnic group, the crab industry results mainly from a combination of economic and technological circumstances that largely came about in the 1930's.

The manner in which Louisiana's three important shellfisheries are conducted and the kind of technology and gear differ in numerous ways. The great common denominator, however, is the excellent physical base which favors all three alike. So much does the physical environment influence and restrict certain industries, it is highly desirable that relationships between physical and
cultural aspects of the shellfisheries be discussed and emphasized in a succeeding chapter of this paper.
Footnotes

1. The blue crab is sometimes taken commercially in fresh waters of the Atchafalaya as much as twenty-five miles above its mouth.


7. Production figures were obtained from the Biennial Reports of the Louisiana Department of Conservation and the Louisiana Department of Wildlife and Fisheries.


11. David G. Cargo, Maryland Commercial Fishing Gears III. The Crab Gears, Chesapeake Biological Laboratory, Solomons Island, Maryland, April, 1954, p. 5.


20. Ibid., p. 8.
22. Cargo, op. cit., p. 381.
23. Gowanloch, op. cit., p. 381.
25. Ibid., p. 65.
CHAPTER VIII

GEOGRAPHICAL AND CULTURAL INFLUENCES IN THE DEVELOPMENT OF THE LOUISIANA SHELLFISHERIES

Ports and Shore Facilities

It has been seen that the physical base for marine life along the Louisiana Coast is exceptionally good. Resource abundance is, however, only one factor involved in the development of a fishery. If other aspects of the natural environment are substantially unfavorable, a fishery may be only slightly exploited. One of the other requirements necessary for a fair degree of success in fishery development is good, accessible ports.

The influence of the type of coastal zone on port development and sea activities is considerable. Generally coasts are classified as coasts of submergence and emergence, but a more specific classification includes ria coasts, fiord coasts, estuarine coasts, and deltaic coasts. The coast of submergence offers superior natural conditions for ports--river valleys and mouths are submerged, and deep water is close to shore, this being especially true for ria coasts where the coast zone has considerable relief. Most estuarine coasts offer good facilities for port and fishing activity, although they may limit vessel size because of shallowness of much of the shore and creek
heads at low tide.

Louisiana has a deltaic coast, which is one of the most unfavorable forms for port development (Plate III). Certain parts of its coast may be considered estuarine, but deltaic features are dominant, especially in the area of its greatest abundance of fish and shellfish. The principal discouraging feature of the deltaic coast is the shallowness that prevails everywhere—on the seaward side of the coast, in the estuarine lakes, in the bayous, and particularly in the form of bars and shoals at the mouths of the bayous and distributaries of the Mississippi River. The shallowness restricts port development, and forces the employment of small vessels that are limited in range and activity.

Not only must the ports be accessible from the sea, but also from the land. When natural conditions are unfavorable for deep-water ports, expensive artificial measures must be employed to establish them, and this will be done only when there is an extremely valuable resource that must be shipped in or out through the particular area. In the case of natural obstacles which interfere with port development, it is often more convenient and profitable to route products to distant coastal areas that have good facilities.

Small fishing communities are found throughout the coastal zone of Louisiana, and some of them have been in existence for a period of two hundred years or more. The function of many such towns in the lower delta has for a long time been that of supplier of sea foods to New Orleans.
Some have had only a subsistence economy. The last thirty years, however, have witnessed some changes. The growth of the shrimp industry and the national demand for shellfish have given these communities some independence from New Orleans. This is especially true of the larger processing centers such as Morgan City and Houma. The development of petroleum fields in the coastal zone has improved and freed many communities from a semi-subsistence condition. Still other communities, such as Lake Charles, have become industrial in nature due to the nearby location of petroleum and sulphur in the coastal zone.

The size and importance of the port of New Orleans and of the lesser ports of Morgan City and Lake Charles can be attributed in part to man's engineering skill. Conditions in the hinterland make it necessary that ports be in these vicinities. This is especially true in the case of New Orleans. Here is a port city situated near the mouth of a large river which drains a vast area—one of the world's richest and most developed regions. In earlier periods of American history, a port was needed here for effective penetration of the continent and for defense of a vast territory. As development of the upper valley progressed through the years, economic factors insured the existence of the city, since shipping down river was the cheapest and nearest outlet to the world for the products produced in the middle and upper valley. It should be noted that water transportation preceded the railroads and
was formerly, as it is today, a cheap form of transport. It was desirable that a port be in the vicinity of New Orleans, regardless of the unfavorable physical nature of the lower delta. This made it necessary to build jetties and to dredge some of the lower distributaries constantly.

Morgan's comment on delta ports is interesting:

Many deltas have important ports, but these arise because of their nodality in commanding a large inland waterway system or a populous inner delta agricultural area, not because of any advantage for port location on the delta coast. In most cases, indeed, these ports are a considerable distance inland rather than on the coast. The coastal zones of such deltas as the Mississippi, Niger, Po, Danube, and Ganges are notable for their absence of any large settlements. Small fishing communities may be scattered about the coastal zone; but these are more usually concerned with fresh-water fisheries on the distributaries than with sea fisheries.1

New Orleans owes its prominence chiefly to its position in relation to the interior. It is located at considerable distance inland, approximately 100 miles from the mouth of the Mississippi. A glance at Plate VIII of ports and fishing communities of Louisiana shows most of them to be located at considerable distances upstream. With regard to Morgan City the situation is somewhat different, since it is nearer the sea than most other ports and fishing communities of Louisiana. The geographic location near the offshore shrimp grounds is largely responsible for its growth and importance. It is the nearest deep-water port to the productive offshore grounds and when exploitation commenced, it was almost certain that Morgan
City would grow and develop as a port and as a processing and distribution center for shrimp.

The role of New Orleans in the development of Louisiana's fisheries and shellfisheries needs to be emphasized strongly. It has been the principal market for the greater period of time, and still receives a considerable share of the output. Without the stimulus provided by the presence of this market through the years, Louisiana's fisheries would be exploited to a lesser degree, perhaps mostly by fishery interests in neighboring states.

To a lesser extent than New Orleans, Houma owes its importance as a seafood processing and distribution center to a similar locational advantage. It is situated at the apex of a former Mississippi delta and has bayous radiating from it like the outstretched fingers of a hand. Its commanding position destined the settlement for a collecting and processing center of seafoods. With advancing technology and increasing market demands for seafoods, the future of this settlement as a collecting center of seafoods was assured.

The type of coastal zone exerts its influence on the fisheries of an area in still another important way—whether or not it restricts or favors transportation from the fishing grounds to the hinterland. Brief mention was made in Chapter IV of the swampy nature of the land immediately behind the south Atlantic and Gulf coasts and that this was an inhibitor to settlement and transportation,
and therefore to the development of fisheries. This point needs to be re-emphasized in a discussion of the Louisiana Coast. Nowhere in the south Atlantic and Gulf regions, except the southwest portion of Florida, are there such extensive marshes and swamps as in Louisiana. The difficulties of developing a good overland transportation system are made even greater in Louisiana by the deltaic character of the region which has caused road-building to be extremely difficult because of gradual subsidence of the loose unconsolidated sediments under the roadbed. Until the last two or three decades and the advent and employment of expensive road-building equipment, coastal Louisiana has suffered from the lack of east-west transportation, both water and land. There is still only one overland route comparatively near the coast extending from New Orleans to Lake Charles. This line is considerably north of the main source of the fish and shellfish, but nevertheless cuts the distance of slow water transportation and aids greatly in the distribution and marketing of the products.

The restrictions on transportation imposed by the marshes and swamps have, of course, exerted a stronger influence in past development of the fisheries than in the present age of gasoline, diesel motors, and road-building equipment. Formerly, the only effective overland transportation was along the natural levees of the Mississippi, its distributaries, and distributaries of former deltaic
complexes lying to the west of the present delta. These bayous of former distributaries have generally a north-south direction, and near the Mississippi River several tend to converge at a point near or just south of New Orleans, accounting in no small way for the comparative ease with which that city could receive its seafoods from a number of fishing communities located on different bayous and separated from each other by distances from ten to fifty miles. Indeed, due to geographical circumstances, contact with New Orleans rather than with a nearby fishing community was quicker and easier. As a result of the delta geomorphology, fishing communities were located on nearly every bayou, and remained small due to restrictions imposed by the vessels, gear, and area to be fished.

Centralization of ports and facilities would have made exploitation of Louisiana's marine resources much greater and easier, but this was not possible until revolutionary developments in technology and markets eased the situation. Today, a considerable amount of centralization has taken place, particularly in the cities of New Orleans, Houma, and Morgan City (the offshore shrimp capital). However, few of the fishing communities have ceased to exist because of this centralization. They still retain their function as primary sites for the exploitation of the particular marine products that are locally abundant, but the processing and transhipping of the products is becoming more centralized. Refrigerated trucks and motor-driven vessels
carry the raw product to the larger centers that process and prepare for further shipment.

Such centers as New Orleans, Houma, and Morgan City are not restricted to the handling of one product. They are merely outstanding for certain ones. Practically every seafood—shrimp, oysters, crabs, turtles, and fish—is received, consumed, processed, and packaged in New Orleans and its suburbs. Houma's activity is about equally divided between oysters and shrimp. Morgan City is overwhelmingly a shrimp center, with crabs also being of importance.

The Importance of Freshwater Fisheries and the Dominance of Marine Shellfisheries on the Louisiana Coast

Morgan's observation that freshwater fisheries on the distributaries of a deltaic coast tend to receive more attention than salt-water fisheries holds true for Louisiana. Up until the period of World War I, Louisiana's freshwater fisheries were far more important than the salt-water finfisheries. Except for the shellfisheries, the freshwater interests are still dominant in production and value. Here again natural forces exert their influence on culture, for deltaic complexes provide an abundance of nutrients and numerous lakes and sluggish streams, which is an advantage to freshwater species as well as to marine forms. Although the freshwater fishery resources are probably not so great as the marine finfish resources, and can scarcely be expected to supply a national or even a large regional market,
they are more accessible and require less expenditure, and may well be great enough to supply the market demands of a small state. With the increasing national demand for shrimp and other shellfish, and the accelerated increase in population and growth of urban centers within Louisiana in the last thirty years, there has been steadily more demand for the seafoods of the Louisiana Coast. Recent technological advances in transportation, refrigeration, and packaging have made exploitation of the salt-water species much simpler and more economical. Rapid spoilage, distance from the coast, and slow water travel favored the development of the fresh-water resources that were nearer at hand. Unquestionably, technological progress has erased more and more of the restrictions imposed by nature on the Louisiana Coast.

At this point the following question might logically be posed: Why have marine shellfisheries in Louisiana long been dominant over salt-water and fresh-water finfisheries? Since all are favored by the drainage complex of the lower delta, there must be some special reasons for the greater attention given to shellfish. Several points, rather than a single one, answer this question. First, the ecological structure and habitat of shellfish are different from and more conducive to exploitation than that of the finfish. Shellfish are less mobile and are more attached to their estuarine environment. This is particularly true for oysters and crabs. Also, their movements do not
fluctuate so greatly from day to day as do those of fish, which may be present in a particular locality in large concentrations on one day and not on the next. In addition, the capture of shellfish is easier and more certain, and in the case of oysters, amounts to little more than going to a certain locality and harvesting. Moreover, except in the case of the offshore shrimp grounds, the shellfish are concentrated most heavily in the shallow coastal waters, bays, and bayous, and thus are more accessible to the typically small craft of shallow draft which has long been characteristic of this region. It is noteworthy that in coastal zones where land-derived nutrients provide an ideal environment for shellfish, exploitation of the marine resources is greater for shellfish than finfish—sometimes to the almost complete neglect of the finfish resource. It has already been illustrated how Florida fisheries have been chiefly concerned with finfish while Louisiana has concentrated more on shellfish, even though Louisiana has many of the same species of fish in equal or greater abundance than Florida.

The Influence of Natural Conditions on Vessels and Gear Used in the Louisiana Shellfisheries

It has already been suggested that vessels and gear are limited in type, size, and range by the kind of natural environment. However, this needs to be emphasized more
strongly, for it can be of extreme importance to fishery development.

Emergent or deltaic coasts are conducive to the development of small, shallow-draft vessels that are restricted in range to near-shore waters, bays, and streams. Until favorable market conditions warrant large investments in vessels, port facilities, and transportation for offshore fisheries, only the near-shore and inside waters will receive attention. This has certainly been true for Louisiana. Except for the expansion of the shrimp industry to offshore waters with large seaworthy trawlers, and the highly specialized menhaden interests of the lower delta, fishery activity is still largely confined to the inside waters and a narrow zone along the coast, and is conducted by vessels of small size and draft.

Morgan attaches great significance to the influence of the coastal zone on vessels:

...Coast zone is reflected particularly in the draught, and hence in the proportionate beam and length necessary for a given load capacity, and in the structural strength it is necessary to impart to the hull.

Craft operating from shore-lines of dominant submergence, faulting, or heavy glaciation, are usually in marked contrast to those of shore-lines of dominant emergence, with which for this purpose, one may include deltas and other outward-building forms. The former offer deep water close inshore, and frequently provide ready-made harbours. The vessels are not seriously limited by considerations of depth of water, and therefore tend to be deep and relatively narrow-beamed...
He states further:

They British vessels are different in build from similar-sized vessels of a deltaic coastline such as the Dutch. These are of shallow draft, and hence, to maintain their load capacity, broad-beamed and slow...The sparse distribution of harbours with deep water alongside the jetty, save where expensive long piers or continuous dredging of channels can be afforded, means that the craft of small fishing centres have often been designed to be unloaded from the beaches at low tide. They are therefore flat-bottomed...However, the general process of centralization of the fishing industry in a few major modern ports has affected Holland, and its fishing is rapidly becoming less distinctive.

The contrasts of type are more marked in small craft than in the larger, and are becoming less clear in such areas as western Europe, the U.S.A., and Canada. Where the fishing has become centred in large ports that can provide artificial deepwater facilities, standard large deep draught modern types of craft have evolved irrespective of the coastline. But over the greater part of the world's coastlines, fishing is still done from small dispersed ports, and the craft are closely related to the natural conditions of the coast.

It can be seen readily how close is the relationship between the Louisiana shrimp and oyster luggers and the deltaic coastline. With the trend toward more centralization of the Louisiana fisheries, it can be expected that vessels will become larger and more standardized, as in the case of the large shrimp trawlers operating out of Morgan City. Although small shallow-draft vessels will continue to be the ideal type for fishing and shellfishing in Louisiana's inside waters, certain changes are now apparent. These are related to general improvements in small craft and to the necessity for quick transportation from the grounds to the processing or shipping firm. As indicated
in another section, the small Louisiana luggers are gradually but certainly disappearing in favor of less distinctive, fast-moving, gasoline-powered skiffs. Where harbor facilities and financial conditions will allow, large shrimp luggers are being replaced by even larger, deeper-draft, sharper-sterned, Florida-type vessels. Discovery and subsequent exploitation of the offshore shrimp grounds introduced and accelerated the latter change. Due to the small size and lack of seaworthiness of the Louisiana vessels, the offshore shrimp grounds almost had to be developed by outside shrimp interests. There were vessels of appropriate size and design, and captains with sufficient marine knowledge in south Atlantic and Florida ports. Fleets of these vessels arrived quickly after discovery of the offshore grounds, and the nearest deep-water port was chosen for the base of operations.

The size and design of gear used in the Louisiana shellfisheries is also related to the natural conditions. Broad, smooth beaches, shallow bays, lakes, and streams are conducive to hand-manipulated gear, such as nets and haul seines. To be sure, small boats are often used in conjunction with such gear, but such activity is, nevertheless, largely hand operated. Where a fishery is largely localized, and where the fishing communities are scattered and isolated, there is the need for gear that requires small investment. In addition, small hand-manipulated gear is usually satisfactory for shellfish capture. However,
shrimp grounds are an exception). Low-cost gear and operations are more suitable for shellfish capture and this industry, due to the nature of the gear, and generally abundant distribution of the resource, favors scattered fishing communities and a relatively large number of fishermen, many who can participate on a part-time basis. Centralization, then, particularly for port and collection centers, is not likely to intensify.

It appears that the following conclusion can be drawn: Wherever natural conditions concentrate a fishery resource in the near-shore and inside waters, and it is abundantly distributed throughout the area, low-cost gear and vessels are satisfactory, and a large number of people can participate in the industry; but where the grounds are more specific and they lie at considerable distance from the coast, high-cost gear and vessels and a relatively small number of fishermen are favored, and centralization results. The offshore shrimp fishery of Louisiana is a good example of the latter, whereas the general activity in inside shrimping, oystering, and crabbing applies to the former. It should be expected that a certain degree of centralization of the processing plants is likely to occur in the shellfisheries, due to a rapidly improving transportation system and increased complexity and cost of plants, but this would not necessarily be the case in facilities for the procurement of the product.
expanding markets and consequent increase in fishing activity result in changes, sometimes even in revolutionary developments. In the case of the shrimp industry, the otter trawl replaced the haul seine as a method of capture, and larger, more seaworthy vessels were necessary for expanding operations to the rich offshore grounds. It is significant that both of these necessary introductions came from outside the state, where differences in environment, distance to fishing grounds, and market demand played a role in their development and had established their use at an earlier date.

Remarkable changes and introductions of gear have occurred in Louisiana, and the future is likely to witness some continuation of it. However, the old methods of capture have not been entirely supplanted, nor are they likely to be within the foreseeable future. Changes and introductions have occurred principally where expansion of the industry has resulted from increased market demand, and in instances where distance to grounds has prevented the employment of traditional vessels and gear. Additional cost of new, more efficient gear has also limited the number of fishermen participating in the offshore shrimping and has caused some centralization of ports and facilities. It must be emphasized that much of the relatively low-cost, traditional forms of gear is satisfactory for pursuit of the shellfish resources in the area of greatest abundance—the near-shore and inside waters of the delta (the offshore
Changes are occurring in gear and vessels within the inside waters, but they are related usually to the employment of a more efficient form that is about as cheap or cheaper than traditional types, rather than to something larger in size and more expensive. An example is the gradual substitution of the open, motor-powered, factory-built skiff for the small shrimp lugger.

It can be seen, then, that a deltaic coastal zone such as that of Louisiana affects the overall fishery pattern in numerous ways—decentralization rather than centralization of ports and shore facilities; a relatively large number of participants within the fisheries; dominance of shellfisheries; greater emphasis on fresh-water finfish than on salt-water forms; small, shallow-draft vessels generally unfit for offshore fishing; and relatively simple, low-cost forms of gear. Sea resources lying off such a coastline may be of little value to the immediate area or to the nation at large due to the unseaworthiness of local vessels and gear and the preoccupation with near-shore and inside fishing. The resources may not even be known because of such slight traffic in the outside waters. In instances where they are exploited, it is usually necessary for outside interests to initiate development. In the Louisiana offshore shrimp and menhaden industries, favorable port locations were sought and developed by interests originating from outside the state. In the above instances, abundance of the resource
and the market warranted the effort and expense, even justifying federal, state, and private expenditure for port and waterway improvement.

It must be added, too, that in many instances factors not related to the fisheries have been partly responsible for the establishment of better water and overland transportation. For example, the presence of mineral resources in the Louisiana coastal zone—petroleum, sulphur, and salt, and their recent exploitation—has been influential. Fortunately, for the fishery interests, these added facilities can be used to advantage. The general prosperity brought into the region by mineral development has aided the small fishing communities, e.g., created jobs for members of a fishing family, increased locally the consumption of seafoods—all of which have assisted fishermen, at least indirectly, in accumulating capital to purchase larger vessels and better gear.

Increased traffic in the outside waters and organized research will undoubtedly yield discoveries of more species of sea life in the offshore zone that may have commercial possibilities. In addition to the offshore shrimp resource in northern Gulf waters, it now appears that there is the basis for a commercial yellowfin tuna industry, something that no one suspected only a few years ago. Such recent bonanza shrimp discoveries as have occurred in the Gulf of Mexico can hardly be expected to occur in waters where offshore fishing has long been
prosecuted and conditions of the bottom well known, as in the case of waters off New England. It has been stated by fishery biologists that there is less known about the physical and biological character of the Gulf of Mexico than of any other partially enclosed body of water of similar size in the world. This fact reflects, though not wholly, the general limitation of fishery interests of the various states surrounding the Gulf. The inside waters of the region and a shallow coastal zone influence type and design of vessels, particularly in Louisiana. Other factors restricting knowledge and development are market character, sparsity of coastal settlement (particularly in Florida), and the low economic importance that the Gulf of Mexico might hold for the distant, advanced maritime nations of the world.

Other Factors Influencing Fishery Development in Louisiana

The relation of natural factors to Louisiana fishery development was stressed in the preceding discussion. A complex of other factors, which may result in part from natural conditions, is also responsible.

Despite the presence of rich marine resources, any area that is principally oriented toward agriculture and animal husbandry, together with a relatively sparse population (20-60 per sq. mi.), will give only slight attention to seafoods, and this will be to satisfy market demands in a few large ports. Several factors account for this.
Certainly since the advent and spread of agriculture and animal husbandry, seafoods have occupied a secondary position to land products. An equal or primary position of seafoods is found only in sections where the land is exceptionally poor and hostile, and where the pressure of an increasing population is a further stimulus to marine activities. For verification of the latter statement, a few observations throughout the world should suffice; some examples are Norway, Japan, Portugal, Brittany, Iceland, Newfoundland, New England, and numerous small islands. These countries or regions have all had conditions hostile to agriculture, but since their location is near the sea, the inevitable pressures of economics and population stimulated an interest in fishing and other marine activities. On the other hand, where the hinterland is favorable to the production of land products, and the population pressure is not great, the sea and its resources are neglected. Argentina, Brazil, Chile, Peru, Venezuela, Australia, Mexico, and southern United States are good examples. Indeed, in the above areas, exploitation of the marine resources is usually prosecuted by fishing fleets based elsewhere, as in the case of Florida, Louisiana, and Texas shrimp trawlers operating in Mexican waters; United States Pacific coast tuna vessels in Mexican and Peruvian waters; Portuguese activity in south African waters; British, Norwegian, and Japanese whaling operations ranging far and wide throughout the southern hemisphere; and the former
New England interests in south Atlantic and Gulf waters.

It is common knowledge that agricultural interests have been dominant in the southern states from the very first settlement. Favorable climate and extensive areas of level, easily tilled soils set the stage for the agricultural orientation of the area. Contact with the sea was limited to a few large ports that existed primarily for cargo shipment. As pointed out in a previous chapter, nearly everywhere there were extensive marshes and swamps that separated the coastal zone from the agricultural hinterland, sometimes by as much as one hundred and fifty miles. This condition meant a sparse settlement in the coastal zone and tended to maintain ignorance of the marine resources and their economic potential. Under such conditions where all economic activities, not only fishing, but manufacturing, commerce, and mining as well, were dwarfed by agriculture, it is small wonder that production and demand for seafoods would be slight. In addition, the southern states, and particularly Louisiana, have numerous fresh-water streams and lakes in the coastal plains and thus an abundance of fresh-water fish and crawfish. The fresh-water resources have, until recent decades, proved adequate in satisfying the southern appetite for fishery products, excepting the large port cities. Recent figures show that fresh-water fisheries still retain a higher production and value within Louisiana than all seafoods except shellfish.
Although there are factors concerning distance to markets, spoilage, shipment, processing, and consumer preferences that are involved in the low economic development of the fisheries of Louisiana and neighboring states, the general agricultural character of the southern hinterland has been more largely responsible for the neglect of its marine resources.

Factors of Markets and Marketing

Resource exploitation is usually a direct reflection of market demand. Development of all the potential supplies of a commodity seldom occurs in an industry due to restrictions imposed by both nature and culture. Those resources nearest to the areas of consumption are first given attention, providing natural obstacles do not make development financially prohibitive. As markets expand, the traditional source area may experience difficulty in supplying them, and increased activity which may create scarcity of the commodity (this is particularly true in fishing) may result in increased cost of product, which in turn may create an opening for a new and cheaper product that is equally satisfying. In addition, the changing location of markets--distance from the source area--may mean that costs of transportation are either prohibitive or will make the price so high that the consumers reject the product. In the case of a highly perishable product such as shellfish, distance and time are the prime considerations in marketing
of the fresh product, and to overcome this problem, various less satisfactory preparations have been developed such as the salting, drying, canning, and freezing of seafoods.

So many factors are involved in the marketing complex surrounding seafoods that an exhaustive treatment here is not possible. Indeed, the problems are not even well understood by the fisheries themselves—there is more that is unknown than is known, and most states that have any interest in developing or expanding the market for their seafoods are currently appropriating funds with which to carry on the needed research. One of the best surveys of the fishery resource and problems of a southern state is one conducted for North Carolina by Harden F. Taylor and a staff of associates. Many of the observations and findings of this survey deal with problems that generally confront the south Atlantic and Gulf states, and some of these very appropriately apply to Louisiana.

Certain factors regarding markets and marketing problems are explained by tradition, historical developments, perishability of the product, urbanization or lack of it, and physical conditions in the production zone and hinterland. Still other factors are obscure and will require much intensive research. With regard to physical conditions, the previous discussion has emphasized the restrictions imposed by them on production and transportation in the Louisiana coastal zone, many of which can be partly overcome, if the market demand is strong enough to
warrant the construction and maintenance of deep-water harbors, overland transportation, and related facilities. Due to increased markets for southern shellfish, particularly shrimp, much development of ports, vessels, gear, transportation media, and plants have occurred in the production zone of Louisiana. These developments, of course, need not be entirely duplicated for the development of other marine resources, and thus, when the time arrives that demand is substantial for some other marine species such as mullet, redfish, drum, and possibly yellowfin tuna, they can serve these interests as well.

As previously stated, the agricultural economy prevailing in the southern states and the general absence of large urban centers, have been factors discouraging the development of marine fisheries. An agricultural population, accustomed to providing, in part, their own subsistence from the land and numerous nearby streams and lakes, is not a good market for seafoods, especially when the cost of the product is comparatively high and its quality (by the time of arrival) is inferior to the fresh product produced in local waters. Large urban centers near the coast—New Orleans, for example—have always been a market for the products of the coast and, until the comparatively recent national demand for shellfish, have been responsible for the little development that has occurred in southern fisheries. A fresh product could usually be marketed in such cities due to their nearness to the coast, in spite of slow
elapsed in storage of the product. By the time the hogshead was opened by the retailer or the consumer, a large percentage would be spoiled or stale. The acceptable percentage was usually quite tasteless, having been robbed of its good flavor by the leaching of proteins and minerals by the melt-water within the hogshead. Only in the coldest months could there be any degree of reliability placed on such shipments. Under such conditions it is small wonder that southern seafoods have been in low demand, except in markets very near the coast where the fresh product could always be obtained. Due to the general absence of large populations in the coastal zone of southern waters, the market has been small and localized, thereby restricting capital investments in vessels and gear on the part of producers and fishermen, the end result of which was a minor salt-water fishing industry—one that has been backward in technology and facilities.

A logical question at this point might be, just why did the southern fisheries, in their failure to market a fresh product, not capture the inland markets with various types of preserved and processed seafoods? The answer to this is found in a complex of circumstances. In the first place, southern species, especially finfish, are not very satisfactory for salting, drying, and smoking—the traditional methods for preserving seafoods. Secondly, the importance of an early start made by New England, America's prime fishery region, needs emphasis. Here is found
transportation and the tortuous routes that it was formerly compelled to follow on the way to market. The fresh product was the key market factor in seafoods during the past even as it is today, but edible freshness was once impossible to maintain where great distances were involved and several days and weeks had to elapse before appearance on the market.

To some extent the character of fish flesh has played an important role in marketing. Southern fish are mainly soft fleshted and deteriorate more rapidly than the firm-fleshed fish which characterize northern waters. The warmer climate only hastens the deterioration. Unlike meat, whose flavor is improved by a period of aging, fish begin to deteriorate in quality as soon as they leave the water. Also, throughout the period of storage and marketing in the conventional manner, melting ice leaches out minerals, proteins, and flavor. Only a few species can retain their natural flavor and freshness longer than six or seven days, after which time stale odors have developed. Even today, with comparatively rapid transportation, the freshest salt-water fish served in the Midwest is over eight days old.5

The chief method of marketing southern fish and shellfish, until recent decades, has been to pack them with ice in hogsheads and ship by rail. Even though shipment was usually to southern cities located from one hundred to four hundred miles from the coast, several days
America's oldest fishing industry, which was for a long time the leading economic activity for the area. The tremendous schooling populations which made the catch economical, together with the relatively good keeping qualities of the fish, favored development. Quick recognition of the resource and rapid developments followed soon after settlement. The region quickly resorted to drying, salting, and smoking fish for shipment to areas that could not obtain the fresh product or a cheaper food item. The American market was not particularly great for these products, but large markets existed in Europe and the West Indies, in the latter case mainly as a cheap food for slaves and plantation workers.

Since much has already been said about the development of the New England fisheries, very little needs to be said here. It is sufficient to state that New England fishery interests have been most active in developing and taking advantage of the latest technology for processing and preserving seafoods—first canning, secondly the use of ice in vessels and shore facilities, and thirdly, quick-freezing and packaging. Their canned and frozen products have for a long time been familiar items to consumers in the markets throughout the nation. Closely following New England in this manner were the vast salmon and tuna interests of the Pacific Coast. Competition with such widely distributed and well-established products, except for a few items, has been beyond the capabilities and
facilities of the relatively minor southern fisheries.

Such has been the market experience for southern seafoods until recent decades, particularly for finfish. The market situation has still not greatly improved for southern finfish, although for shellfish there have occurred tremendous developments, the nature of which will be discussed at another place in this chapter.

Recent studies on consumer reactions indicate a growing national preference for quick-frozen fillets and pre-cooked seafoods. New England filleted products and foreign imports have already firmly established themselves in the markets. Indeed, with the advent of frozen filleted products, New England found the means for rejuvenating a declining industry and has capitalized greatly on this, being able now rapidly to expand the markets for her products and compete more favorably with the canned tuna and salmon from the West Coast. As would be expected in the light of past developments, the southern finfisheries have not kept pace and have thus lost out in this field to the larger and more enterprising northern and West Coast fisheries.

Part of the problem is again in the character of southern species—they do not take well to filleting, due to the relatively small size of most commercial species, and another factor is the inertia that has long characterized southern fisheries.

Southern finfisheries are still, in the main, marketing their fish locally, regionally, and nationally in
the whole or "round" state. Until the present time, transportation costs and delays that favor spoilage have limited the production and supply. Only large city markets, such as New York, Boston, and Chicago, have much acquaintance with southern species, and this experience is with only a few exotic and choice species such as red snapper and pompano. Small shipments are made to these markets by fast truck and rail express and upon arrival are quickly dispersed to luxurious hotels and restaurants, where they are offered at top prices on the menu.

The southern finfish products can hardly expect to compete in the national market with the vast quantities of attractively packaged, filleted, well-known varieties of northern and imported fish. Their best hope of competing still lies in the marketing of the fresh product, which for most southern species far surpasses in taste most species of northern fish, whether fresh or frozen. However, progress lies in abandoning or improving conventional methods of processing, packaging, refrigeration, and transportation. Greater vision as to the potentialities, more capital investment in plants and facilities, and biologic and economic research are all necessary.

Despite the past and present difficulties of marketing fresh whole fish, the future does not look altogether dark; indeed, if needed research, organization, and advertising is forthcoming, there may be considerable expansion of markets. The panacea for southern producers and packers
of fresh whole fish appears to be shipment by airfreight. "Air-cargo studies at Wayne University indicate that people in this country would like to consume an additional one-half billion pounds of strictly fresh fish. A goodly portion of this 62 per cent increase above present consumption could be achieved if improved methods of producing, cooling, packaging, transporting, and merchandising were employed to bring to market in prime condition the products of the sea." Present airfreight shipments of fish from the Great Lakes area into New York City are highly satisfactory. The fish are on the retail markets twenty-four hours after leaving the water. Airfreight saves one full day in this operation over shipments by railway express and, it might be added, one day means a great deal in the quality of the fish, especially if it happens to be the fourth to sixth day. Interestingly, the costs are generally identical with the costs of shipping by rail express. Various factors of economics such as unused capacity of aircraft, direction of flights, and abundant supply of seafood suitable for shipment mean that the situation is not always so favorable to air shipment as it is in the Great Lakes area. Larsen has discovered that there is a propensity of seafoods for air shipment:

Factors which weigh with force in the determination of the kinds of fish most amenable to air shipment are consumer preference, price per pound, volume of catch, seasonal variation in the catch, and rate of perishability. All of these factors were used in devising the formula to measure the disposition of various species of seafoods to air shipment.
Consumer preference surveys conducted in Kansas City, Chicago, and Detroit, gave consumers an opportunity to express their preferences for various species of fin and shellfish most desired in air shipment. Top ten on the list were shrimp, pompano, red snapper, salmon, lobsters, swordfish, oysters, sturgeon, crabs, and scallops—70 per cent of which are found in the waters of the Gulf and South Atlantic.

...It is significant that almost all (95 per cent) of the total annual catch of shellfish rate "excellent" on the propensity index and the remaining 5 per cent rate "good." In this field lies a vast potential for airfreight. The air transporter of seafoods should be interested particularly in those species which show highest propensity to air carriage, and that, at the same time, are caught in sufficient quantities to provide worthwhile loading over a long season of time.10

The results of Larsen's study are very encouraging to the southern fisheries, especially the poorly developed finfisheries. Shellfish products, however, rate high on the propensity list, and will undoubtedly constitute the greater bulk in the future reliance on air shipment. The study shows that fifty per cent of the seafoods produced in United States waters having a high propensity for air shipment is found in the waters of the Gulf, Caribbean, and south Atlantic. Present methods of preparation and packaging will not suffice for air shipment, and drastic changes are necessary. One of the most important changes must be the elimination of as much weight as possible—viscera, heads, ice, and heavy containers. Whether the southern fisheries will fully exploit the advantage they have for shipment by airfreight remains to be seen, but it is one of the few bright prospects favoring improvement and
states is probably due more to the great demand and good prices than to abundance of the resource.

The continuous economically sick condition of southern fisheries at the present time results from a complex of many factors, several of which have already been discussed. Many of the retarding cultural and economic conditions of American fisheries generally are brought to light in a detailed survey of North Carolina's fisheries, a large section of which is devoted to problems of fisheries generally, and so would be of little value in accounting specifically for the backwardness of southern fisheries. The most that can be said is that some of the main problems are even more aggravated in the southern fisheries than in other sections of the country. A brief list of general problems of the fisheries that are most applicable to the southern fisheries are the following:

1. The fishery sources are not privately owned or controlled but, subject to public regulation, are free for all with a few exceptions.

2. A general lack of technical and industrial progress.

3. In the remoteness from the market of the sources of supply the fisheries are at a disadvantage with respect to agriculture. In a few places, rich fisheries are located very near well developed centers.

4. The fluctuations of quantity and composition of catch are one of the most difficult economic problems, causing erratic prices and disappointment when good catches are made.

5. The perishability of seafood is a definite handicap.
competition in the national market.

Benefits that can accrue to Louisiana if more use of airfreight is forthcoming in that state's fisheries are especially significant. The species which rank highest on the propensity list come under the shellfish category, and some of these are found in greater abundance in Louisiana than any other area of the nation, with the possible exception of oysters in the Chesapeake Bay region. Since the shellfish industries are already comparatively well developed and the products, especially shrimp, have national distribution and demand, airfreight shipment is more pertinent to the development of the finfisheries. Pompano, flounder, and red snapper—all high on the propensity list—are found in as great abundance in Louisiana waters as elsewhere in the Gulf and south Atlantic (red snapper may be an exception). Considerable stimulation in these fisheries is needed, and might result in general use of airfreight. However, these fish resources have experienced only slight development in Louisiana, even in relation to Florida and other southern states—a fact probably resulting from the great attention given to shellfisheries and fresh-water fisheries. In the case of some other states, notably Florida, the marine shellfish and fresh-water resources have not been exceptional, and greater concern has been applied to the salt-water finfisheries. Shrimp may be an exception, but it appears that increased activity in this industry by Florida and other southern
6. There are no quality standards of fresh fish, and the size classifications are generally elastic and unenforceable. Inspection of fish by government or trade association has never been found practicable because of the perishability of fish.

7. The difficulty of obtaining credit is a serious one, for unlike agriculture wherein privately owned land can be pledged or mortgaged, the fisheries cannot give the water as collateral. Boats are insurable, but at such high premiums that small fishing units are often without insurance and therefore not acceptable collateral for loans.

8. The unfamiliarity of the public with fish is a serious handicap. The multiplicity of kinds of fish is undoubtedly a serious impediment to the sale of fish. This unfamiliarity is aggravated by the profusion of unstandardized common names and ignorance of seasons of abundance, and leads to a lack of confidence in purchasing and to deception by unscrupulous dealers.

9. In the case of whole fish and shellfish shipped in the shell, the shipping weights are excessive in proportion to the edible parts. Meats are always shipped dressed.

10. The fisheries have been characterized by general primitiveness and crudity until the present time. The industry has never received much scientific research, technical and engineering improvements in efficiency, and expert management and salesmanship—all of which are necessary to meet competition. There has been only slight assistance from government agencies, universities, and foundations.

Some Factors Responsible for Growth in the Shrimp and Blue Crab Industries

The truly bright spot in southern fisheries is the comparatively recent growth and development of the shrimp and crab industries, a condition most outstanding in
Louisiana. Southern shellfish products presently have national distribution and demand, a condition not existing, even in a small way, for most other southern seafoods. Considering the general backwardness that has long characterized southern fisheries, what, then, accounts for the present prominent position held by southern shellfish, particularly shrimp and crabs? It is a matter of record that southern shellfish, excepting oysters, have not always occupied such an important position.

The answer for it lies in the nature of several areas—natural qualities which favor abundance of shellfish, relative ease of capture and low capital investment in vessels and gear, and historical developments connected with the introduction of efficient methods of gear (otter trawl, for instance) and discoveries of more productive grounds (shrimp). Other factors involved are largely cultural: changes in the national economy; population growth; food preferences; and revolutionary developments in processing, packaging, and transportation.

It should be stressed that growth in shellfish production applies only to shrimp and crabs. Although oysters are an important segment of southern seafood industries, especially in Louisiana, the history of the industry has been one of decline in production and dollars since 1890. Indeed, at that time oysters were the foremost seafood product of the nation, their net weight exceeding the gross weight of any other product of the food fisheries,
and their value 38 per cent of that of all food fish and four times that of the nearest rival, the five Pacific salmons combined. It continued as the most important fishery until the World War I period, but had decreased in importance, a trend which has continued to the present time. Today, it is far outranked by shrimp in the south Atlantic and Gulf states, and in Florida, by several species of finfish.

Oyster production, therefore, has been characterized by a long continued decline in volume at prices which have not risen to compensate for the increasing shortage—this in a country with a rising population and level of living. Shortage of supply does not seem to explain the decline in production, for if scarcity had limited production, prices should have risen as they did for Great Lakes fisheries and other species when shortages occurred. Indeed, a sharp rise in price should have caused the opening of new grounds and increased cultivation on old grounds, neither of which has occurred.

There must be other explanations for the decline of this industry. Undoubtedly, several interrelated factors are partly responsible. It seems to be more than coincidence, however, that during the decline of the oyster trade there was a corresponding rise in shrimp and crab production, both of which were insignificant seafood items around the turn of the century, when oysters held such a leading position. It is strongly suggested here that decline in
oyster production in no small way resulted from the competition given by the rapidly expanding shrimp industry, and to a lesser extent, crabs. Several factors appear unfavorable to the oyster trade when compared with the shrimp and crab industries. A tremendously greater amount of laborious work accompanies oyster production than is true for shrimp and crabs—much labor is needed to dig, dredge, or tong the oysters from the bottom, and much hand labor is required for culling and shucking, little of which has been mechanized. In the last half century when labor costs have continued to rise and mechanization has been necessary to cut operating costs and increase production for a growing market, this disadvantage of the oyster trade is undoubtedly an important factor connected with its decline.

On the other hand, the shrimp industry enjoys many advantages. Mass capture is accomplished easily, the edible portion is high in relation to the total weight, little processing is required and that is not expensive, it is well suited for marketing in canned, frozen, or fresh form, and it reaches commercial size in the same year as spawning.

Several factors probably account for the fact that the oyster trade developed to such gigantic proportions when shrimp and crabs were of little commercial significance. But two highly influential factors were familiarity with oysters and the location of the resource. Settlers of the Atlantic seaboard had considerable familiarity with oysters
in Europe, where they had long been cultivated and were held in regard as a seafood delicacy. So, upon recognition that very productive natural oyster reefs were liberally distributed along the American Atlantic coast, it is small wonder that oysters soon gained favor in the New World. Little time was lost before colonists were aware of the resource, for Indians were found to be eating them. The low capital investment and expense of harvesting, except for labor (which was cheap), favored early development. Location was of paramount importance, however, for oysters were found adjacent to what proved to be a populous coast with large city markets. Although the distribution of oysters extends along the south Atlantic and Gulf coasts and into Mexican waters, the range also extended as far north as the Gulf of St. Lawrence, and they were formerly abundant in southern New England, Long Island Sound, and New Jersey. Oysters were found, then, adjacent to a populous area and one that early developed seafaring interests, while the range of the commercial forms of shrimp extended no farther north than North Carolina waters and so were located in what proved to be a backward area with regard to fisheries. The facts of location and familiarity certainly made a tremendous difference in recognition and development of these respective resources. Enterprising New England and Long Island oystermen, upon depletion of the natural reefs, soon took to cultivation and by the time of the Civil War had extended their operations into the
Chesapeake region. Additional factors not favoring shrimp exploitation at this time were ignorance of their presence and migrations (shrimp being highly mobile creatures) and restrictions imposed by the lack of suitable gear and vessels with which to capture them in mass.

Exploitation of the tremendous shrimp resources of the south Atlantic and Gulf states had to await more favorable developments, notably the otter trawl, growth of population, and improvements in overland transportation. These developments were, however, of such profound importance that the shrimp industry quickly outdistanced oysters and apparently contributed to the decline of the latter.

The growth of the blue-crab industry had been more modest than that of shrimp, and although it has not yet outdistanced oysters in production and dollar value, its growth has been steady for the past half century and quite rapid within the past two decades, whereas the latter have barely held on, experiencing no true expansion. The blue crab, as contrasted with oysters, has to a lesser extent some of the same favorable biological and economical characteristics as shrimp—abundance of the population; less labor and time needed in capture; less capital investment required; and some recent innovations in gear, making possible mass capture.

The superior taste of shrimp and crabs, and also oysters, has been an advantage held by southern shellfish over finfish and has in a large way accounted for their
popularity and growing markets. Indeed, their palatability has tended to give them the distinction of delicacies, and with costs reasonable and comparable to other seafoods, it is not surprising that they have gained national esteem, which in the case of shrimp and blue crabs has constantly increased.

Lastly, but certainly not least in accounting for the phenomenal rise of shrimp and the more modest growth of crabs in the national markets, is the general lack of competition. A vacuum has been filled in the seafood markets. With the exception of lobsters, clams, and scallops in the New England and middle Atlantic markets, and a small luxury trade elsewhere of those seafoods, shrimp and crabs have had no serious shellfish competitors in the national market except for a few imported items from Japan and South Africa. This has been particularly true in the populous Great Lakes and midwest regions. Since competition by finfish with these tastier, better preserved products can be virtually excluded, an almost wide-open market opportunity was present—one that was recognized and satisfied. Had similar shrimp and crab resources been equally abundant and easy to exploit in New England waters, there would be little doubt as to their commercial status in the southern states—one of minor importance, satisfying at the most, the local markets. It is highly significant that preference for shrimp and crabs is lower in the New England regions than
elsewhere, due to competition with the long-established lobster and scallop interests, and that demand outside of the southern states is heaviest (for shrimp) in the North Central states. 14
Footnotes


2. The Biennial Reports of the Louisiana Conservation Department and the Department of Wildlife and Fisheries show this to be clearly the case.


6. Small markets formerly existed in the southern hinterland for salt fish packed in hogsheads. Because of the cheapness of the product and its preserved state, some southern planters bought considerable stores of it to feed their slaves. Also, small quantities of salt and smoked mullet from the Tampa area of Florida and Florida Keys were shipped to Cuba.


CHAPTER IX

CONCLUSION

Perhaps no one is so expertly trained as to feel fully competent to conduct an inquiry into the many dimensions of an industry. Yet, the task must be undertaken, of course, if a total picture is desired; and just such a picture should be the expressed aim underlying any approach to the economic geography of an industry. Far too often, however, studies in the economic geography of an industry are limited to two principal phases: the physical setting and the present economic composition of the industry. Emphasis is placed on the physical factors influencing the character of the industry and on the expansion and developments accruing to the industry from technological improvements and a growing market. But however excellent such a treatment may be, it renders only a partial account. If a total picture is to be brought into perspective, it is also necessary to trace the role of cultural factors that include the diffusion of techniques and material objects, the ethnic composition of peoples participating in the industry, and historical factors that set the stage for certain industries and traditions.

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This study has revealed and investigated a complex of physical, historical, economic, cultural, and geographical factors that have contributed to the growth and development of the shellfisheries of Louisiana. One can scarcely expect to find within such a complex an equal distribution of importance among the many factors, and hence several can be singled out here as having made a far more important contribution than have the others. In such related marine industries as the three shellfisheries of Louisiana it is not surprising that an excellent physical base is the factor common to all three. With the shrimp industry, revolutionary developments in gear and vessels together with scientific research in ecology and distribution appear to have been of paramount importance to growth. The early acquaintance of Americans with oysters and the relative ease of harvesting them were most important in accounting for this industry's early lead in the shellfisheries of the south Atlantic and Gulf states, but for the promotion of the industry into one of permanence and continuing importance, the ethnic factors weigh most heavily in Louisiana. Technological developments in canning, extraction of crab meat from the shell, and packaging and freezing, together with an ever-increasing national prosperity and demand for shellfish account principally for the development of crabbing into an important industry.

It is hoped that the approach used in this study of the Louisiana shellfisheries, with its emphasis upon a total
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picture arrived at by investigation into a complex of factors, might be profitably used in future studies in economic geography, not only for marine industries but for land industries as well. Thus far, there have been comparatively few fishery studies by geographers. It is the writer's belief that this monograph will demonstrate that sea industries are worthy of the geographer's attention, and can be studied with about the same facility, and profit, as can land industries.

Perhaps a lack of literature concerning the physical character of water areas and the ecology of marine life was a discouraging factor to geographers in preceding years. If this were true, it is no longer so. Although man's knowledge of the physical character and processes affecting the sea environment is small in proportion to what is yet to be discovered and understood, there is, nevertheless, a considerable amount of literature available today on the New England waters, sections of the United States Pacific Coast, the Japanese waters, and the waters of the North Atlantic adjacent to Europe. Several excellent publications dealing with oceanography are now available. Indeed, there is available enough material to give the geographer a good beginning in treating the physical base in his study. By gleaning carefully the information on his locality and augmenting these data with some of his own personal observations, he can be well on his way to developing a study of a sea industry.


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Herbert Ryals Padgett was born October 1, 1924, at Glenwood, Georgia. He first entered school at Valdosta, Georgia, and later during the fourth grade moved to nearby Quitman, Georgia, where he completed a high school education. He grew up on a farm and continued on in this work during the World War II period. In 1947 he entered Emory Junior College at Valdosta, Georgia. He later transferred to Florida State University where he received an A. B. degree in Geography. While at Florida State University he married Helen Hearn. He spent one year teaching at Florida State University following the granting of the M. A., and in the fall of 1952 an instructorship was accepted at Auburn University. In June of 1954, he entered as a Geography student in the Graduate School at Louisiana State University. Upon completion of residence and course requirements for the Degree of Doctor of Philosophy, he left Louisiana State University in the fall of 1956 to take a position as Assistant Professor of Geography at Jacksonville University, Jacksonville, Florida. He still held this position at the time he received the degree of Doctor of Philosophy in Geography from Louisiana State University in June of 1960.
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