ECONOMIC IMPACT ANALYSIS OF TEXAS MARINE RESOURCES AND INDUSTRIES

Prepared by
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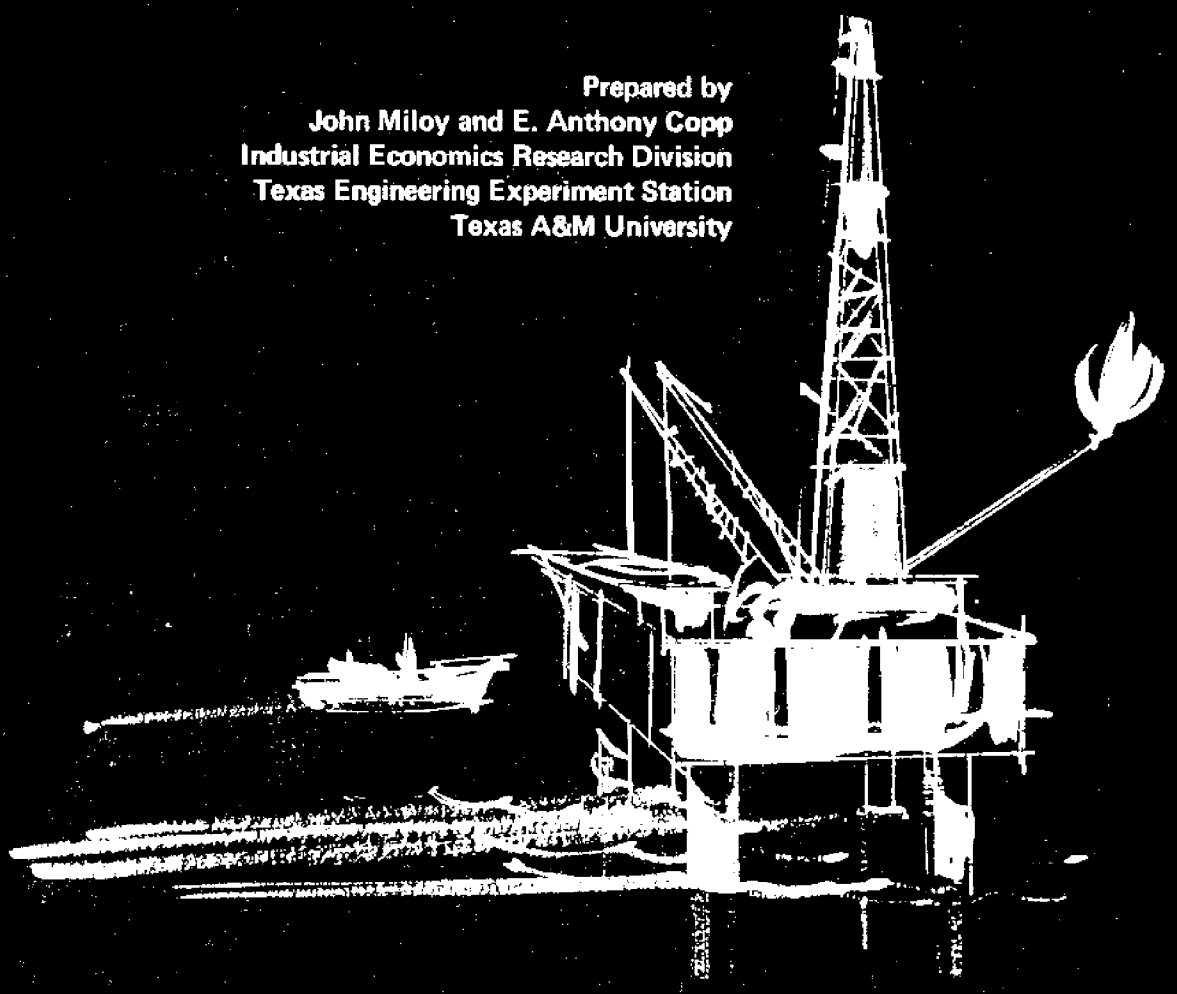

TEXAS A&M UNIVERSITY SEA GRANT PROGRAM

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FOREWORD

The first known effort to assess the economic interrelationship and impact of the marine resources and industries of Texas has been assembled in this study, Economic Impact Analysis of Texas Marine Resources and Industries.

The approach of the authors has been to incorporate concepts of regional economic growth theory and resource economics to the problems of marine resources and industries. In particular, the dynamic roles of marine resources and industries within identified growth core areas along the Texas coast are emphasized. Individual analyses of major marine industry groups are presented along with estimates of the total employment and sales impact of these industries on the Texas economy. Projections to the year 2000 for these industries also are provided.

The Industrial Economics Research Division is grateful for the assistance of more than 700 individual firms in Texas, various state agencies, and many individuals who provided information and other assistance in the development of the study.

This project was partially funded by the National Science Foundation's Sea Grant Program institutional grant GH-59 made to Texas A&M University.

James R. Bradley, Head
Industrial Economics
Research Division

June, 1970

SYNOPSIS

A Texas Marine Region of 63 counties is delineated as a study area for the economic impact of marine industries. This region is divided into Primary Marine Regions I and II and a Secondary Marine Region. Periphery and growth core areas are located within each sub-region. The structure and location of marine industry complexes are analyzed in terms of a lead-lag relationship between growth core areas and the periphery. A shift-share and location quotient analysis indicate that Texas Marine industries have a record of high growth.

The coastal onshore and offshore geologic structures of Texas are related. The major mineral produced onshore is natural gas with significant amounts of oil; natural gas has been the major mineral produced offshore.

More than 40 percent of the state population resides in the Texas Marine Region; 75 percent of this total lives in Primary Marine Regions I and II, located adjacent to the Texas coast.

The core area of Primary Marine Region I is the marine industrial center of Texas. This area represents a major world offshore industry center and is a major import-export marine complex of the United States.

Offshore mineral industries in Texas in 1969 employed more than 23,000 persons and had sales of more than $972 million. Marine transportation industries employed more than 18,000 persons; sales were more than $439 million. Commercial fisheries had approximately $219 million in sales and employed more than 12,500 persons. Marine recreation and tourism generated $190 million in expenditures by out-of-state visitors with millions more generated by local demand. Government employed approximately 5,200 persons in marine related activities.

The total direct and indirect impact of marine industries in the Texas Marine Region was estimated to be approximately $1.9 billion in sales. Total employment generated was more than 150,000 workers.

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CHAPTER I

INTRODUCTION: THE INTERRELATIONSHIPS BETWEEN MARINE RESOURCES AND ECONOMIC STRUCTURE

Attention has centered in recent months on the importance of the oceans and shipping for the economy of the United States. Particular focus has been on the economic influence and potential of marine resources on the economies of all nations in the world. Marine resources and marine industries have historically been major propulsive elements of economic growth in the state of Texas. The following sections will focus on the overall economic importance of the marine environment with specific reference to marine-oriented activity in Texas.

1. Economic Focus of the Marine Environment: A World Overview

The strategic economic role of the world marine environment is confirmed by the following facts: (1) all major industrial nations have extensive coastlines; (2) an estimated two-thirds of the gross world product is produced in coastal zones; (3) more than 80 percent of the world metropolitan areas are coastal areas; (4) of the 25 largest United States cities, 18 are coastal cities; (5) more than 75 percent of the total population of the United States resides in coastal or Great Lake states; (6) more than 45 percent of the nation's urban population resides in coastal counties, and (7) all of the major megalopoli now projected for the year 2000 are located in coastal zones - the margin where land and water meet and interact.[1]

The primary role of major water bodies in the world economy has been to provide inexpensive transport linkages to distant markets and resources. Coastal zones of the world have been the location points for heavy and medium size industries. Reduced transportation costs, time, raw material availability, access to major markets, and the economies available to industry at port sites have been major factors in coastal zone industrial locations.

2. An Overview of Texas' Marine-Related Economic Development

Areas proximate to the Texas marine environment have experienced a development pattern similar to other regions of the world. Economic growth in Texas has been directly related to access to the Gulf of Mexico and to the rich mineral resources found along the Gulf Coast. The Texas coastline covers more than 1,080 miles.

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[1] Marine Science Affairs - Selecting Priority Programs. Annual Report of the President to the Congress on Marine Resources and Engineering Development. (Washington: Government Printing Office, April, 1970) p. 31.

Gulf of Mexico air masses dominate the state's weather and the substructure of the Gulf Coast explains the geophysical content of the Texas coastal region. In addition to providing inexpensive water transportation, the estuaries, bays and other inland waters along the Texas coast constitute the major spawning and nursery areas for more than 70 percent of the fish population in the Gulf of Mexico. The coastal area of Texas is also one of the world's major oil and natural gas production centers.

Marine-related leisure activities are also big business in Texas. Sport fishing, boating, swimming and hunting along the coast generate employment and incomes for thousands of Texans. The impact of these and other marine-related activities is responsible to a large extent for the population and industrial concentration apparent along the Texas coast.

More than fifty percent of the residents of Texas are located within a radius of less than 100 miles from the coastline. Two-thirds of the state's total value added in manufacturing emanates from industries located within the coastal area.

The early development and maturation of the Texas economy is explained largely in terms of Gulf Coast resources and related industrial activity.

The Texas "Industrial Revolution" began with the discovery of oil and natural gas along the state's coastal region and the development of port and harbor facilities along the eastern half of the Texas coast. Additional coastal hydrocarbon discoveries provided the primary growth thrust for attracting people and industry to the Gulf Coast. Increased population, greater industrial diversification, and the specialized industrial growth stemming from oil and gas were the major factors contributing to the transformation of the state's coastal region from a rural to urban industrial complex.

The World Wars marked another turning point in the maturation stage of the Texas coastal economy. The demand for petrochemical products along with the increased requirements for oil and natural gas during and following World War II stimulated large-scale investments in coastal refining and processing facilities. The Texas Gulf Coast is currently the location for the world's largest petrochemical complex in terms of output and investment. The Texas Gulf Coast is the most important source of natural gas in the United States and contains reserves of more than one trillion cubic feet. Construction of the Intracoastal Waterway and expansion of port facilities by private industry and navigation districts in Texas were reinforcing factors in the development of coastal petro-industrial activity.

Within the past 20 years, new mining technologies and the world demand for larger energy supplies stimulated the search for oil and natural gas on offshore leases. The Texas offshore oil and gas industry is now concentrated from the Galveston Bay area to

the Louisiana border. The environmental demands for maintenance and supplies for offshore platforms and exploration vessels have attracted new supply industries to the Texas coast. As a result of these demands, the Houston area now is one of the world's major offshore exploration and supply centers.

The rise in population and personal income following World War II increased the demand for marine recreational facilities on the Texas coast. The state's coastline is now dotted with several communities whose major source of local income is generated by the demand for marine recreational facilities.

In summary, the natural resources, the access to world markets and resources, population growth, climate and the self generating economies of industrial concentration along the Texas Gulf Coast have been major stimulants to the economic growth of the state.

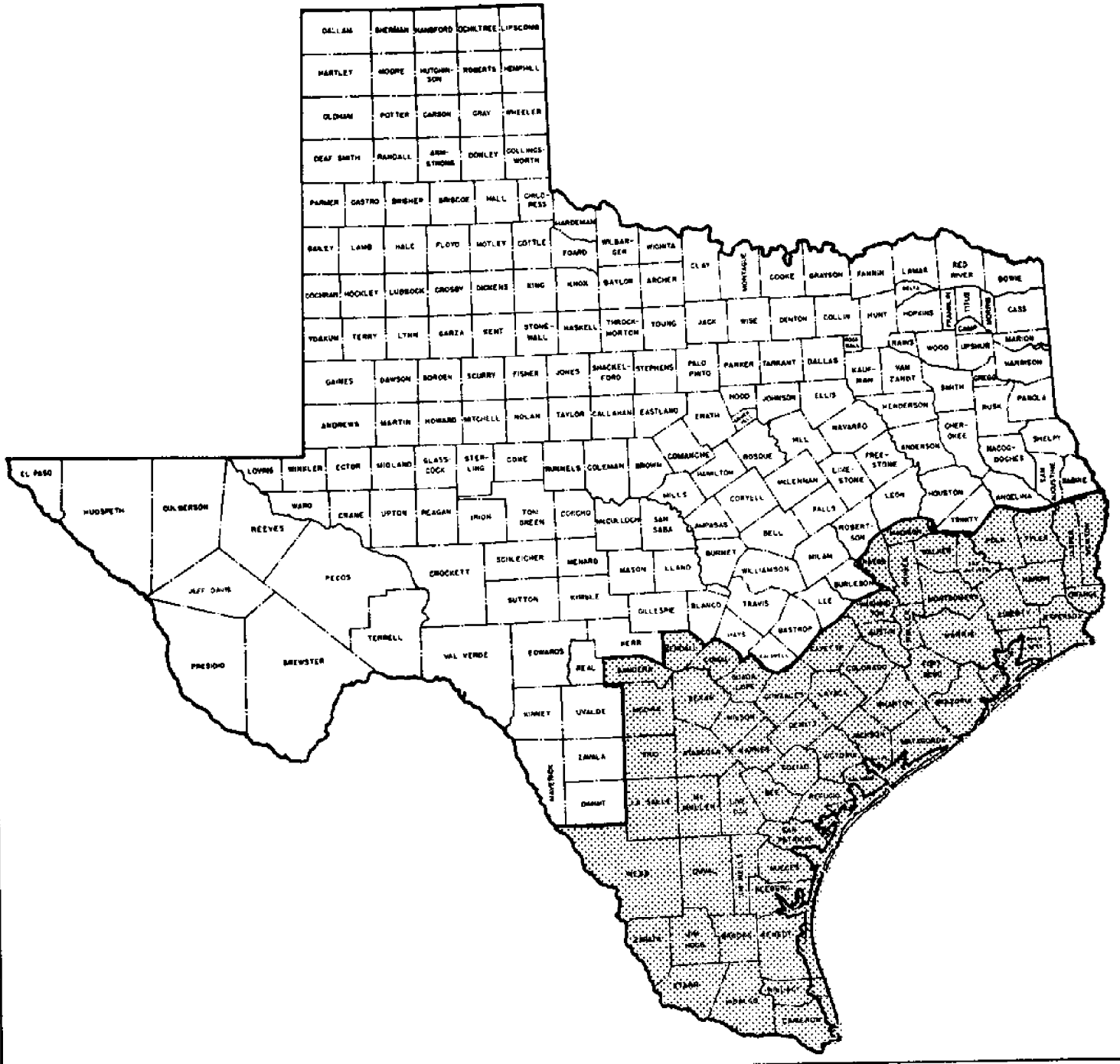
3. Regional Delineation of Study Area: Definitional Issues

To facilitate the assessment of the role of the marine environment on the Texas economy, a marine region has been delineated as the study area of this report.

The region consists of 63 counties located in the southern half of Texas as shown in Figure 1. The Figure includes the "coastal zone" of Texas along with a buffer zone of counties that have important economic linkages with marine activities on the Texas coast.

In similar studies conducted for other states, the term coastal zone has been used as the area of analysis for the assessment of marine activities. In these studies, the coastal zone has been defined as those geographic areas having a boundary with the sea or ocean. This coastal zone has also been defined as that portion of the land which is affected by its proximity to the sea and that part of the ocean that is affected by its proximity to the land. It includes the inshore part of the continental shelf, ocean shoreline, and estuaries with their marginal shores. This approach emphasizes the sensitive ecosystems in the estuaries and related shallows and the impact of coastal development on local resources and environment. Using either one of these coastal zone definitions as a basis for delineating the study area for Texas' marine activities would ignore the direct role of several major Texas marine industries.

The coastal zone definition is adequate for analysis of offshore mineral resources, the fisheries, oceanographic-related research, pollution, air-sea interaction, aquaculture and marine recreation. The coastal zone definition, however, does restrict the analysis to the contiguous coastal area. Alternatively, a more liberal approach to studying the influence of marine activity has been the "hinterland" concept. This concept has been used in numerous studies to assess the economic impact of ports and harbors. The hinterland is the areal extent of inland trade points linked with



ORIENTATION OF THE STUDY AREA IN TEXAS
FIGURE 1

a given coastal port; it is the area for which the port forms an economic outlet because of lower transportation costs. A port may have a different hinterland for different commodities that enter into its trade. When some of these commodity hinterlands coincide, a rough linear boundary can be drawn. Variations in the boundaries of these hinterlands arise from the nature of commodities, commodity rate structure, with which it is trading, and the type of sea transport.[2] With no less than 12 major deep water ports along the coast of Texas, a complex hierarchy of hinterlands with boundaries far beyond the border of the state can be specified. Geographers have distinguished three components of a typical hinterland: (1) the immediate metropolitan area of the port; (2) the "non-competitive hinterland," in which the port has a freight rate advantage and (3) a peripheral region where rates are equal or the rate differential is low enough so that a port may compete for traffic on the basis of factors other than rates.[3]

Although a knowledge and understanding of the economic hinterland of Texas' ports is germane to an analysis of the economic impact of marine industries, the hinterland approach does not encompass some key marine activities although it does focus on major sources of demand for marine transportation services in Texas.

The coastal zone approach is too limited and the hinterland approach is too specialized. In this report, a more general marine industrial regional approach is presented. The study area of 63 counties is delineated based on marine resource and marine industrial interrelationships. Figure 2 indicates this delineation.

The study area is sub-divided into a primary and secondary region. The Primary Region consists of Regions I and II. The Secondary Region consists of Region III, and the remaining 191 counties of the state are described as the rest of Texas. Primary Region I contains 25 counties; Primary Region II contains 17 counties, and Secondary Region III is comprised of 21 counties. An alphabetical listing of these counties in each region is shown in Appendix A.

Each sub-region is further identified by a core-growth area and a periphery. The core area constitutes the location of the major marine-industrial activity in the sub-region. The periphery is identified as those areas whose economic growth is dependent on the marine industrial and related activity in the core area. Section 6 of this chapter discusses the complex economic relationship between core and periphery.

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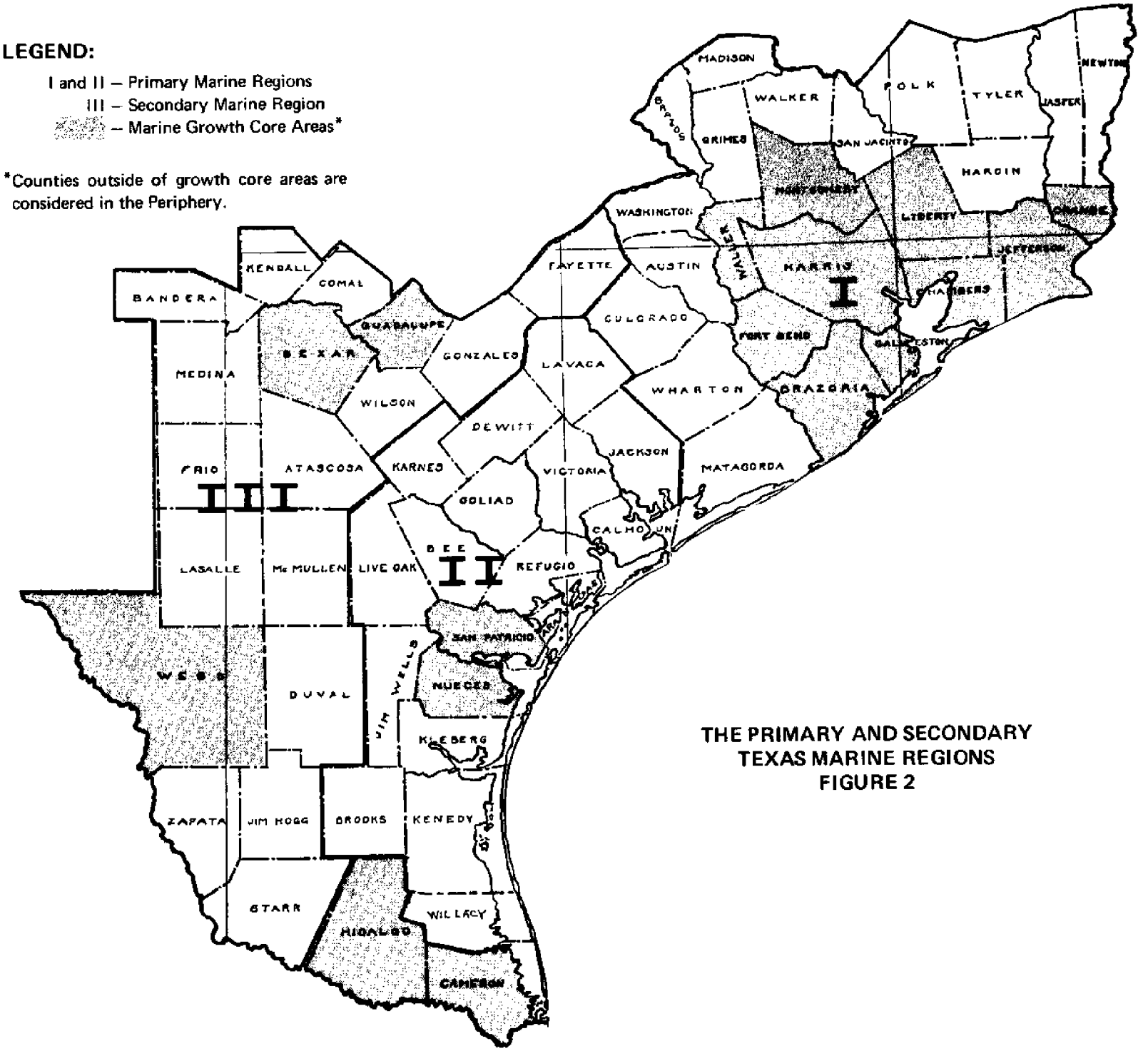
[2] F. W. Morgan and James Bird. Ports and Harbors. (London: Hutchinson University Library, 1961). p. 111.

[3] Eric Schenker. The Port of Milwaukee: An Economic Review. (Madison: The University of Wisconsin Press, 1967). p. 54.

LEGEND:

I and II – Primary Marine Regions
III – Secondary Marine Region
– Marine Growth Core Areas*

*Counties outside of growth core areas are considered in the Periphery.



THE PRIMARY AND SECONDARY TEXAS MARINE REGIONS
FIGURE 2

Unique relationships exist between the complexity of the marine industries in the State of Texas and the quality and quantity of marine resources directly or indirectly related to the Gulf of Mexico. The delineation and structuring of the Texas Marine Region is based upon the economic approach to marine resource analysis and the theory of interregional economic development. Sections four and five discuss these issues and section six generates the major hypothesis of this report as to resource interrelationships and the state's economic growth. Section seven provides a general outline of the total study project.

4. Economic Approach to Marine Resources Analysis: Texas and the Gulf of Mexico

Economic analysis of marine resources and marine industries for Texas is concerned with the direct and indirect interdependency of onshore activities in Texas with the Gulf of Mexico. The interface of the Gulf of Mexico with the Texas coast covers more than 1,080 miles. The Gulf itself is slightly less than three times the size of Texas.

The presence of this massive body of water and the natural construct of bays and estuaries along the state's coast constitute a major asset in the overall economic wealth of Texas. The bays and estuaries and the tidelands 10.4 miles from shore are the property of the State of Texas. Beyond these boundaries, the federal government controls leasing rights for offshore exploration of mineral resources. Knowledge of the geophysical structure, depth, climatic condition, mineral and fishery contents of the Gulf would seem to provide a comprehensive assessment of the economic potential of the Gulf. This approach, however, is necessarily partial and stems from ambiguities in the current use and meaning of a marine resource.

In economic life, man consumes two fundamental kinds of naturally occuring scarce resources: (1) replenishable resources, such as fish, timber, and waterfowl and (2) non-replenishable resources, such as petroleum and natural gas. This second category is often called "exhaustible resources."[4] The first category of resources is capable of regeneration as man consumes a flow of the resource, while the second represents a fixed stock whose inventory can only be exhausted over time.[5] A marine resource may not be exhausted in the physical sense, but in the economic sense. A resource may exist but its small availability and low expected return may eliminate it from economic consideration.

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[4]Vernon L. Smith. "Economics of Production from Natural Resources." American Economic Review, p. 409.

[5]Ibid.

This view of natural resources is analytically useful for specific resource problems and is widely used. It does, however, provide only a partial view of natural resources in that it encourages a static typology of marine resources such as fish, minerals, beaches, and harbors that fails to highlight the interrelationships among all marine activities and the real socio-economic benefits and costs of these activities. The current view would identify the state's marine resources as all replenishable and non-replenishable resource elements directly or indirectly related to the Gulf of Mexico. However, as indicated in the previous section, the assessment of marine resources is a regional problem that concerns not only productive elements in the coastal zone but also activity and resources over a much wider geographical and economic landscape.

A more generalized approach in evaluating the state's marine environment would be to consider the Gulf of Mexico as the basic marine resource and to analyze the alternative uses of the Gulf as products or services produced by the combination of the Gulf's resource elements with labor, capital and management.[6]

This approach to marine resource analysis allows the analyst to distinguish between a resource called fish and a product called fish.[7] The latter is the result of factor input utilization in a production process; the former constitutes part of the replenishable resource wealth of the Gulf. The output of the offshore mineral industry, the fisheries, the ports, the services of coastal recreation and all other marine related industry can be assessed as the product of the combination of the marine resource, the Gulf of Mexico, along with other factors of production. This approach also facilitates the identification of alternative use-demands for the marine resource, i.e., fish caught by the sportsman versus species caught by commercial fishermen or water resources for recreational use versus ocean-going trade. This approach to resource allocation also facilitates delineation of the collective and specific diseconomies or externalities resulting from resource disequilibrium from marine oriented manufacturing activity. The impact of a hurricane on all economic activities in the coastal area, or the impact of air and water pollution on the ecological equilibrium of the marine resource are examples of collective externalities.

The dichotomy of replenishable and non-replenishable resources can be utilized to focus on specific problems within a more general regional economic approach to marine resources and marine industries. This report focuses on the total marine environment generated by the

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[6]Niels Rorholm, Harlan C. Lampe, and Joseph F. Farrell. A Socio-Economic Study of Narragansett Bay, Rhode Island. (Providence, R. I.: University of Rhode Island, 1968). p. 3.

[7]Ibid.

Gulf of Mexico. Given this analytical approach to marine resources, specification of what activities constitute marine industries can be clarified.

5. Marine-Related Industries

Marine-related industries are those activities that (1) require marine resource inputs to produce a given output or service or (2) that provide services or products to the directly related marine industries under (1). Examples of industries under (1) are the water transportation, fishery, offshore exploration and mining, marine recreation, and oceanographic research and development industries. Each of these activities requires direct access to the Gulf of Mexico to produce its product or to provide its particular service. The second category produces goods and services required by the direct marine industries. Examples of industries include the offshore supply industries, shipbuilding and repair industries, marine electronics, and marine engineering and construction industries.

In this report, marine industries will be identified by a four-digit Standard Industrial Classification (S.I.C.) number. This is a classification system of industry used by the federal government that identifies firms by the type of product or service produced. Five general industry groups will be used in this report. They are (1) Offshore Mineral Industries, (2) Water Transportation, (3) Fisheries, (4) Tourism and Recreation, and (5) Other Industry.

The S.I.C. categories that produce marine-related products or that allocate some or all of their employment effort to providing marine-related services are listed in Appendix B of this report. This listing is designed not to reflect only those industries whose activities are 100 percent marine related (such as fisheries), but also to include those industry groups producing marine-related products, equipment or providing auxilliary services to marine industries.

6. Regional Marine Resource and Marine Industry Analysis: Theory and Practice

The 63-county marine region, as already indicated, is geographically larger than a "coastal zone" delineation and smaller than the hinterland approach. The rationale behind the specified study area lies in the functional approach to regional delineation. The functional approach relates the interdependencies of major industrial activity in a region to the secondary economic structure of the region.[8]

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[8]Horst Siebert. Regional Economic Growth: Theory and Policy. (Scanton, Pa.: International Textbook Company, 1969), Chapter Two; and Harry W. Richardson. Regional Economics. (New York: Praiger Publishers, 1969), Chapter 9.

The areas where these interdependencies are concentrated are called growth core or growth pole areas. In this report, a marine core or marine growth pole area and a surrounding periphery are identified. As shown in Figure 2, the Texas Marine Region is subdivided into three smaller regions. The Primary Marine Region contains Region I and Region II. In each region, a marine core and a periphery have been identified. In the Primary Marine Region, the marine core areas are the Houston-Galveston-Port Arthur complex and the Corpus Christi-Brownsville complex. The Secondary Marine Region core consists of the San Antonio-Laredo areas. The Secondary Region is identified as a major source of marine recreational demand. The rest of Texas includes the remaining 191 counties. The core area region contains the center of marine-related activity, and the core area marine industries provide the major economic growth thrusts to the communities and industrial activities in the peripheral counties.

Core areas of marine industry concentration are often described as regional growth poles. Each region can be described as being "polarized," i.e., its growth is viewed as a function of economic activity in the core area. Region I in Figure 2 is polarized on the Houston-Galveston-Port Arthur complex; Region II is polarized on the Corpus Christi-Brownsville centers. Core areas are also the population centers within the region and the primary node for transportation networks, communications, the location and/or processing center for raw materials, and for the maze of secondary industrial and service industries typical of major urban centers. In viewing the economic development of the Texas Gulf Coast, the economic hierarchy begins with the core area.

The process of economic growth in the Texas Marine Region is explained by the "spillover" or "spread" effects of core industrial activity. The direct employment and income generated by these marine industries stimulates employment in secondary and tertiary industries by some multiple factor. These industry multipliers are important in assessing the economic impact of these industries. For example, expansion of offshore drilling activity has a direct employment effect on the Houston-Galveston-Port Arthur core area. Materials necessary for exploration, platform construction, oil well equipment, supplies, maintenance, and pipeline construction, may be purchased from a variety of locations inside and outside the core area and also outside the region. This expansionary effect has considerable indirect effects on employment and incomes within and outside the region. In addition, demands for marine related commodities may come from outside the Texas Marine Region. For example, the increase in world offshore exploration has stimulated significant amounts of business in the Region I core area. This "external" or "export" demand is an important factor in the growth rate of each region. Particularly with regard to the port and harbor activity on the Texas coast, the United States and world demands for commodities competitively exportable from Texas ports constitute the critical factor in the growth of port-related urban complexes. All

major and intermediate size urban areas in the primary regions of the Texas coast have direct access to a port. Reduction of this external demand would critically influence the growth rate of the Primary Marine Region core areas. The regional delineation and core-periphery approach outlined provide the analytical stage for in-depth analysis of the total regional economy of the Texas Gulf Coast and the role the marine industries and marine resources play in the total state economy. The following section will discuss the overall outline of this report.

7. Summary of Marine Impact Analysis Study

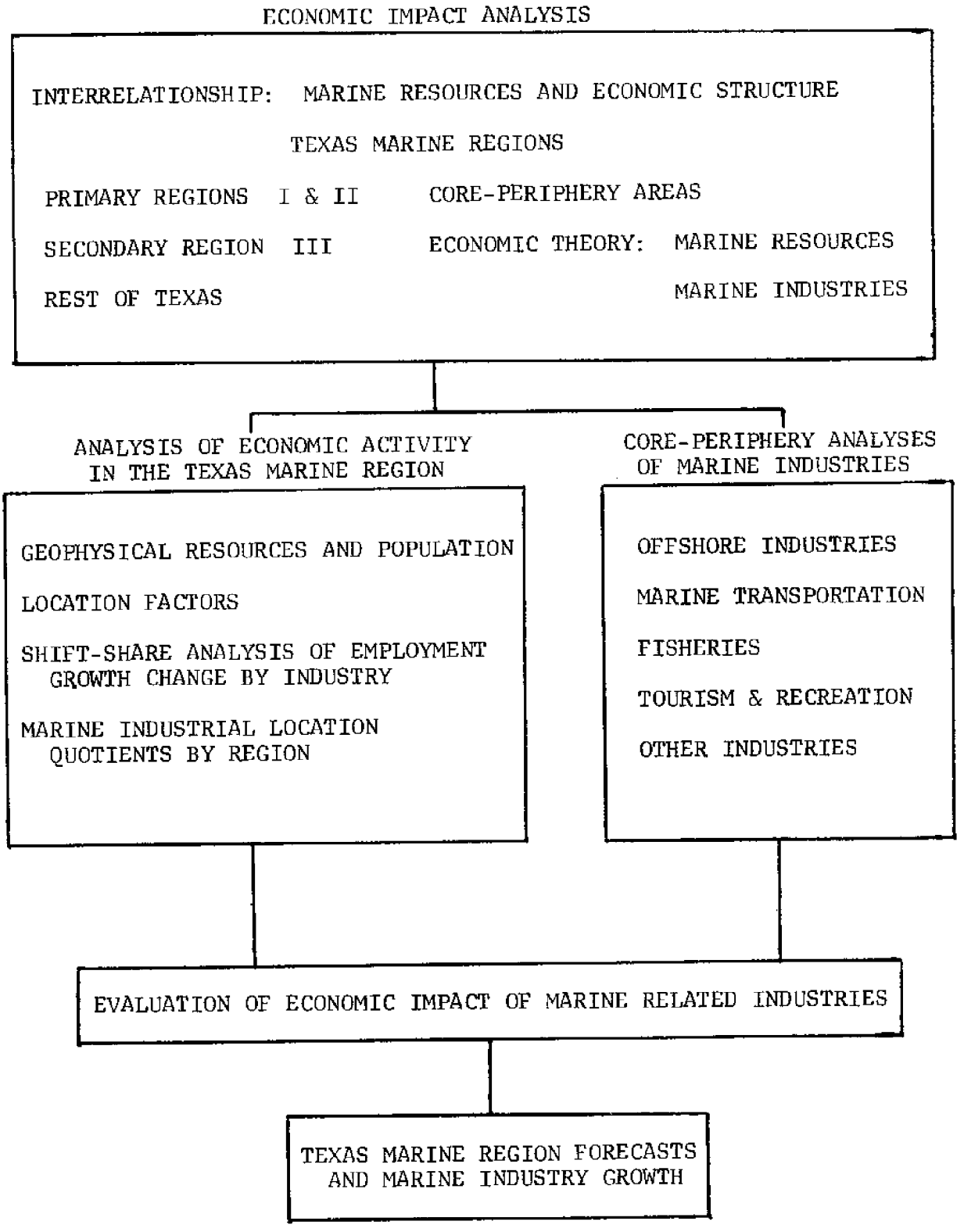
The recent attention to the problems of coastal zone management and growth has prompted the search for underlying relationships between marine resources and marine-related industrial growth. Several theoretical tools of analysis lend themselves to assessing these relationships and the economic impact of marine industries on the economy of Texas.

Given the delineation of the Texas Marine Region and its alternative core and periphery and also the definition of marine resources and marine industries, a framework of analysis can be established to study the economics of marine activity in Texas. A schematic is presented in Figure 3 that outlines the analytical approach of this report.

As the schematic shows, the initial phase of the report relates the delineation of the Texas Marine Region into component subregions with a core and periphery. This includes discussion of the definition of marine industries and marine resources contained in Chapter I.

The second phase of the report provides a comprehensive socioeconomic analysis of the entire Texas Marine Region. Included are an overview of the resource base of the region, a location quotient analysis that will identify the relative concentration of industries in the region, a shift-share analysis to identify lead-lag relationships of employment growth among alternative industries and forecasts of population, employment, and income.

To delineate the role of Texas' marine industries in this overall projected growth, a series of brief analyses of major marine industry groups is provided. With knowledge of the relative impacts of these marine industry components, and from estimated multipliers of the direct and indirect impact of marine industries, the estimation of the overall impact of marine-related firms in Texas can be made. Forecasts of this total marine activity and its expected future impact will conclude this report.



OUTLINE FOR MARINE INDUSTRY IMPACT STUDY

FIGURE 3

CHAPTER II

ANALYSIS OF THE GEOPHYSICAL AND SOCIO-ECONOMIC STRUCTURE OF THE TEXAS MARINE REGION

A greater understanding of the interrelationships of marine industries and marine resources requires a detailed assessment of the geophysical and socio-economic structure of the Texas Marine Region. The following sections will discuss and analyze the geophysical resource base and the overall industrial growth of the region and indicate the cause-effect relationship of marine resources and industrial growth.

1. Geophysical Resources in the Texas Marine Region

The Texas Marine Region comprises more than 25 percent of the state's total land area. The 63-county study area is located in the Coastal Plain physiographic province, a segment of the greater Gulf Coastal Plain that extends from Florida to Mexico. In Texas, the Coastal Plain province includes all of the Neches and San Jacinto River basins, most of the Trinity, San Antonio, Nueces River basins, and significantly large segments of the remaining three basins, the Brazos, Colorado and Guadalupe. The approximate extent of the Texas Marine Region within the Coastal Plain province is provided in Figure 4. The other major Texas physiographic provinces are also indicated in Figure 4 as the Central Lowland province and the Great Plains province.

Elevation in the Coastal Plain province rises from sea level along the Gulf Coast to more than 500 feet at the Balcones Escarpment as shown in Figure 4. The Escarpment marks the abrupt rise from the Coastal Plain to the Edwards Plateau of Southwestern Texas. Most of the Texas Marine Region is related topographically. The eastern Texas forested lands lead into rich-soiled prairies toward the west to the Rio Grande, the prairies merge into undulating brushy plains country.[1]

The Coastal Prairie is largely a deep accumulation of sediments. This belt of coastal lowland, some 50 to 75 miles wide, is the most recently emerged portion of the continental shelf. Quite level for some distance inland, the Coastal Prairie rises rapidly to about 100 to 175 feet along its inland edge. Except for the steep-sided channels of traverse streams, the Coastal Prairie is a clay plain

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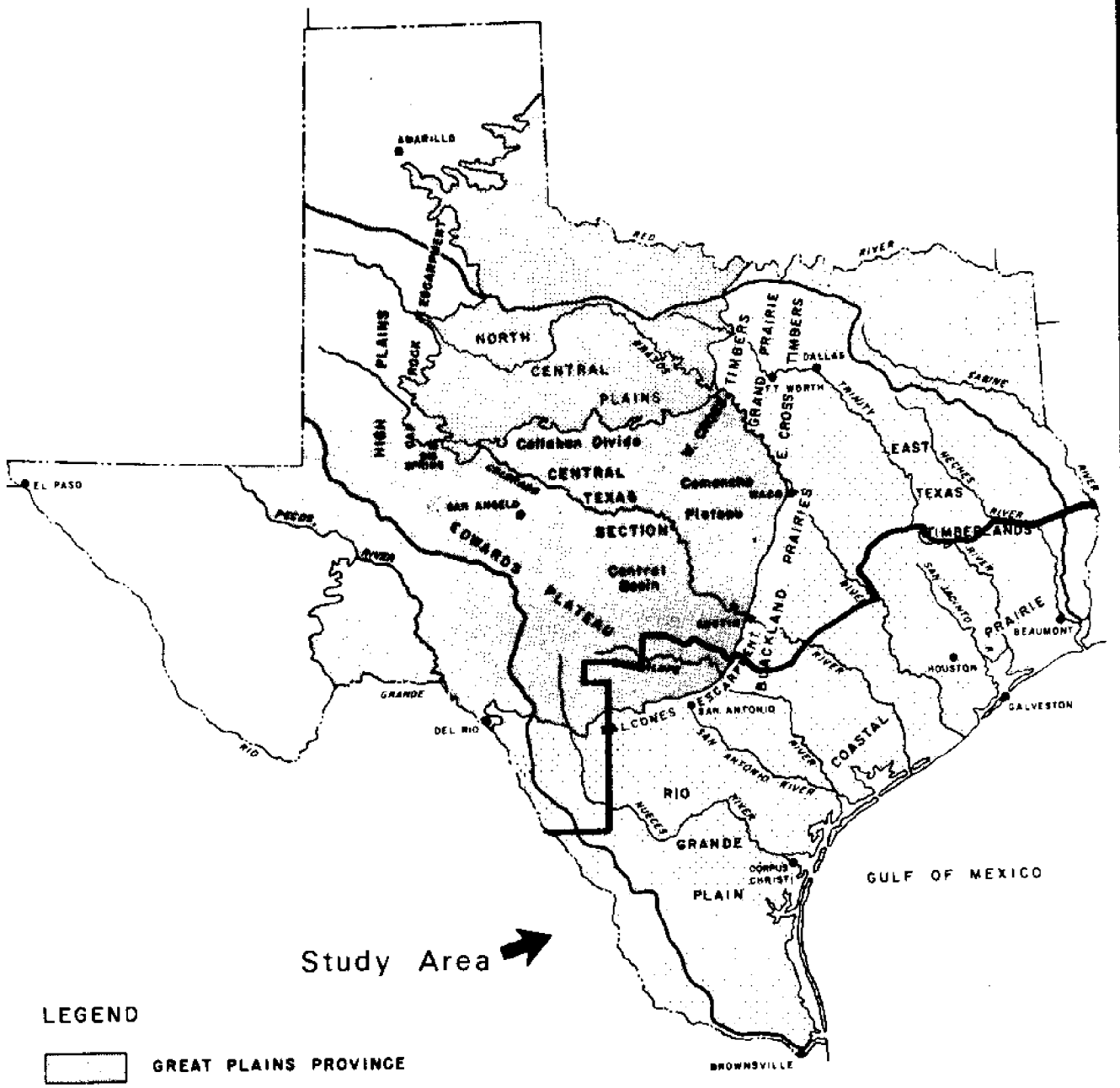
[1] The Report of the U. S. Study Commission - Texas, Part II, Resources and Problems. U. S. Study Commission on the Neches, Trinity, Brazos, Colorado, Guadalupe, San Antonio, Nueces, and San Jacinto River Basins and Intervening Areas. (Washington: Government Printing Office), March, 1962.



PHYSIOGRAPHIC PROVINCES OF TEXAS

FIGURE 4

almost unrelieved by erosional features. Timber increases toward the more humid eastern portion of the prairies. There is a considerable area of marshland along some parts of the upper coast, notably east of the Trinity River.[2]

2. The Geophysical Relationship of the Gulf of Mexico and the Texas Marine Region

The major structural feature geologically in the study area is the Gulf Coast geosyncline that underlies the Gulf Coastal plain. The geosyncline is the sedimentary basin comprising the Gulf Coastal plain and the northwestern part of the Gulf of Mexico.[3] The landward limit of the geosyncline is considered to extend less than 200 miles north of the present Texas shoreline. The southern limit of the geosyncline is believed to occur in the vicinity of the Sigsbee Escarpment as indicated in Figure 5.

The structural history of the Western Gulf Coast and adjoining parts of the Gulf of Mexico is essentially the development of this geosyncline. The structure of the geosyncline explains to a large extent the composition of mineral deposits found onshore and offshore Texas and the Gulf Coast. The alignment of the geosyncline extends from Alabama to northeastern Mexico. Figure 5 provides a zonal delineation of the seven major geologic provinces of the Gulf of Mexico. The Texas-Louisiana Continental Shelf area constitutes the area of greatest offshore industrial activity. The offshore area south of Texas and Louisiana, which includes a major portion of the geosyncline, is characterized by diapiric salt structures from near-shore to the Sigsbee Escarpment.[4] Figure 5 shows that the shape of the Texas-Louisiana Continental Shelf extends more than 100 miles off the Texas shore and tends to narrow near the Louisiana delta area. Geologic structures and sands in the Louisiana-Mississippi delta area contain large quantities of mineral resources. This shallow, low level area has been a major factor in hydrocarbon and natural gas offshore development along the Gulf Coast and has influenced the characteristics of port and harbor development along the Texas coast.

Texas onshore mineral development is geologically related to offshore deposits. One of the leading minerals, natural gas, has been produced extensively in both onshore and offshore areas.[5]

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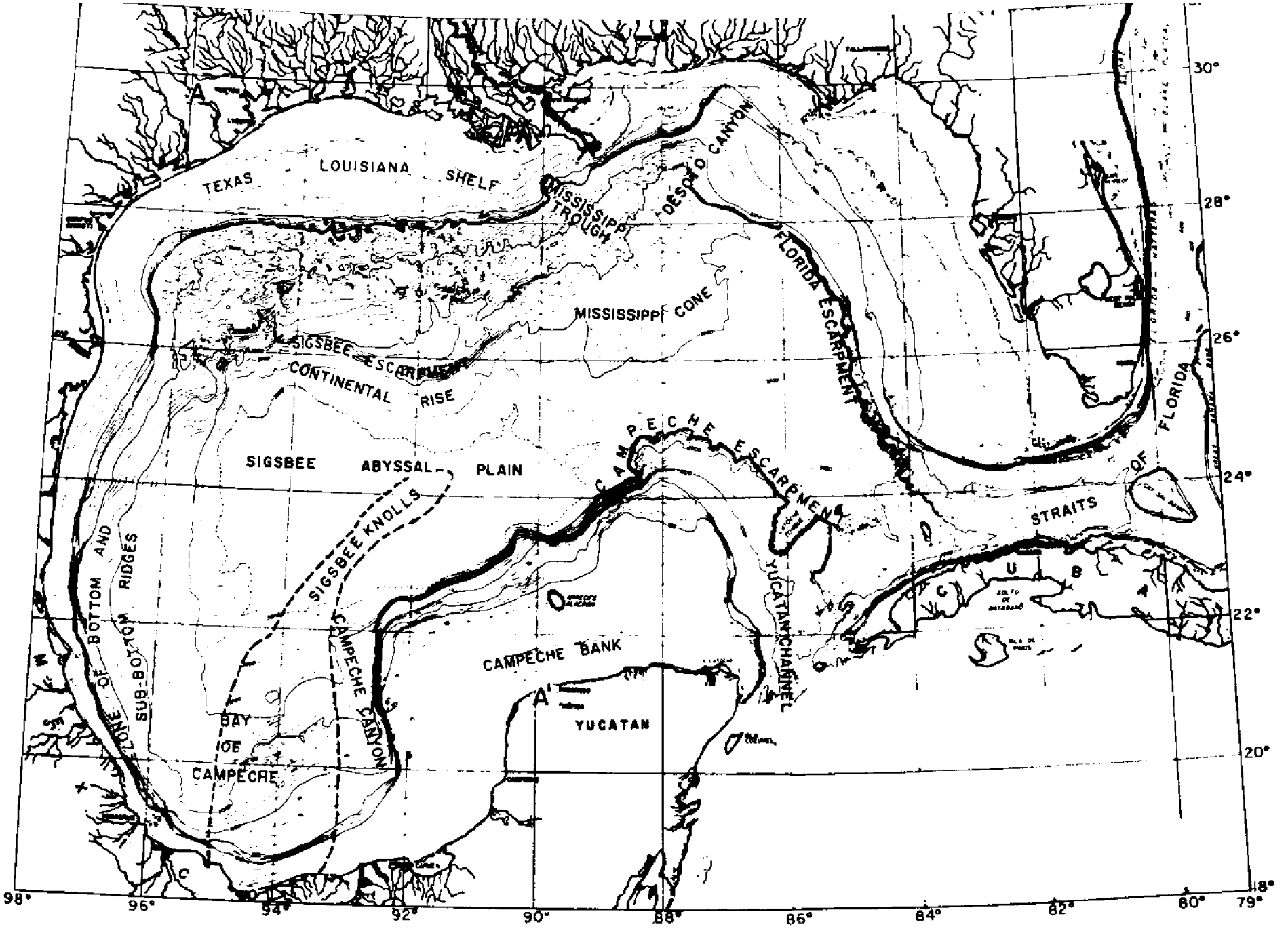
[2]Ibid.

[3]E. H. Rainwater and R. P. Zinguia (eds.). Geology of the Gulf Coast and Central Texas. (Houston: Houston Geological Society, 1962).

[4]John W. Antoine and James C. Gilmore. "Geology of the Gulf of Mexico," Ocean Industry, Vol. 5, No. 5, (May, 1970), p. 37.

[5]"Big Unknowns in Geology," Petroleum Engineer. (January, 1969), p. 81.



GEOLOGIC PROVINCES OF THE GULF OF MEXICO

FIGURE 5

Three major structural features in Texas have affected the oil and gas accumulation in the Coastal Plain of Texas: the East Texas Embayment, the coastal salt domes and the Rio Grande Embayment. Figure 6 indicates the oil and gas geologic features in the State of Texas with the boundary of the Texas Marine Region. Geologically, all major and giant hydrocarbon fields in the coastal province occur in association with or basinward from the Mexia-Talco fault systems or its equivalents. More than 90 percent of all major oil deposits discovered in the coastal region occur Gulfward from these systems of faulting. Houston, in Harris County, is in the center of a region characterized structurally by a great many salt domes and other structures related to subsurface salt movement.[6] The important oil and gas deposits associated with these features have been in Cenozoic rocks alternating from shale to sand. Other important mineral deposits on the coastal province include lignite, gypsum, extensive supplies of shell from the coastal bays, sulfur obtained from the cap rocks of salt domes and the tidelands of Texas, and salt. The extent of mineral resources off the coast of Texas is not yet established. Recent geophysical surveys indicate that the Gulf of Mexico is a large reservoir of oil, gas and sulfur along with economically significant amounts of titanium, zirconium and other minerals. Most of the mineral production on the Texas continental shelf has been natural gas. While early production occurred in the state-owned bays, much of the current exploratory activity is on areas leased from the federal government.

The Texas Gulf Coast is the most important source of natural gas in the United States. Reserves are estimated at more than one trillion cubic feet.[7] The presence of this resource in the coastal province has stimulated the development of the vast petrochemical complex in the coastal region.

The interrelationships of the geologic structure of the coastal province and the mineral resources found in the area provide the basis for understanding the importance of the Texas marine environment. The Gulf of Mexico, the world's ninth largest body of water, is itself the key marine resource available to Texas. Most of the shrimp consumed in the United States are caught offshore Texas. Other marine food forms are being studied. In addition, the Gulf is a supply of water reclaimed through desalination plants located on the coast. At the interface of land and the Gulf of Mexico, are the extensive natural bays and estuaries that provide breeding and nursery areas for the fish populations in the Gulf. Marine

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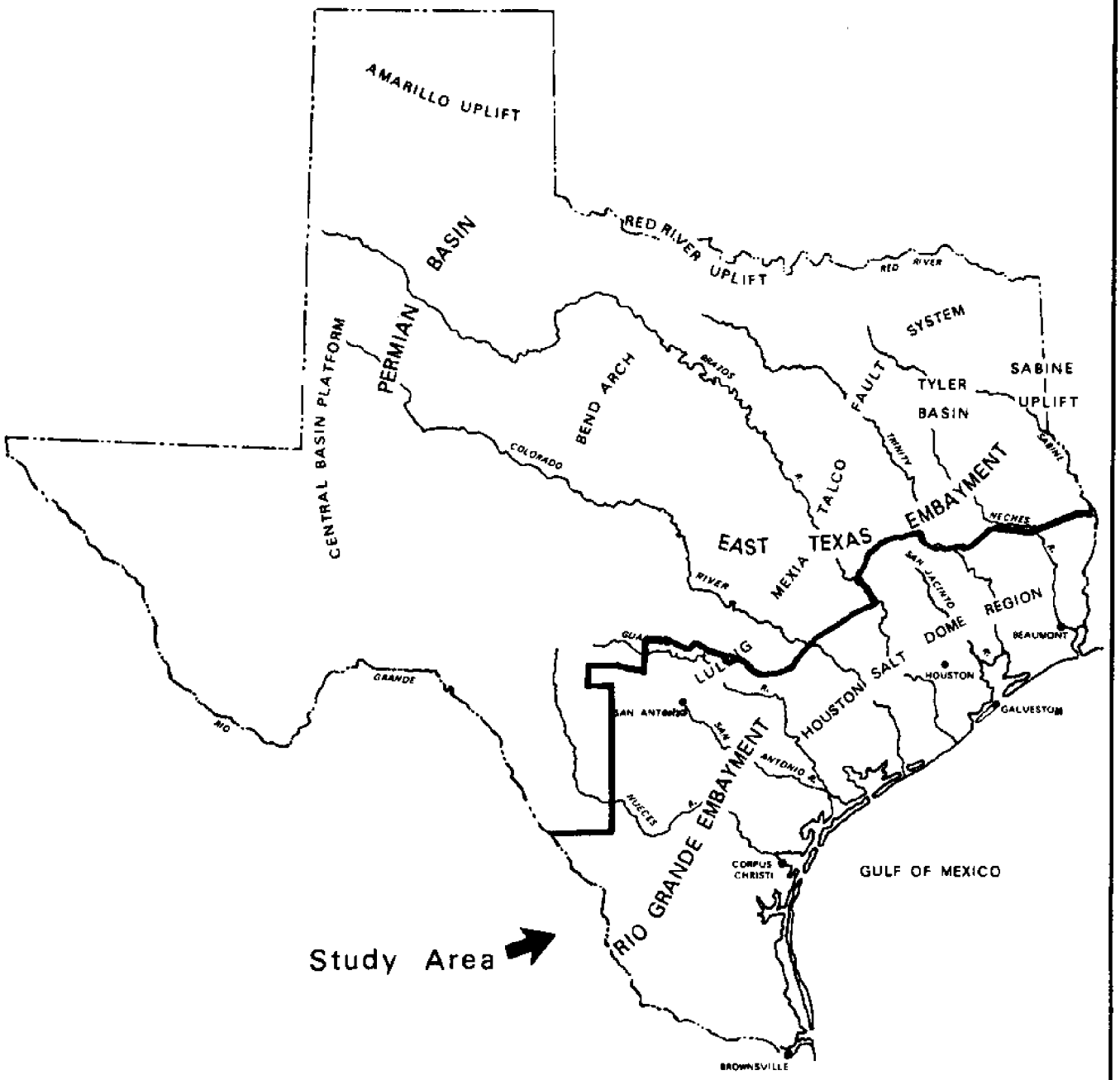
[6] Ibid. p. 11-13.

[7] Michael T. Halbouty. "Economic and Geologic Aspects of Search for Gas in Texas Gulf Coast," Natural Gases of North America, Vol. I, B. Warren Beede (ed.). (Tulsa: American Association of Petroleum Geologists, 1968). p. 271.



OIL AND GAS GEOLOGIC FEATURES OF THE STATE OF TEXAS

FIGURE 6

recreational areas have also provided a huge outlet for Texas residents. In addition, the Gulf of Mexico acts as a depository for natural sediments and industrial pollutants from the land areas of Texas. Much of the industrial locational influence exerted by the coastal region derives from the direct access to the Gulf. This access to a water outlet is a key marine resource. A major influence of the Gulf on socio-economic activity of Texas is the climatic conditions influenced by the marine environment. The following sections will discuss briefly the Gulf coastal climate and the population affected by this marine environment.

3. Climate

The Gulf of Mexico dominates the climate of the Texas Marine Region. Warm, moist Gulf air masses move over the study area throughout the summer and spring seasons. The coastal area is generally humid with temperatures ranging from up to 100 degrees in summer to the low 30's during the winter months. Tides along the Gulf Coast are predominantly diurnal, i.e., there is usually but one low water and one high water in a tidal day.[8]

Other key factors of climatic conditions created by the marine environment are the seasonal storms and hurricanes. Hurricanes reaching the Texas coast generally follow a west-northwest course across the Gulf of Mexico and curve north after reaching land areas. During the 1960's the entire Gulf Coast area experienced its worst hurricanes. Carla, Betsy, and, recently, Camille destroyed over $1 billion in homes, factories, business establishments, offshore structures, along with taking a large toll in human life.[9]

4. Population in Texas Marine Region

The spatial distribution of the population located in the Texas Marine Region has tended to cluster in the southeastern Gulf Coast area of Primary Marine Region I. The region contains the greatest concentration of oil and gas reserves in Texas, and is the state focus for offshore production and leading port facilities. It is also the center of the petrochemical and fabricated steel industries. The importance of the regional core areas as population centers can be seen in Table 1.

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[8]Charles Theurer. "Mapping the Coastal Margin," Law and the Coastal Zone. National Science Foundation Sea Grant Program (College Station: Texas A&M University, 1970). p. 36.

[9]Damage to offshore oil structures by Hurricane Camille in 1969 was estimated at $100 million. More than 150 persons were killed by the storm. See "Camille's Impact," by W. Jeff Davis, Ocean Industry, Vol. 4, No. 10, (October, 1969), pp. 11-17.

TABLE 1

SPATIAL DISTRIBUTION OF TEXAS
MARINE REGION POPULATION
1968

REGION	NUMBER OF COUNTIES		POPULATION (In Millions)	
Primary Marine Regions				
Region I				
Core	10		2.4	
Periphery	15		.4	
Total Region I		25		2.8
Region II				
Core	4		.7	
Periphery	13		.3	
Total Region II		17		1.0
Secondary Marine Region				
Region III				
Core	3		1.0	
Periphery	18		.2	
Total Region III		21		1.2
TOTAL TEXAS MARINE REGION		63		5.0

SOURCE: Bureau of Census, U. S. Department of Commerce, Washington, D. C.

The table indicates that more than 75 percent of the population in the Texas Marine Region resides in the Primary Region with the heaviest concentration in the core area of Primary Region I. The total Texas Marine Region population accounts for more than 40 percent of the total state population.

5. Summary of Industrial Location Factors in the Texas Marine Region

The industrial locational appeal of the Texas Marine Region results from a unique combination of natural, technological, and community resources. The intensity of locational attractiveness varies in the core area and periphery of each region. In the primary areas that include Regions I and II, the most influential factors of location

are the availability of natural resources, the inexpensive water transportation outlets provided by the ports, and access to major markets.

In the core area of Region I are contained some of Texas' largest reserves of oil and gas. The area is also the production center for the offshore oil and gas industry in Texas and contains the world's largest concentration of petrochemical processing plants. Many of these plants are located adjacent to the port facilities in the core area. Primary Region I's core area includes the Port of Houston, the nation's third largest port in tonnage along with five other general cargo and bulk goods ports. The reinforcing influence of these transport facilities along with the integrated complex of chemical and oil refining plants in the core area has been a major factor in attracting people and industry to the core area and also to the periphery. The core area is the hub for a vast pipeline system popularly known as the "Spaghetti Bowl" that interconnects oil, gas and petrochemical plants. Extensive rail and highway linkages have facilitated the movement of intermediate commodities and finished goods from the periphery of the core area. The mobility of goods and services between the core and periphery of Primary Region I and with other regions in the United States and the world has been a major influencing factor in the growth of the Texas Marine Region.

Primary Region II features a locational appeal similar to Region I. The Region contains large stores of natural gas and oil reserves and a complex of petrochemical and other mineral processing plants. Major transport outlets are provided by the Port of Corpus Christi and Brownsville in the core area. The marine recreational facilities provided by the Padre Island National Seashore constitute a major locational attraction to Primary Region II. The warm climate characteristic of the Texas Gulf Coast has greatly complemented the development of marine recreation industries along the southern coast of Texas. Access to processing plants in Region I by barge over the Gulf Intracoastal Waterway has also been an important factor in attracting plants to the Region II area.

The economic appeal in the Primary Region also influences the locational appeal of Region III. Marine transport industries of the primary region provide Region III economic access to resources and area markets. This factor has promoted the scale of industrial activity particularly in the San Antonio region. The recreational appeal of the Texas coast has also stimulated the growth of marine recreational industries in the area. Defense related and agricultural products industries are leading industries for these areas. The attraction of favorable weather conditions dominated by the Gulf of Mexico and the existence of a major market area centrally located to other markets in South Texas and Mexico are major locational influences of this area.

In summary, the Marine Region's climate, oil and gas resources, ample water and power supplies, the diversified transportation complex, the agglomeration of petrochemical industries and supporting industries, and proximity to other Texas, United States and world markets have been the major location factors on the Texas coast. These location factors are not limited to pecuniary considerations but also account for the significant non-economic factors such as the amenities of warm climate and visual access and participation with marine activities provided by the Gulf of Mexico.

Destabilizing considerations that may influence the intensity of locational appeal range from the warm humid climate and potential for hurricanes to the existence of industrial air and water pollution.

With a knowledge of the overall resource base and location factors of the study area, a detailed analysis of the total economy of the study area shows the historical record of growth and indicates the extent of influence that defined marine growth core areas have had on the area's economy.

6. Industrial Structure and the Components of Regional Employment Change in the Texas Marine Region: Shift-Share Analysis

Assessing the total economic growth record of the Texas Marine Region provides a useful benchmark for relating the importance of marine industries. A simple analytical technique called "shift-share" analysis can be used to provide the analysis of industrial growth in the Texas Marine Region for the time period 1940-1960.

The shift-share analysis can then be supplemented by more recent data on particular marine-industry groups. The shift-share technique is designed to examine the close relationship of industrial composition and regional growth. In general, a shift-share analysis divides the growth of a regional variable, such as employment, into three components: the regional share, the proportionality shift and the differential shift.[10]

The regional share or national growth component (R) is the amount by which total employment in the region would have grown during the period studied if it grew at precisely the same rate as total employment in the nation as a whole. The proportionality shift,

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[10] L. D. Ashby. "A Statistical and Analytical Technique for Regional Analysis," The Regional Science Association Papers and Proceedings, Vol. VI, 1960, pp. 97-112 and "The Geographical Redistribution of Employment: An Examination of the Elements of Change," Survey of Current Business, (October, 1964) pp. 13-20. Also F. J. B. Stilwell, "Regional Growth and Structural Adaptation," Urban Studies (June, 1969) Vol. 6, No. 2, pp. 162-178.

often referred to as the industrial mix component (P) is the extra amount by which employment in the region has grown as a result of the region specializing in nationally fast-growing or slow-growing and declining industries. This shift will be positive if the region has an above average proportion of employment in industries with rapid growth rates at the national level, and negative if the region specializes in nationally declining industries. The differential shift or regional component (D) reflects the extra amount of employment growth in the region resulting from employment in each industry in the region growing at a faster or slower rate than its national growth rate. A positive differential shift means employment in the region grew faster than its industrial mix would suggest and negative if the reverse occurred. The sum of the two shifts (P+D) represents a net gain or loss (or shift) to the region over and above the regional share. The three components therefore exhaust the actual regional growth of total employment.

Algebraically, the model can be formulated as follows:[11]

Let
N_{ij} = number employed in the ith industry in region j
$\Sigma_i N_{ij}$ = number employed in all industries in region j
$\Sigma_j N_{ij}$ = number employed in the ith industry in all regions
$\Sigma_i \Sigma_j N_{ij}$ = number employed in all industries in all regions

If the subscript "o" indicates the base year and subscript "t" denotes the terminal year of the period studies, and if the "i" and "j" subscripts on each N are omitted for simplification, the following equations are obtained.

Total growth in region j $= \Sigma_i N_t - \Sigma_i N_o$

$= (R + P + D)$

Regional Share (R) $= \Sigma_i N_o (\Sigma_i \Sigma_j N_t / \Sigma_i \Sigma_j N_o) - \Sigma_i N_o$

Total Shift (P+D) $= \Sigma_i N_t - \Sigma_i N_o (\Sigma_i \Sigma_j N_t / \Sigma_i \Sigma_j N_o)$

Proportionality Shift (P) $= \Sigma_i N_o \left[(\Sigma_j N_t / \Sigma_j N_o) - (\Sigma_i \Sigma_j N_t / \Sigma_i \Sigma_j N_o) \right]$

Differential Shift (D) $= \Sigma_i \left[N_t - N_o (\Sigma_j N_t / \Sigma_j N_o) \right]$

Magnitude and direction of proportionality shifts depends on the suitability of each region for the location of each industry. The locational influence also aids in the explanation of the differential

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[11] Stilwell, op. cit., p. 163-164.

shift. As a result, differential growth is affected by the accessibility to resources and markets.[12]

A shift-share analysis has been conducted for the entire Texas Marine Region, for each region, and for the core area and periphery of each region. Similar analyses are available for the State of Texas and for the United States. The time period of analysis is from 1940-1950 and from 1950-1960.

The industrial structure of the Texas Marine Region is aggregated into 32 industrial groups. The listing of these industry groups and their identification number on the tables are as follows:

CODE NUMBER	INDUSTRIES
1	Agriculture
2	Forestry and Fisheries
3	Mining
4	Contract Construction
5	Food and Kindred Products Manufacturing
6	Textile Mill Products Manufacturing
7	Apparel Manufacturing
8	Lumber, Wood Products, Furniture Manufacturing
9	Printing and Publishing Manufacturing
10	Chemicals and Allied Products Manufacturing
11	Electrical and Other Machinery Manufacturing
12	Motor Vehicles and Equipment Manufacturing
13	Other Transportation Equipment Manufacturing
14	Miscellaneous Manufacturing
15	Railroads and Railway Express
16	Trucking and Warehousing
17	Other transportation
18	Communications
19	Utilities and Sanitary Service
20	Wholesale Trade
21	Food and Dairy Products Stores
22	Eating and Drinking Places
23	Other Retail Trade
24	Finance, Insurance and Real Estate
25	Hotels and Other Personal Services
26	Private Households
27	Business and Repair Services
28	Entertainment, Recreation Services
29	Medical, Other Professional Services
30	Public Administration
31	Armed Forced
32	Industry Not Reported

[12]Harvey S. Perlogg, Edgar S. Dunn, Jr., Eric E. Lampard and Richard F. Muth (eds.). Regions, Resources and Economic Growth, (Lincoln: University of Nebraska Press, 1967).

Most of the marine activities are contained in industry groups 2, 3, 4, 10, 11, 13, 14, 17, 21, 22, 25 and 28. A shift-share analysis is completed for each of these 32 industry groups for all identified core and periphery areas. A major hypothesis emerging from the shift-share analysis is that growth in the core area influences the economic activity of the periphery. The hypothesis indicates that industries featuring strong growth in the core area stimulate growth of similar and supporting industries in the core and periphery.

Computations for selected core areas are presented in Appendix C. Tables 2 and 3 present the shift-share results for Primary Marine Regions I and II for 1940-1950 and 1950-1960, respectively. Similar results for the entire Texas Marine Region for the same time periods are shown in Tables 4 and 5. The tables show that the marine industry groups maintained a strong growth record in both the core and periphery.

From 1940 to 1950, as shown in Table 2, the Primary Marine Regions experienced relatively large positive differential shifts in mining, contract construction, chemicals and allied products manufacturing, medical and other professional services and other miscellaneous manufacturing. Most of this growth was accounted for by the high employment growth in the core area of Region I (Houston-Galveston-Port Arthur complex). Industries in this core area not only grew faster than similar industries nationwide, but a greater share of these industries also were attracted to the Texas Marine Region compared to other national areas. From 1950 to 1960, large employment increases occurred in mining, chemicals and allied products, electrical and other machinery manufacturing. Significant employment growth occurred in trucking and warehousing and other transportation which includes primarily water and pipeline transportation. A similar result is seen in the aggregated Texas Marine Region. Industry groups containing marine industries again showed strong employment increases relative to the national average.

The shift-share tables provide a detailed record of the growth trends in the coastal region of Texas. The growth of chemicals and allied petrochemical products and all supporting industries has developed from the huge petroleum and natural gas resource base of the Texas Gulf Coast area. Nearly 100 percent of the oil and gas equipment demanded by domestic and international petroleum and natural gas mining, and production industries was for onshore use during 1940-1960. The overall industrial growth of the Primary Marine Regions influenced employment in the water transportation and fishery industries. The demand for bulk cargo space by the petroleum and chemical industries and the large demand for general cargo capacity stimulated the expansion of Texas port and harbor facilities and the use of the Intracoastal Waterway. These activities in turn created new employment opportunities in the service industries in the core area and periphery of Regions I and II. This lead-lag process during the 1950's resulted in the development

TABLE 2

PRIMARY MARINE REGIONS: COMPONENTS OF EMPLOYMENT CHANGE
1940-1950

INDUSTRY	EMPLOYMENT IN 1940	EMPLOYMENT IN 1950	EMPLOYMENT IN 1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	1940-1950 CHANGES RELATED TO INDUSTRIAL MIX (P)	1940-1950 CHANGES RELATED TO DIFFERENTIAL SHIFT (D)	1940-1950 TOTAL CHANGE
1 Agriculture	139,769	107,259	78,281	37,270	-62,347	-7,427	-32,504
2 Forestry & Fisheries	1,799	2,792	2,288	479	-188	711	1,002
3 Mining	19,977	27,568	32,524	5,328	-5,058	7,322	7,592
4 Contract Construction	35,502	75,438	79,142	9,462	14,370	16,118	39,950
5 Food & Kindred Products Manufacturing	11,782	17,384	23,482	3,143	138	2,319	5,600
6 Textile Mill Products Mfg.	1,436	1,701	1,502	386	-271	156	271
7 Apparel Manufacturing	1,379	1,961	3,169	369	88	126	583
8 Lumber, Wood Products, Furniture Manufacturing	13,797	16,324	11,043	3,679	1	-1,156	2,524
9 Printing & Publishing Manufacturing	5,218	7,858	10,512	1,392	446	799	2,637
10 Chemicals & Allied Products Manufacturing	2,513	16,330	32,722	670	582	12,576	13,828
11 Electrical & Other Machinery Manufacturing	9,983	13,648	24,679	2,665	6,756	-5,760	3,661
12 Motor Vehicles & Equipment Manufacturing	475	750	739	125	114	26	265
13 Other Transportation Equipment Manufacturing	2,585	3,299	4,961	689	788	-769	708
14 Miscellaneous Manufacturing	37,259	68,532	82,679	9,934	2,316	19,022	31,272
15 Railroads & Railway Express	13,813	17,787	13,348	3,683	-629	924	3,978
16 Trucking & Warehousing	9,320	10,795	16,316	2,486	1,131	-2,145	1,472
17 Other Transportation	14,468	21,418	22,243	3,854	4,698	-1,605	6,947
18 Communications	4,196	10,290	10,851	1,121	2,241	2,734	6,096

TABLE 2 (Continued)

PRIMARY MARINE REGIONS: COMPONENTS OF EMPLOYMENT CHANGE
1940-1950

INDUSTRY	EMPLOYMENT IN 1940	1950	1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
19 Utilities & Sanitary Service	6,638	14,852	20,492	1,770	1,167	5,277	8,214
20 Wholesale Trade	20,263	34,509	49,527	5,404	7,535	1,306	14,245
21 Food & Dairy Products Stores	19,851	27,207	32,845	5,293	-2,248	4,316	7,361
22 Eating & Drinking Places	19,320	30,786	30,939	5,157	4,714	1,603	11,474
23 Other Retail Trade	50,995	82,440	108,326	13,595	6,149	11,701	31,445
24 Finance, Insurance & Real Estate	16,418	26,425	41,294	4,376	657	4,973	10,006
25 Hotels & Other Personal Services	25,256	31,535	35,987	6,739	-4,163	3,706	6,282
26 Private Households	49,533	40,530	46,545	13,209	-27,984	5,770	-9,005
27 Business & Repair Services	11,760	19,352	27,258	3,138	2,908	1,550	7,596
28 Entertainment, Recreation Services	5,143	6,651	7,760	1,373	-102	243	1,514
29 Medical, Other Professional Services	35,429	63,635	116,613	9,446	6,159	12,604	28,209
30 Public Administration	12,815	25,779	34,098	3,420	5,474	4,074	12,968
31 Armed Forces	1,758	9,626	16,537	468	3,674	3,724	7,866
32 Industry Not Reported	7,634	11,975	50,304	2,034	-354	2,658	4,338
TOTAL	608,084	846,456	1,069,006	162,157	-31,238	107,476	238,395

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965, and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 3

PRIMARY MARINE REGIONS: COMPONENTS OF EMPLOYMENT CHANGE
1950-1960

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
1 Agriculture	16,603	-57,866	12,281	-28,982
2 Forestry & Fisheries	427	-1,145	211	-507
3 Mining	4,268	-12,465	13,148	4,951
4 Contract Construction	11,683	-3,854	-4,147	3,682
5 Food & Kindred Products Manufacturing	2,691	2,331	1,075	6,097
6 Textile Mill Products Mfg.	262	-656	189	-205
7 Apparel Manufacturing	300	-126	1,036	1,210
8 Lumber, Wood Products, Furniture Manufacturing	2,527	-4,215	-3,593	-5,281
9 Printing & Publishing Manufacturing	1,218	1,406	27	2,651
10 Chemicals & Allied Products Manufacturing	2,527	2,554	11,311	16,392
11 Electrical & Other Machinery Manufacturing	2,112	4,247	4,673	11,032
12 Motor Vehicles & Equipment Manufacturing	115	-135	11	-9
13 Other Transportation Equipment Manufacturing	507	2,868	-1,714	1,661
14 Miscellaneous Manufacturing	10,610	2,238	1,301	14,149
15 Railroads & Railway Express	2,754	-8,475	1,289	-4,432
16 Trucking & Warehousing	1,670	1,533	2,314	5,517
17 Other Transportation	3,317	-2,727	237	827
18 Communications	1,588	0	-1,027	561
19 Utilities & Sanitary Service	2,298	-154	3,495	5,639
20 Wholesale Trade	5,343	-1,320	10,993	15,016

TABLE 3 (Continued)

PRIMARY MARINE REGIONS: COMPONENTS OF EMPLOYMENT CHANGE
1950-1960

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
21 Food & Dairy Products Stores	4,214	-4,753	6,180	5,641
22 Eating & Drinking Places	4,767	-2,785	-1,821	161
23 Other Retail Trade	12,764	1,577	11,548	25,889
24 Finance, Insurance & Real Estate	4,093	6,555	4,223	14,871
25 Hotels & Other Personal Services	4,883	-3,530	3,097	4,450
26 Private Households	6,271	583	-842	6,012
27 Business & Repair Services	2,997	1,387	3,520	7,904
28 Entertainment, Recreation Services	1,033	-918	1,002	1,117
29 Medical, Other Professional Services	9,850	27,032	16,090	52,972
30 Public Administration	3,991	3,068	1,258	8,317
31 Armed Forces	1,485	5,156	267	6,908
32 Industry Not Reported	1,856	23,242	13,233	38,331
TOTAL	131,024	-19,347	110,865	222,542

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965, and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 4

TEXAS MARINE REGION: COMPONENTS OF EMPLOYMENT CHANGE
1940-1950

INDUSTRY	EMPLOYMENT IN 1940	EMPLOYMENT IN 1950	EMPLOYMENT IN 1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	1940-1950 CHANGES RELATED TO INDUSTRIAL MIX (P)	1940-1950 CHANGES RELATED TO DIFFERENTIAL SHIFT (D)	1940-1950 TOTAL CHANGE
1 Agriculture	189,666	143,976	102,562	50,576	-84,604	-11,654	-45,682
2 Forestry & Fisheries	1,816	2,836	2,366	483	-189	736	1,030
3 Mining	23,550	31,165	36,170	6,280	-5,961	7,299	7,618
4 Contract Construction	45,548	95,550	100,728	12,140	18,434	19,420	49,994
5 Food & Kindred Products Manufacturing	16,609	24,286	32,456	4,430	194	3,048	7,672
6 Textile Mill Products Mfg.	2,322	3,274	3,386	624	-439	775	960
7 Apparel Manufacturing	2,779	4,732	6,173	742	178	1,034	1,954
8 Lumber, Wood Products, Furniture Manufacturing	14,896	17,654	12,297	3,971	1	-1,217	2,755
9 Printing & Publishing Manufacturing	7,053	10,583	13,765	1,883	604	1,042	3,529
10 Chemicals & Allied Products Manufacturing	2,933	16,870	33,347	783	678	12,489	13,950
11 Electrical & Other Machinery Manufacturing	10,862	15,272	26,826	2,898	7,351	-5,845	4,404
12 Motor Vehicles & Equipment Manufacturing	679	979	988	178	163	-56	285
13 Other Transportation Equipment Manufacturing	2,621	3,376	5,613	699	799	-750	748
14 Miscellaneous Manufacturing	40,801	73,976	89,686	10,879	2,537	19,759	33,175
15 Railroads & Railway Express	17,523	22,763	16,256	4,672	-800	1,369	5,241
16 Trucking & Warehousing	11,190	13,976	20,009	2,987	1,358	-1,559	2,786
17 Other Transportation	16,057	24,568	25,298	4,277	5,213	-983	8,507
18 Communications	5,424	13,371	14,064	1,450	2,896	3,603	7,949

TABLE 4 (Continued)

TEXAS MARINE REGION: COMPONENTS OF EMPLOYMENT CHANGE
1940-1950

INDUSTRY	EMPLOYMENT IN 1940	1950	1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
19 Utilities & Sanitary Service	8,305	17,979	25,163	2,214	5,459	5,999	9,672
20 Wholesale Trade	26,387	44,808	62,202	7,036	9,814	1,572	18,422
21 Food & Dairy Products Stores	27,203	35,918	42,050	7,253	-3,080	4,548	8,721
22 Eating & Drinking Places	25,332	40,140	40,519	6,760	6,181	1,877	14,818
23 Other Retail Trade	68,784	110,138	142,258	18,340	8,293	14,721	41,354
24 Finance, Insurance & Real Estate	21,971	34,630	53,996	5,859	878	5,923	12,660
25 Hotels & Other Personal Services	33,972	42,015	47,103	9,062	-5,599	4,584	8,047
26 Private Households	63,415	50,783	58,054	16,909	-35,826	6,282	-12,635
27 Business & Repair Services	15,971	26,108	35,901	4,262	3,948	1,930	10,140
28 Entertainment, Recreation Services	6,805	9,013	9,781	1,715	-135	534	2,214
29 Medical, Other Professional Services	47,830	82,151	147,138	12,753	8,314	13,257	34,324
30 Public Administration	18,958	50,885	71,959	5,059	8,098	18,777	31,934
31 Armed Forces	20,281	41,246	61,565	5,407	42,390	-26,835	20,962
32 Industry Not Reported	10,283	15,751	61,557	2,740	-479	3,202	5,463
TOTAL	807,826	1,120,772	1,401,236	215,321	7,331	104,881	312,971

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965, and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 5

TEXAS MARINE REGION: COMPONENTS OF EMPLOYMENT CHANGE 1950-1960

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
1 Agriculture	22,287	-77,676	13,969	-41,420
2 Forestry & Fisheries	432	-1,162	258	-472
3 Mining	4,827	-14,091	14,265	5,001
4 Contract Construction	14,794	-4,879	-4,737	5,178
5 Food & Kindred Products Manufacturing	3,760	3,258	1,153	8,171
6 Textile Mill Products Mfg.	505	-1,260	862	107
7 Apparel Manufacturing	727	-306	1,023	1,444
8 Lumber, Wood Products, Furniture Manufacturing	2,733	-4,559	3,533	-5,359
9 Printing & Publishing Manufacturing	1,640	1,897	-354	3,183
10 Chemicals & Allied Products Manufacturing	2,612	2,640	11,230	16,482
11 Electrical & Other Machinery Manufacturing	2,363	4,752	4,439	11,554
12 Motor Vehicles & Equipment Manufacturing	150	-176	38	12
13 Other Transportation Equipment Manufacturing	518	2,936	-1,217	2,237
14 Miscellaneous Manufacturing	11,453	2,417	1,843	15,713
15 Railroads & Railway Express	3,524	-10,847	824	-6,499
16 Trucking & Warehousing	2,163	1,987	1,882	6,032
17 Other Transportation	3,803	-3,129	57	731
18 Communications	2,065	0	-1,371	694
19 Utilities & Sanitary Service	2,778	-185	4,589	7,182
20 Wholesale Trade	6,937	-1,712	12,169	17,394

TABLE 5 (Continued)

TEXAS MARINE REGION: COMPONENTS OF EMPLOYMENT CHANGE 1950-1960

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
21 Food & Dairy Products Stores	5,563	-6,273	6,849	6,139
22 Eating & Drinking Places	6,214	-3,633	-2,199	382
23 Other Retail Trade	17,052	2,108	12,962	32,122
24 Finance, Insurance & Real Estate	5,363	8,590	5,412	19,365
25 Hotels & Other Personal Services	6,507	-4,703	3,283	5,087
26 Private Households	7,860	731	-1,320	7,271
27 Business & Repair Services	4,041	1,874	3,877	9,792
28 Entertainment, Recreation Services	1,399	-1,244	622	777
29 Medical , Other Professional Services	12,718	34,896	17,366	64,980
30 Public Administration	7,880	6,055	7,137	21,072
31 Armed Forces	6,377	22,089	-8,149	20,317
32 Industry Not Reported	2,440	30,569	12,797	45,806
TOTAL	173,485	-9,036	116,026	280,475

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965, and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

of the world's largest oil-gas-petrochemical complex, a major metals fabrication complex, the expansion of deep water capacities and berth facilities in the Primary Marine Regions.

As an indicator of the extent of industrial concentration of the high-growth marine industries in the Texas Marine Region, a "location quotient" is computed for these industries in the following section.

7. Location Quotients, Income and Employment for Marine-Related Industry

The relative concentration of marine-related industry by region and for the total Texas Marine Region can be assessed by computing a location quotient for these industries. A location quotient is a device for comparing a region's percentage share of a particular activity with its percentage share of some basic aggregate.[13] It is a measure of the self-sufficiency of an industry within a region. The formula for this quotient for a given industry is:

$$\text{Location Quotient} = \frac{Si/S}{Ni/N}$$

where Si = the number of employees in manufacturing industry "i" in a given state.

S = number of employees in all manufacturing industries in the same state.

Ni = number of employees in manufacturing industry "i" in the nation.

N = number of employees in all manufacturing industries in the nation.

Employment is chosen here as the base aggregate. A location quotient for an industry greater than one means that the region is more than self-sufficient in supplying the needs of the local regional market and is likely to export the industry's goods beyond the region's boundary. A quotient less than one means that the region's industry is not self-sufficient and the region may import some of this commodity. Location quotients for 10 groups of industries that contain major marine-related activity have been computed in Table 6. The location quotients are provided by individual regions to indicate the geographical concentration of these industries in the Texas

[13]Walter Isard. Methods of Regional Analysis. (Cambridge: The M.I.T. Press, 1967). p. 124.

TABLE 6

LOCATION QUOTIENTS FOR MARINE-RELATED INDUSTRY
IN TEXAS MARINE REGION
1968

INDUSTRY	TEXAS	REGION I	REGION II	REGION III
Fisheries Production	1.92	1.30	22.72	--
Mining - Oil and Gas-Sulphur (Includes Offshore)	5.92	2.67	10.39	1.76
Fish Processing	1.42	.27	4.45	.76
Oil and Gas Processing	.96	.75	--	--
Fabricated Metals	1.16	1.87	.15	.40
Machinery (Construction-Mining)	1.78	3.06	--	.45
Marine Instruments and Scientific Equipment	.12	--	--	--
Ship and Boat Building and Repairing	1.10	1.18	.15	.15
Water Transportation	1.56	3.95	.51	--
Fish, Retail, Wholesale	1.26	1.43	.76	.76

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

Marine Region. Location quotients for the entire state are provided for comparison. Specification of the 10 industry groups was completed by aggregating four-digit Standard Industrial Classification industries that are directly marine-related or that have a major portion of their activity accounted for by marine-related goods and services. Quotients were computed using 1968 employment data.

Results from Table 6 indicate that Region I is the export center for marine-related machinery and equipment, transportation and mining. The location quotients are reflective of the greater industrial diversity in Region I. Region II is the state's center for fishery

production and processing with location quotients of 22.72 in fisheries production and 4.45 in fish processing. Mining is also a major industry in Region II with a 10.39 location quotient. The remaining low location quotients for Region II indicate a relatively low concentration of these industries in the area. Region III as expected has low location quotients in these industries with the exception of mining and the marketing of fish.

Table 7 indicates the relative size of the payrolls generated directly by these industries. Primary Region I accounts for most of the direct marine-related income generated by the identified 10 industry groups. More than $500 million in wages and salaries are generated by these industries annually in Primary Region I alone. The combined direct income created by these marine-related activities is more than $640 million annually in the Texas Marine Region. Table 8 shows 1968 employment for these marine industry groups. Oil and gas mining, construction and water transportation were the major employment categories in the marine industry. The majority of these workers were located in Primary Marine Region I. The government figures presented in Table 8, however, have been found by the researchers to be low. Some figures (fisheries, for example) are more than 100 percent of the true total whereas employment in fish processing are considered to be high. Low figures also occur in shipbuilding. Figures for these industry groups generated by the authors are believed to be more representative of true totals. Discrepancies in County Business Patterns data can be largely accounted for by government disclosure rules.

8. Summary Assessment of Texas Marine Region Economy

The marine environment has been a critical factor in the development of the Texas economy. The resource content of the Gulf of Mexico and the marine industries generated by the presence of the Gulf provides Texas with a strong marine economic base.

Natural gas and oil are the major mineral assets of the Texas Marine Region. Numerous hydrocarbon industries have located near the ports and harbor facilities along the Texas coast. Access to raw materials, major markets, and inexpensive water transportation, and climate have been the major location factors for the Texas Marine Region.

A shift-share test of the growth record for the study area indicates that the core area growth tended to become more specialized and that the industrial development of the periphery tended to follow the core area marine industry growth. Most of the major marine-related activities occur in Primary Marine Region I.

The following chapters provide a summary analysis and highlight the internal structure, location, and areal impact of the major marine industry groups in Texas.

TABLE 7

TAXABLE PAYROLLS IN MARINE-RELATED INDUSTRY,
UNITED STATES AND TEXAS MARINE REGIONS
(thousands)

INDUSTRY	UNITED STATES	REGION I	REGION II	REGION III
Fisheries Production	$ 70,600	$ 960	$ 3,360	--
Mining - Oil and Gas-Sulphur (Includes Offshore)	1,971,280	87,760	62,280	$10,680
Fish Processing	901,480	3,800	7,560	1,760
Oil and Gas Processing	933,200	10,120	--	--
Fabricated Metals	3,645,680	101,720	1,440	5,280
Machinery (Construction-Mining)	1,985,440	85,960	--	3,000
Marine Instruments and Scientific Equipment	4,014,240	--	--	--
Ship and Boat Building and Repairing	1,750,000	29,920	600	880
Water Transportation	2,182,680	89,600	3,640	--
Fish, Retail, Wholesale	5,193,240	114,120	10,480	11,760
TOTAL	$22,647,840	$523,960	$89,360	$33,360

SOURCE: County Business Patterns, 1968, U. S. Department of Commerce, Washington, D. C.

TABLE 8

EMPLOYMENT FOR MARINE-RELATED INDUSTRY
IN THE UNITED STATES, TEXAS,
AND THE TEXAS MARINE REGIONS
1968

INDUSTRY	UNITED STATES	TEXAS	REGION I	REGION II	REGION III
Fisheries Production	15,204	1,479	286	1,035	--
Mining - Oil and Gas-Sulphur (Includes Offshore)	272,720	81,715	10,510	8,490	1,863
Fish Processing	163,170	11,713	645	2,177	479
Oil and Gas Processing	114,242	5,544	1,239	--	--
Fabricated Metals	501,103	29,311	13,564	226	781
Machinery (Construction-Mining)	256,557	23,039	11,343	--	449
Marine Instruments and Scientific Equipment	475,274	2,827	--	--	--
Ship and Boat Building and Repairing	257,882	14,374	4,407	117	147
Water Transportation	322,205	25,481	18,404	490	--
Fish, Retail, Wholesale	776,329	49,623	16,062	1,767	2,284
TOTAL	3,154,686	245,106	76,460	14,302	6,003

SOURCE: County Business Patterns, Texas, 1968, U. S. Department of Commerce, Washington, D. C.

CHAPTER III

TEXAS OFFSHORE MINERAL INDUSTRIES

Demand for more energy supplies of oil and gas coupled with apparent declining onshore reserves has fostered the "Offshore Revolution" and created a new breed of mineral industrial activity operating in the oceans of the world. For many years Texas has been the nation's leader in oil and gas production and reserve capacity. The advent of the Texas offshore mineral industry has created new opportunities for industrial expansion along the coast and throughout Texas. This section will assess the relationships between Texas' onshore and offshore activities, analyze the structure of the offshore industry, and indicate the relative impact of the offshore industries on the state's economy.

1. Overview of Texas' Oil and Gas Activity and the Growing Importance of Offshore Industries

Texas accounts for more than 30 percent annually of the total domestic crude oil and condensate production. More than 40 percent of the nation's natural gas reserves are located on the Texas Gulf Coast.

The state is divided into oil and gas districts under the jurisdiction of the Texas Railroad Commission. Districts 2, 3 and 4 conform roughly to the boundary of the Texas Marine Region.

Output for oil and gas wells in the Texas Marine Region are controlled by a monthly allowable established by the Railroad Commission. The market demand factor is an allowed percentage of the maximum efficient recovery (MER) of a well defined as two-thirds of a well's full allowable. Offshore allowables are more liberal than onshore. By pro-rationing, Texas, which has been characterized as the "balance wheel" of the oil industry, attempts to balance the domestic supply of oil sufficiently to sustain its price and to conserve available supply.[1]

An indication of oil and gas related output and employment in the Texas Marine Region is presented in Figures 7, 8 and 9. Figures 7 and 8 indicate that Primary Marine Region I is the major producing area along the Texas coast in both oil and gas. Region I also leads in employment in the crude oil and natural gas industry (Standard Industrial Classification 13) as shown in Figure 9. Figures 7, 8, and 9 indicate the large gains in productivity as the output/employment ratio in the oil and gas industry has risen over the decades.

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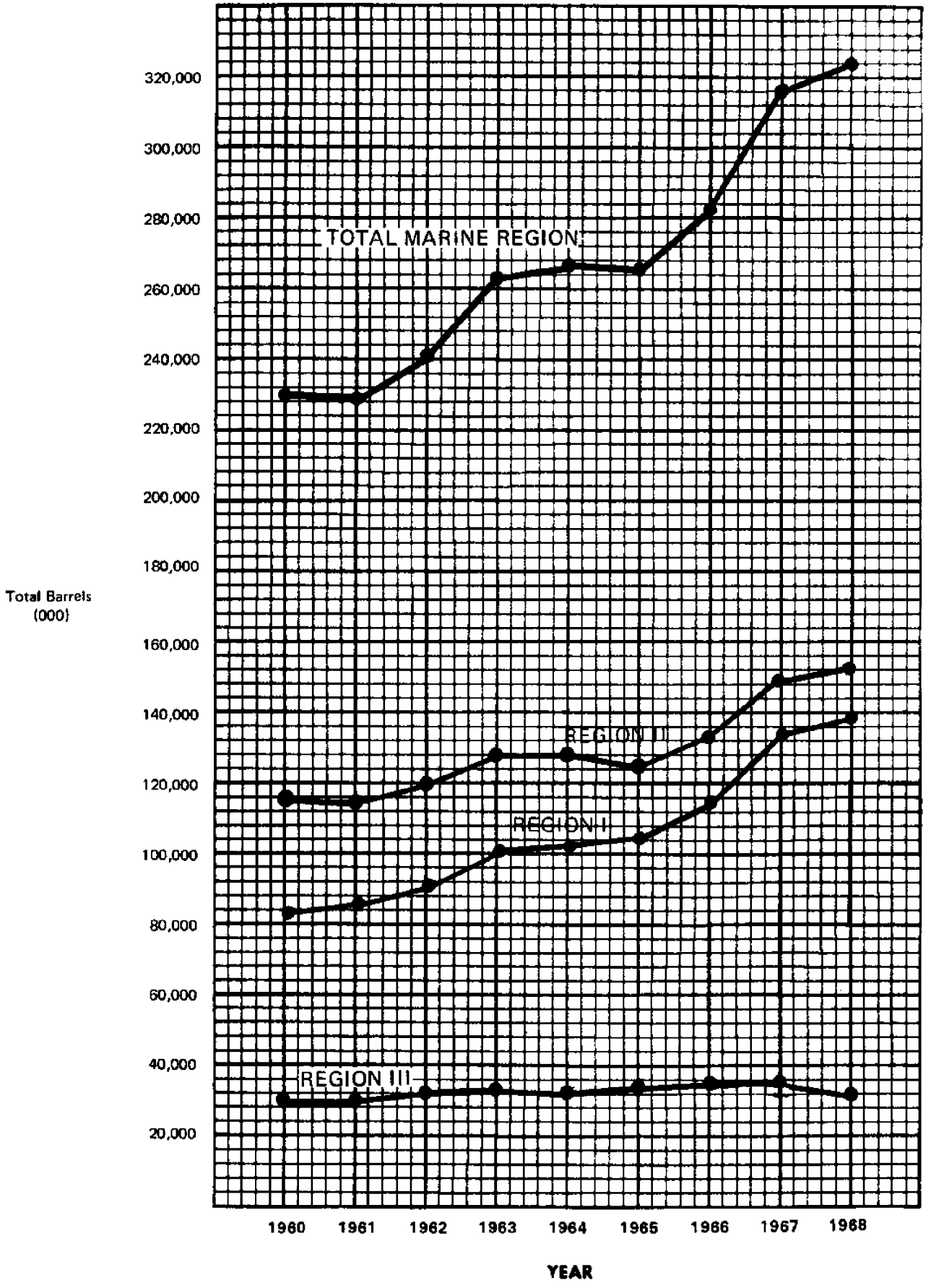
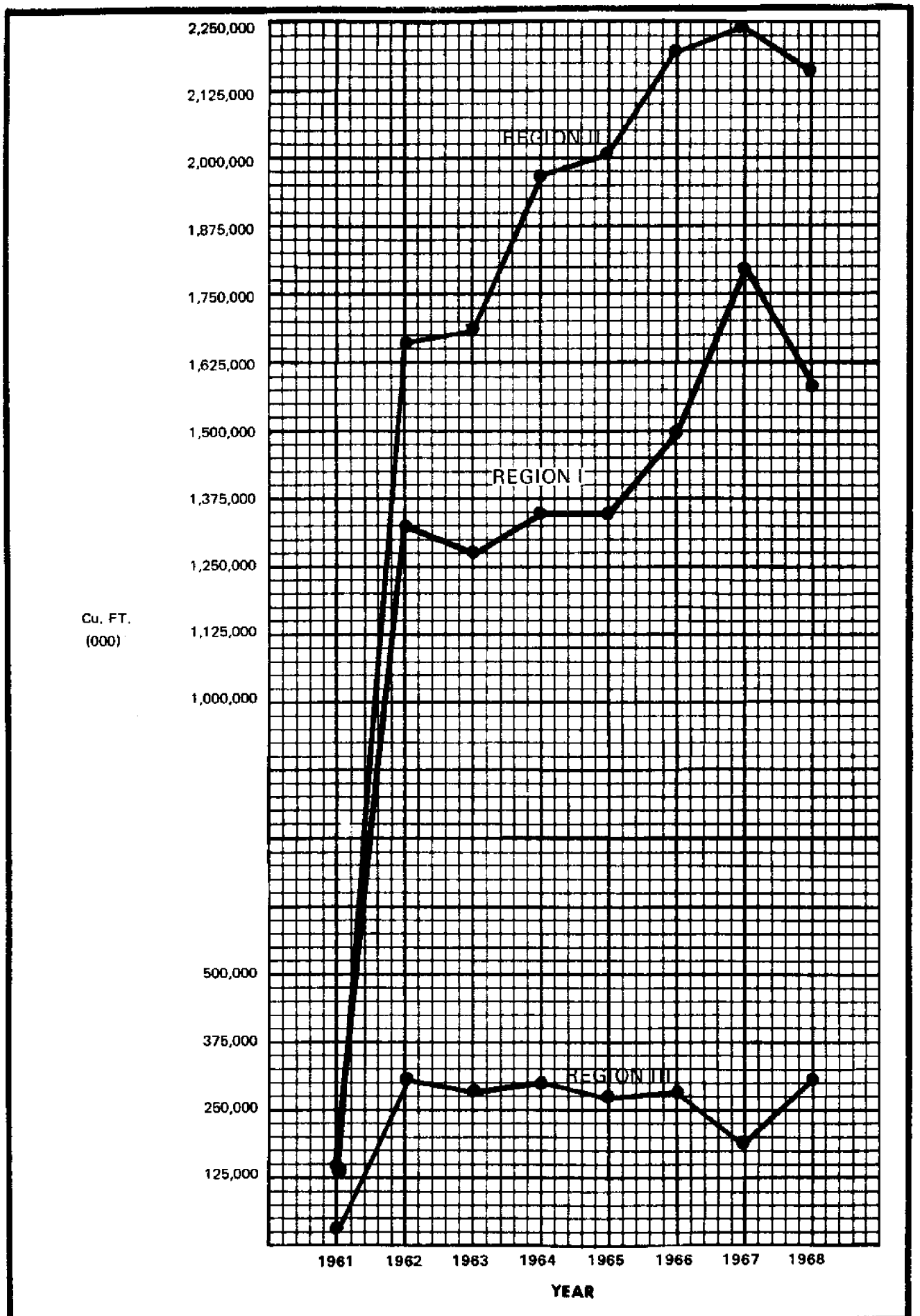
[1] James E. Jensen, "Texas: Balance Wheel in Control of Crude Oil Supply," Land Economics, Vol. 42, (June, 1966). pp. 271-275.



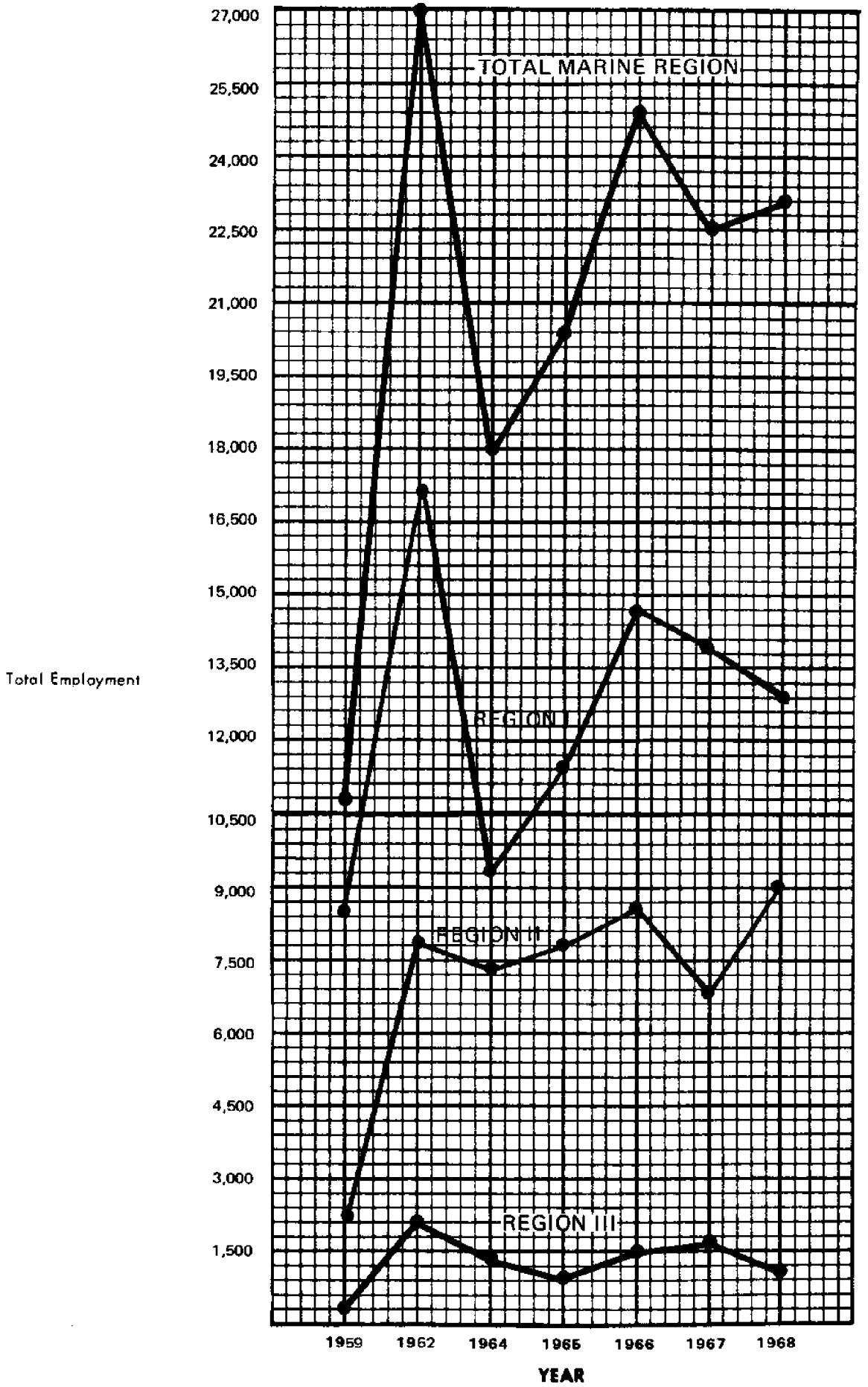
CRUDE OIL PRODUCTION IN THE
TEXAS MARINE REGION

FIGURE 7



NATURAL GAS PRODUCTION IN THE
TEXAS MARINE REGION

FIGURE 8



EMPLOYMENT IN MINING OF OIL AND
NATURAL GAS IN THE TEXAS MARINE REGION

FIGURE 9

In 1968, the core area of Primary Marine Region I accounted for more than 75 percent of the crude oil production and more than 60 percent of the natural gas output in the entire Primary Marine Region. In Primary Marine Region II, the periphery was the leading oil and gas producing area. It accounted for more than 80 percent of the crude oil production and more than 75 percent of the natural gas output.

The industrial growth effect of the concentrated oil and gas resources in the core area of Region I is demonstrated by the huge agglomeration of oil and gas refineries and processing plants, oil field equipment manufacturers and suppliers, heavy and medium supporting industry and related service industries. The rate of onshore exploration and drilling activity, however, has declined recently. Explanations for this reduction have ranged from the high cost and risk of drilling to the influence on per barrel price of rising oil import quotas.[2]

Texas' share of reserves and national output has also declined over the past 20 years. From 1954 to 1968, Texas production decreased from more than 42 percent to less than 35 percent of the United States total.[3] This fact has prompted many oil geologists to observe that Texas may be over its prime as a major oil producing

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[2]A comparison of United States and world prices for crude oil shows the difference in costs of oil transported from a Texas port to an east coast location versus costs of imported oil. Import quotas have tended to maintain price.

Middle East Crude Oil	
Price of Iranian heavy crude 31.0° average gravity FOB	$1.35
Transportation cost to U. S. east coast port	.75
Total delivered price before tariff	$2.10
U. S. Tariff 10½¢ per barrel	.10
Total delivered price after tariff	$2.20
U. S. Crude Oil	
Price of Texas crude 31-31.9° gravity, Refugio, Texas	$3.12
Transportation cost to east coast port	.30
Total delivered price	$3.42

Walter J. Mead, "The System of Government Subsidies to the Oil Industry." Natural Resources Journal. Vol. 10. (January, 1970) p. 113-114.

[3]L. K. Weaver, C. J. Jirik and H. F. Pierce, Impact of Petroleum Development in the Gulf of Mexico. Information Circular 8408, Bureau of Mines, U. S. Department of Interior (Washington, D. C., 1969).

state.[4] As exhaustible resources, oil and gas are described by a beginning, a period of increase, a period of decline and ultimately an end. Experts believe that Texas is in the transitional stage between the period of increase and period of decline. This stage begins when the rate of production or recovery exceeds the rate of newly discovered reserves.

In the past two decades the United States and world oil industry has shifted its attention to offshore sources of oil, gas and other minerals. The extension of drilling and production technology to offshore oil provinces has perhaps been the greatest single "innovation" in the industry to maintain its reserves and capacity position.

More than 14 percent of the nation's oil and gas comes from offshore. Approximately 40 percent of the industry's exploration and production investment is now directed seaward.[5] Recent studies have shown that offshore oil and gas resources supplied more than nine percent of the United States' oil and gas in 1968.[6]

The Standard Industrial Classifications for the offshore mineral industries of Texas are a cross-section of numerous manufacturing and non-manufacturing activities. These extensive industrial linkages are derived from the problems of economically developing the resource base of the marine environment. Offshore oil and gas production involves exploration, drilling, underwater services, specialized construction activity, specialized marine transportation requirements, highly skilled engineering expertise and many other interrelated activities.

The following S.I.C. categories include the major activities of the offshore industries:

S.I.C. Number	Category
1311	Crude Petroleum and Natural Gas
1321	Natural Gas Liquids
1381	Drilling Oil and Gas Wells
1382	Oil and Gas Field Exploration Services
1389	Oil and Gas Field Services, Not Elsewhere Classified

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[4]M. King Hubert, "Degree of Advancement of Petroleum Exploration in United States," The American Association of Petroleum Geologists Bulletin. Vol. 51, No. 11. (November, 1967). pp. 2207-2227.

[5]"Offshore Oil Hunt Spreads, Costly Investments to Soar," The Houston Post. February 8, 1970. Section 10, p. 6.

[6]Petroleum and Sulfur on the U. S. Continental Shelf. Department of the Interior. (Washington: Government Printing Office, 1969). p. 23-24.

S.I.C.	Category
1621	Heavy Construction, Except Highway and Street Construction
3429	Marine Hardware
3531	Marine Construction Machinery and Equipment
3533	Oil Field Machinery and Equipment
3731	Shipbuilding and Repair
4454	Marine Towing
4469	Marine Surveyors
4521	Marine-Related Aircraft Services
4612	Crude Petroleum Pipelines
4922	Natural Gas Pipelines
5088	Marine Supplies
8911	Marine Engineering

2. Gulf of Mexico Oil and Gas Activity

Major development of hydrocarbon resources in the Gulf of Mexico did not begin until after the Submerged Lands Act and the Outer Continental Shelf Lands Act were passed in 1953. The Gulf of Mexico was the location of the first offshore oil well drilled (March, 1938). In 1947, significant hydrocarbon development began off the Louisiana coastline.[7] By 1969, more than 2.1 billion barrels of oil and condensate and 10 trillion cubic feet of gas had been produced in the Gulf of Mexico. By 1975, annual oil and condensate production from the Gulf of Mexico is expected to be in the range of 750 million barrels to 1,150 million barrels and account for approximately 20 to 30 percent of the estimated total domestic production.

Some 30 percent of the increase in United States production (onshore plus offshore) from 1954 to 1966 was from wells in the Gulf of Mexico.[8] Annual Gulf of Mexico crude oil and condensate production has increased steadily from less than one percent of the national total in 1954 to more than eight percent in 1967.

Figure 10 shows the progressive impact offshore activity had on onshore geophysical exploration, drilling and crude oil and condensate production in the United States and the Gulf of Mexico. While the number of onshore wells decreased from 1956 to 1966, more than 400 wells were drilled offshore in 1955 in the Gulf of Mexico with a

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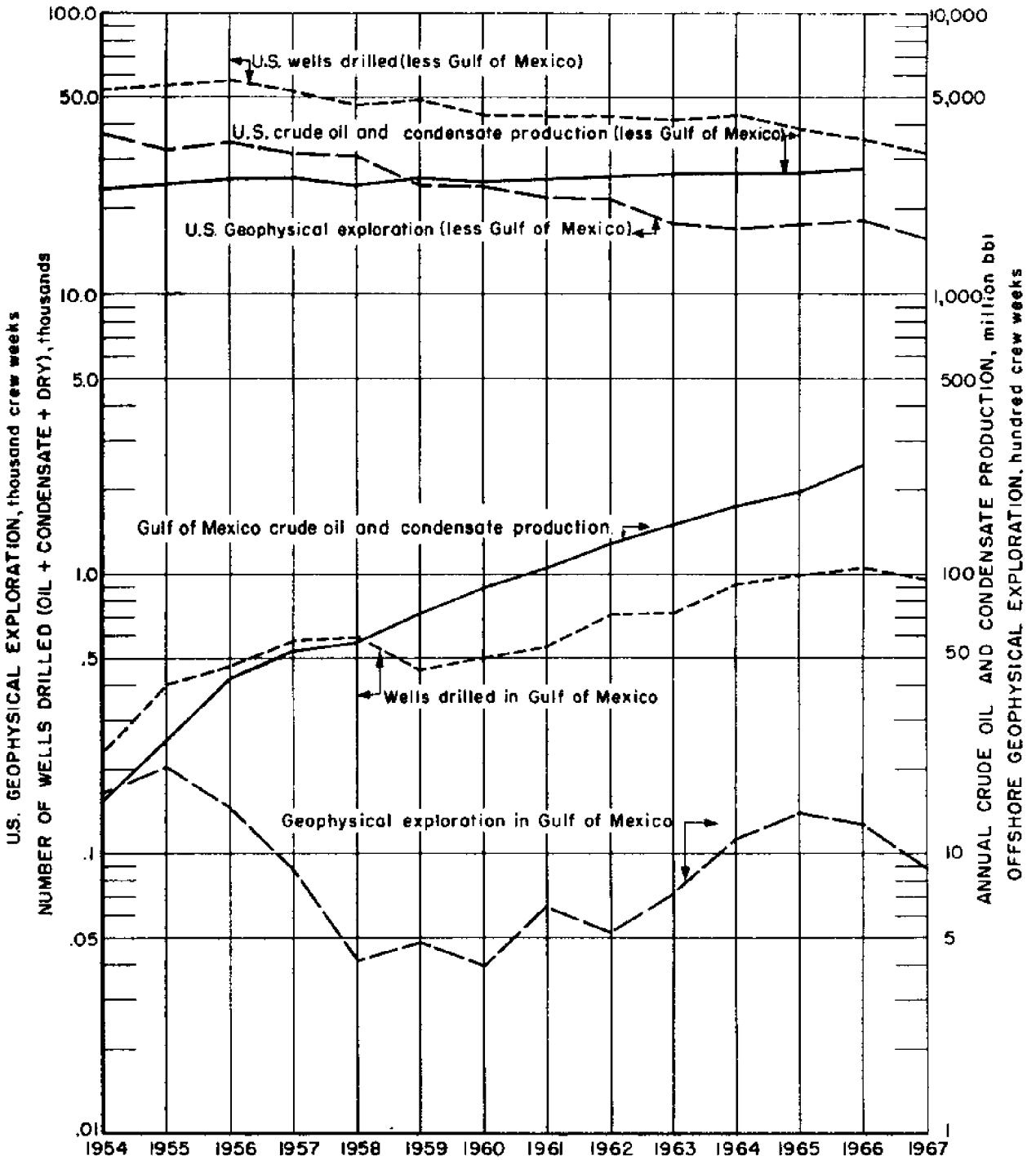
[7]Weaver, Pierce, Jirik, op. cit., p. 3.

[8]Ibid., p. 6.



GEOPHYSICAL EXPLORATION, DRILLING, AND CRUDE OIL AND CONDENSATE PRODUCTION HISTORIES OF ONSHORE UNITED STATES AND GULF OF MEXICO

FIGURE 10

total footage of less than 4 million feet. Offshore wells drilled increased in 1966 to more than 1, .60 with footage totaling more than 11 million feet. Production of crude oil and condensate from the federal lease areas only in the Gulf of Mexico increased from about 0.1 percent of the United States total in 1954 to more than six percent in 1968.

Two key reasons for the high growth rate in the Gulf of Mexico was the high success ratio of exploratory drilling and the reserves found. Except for 1962, the success ratio for exploratory wells drilled offshore has been higher than the onshore United States ratio. From 1953 to 1967, the average success ratio for exploratory wells in the Gulf of Mexico was 26 percent, compared with a ratio for onshore United States of about 18 percent.[9] In 1967, some 47 percent of all active mobile offshore rigs in the world and 57 percent of all fixed platform rigs were operating in the Gulf of Mexico.

3. Texas Offshore Activity

Texas and Louisiana areas have accounted for virtually all of the marine mining activity in the Gulf of Mexico. More than 99 percent of the Gulf of Mexico production has come from offshore Louisiana and the remainder from offshore Texas.[10] The first discovery in offshore Texas was made in October, 1949 on state lease 245 and is still listed as a shut-in gas-condensate well.[11] Gas has continued to be the major resource produced in offshore Texas. The exploratory record for operations on the continental shelf off Louisiana and Texas is shown in Table 9. Texas offshore activity is relatively small compared to offshore Louisiana. The table also indicates that most of the drilling activity offshore Texas occurred during the 1960's.

The continental shelf off Texas is at no point less than 50 miles wide and ranges up to more than 100 miles in the eastern sector. While the Federal portion of the continental shelf covers more than nine million acres, only one million acres have ever been leased and approximately 648,000 acres are currently under lease. Only 22 of the 145 active federal leases lie in water more than 120 feet deep. The location of the Federal lease areas outside of the three league state lease areas is shown in Figure 11. Also indicated are the lease areas where the intensive exploration and production activity offshore Texas has occurred. These areas are mostly offshore Region I.

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[9] Petroleum and Sulfur on the U. S. Continental Shelf. op. cit. p. 23-24.

[10] Weaver, Jirik and Pierce, op. cit., p. 27.

[11] Ibid., p. 3.

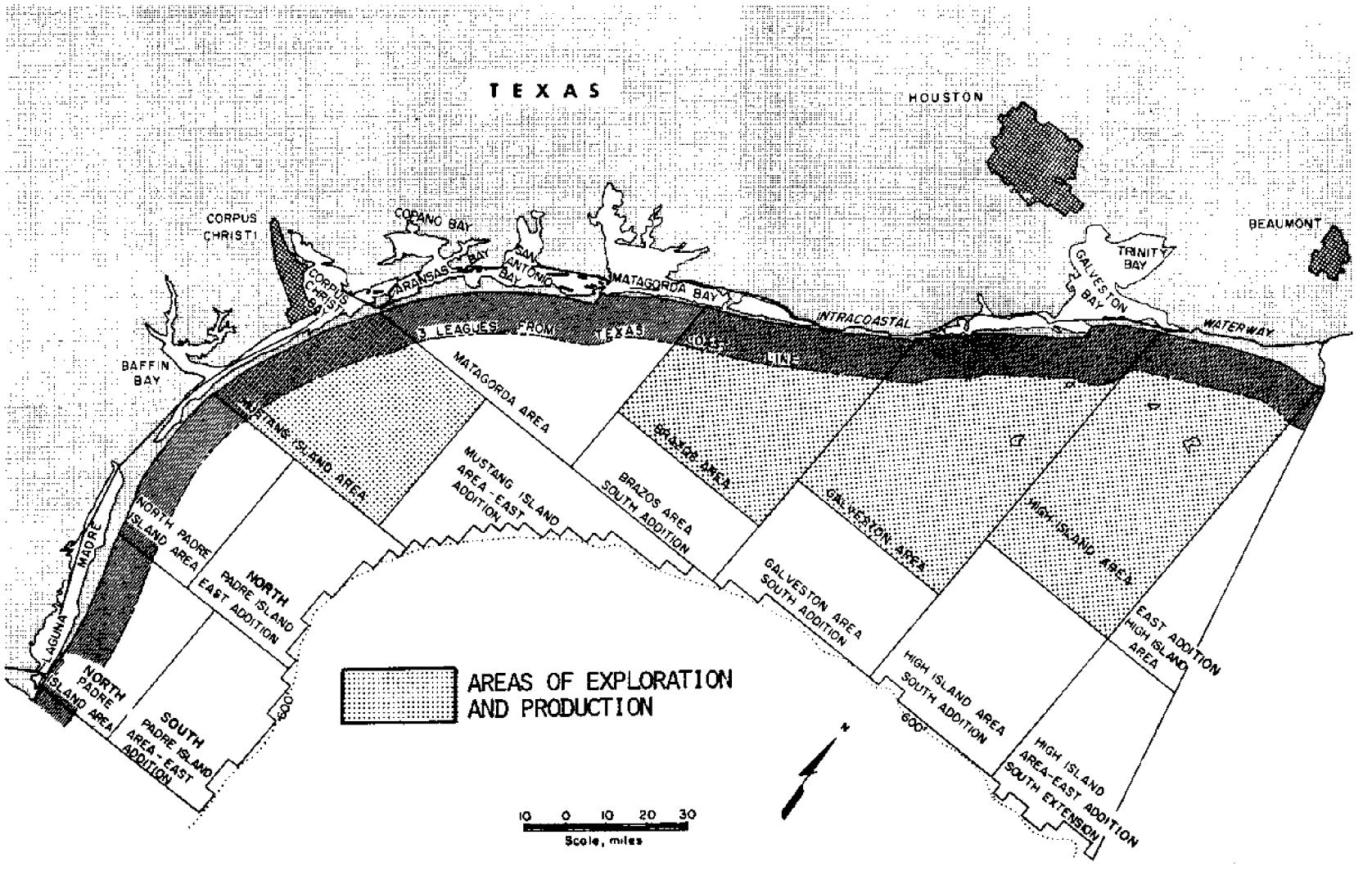
TABLE 9

OFFSHORE EXPLORATORY DRILLING--GULF OF MEXICO
1957-1968
(Footage in Thousands of Feet)

YEAR	PRODUCING WELLS		DRY HOLES		TOTAL WELLS		PERCENT SUCCESS
	NUMBER	FOOTAGE	NUMBER	FOOTAGE	NUMBER	FOOTAGE	
			Off Louisiana				
1957	59	658	100	1,054	159	1,712	37
1958	43	471	54	569	97	1,040	44
1959	56	603	69	731	125	1,334	45
1960	40	466	65	823	105	1,289	38
1961	22	277	58	651	80	928	28
1962	23	268	123	1,227	146	1,495	16
1963	42	632	182	2,033	224	2,665	19
1964	42	470	138	1,497	180	1,967	23
1965	24	303	102	931	126	1,234	19
1966	72	928	221	2,621	293	3,549	25
1967	74	953	239	2,512	313	3,465	24
1968	68	906	284	3,125	352	4,031	19
TOTAL	565	6,935	1,635	17,774	2,200	24,709	26
			Off Texas				
1957	1	12	5	54	6	66	18
1958	3	25	11	84	14	109	21
1959	2	22	5	46	7	68	29
1960	0	0	10	96	10	96	0
1961	3	37	14	148	17	185	18
1962	N.A.	N.A.	4	52	4	52	N.A.
1963	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1964	1	10	6	60	7	70	14
1965	4	41	24	231	28	272	14
1966	2	18	37	339	39	357	5
1967	22	200	39	345	61	545	36
1968	10	90	30	284	40	374	25
TOTAL	48	455	185	1,739	233	2,194	21
TOTAL GULF OF MEXICO	613	7,390	1,820	19,513	2,433	26,903	25

N.A. - Not Available

SOURCE: Compiled from American Association of Petroleum Geologists Drilling Statistics, Petroleum and Sulfur on the U. S. Continental Shelf. U. S. Department of the Interior, Washington, D. C.



MAJOR FEDERAL AND STATE AREAS OF OFFSHORE OIL AND GAS EXPLORATION AND PRODUCTION

FIGURE 11

Texas offshore wells have been allowed to produce at substantially higher rates than wells onshore. This additional allowable has tended to encourage the exploration and development of Texas' offshore fields. The current allowable schedules for Texas and Louisiana for wells of selected depths are provided in Table 10. These schedules take into account the additional costs to producers of drilling wells in a marine environment over those onshore. Costs of offshore structures average up to 50 percent more than onshore structures. In Texas the advantage of the offshore well is much more pronounced due to the relatively low allowables granted to onshore wells compared with those of Louisiana. Consequently, the offshore bonus for a 10,000 foot, 40-acre well in Texas amounts to 155 percent of the onshore allowable. The practical value to the owner of a 10,500 foot well on 40 acres in Texas producing at a market demand factor of 45.8 percent of allowable (May, 1968 figure), for example, would be 88 barrels a day onshore and 235 barrels a day offshore. This differential allowable has been a key factor in Louisiana offshore development. Offshore Texas has a relatively larger advantage that provides a seemingly better incentive for offshore activity. The effect of the sharply contrasting treatment of allowable production onshore and offshore Texas, however, has not yet made a strong impact due to the small scale of oil production off the Texas coast.[12]

TABLE 10

LOUISIANA AND TEXAS PRODUCTION ALLOWABLE RATES
1969
(Barrels Per Day)

DEPTH INTERVAL (Feet)	LOUISIANA		TEXAS	
	ONSHORE	OFFSHORE	ONSHORE	OFFSHORE
5,000 - 6,000	150	296	102	305
8,000 - 9,000	239	416	133-142	420
10,000 - 11,000	310	512	192-212	515
12,000 - 13,000	383	605	287-312	620

SOURCE: Petroleum and Sulfur on the U. S. Continental Shelf. U. S. Department of the Interior, Washington, D. C.

[12] Petroleum and Sulfur on the U. S. Continental Shelf. op. cit., p. 39.

Until 1969, less than one million barrels had been produced annually off Texas. Table 11 indicates the number and production of state and federal gas and oil wells offshore Texas for 1969 and cumulative to January 1, 1970. District 3, located in Region I, is by far the most important production area for offshore Texas.

The table also indicates that most of the yield from offshore Texas to date has been gas. Most of the major offshore oil and gas discoveries have been made since 1961. The most distant offshore well drilled was 50 miles from Galveston; the deepest wells drilled ranged from 14,000 to 17,000 feet in depth. Federal lease sales have generally been in the upper half of the Galveston and High Island areas as was shown in Figure 11. The greater sand accumulations, geologic configurations and the better environmental conditions such as water depths have been influencing factors in the concentrated exploratory and production offshore activities.[13]

The refinery complex located in the core area of Region I in the Texas Marine Region is the major receiving point for offshore oil and gas from both Texas and Louisiana.

Oil is moved from offshore areas to the Texas coast by barge and pipeline. Barging is the common method for moving oil from distant deep water fields. Although pipeline costs are lower, the mobility of barging permits loading at remote wells that yield volumes of oil too small to justify construction of a pipeline. Pipeline costs to shore in the Gulf of Mexico average approximately 10 cents per barrel; barging averages about 15 cents per barrel.[14] Region I is also the major center for the offshore oil and gas service industry. Supply boats, barge service, towing services for offshore rigs, general utility boats and crew boats are based in the Galveston-Freeport area.

Known reserves and potential additions of oil and gas offshore in the Gulf of Mexico and other offshore areas of the United States are shown in Table 12. Reserves on the continental shelf off Texas and Louisiana amounted to 2.4 billion barrels of crude oil and 34.2 trillion cubic feet of natural gas. Most of these reserves are considered to be located in the region off the Louisiana coast. Strong indications of large oil deposits in the Gulf of Mexico have been detected by scientists aboard the USNS KANE.[15]

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[13]John Scott, "Texas Offshore: Breakthrough in the Making," Petroleum Engineer, (January, 1969). p. 54.

[14]Petroleum and Sulfur on the U. S. Continental Shelf, op. cit., p. 40-41.

[15]"Gulf of Mexico...Giant Deep Water Oil Province of the Future?" Ocean Industry, Vol. 4, No. 5, (May, 1969), pp. 68-72; and "Geology of the Gulf of Mexico" by Antoine and Gilmore, op. cit., pp. 34-38.

TABLE 11

NUMBER AND PRODUCTION OF TEXAS AND FEDERAL OFFSHORE GAS AND OIL WELLS

DISTRICT	NUMBER OF WELLS*		PRODUCTION 1969		CUMULATIVE PRODUCTION (January 1, 1970)	
	OIL	GAS	OIL (Barrels)	GAS (MCF)**	OIL (Barrels)	GAS (MCF)**
District 3						
State Offshore	13	56	75,297	73,415,377	369,821	198,149,583
Federal Offshore	38	81	1,579,112	120,216,872	5,260,164	369,453,987
District 4						
State Offshore	8	63	58,113	37,544,084	3,298,010	140,874,650
Federal Offshore	0	0	0	0	0	0
TOTAL	59	200	1,712,522	231,176,333	8,927,995	708,478,220

* Includes both producing and non-producing wells.

** Million cubic feet.

SOURCE: Texas Railroad Commission, Austin, Texas.

TABLE 12

KNOWN RESERVES AND POTENTIAL ADDITIONS OF OIL AND GAS
IN PRODUCTIVE OFFSHORE PROVINCES AS OF JANUARY 1968

PROVINCE	OIL (Billion Bbls.)			GAS (Trillion Cu. Ft.)		
	RESERVES	PROSPECTIVE ADDITIONS*	SPECULATIVE ADDITIONS**	RESERVES	PROSPECTIVE ADDITIONS*	SPECULATIVE ADDITIONS**
Gulf of Mexico						
Texas and Louisiana	2.4	2.0	2.0 - 4.0	34.2	25.0	25.0 - 50.0
Southern California	1.4	0.5	4.0 - 10.0	N.A.	1.0	2.0 - 10.0
Cook Inlet	0.5	0.5	1.0 - 2.0	N.A.	1.0	5.0 - 10.0
TOTAL	4.3	3.0	7.0 - 16.0	34.2	27.0	32.0 - 70.0

* Estimated reserves to be found by development and extension of existing fields.

** Reserves which may be found in new fields.

N.A. - Not Available.

SOURCE: Petroleum and Sulfur on the U. S. Continental Shelf, U. S. Department of the Interior, Washington, D. C.

Other minerals of value such as sulfur, have been produced in the Gulf of Mexico. Only two commercial sulfur deposits, however, have been developed offshore. Both are on the outer continental shelf off southeast Louisiana. Gulf of Mexico sulfur deposits account for about 15 percent of the national output. Recent exploration off the Texas outer continental shelf has not led to any discoveries, but several confirmed offshore salt domes and numerous unknown structures suggestive of salt domes have not been tested.

The understanding of the general scale and geological interrelationships of the offshore Texas oil and gas industry provides a framework of analysis toward assessing the industry's internal structure and importance. The following section looks at the economic impact of the major offshore groups.

4. Economic Impact of Offshore-Related Industries in Texas

The economic impact of any activity is either a measure of the effect of a change in a region's economic scale or the effect on the regional economy of a change in a sector of the economy. Growth in offshore industries represents an alteration of the scale of the total regional economy stimulated by propulsive growth linkages with major manufacturing and service activities in and outside of Texas. Preliminary indicators of the economic impact of offshore activities can be derived by viewing their direct sale and employment impact.

Four general industry groups can be identified as the major components of the Texas offshore mineral industry.[16] These components are as follows:

a. Marine Exploration. Companies involved in geophysical activity to collect seismic information for oil activity.

b. Marine Construction. Companies engaged in laying offshore pipelines, fabricating offshore platforms and other offshore structures, installing offshore platforms and other offshore structures; packaging of drilling or production platform facilities; building mobile drilling units or derrick and pipelaying barges.

c. Drilling Contractors and Rig Owners. Contractors owning offshore drilling equipment (mobile rigs - tenders - fixed platform rigs) or with drilling crews working offshore; oil companies who own their own offshore drilling equipment; inland water drilling contractors operating inland bay or shallow water (less than 20 feet) marine drilling equipment; offshore workover companies who own or operate workover drilling type rigs.

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[16] World Offshore Directory, (Houston: Gulf Publishing Company, 1970).

d. General Marine Services. Companies contracting transportation services to the offshore oil industry; companies providing diving services; companies owning saturation diving systems; companies with submersible work vessels.

Other aspects of this integrated industry include manufacturing of marine equipment, research and development activities, pollution control and application of aerospace technology.

Much of the demand for the products and services of the offshore industries is non-local. This non-local or external demand is particularly relevant for local marine exploration and construction industries. The worldwide search for offshore oil and gas has been a major factor in the growth rate of Texas' offshore industry. To ascertain the employment and sales impact of the offshore industry groups on the State of Texas, data from a survey of all known offshore-related firms in Texas and from all available secondary source materials show the employment, investment and sales of these firms. Over 600 firms identified by their marine activity were screened. Multiple product firms were asked to provide the total percentage of their sales and employment directly related to producing offshore products or services. Most of the firms were producers of marine-related machinery and equipment. More than 60 percent of the firms gave their percentage allocation figures, which were then applied to their sales and employment figures to determine total marine related sales and employment. Those firms not responding were arbitrarily given a 20 percent factor. Basis for this allocation stems from information from the Petroleum Equipment Suppliers Association that about 20 percent of their equipment and service sales was for offshore operations.[17] It was assumed that the percentage of marine-related sales and employment in the multiple product firms was constant. The total direct marine-related sales and employment generated by the major component group, by S.I.C. category, were then tabulated.

Most of the direct offshore activity is accounted for by the S.I.C. 1300 group, exploration and mining of crude oil and natural gas. Within this category are included the marine geophysical companies, the offshore drilling and workover companies, the actual producers and operators of offshore platforms and related activities. Marine construction excludes the shipbuilding and repair industries, but includes all major offshore construction firms.

Recent figures, excluding major oil companies whose marine operations are vertically integrated, indicate that less than 25 firms account for the majority of the Texas-based offshore geophysical industry. Total cumulative investment in boats by these firms is estimated at more than $28 million and an additional $5.9 million

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[17] Donald E. Klierver. Editorial. World Oil. Vol. 163, No. 1, (July, 1966). p. 7.

is expended for leasing of boats for a total investment of $33.9 million for these activities in 1969. Estimates do not account for depreciation. Figures are based on average cost and investment data for a 1970 survey of marine service industries.[18] Annual maintenance costs for the boats are estimated at $560,000. This estimate involves 60 vessels owned and/or leased by Texas-based companies.

Investment in the marine construction industry in derrick barges, pipelaying barges, cargo and other work barges and other specialized water carriers by these offshore construction firms is estimated at $130 million. Annual maintenance costs on these vessels amount to more than $5 million.[19]

The direct employment and sales impact of the Texas offshore industry is indicated in Table 13. Offshore activity excludes the shipbuilding and repair industry and marine transport industry. Although components of both these activities are important segments of the offshore industry complex, they are also closely tied to ports and harbors activity in Texas. Offshore marine transport services and shipbuilding and repair figures are presented in Chapter IV. To incorporate these activities in the total direct figures, an estimated 3,240 employees and $83.2 million in sales could be added to the total figures for offshore services. These estimates include aircraft, offshore-related shipbuilding, and offshore transport services to the marine industry. Adding the sales and employment figures of these industries to the totals and including the operations of major oil companies, the total sales are $1.06 billion and the total employment amounts to 26,857.

The Primary Marine Region accounts for more than 80 percent of the offshore industry employment and sales. Total estimated sales by the industry were more than $972 million in 1969. If the major oil companies are excluded and only the primary offshore-related companies are included, approximately $280 million can be deducted from the total offshore figures.

Total direct employment generated by the offshore industry is more than 23,600. Employment in offshore mining, drilling and exploration amounts to about 20 percent of the total Texas employment in crude oil and gas activity and about 40 percent of the hydrocarbon activity in the study area. Chapter VIII of this report will evaluate the multiplier influence of offshore-related activities on the total state economy.

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[18]Robert Alderdice, "Offshore Work Fleet Gives Mobility to Oil Industry," OFFSHORE, Vol. 30, No. 6, (June, 1970), pp. 44-46.

[19]Ibid.

TABLE 13

DIRECT EMPLOYMENT AND SALES IMPACT OF OFFSHORE MINERAL INDUSTRIES IN TEXAS[1]
1969

AREA	OFFSHORE ACTIVITY	DIRECT EMPLOYMENT	DIRECT SALES
Primary Marine Regions I and II	Offshore Mining[2]	1,161	$306,930,000
	Offshore Drilling	5,830	194,000,000
	Offshore Exploration[3]	3,172	52,476,000
	Marine Construction and Equipment Mfg.[4]	12,544	336,010,000
Secondary Marine Region III	S.I.C. 1300 Series Offshore[5]	150	8,930,000
Rest of Texas	S.I.C. 1300 Series Offshore[6]	760	74,450,000
TOTAL OFFSHORE		23,617	$972,796,000

[1]Excludes offshore transport services and shipbuilding.

[2]Includes major oil company operations and offshore well services activity exclusive of transport services and S.I.C. 1389.

[3]Includes both S.I.C. 1382 and 1389.

[4]Includes S.I.C. 1621 and S.I.C. 3500 series in marine equipment. Does not include shipbuilding and repair industries.

[5]Primarily marine geophysical activity.

[6]Includes all S.I.C. 1300 series in marine drilling and geophysical companies.

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

CHAPTER IV

MARINE-RELATED TRANSPORTATION AND SHIPBUILDING

Marine transportation and shipbuilding activities in Texas constitute one of the major economic advantages in the state's economy. Waterborne access to the United States and other world markets via the Gulf of Mexico has been a major resource asset influencing the industrial development and economic potential of Texas. This chapter provides an overview of the economic structure and impact of marine transportation and shipbuilding activity on the economy of Texas. The following section is devoted to those activities related to the location and structure of Texas ports and harbors and the Texas shipbuilding and repair industries.

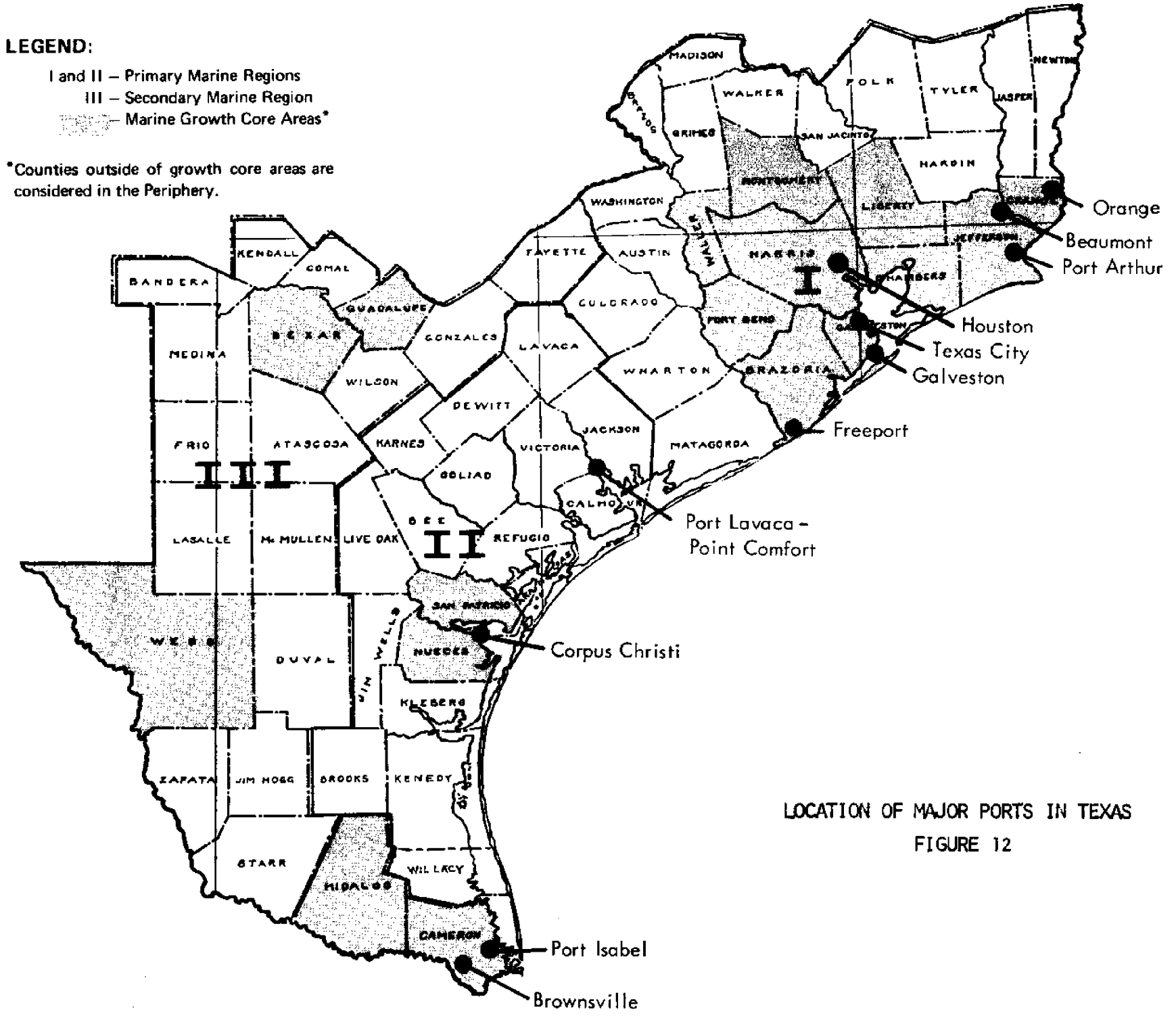
1. Location Economics and Geography of Marine Transportation Activity in Texas

The location of major Texas ports are shown in Figure 12. Most of these major ports are located in the growth core area of Primary Marine Region I. Chapter I of this report indicated how Texas' port complexes have been important in the economic growth of the state. Discoveries of oil and gas along the Texas coast, the development of industrial ports and the location of industry at these sites were critical factors in the maturation of the Texas coastal economy. The majority of Texas ports can be classified as industrial ports specializing in bulk commodities while obtaining the major portions of their revenues from general cargo.

Texas can be viewed as having an economic hierarchy of ports spatially distributed to accommodate the needs of coastal growth points while in turn acting as major growth points. An indication of the rankings in this port hierarchy can be given by the extent of the hinterlands of all Texas ports.

In their role as transit areas through which goods and people move to and from the seas, every port has a hinterland or total zone of influence. Ports consequently attempt to maximize the extent of their hinterland in order to obtain the maximum share of exportable and importable traffic. For example, although the core area of Primary Marine Region I is virtually a self-contained market, a major portion of goods leaving and entering ports in the core area come from as far east as the Mississippi River and as far west as the Rocky Mountain area. Hinterlands for ports in Primary Marine Region II generally do not extend as far as those in Region I.

The extent of the hinterlands for each port in Texas is a function of the freight rates to the ports, the facilities at the ports, the balance of general and specialized trade cargoes, the time availability and supply of vessel space, the demand for the products



LOCATION OF MAJOR PORTS IN TEXAS

FIGURE 12

produced in hinterland areas, and port costs.[1] Facilities vary at each port and consequently, an overlapping spatial distribution of hinterlands characterizes the true zone of influence of the ports. For example, the relative superiority in container facilities, grain elevators or other specialized facilities, the location of final markets, and rapid transshipment capacity by barge are major influences in the level of traffic at Texas ports. Hinterlands are consequently much larger areas than the traditionally defined "coastal zones."

Accessibility to the United States and world markets has been a major factor in influencing the hinterland structure and overall growth of Texas ports and port-related industries. Examples of established United States foreign shipping routes to and from Gulf ports are indicated in Figures 13 and 14. These figures show the routes to countries and ports that continually have large numbers of vessels destined for Texas ports. Major import and export areas for Texas include Japan, England, Western Europe and the United States East Coast. Access to major inland markets by barge from Texas ports is provided by the Intracoastal Waterway. Figure 15 indicates the coastal and inland barge routes accessible to Gulf port traffic.

Barging to market and production points located near inland waterways has had the effect along the Texas coast of attracting major manufacturing industry away from relatively locked-in sites near central cities while providing a free flow of inputs and outputs to major core complexes.[2] The existing industrial base along waterways in turn stimulates demand for barge-transported inputs. For example, the metals fabrication complex in the Houston area requires large amounts of iron and steel raw materials which are barged into the Houston area. Other examples of minerals barged along the Texas Intracoastal Waterway include aluminum, cement, coal, salt, sand and gravel, and sulfur.

Barge transportation is also an important factor in the petroleum industry. Small oil companies which are unable to finance a pipeline can secure supplies of crude for their refineries by means of barges. Major oil companies use barge transportation to supplement crude supplies obtained by other modes. About 60 percent of

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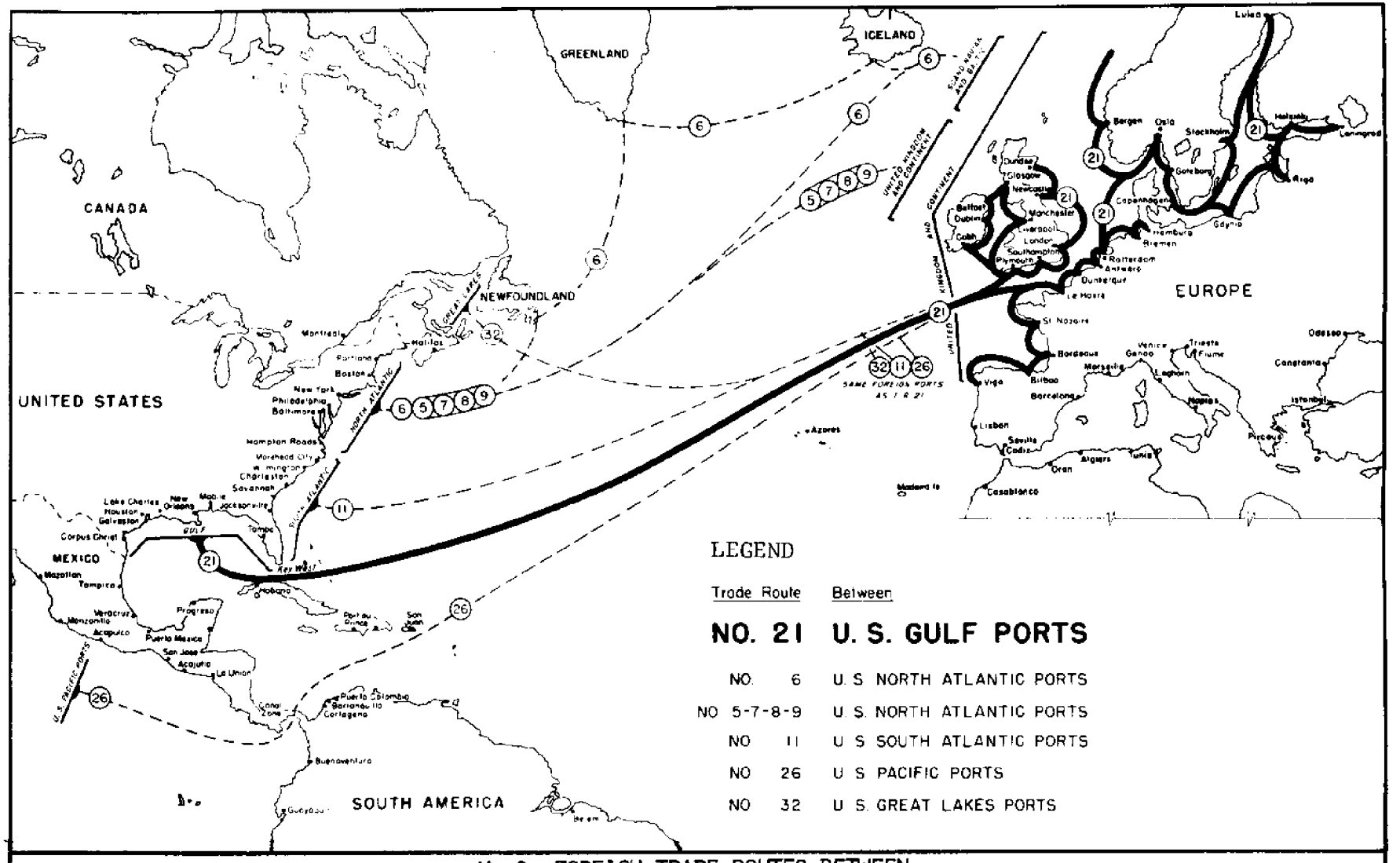
[1] Allan Pred, The External Relations of Cities During Industrial Revolution. (Chicago: The University of Chicago Press, 1962) and F. W. Morgan, Ports and Harbors. (London: Hutchinson University Library, 1958).

[2] Minard I. Foster, "Broad Scope of Navigation's Economic Impact," Journal of the Waterways and Harbors Division Proceedings of the American Society of Civil Engineers (February, 1969) pp. 23-34.

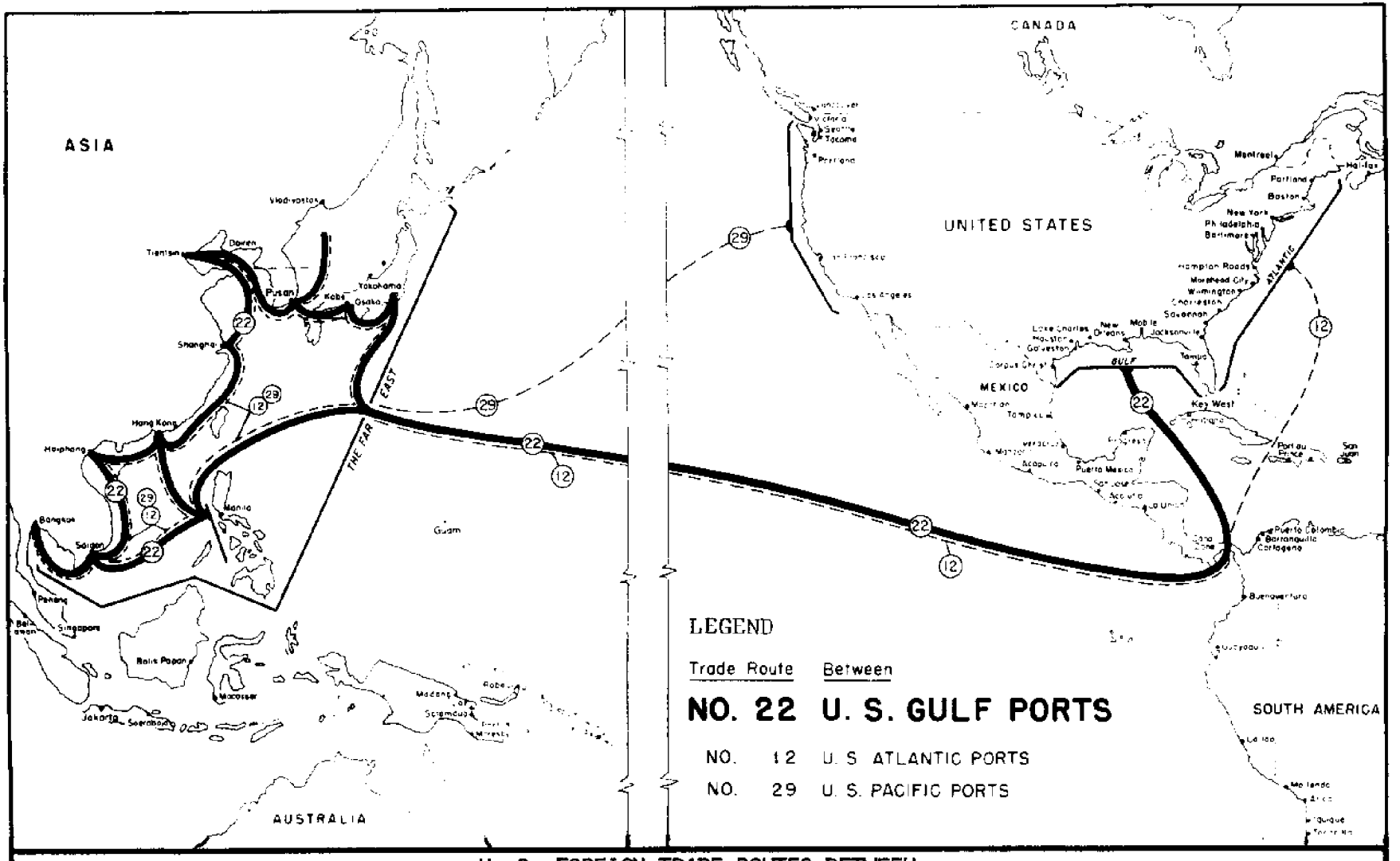


LEGEND

Trade Route	Between
NO. 21	**U. S. GULF PORTS**
NO. 6	U. S. NORTH ATLANTIC PORTS
NO. 5-7-8-9	U. S. NORTH ATLANTIC PORTS
NO. 11	U. S. SOUTH ATLANTIC PORTS
NO. 26	U. S. PACIFIC PORTS
NO. 32	U. S. GREAT LAKES PORTS

U. S. FOREIGN TRADE ROUTES BETWEEN
GULF PORTS AND EUROPE

FIGURE 13



U. S. FOREIGN TRADE ROUTES BETWEEN
GULF PORTS AND THE FAR EAST

FIGURE 14

INLAND WATERWAYS OF THE CENTRAL AND EASTERN UNITED STATES

FIGURE 15

the Louisiana crude petroleum shipped to Texas is moved by barge and tanker, the rest by pipeline.[3]

The joint demand for barging and towing provides employment for hundreds of workers and also stimulates activity in the shipbuilding and repair industry. The size of these barge tows are restricted on the Intracoastal Waterway. Towing movements range from single barges of 972 tons (7,000 barrels); single barges of 4,166 tons (30,000 barrels); to tows of 11,111 tons (80,000 barrels). Barge capacity like the recent tankers and container ship has risen dramatically. In 1935, the average barge had a cargo capacity of 300 tons. In 1940, it was 800 tons. Barges in use on the rivers and canals now carry from 1,000 tons to 3,000 tons including both dry cargo and barges and tank barges.[4] Limits are also necessary on ship sizes entering Texas ports. Deepest draft of dry cargo vessels is 36 feet while tankers can enter with 37 foot drafts.[5]

Shipbuilding and repair activity in Texas includes the construction of tugs, towboats, barges, tankers, regular cargo ships, oceanographic research vessels, mobile oil drilling units, shrimp trawlers, and various types of pleasure craft. Most of the Texas shipbuilding activity is located in the core area of Primary Marine Region I.

The S.I.C. categories of activities discussed in this section include:

S.I.C. Number	Category
3731	Ship Building and Repairing
3732	Boat Building and Repairing
4411	Deep Sea Foreign Transportation
4421	Transportation to & Between Non-Contiguous Territories
4422	Coastwise Transportation
4423	Intercoastal Transportation

[3]Frank B. Fulkerson, Transportation of Mineral Commodities on the Inland Waterways of the South-Central States. Information Circular 8431. Bureau of Mines. U. S. Department of the Interior (Washington, D. C., 1969), p. 41.

[4]Braxton B. Carr, "Barge Transportation - Energizer of Production and Marketing," Journal of Waterways and Harbors Division, Proceedings of the American Society of Civil Engineers. (May, 1969), pp. 167-168.

[5]United States Seaports Gulf Coast, Port Series, Part I. Maritime Administration, April, 1965, U. S. Department of Commerce, Washington, D. C.

S.I.C. Number	Category
4441	Transportation on Rivers & Canals
4452	Ferries
4453	Lighterage
4454	Towing & Tugboat Services
4459	Local Water Transportation not Elsewhere Classified
4463	Marine Cargo Handling
4469	Water Transport Services Not Elsewhere Classified
4712	Freight Forwarding
4721	Arrangement of Transportation
4782	Inspection & Weighing Services Connected with Transportation
4783	Packing & Crating
4789	Services Incidental to Transportation not Elsewhere Classified

2. Analysis of Factors Affecting Economic Impact of Texas Marine Transport Industries and Shipbuilding Industry

The tonnage handled by Texas' deep draft and shallow draft ports is provided in Table 14. The table indicates that tonnage handled at deep draft ports experienced a stable growth from 1959 to 1968 while shallow draft port tonnage tripled. More than 25 points along the Texas coast handled cargo during this period. Much of the increase can be attributed to the development of new inland waterways and the expansion of shallow draft ports during the period. Most of the tonnage consisted of bulk commodities and in particular, crude petroleum.

Specialization in bulk commodities along with the strategic role of Texas ports and harbors as industrial location points are two factors to consider in assessing the economic impact of marine-transport related activities. Ports have historically been the growth points for industry through their dual role as a distribution junction and a terminal site. Every major Texas port is the location point for petroleum refineries, bulk terminals, and petrochemical plants. More than $4 billion in petrochemical facilities alone are located near port sites in the growth core of Primary Marine Region I.[6] The flow of bulk commodities and in particular, crude petroleum are important inputs to these port industrial complexes. The Port of Houston is a major example of an industrial

[6]Carleen O'Laughlin, The Economics of Sea Transport. (London: Pergamon Press, 1967).

TABLE 14

TONNAGE HANDLED AT TEXAS PORTS AND OVER GULF INTRACOASTAL WATERWAY
(Short Tons)

PORTS AND WATERWAYS	1940	1950	1959	1960	1968
DEEP-DRAFT PORTS					
Brownsville	201,935	1,141,800	842,717	970,361	4,838,193
Port Isabel	321,692	390,723	623,053	444,627	326,701
Port Aransas - Corpus Christi Waterway	14,180,404	21,131,509	24,112,415	24,840,443	28,400,998
Freeport	282,593	3,014,177	3,948,268	3,648,739	4,626,306
Galveston	4,098,371	6,953,452	6,707,618	6,072,922	2,821,873
Houston	27,385,598	40,825,048	60,265,293	57,132,659	57,806,214
Texas City	13,490,722	10,928,572	13,649,143	15,401,847	16,713,495
Sabine Pass Harbor	644,680	857,582	216,509	365,282	137,698
Port Arthur	18,520,456	19,323,487	23,095,561	28,207,396	22,627,804
Beaumont	19,387,986	21,425,323	26,125,522	27,113,480	30,791,856
Orange	65,412	632,299	944,281	1,022,784	1,535,167
Subtotal	98,579,939	126,623,972	160,530,380	165,220,540	170,626,305
SHALLOW-DRAFT PORTS					
Port Lavaca	--	243,664	1,157,281	2,037,369	5,033,640
Anahuac	41,649	145,445	128,738	109,015	127,544
Trinity River, Channel to Liberty	16,336	30,858	1,225,372	965,416	366,385
Double Bayou	2,067	29,978	149,923	58,261	6,048
Cedar Bayou	427,796	658,417	338,822	227,893	155,985
Sweeny (San Bernard River, Texas)	--	1,605,308	964,366	840,223	1,440,344
Chocolate Bayou, Texas	--	--	--	--	2,300,617

TABLE 14 (continued)

TONNAGE HANDLED AT TEXAS PORTS AND OVER GULF INTRACOASTAL WATERWAY
(Short Tons)

PORTS AND WATERWAYS	1940	1950	1959	1960	1968
SHALLOW-DRAFT PORTS (Continued)					
Palacios	--	86,245	102,273	140,844	79,555
Rockport	--	--	4,423	5,701	355
Aransas Pass	--	46,563	68,683	97,001	16,709
Port Mansfield	--	--	18,963	114,799	20,695
Rio Hondo - Harlingen	--	650	206,575	215,100	357,528
Long Mott (Guadalupe River to Victoria)	--	--	349,944	252,504	1,799,172
Subtotal	497,848	2,847,128	4,715,363	5,064,126	11,704,557
TOTAL PORTS	99,077,787	129,471,100	165,245,743	170,284,666	182,330,862
GULF INTRACOASTAL WATERWAY					
Sabine River to Galveston	6,925,091	14,239,348	23,021,805	24,728,605	42,689,115
Galveston to Corpus Christi	362,205	6,198,624	8,057,685	8,558,825	18,729,357
Corpus Christi to Mexican Border	--	556,081	1,063,075	1,180,138	1,927,713
Subtotal	7,287,296	20,994,053	32,142,565	34,467,568	63,346,185
Less Duplications	-214,526	-2,242,683	-3,370,524	N. A.	N. A.
TOTAL GULF INTRACOASTAL WATERWAY	7,072,770	18,751,370	28,772,041	34,467,568	63,346,185

N.A. - Not Available

SOURCE: The Report of the U. S. Study Commission - Texas, Part II, Resources and Problems, 1962, U. S. Study Commission, Washington, D. C., and Waterborne Commerce of the United States, Part 2, 1968, Corps of Engineers, Department of the Army, Washington, D. C.

port specializing in bulk commodities. An indication of the growing volume of crude petroleum traffic from 1954 to 1966 over the Gulf Intracoastal Waterway and receipts by Texas refineries is provided in Table 15. The table indicates that crude petroleum traffic may more than double by 1980. From 1960 to 1966, crude traffic increased by more than 60 percent. The introduction of unit trains have stimulated a trade diversion from barges to specialized carriers. The Port of Galveston, for example, recently began handling molten sulfur transported to dockside by unit trains.

TABLE 15

GULF INTRACOASTAL WATERWAY FREIGHT TRAFFIC OF CRUDE PETROLEUM, AND TEXAS REFINERY RECEIPTS OF CRUDE PETROLEUM FROM LOUISIANA
1954-1966 AND 1980

YEAR	GULF INTRACOASTAL WATERWAY INTERNAL TRAFFIC, CRUDE PETROLEUM, (Million Short Tons)	TEXAS REFINERY RECEIPTS OF CRUDE PETROLEUM FROM LOUISIANA (Million Barrels)
1954	11.3	61.1
1955	9.5	56.8
1956	14.7	63.2
1957	16.6	71.2
1958	15.3	85.0
1959	18.0	98.9
1960	21.5	124.5
1961	23.0	140.0
1962	24.0	151.7
1963	27.3	168.5
1964	26.3	171.4
1965	30.0	186.1
1966	N.A.	209.0
1980:		
Low	30.0	200.0
Medium	45.0	300.0
High	60.0	420.0

N.A. - Not Available

SOURCE: Transportation of Mineral Commodities on the Inland Waterways of the South-Central States, 1969, Bureau of Mines, U. S. Department of the Interior, Washington, D. C.

Examples of other bulk commodities include ores, agricultural products, and oils along with mineral products. Houston is also a major export port for wheat because of its proximity to the wheat belt and has specialized facilities to handle this cargo. Many of these commodities are mechanically loaded and unloaded into and out of private fleets from private piers.

Most major Texas ports are characterized by substantial private investments in port facilities located near those owned and operated by port authorities or Navigation District of the local communities.[7] This relatively independent structure sets Texas apart from other Gulf Coast areas where state governments own and operate port facilities. From 1824 to 1966, the federal investment in Gulf Coast ports exclusive of operating costs, have been more than $368 million. Non-federal contributions were more than $38 million.[8]

The sensitivity of Texas ports to longshore strikes is related to the mix of facilities and cargoes and consequently provides an indication of the importance of the ports to the state economy. Sensitivities of Gulf of Mexico ports to strikes are indicated by the ratio of tanker shipments (that are less susceptible to union stoppages) to total shipments out of or into a port. The ratio is important in that tanker cargo is not limited to fluids such as petroleum, but also includes other important Texas bulk commodities such as wheat and feed grains.

Gulf Coast ports are the major exporting outlets for tanker cargoes, contributing 64 percent of all tanker exports. Galveston is the most important of these ports, handling 13 percent of all tanker exports from the United States. For all Gulf Coast ports, 18 percent of imports and 20 percent of exports are shipped via tanker. The lesser susceptibility to tanker shipments during the 1968-1969 longshore strike is indicated by the fact that tanker shipments from the Gulf Coast decreased 20 percent versus a decrease in dry cargo of 72 percent.[9]

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[7]Dow Wynn, "Port Authorities in Texas," in Texas Marine Resources and the Sea Grant Program, Conference Proceedings, January, 1969. Publication No. 102. (College Station: Texas A&M University, 1969), pp. 87-95.

[8]Port Development, A Problem and an Opportunity. U. S. Army Corps of Engineers, July, 1968, p. 6.

[9]Impact of Longshore Strikes on the National Economy, U. S. Department of Labor. Task Force Report. Chapter VII. (January, 1970). p. 55.

The impact of the 1963 strike to the Port of Houston, for example, was estimated at $3 million per day to the port economy; $285,000 per day to the port and a combined loss of more than $60 million over the entire strike period.[10] The loss to shippers of the 1968-69 strike was estimated at $300,000 per day. The direct employment effect was not as substantial as the income loss. Approximately 4,700 workers in water transportation were idle during the 1968-69 strike in Houston. Less than half of these workers however, relied on dock activity for all of their personal income.

The frequency of strikes, the diversity of goods traded and sold, the hinterland of ports, the demand for import and export goods in the hinterland, the access to market areas, and the desirability of a port as an industrial location site all constitute major factors influencing the economic impact of ports and harbors.

Innovation diffusion of new marine-related technology and systems is also critical to an impact evaluation of port activity. Containerization and increased ship size are major examples. The rising concern with the nation's shipping activity and the world focus on fast, advanced ocean transport systems has fostered a virtual "container rush" at Texas Gulf Coast ports. The push to be the "first" or the "finest" container port on the Gulf Coast results in not only an attempt at product differentiation by port officials, but also in the desire to remain competitive in the containerized world cargo trade of the future. Ports differentiate their "product" by providing better quality container facilities. These new investments stimulate employment and incomes into the local regional economy. While more business may be attracted to the port resulting in increased revenues, the new container technology may also reduce dockside employment. Resources freed for alternative uses by the innovation of containers can be considered the "social saving" resulting from the innovation. If freed resources remain unemployed, an adverse income distribution effect may occur within the region. For example, the average semi-container ships and the smaller all container ships will tend to make obsolete the dry cargo wharves at Texas ports and reduce labor inputs for container cargo. The need for accelerated physical transfer of containers to and from ships has been prompted by at least three major factors: (1) the time factor in handling a greater number of containers with larger ships, (2) the costs per hour of vessel time of large container ships, and (3) problems of serving small volume ports given the large investment and size of container ships. With ship time so costly, it might not be profitable to go into a port for small loads that were formerly attractive.[11]

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[10] Ibid.

[11] Gayton E. Germane, "Impact of Containerization on Ocean Transportation: Dimensions of the Problem", Papers - 8th Annual Meeting, Transportation Research Forum. (Oxford, Indiana: Richard B. Cross Co., 1967), p. 11.

Rapid unloading and fast turnaround are thus major factors in optimizing container operations. The drafts and size of new container ships present no major problems for Texas ports. Lengths of new container vessels built in the 1960's were from 600 to 720 feet with widths from 80 to 95 feet. Unlike tankers, whose draft generally increases with size, most of the new container ships have retailed general cargo ship design drafts averaging from 28 to 33 feet. By 1969, there were approximately 150 container ships operating in international trade, according to the American Bureau of Shipping. The largest was 100 feet wide and had a draft of 35 feet when fully loaded.[12] Container ships moving into the Port of Houston generally carry 250 35-foot containers.[13]

The size innovation in tanker fleets is more pronounced. United States tanker trade requirements have had little, if any, influence in recent determinations of maximum tanker size. The bulk of the United States tanker trade is from Venezuela and the Gulf Coast to the Atlantic Coast. Volume movements from the Persian Gulf and Africa to the United States are smaller by comparison. Existing Gulf Coast and Atlantic ports do not now have channel depths capable of accepting fully loaded tankers of more than 80,000 deadweight tons.[14]

Table 16 provides projections of the world tanker fleet size compared with actual 1966 sizes. Most of the current tanker fleet is capable of entering Texas ports. However, expected increases in world petroleum demand along with the general growth in world trade tend to generate constant pressure to deepen and widen ports in Texas. The financing for these projects, including the site selection and government approval of spoil disposal areas and the actual dredging and construction operation all require a lengthy time period. Recent emphasis on ecology and environmental equilibrium in the selection of spoil disposal areas has tended to cause delays in these port expansion projects.

3. Economic Impact of Texas Ports and the Shipbuilding Industry

Growth stimulating factors mentioned in Sections 1 and 2 of this chapter indicate the important economic activities upon which Texas ports and harbors and the shipbuilding support rely. Examples of

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[12] Merchant Vessel Size in United States Offshore Trades by the Year 2000. The American Association of Port Authorities, Committee on Ship Channels and Harbors. June, 1969. p. 27.

[13] "Ports Stress Containers," The Houston Post, June 28, 1970. Section 5, pp. 1-2.

[14] Ibid.

TABLE 16

WORLD TANKER FLEET
1966 AND 1983

VESSEL DEADWEIGHT TONS (In Thousands)	NUMBER OF VESSELS	
	1966	1983*
10- 20	1,184	1,337
20- 40	889	456
40- 60	467	317
60- 80	202	429
80-100	86	760
100-125	29	397
125-150	5	48
150-200	2	224
200-300	---	371
400-600	---	45
TOTAL	2,864	4,384

* Projected

SOURCE: Merchant Vessel Size in United States Offshore Trades by the Year 2000, June, 1969. The American Association of Port Authorities Committee on Ship Channels and Harbors, Washington, D. C.

the inter-relationship of industrial location, regional growth, and port activity is indicated in two recent studies of the Port of Houston[15] and Port of Galveston.[16]

Industries located along the Houston Ship Channel were estimated to employ 100,000 persons generating more than one-half billion dollars in income. More than 55,000 persons or approximately more than double the number employed by waterborne transport industries, as defined by the Standard Industrial Classification, were estimated as directly employed by the Houston port's activity. This is about 11 percent of the total employment in the Houston area. Total impact of payrolls range up to $280 million annually.[17] In Galveston, 61 percent of the total wage and salary income of the city was estimated to be generated by the Port of Galveston. Nearly 18,000 workers, or slightly more than double the number of persons employed solely in waterborne commerce were directly involved in employment as a result of the Port of Galveston in 1968.[18]

For all ports in Texas, preliminary indications of importance are promoted by regional tonnage data. The distribution of commodity traffic between Primary Marine Region I and Primary Marine Region II by major and shallow draft ports is shown in Table 17. Major draft ports in Primary Marine Region I accounted for more than 80 percent of deep draft tonnage in Texas while shallow draft ports in Primary Marine Region II account for most of the Texas coast shallow draft traffic. This traffic generates a considerable volume of expenditures or incomes accruing to a variety of port industries. Each ton of cargo, for example, requires some expenditure for ship towing, cargo handling, and use of port facilities. Cost estimates for these diverse port services have been developed by the American Association of Port Authorities (AAPA) to ascertain the "value of a ton of cargo to the port economy."

In 1968, for example, the AAPA estimated that an average of more than $16 was generated per ton of general cargo. Cost estimates for tanker cargo, grains and ores have also been developed for each year to 1970 by the AAPA.[19] In addition, alternative cost estimates

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[15]Warren Rose, "Catalyst of an Economy: The Houston Ship Channel, Land Economics, No. 1, Vol. 63. (February, 1967), pp. 33-43.

[16]Warren Rose, The Port of Galveston: Employment and Income Impact. Prepared for Galveston Wharves, February, 1970.

[17]Ibid., p. 1.

[18]Ibid.

[19]"Method of Determining a Port's Economic Impact and Dollar Value of Earnings," American Association of Port Authorities, report, February, 1970.

TABLE 17

TEXAS MARINE REGION FREIGHT TRAFFIC
1968
(Short Tons)

REGION	GENERAL CARGO	TANKER CARGO	GRAIN	ORE
Region I				
Major Ports	42,262,614	84,007,146	9,139,026	1,021,627
Shallow-draft Ports	892,170	1,283,691	---	---
TOTAL REGION I	43,154,784	85,290,837	9,139,026	1,021,627
Region II				
Major Ports	3,893,422	20,233,482	1,849,066	2,826,297
Shallow-draft Ports	6,137,529	1,090,550	---	---
TOTAL REGION II	10,030,951	21,324,032	1,849,066	2,826,297
TOTAL REGION	53,185,735	106,614,869	10,988,092	3,847,924

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

based on "export employment" have been developed by the Maritime Administration.[20] The services provided by a port authority or by businesses operating within a port are numerous and include services to shipowners, to cargo importers and exporters and handlers. The services provided to ships are those concerned with bringing the ship in and out of port, such as pilotage, towage, and the maintaining of channels, marks and buoys; the provisioning of ships with stores, water and fuel; and stevedoring. In Texas, port authorities vary in the extent of services they provide and the degrees of centralization of port activities.

To approximate the income-generating effects of port expenses, it will be assumed that the relationship between economic impact and

[20] Economic Impact of United States Ocean Ports, Maritime Administration, U. S. Department of Commerce, (Washington, D. C., 1966).

tonnage of freight handled in a port is roughly the same in Texas as it is in other areas of the country. This assumption means that regional cost differentials are ignored and the AAPA figures will be used. The AAPA figures should be considered as slightly higher than actual costs at Texas ports. One partial study of the Port of Port Arthur estimated that $7.70 per short ton of 2,000 pounds was directly generated by a "typical water terminal operation, vessel by vessel."[21] The AAPA cost figures are given for 1968 and estimated for 1970.

Based on the AAPA figures, the direct value of a ton of cargo for deep draft Texas ports for 1968 is provided in Table 18. Using the 1968 cost estimates, more than $1.3 billion in revenues were generated by deep draft Texas ports in 1968. Assuming the same level of traffic, and applying the 1970 cost figures, the total direct revenues generated by deep draft ports were more than $1.4 billion as shown in Table 19. Shallow draft ports generated another $140 million in 1968 and an estimated $145 million in 1970 as shown in Table 20.

A breakdown by Primary Marine Region and by major deep water and shallow draft ports of the value of cargo to port economies is presented in Tables 21 and 22 for 1968 and 1970, respectively. Primary Marine Region I accounted for 80 percent of the total direct revenues accrued to the local port economies. The total direct revenue accrued to all Texas port economies in 1968 amounted to more than $1.5 billion. Using 1970 cost figures and 1968 cargo data, the direct revenue effect would be about $1.6 billion.

Other indicators of the economic impact of port activities and shipbuilding are direct employment and sales. Table 23 provides a breakdown of direct employment and sales in the Texas Marine Region and the rest of Texas of the marine transport and shipbuilding activity in 1969. Survey results were compiled by the Industrial Economics Research Division of all firms listed with appropriate Standard Industrial Classification groups.

Shipbuilding and repair industries include firms such as Todd Shipyards, Levingston, Rockport Yacht and Supply Company, Bludworth Shipyards, Gulfport Shipbuilding Company, Marine Mart and other firms listed under S.I.C. 3731. Total direct employment generated by shipbuilding and repair activities in 1969 was 6,451 and direct sales were more than $126 million.

Less than 600 employees and more than $6 million in sales were generated by the boat building and repair industry. Deep sea, domestic, canal and local water transportation services include canal barge transportation, towing and tugboat service for ports,

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[21] Dow Wynn, op. cit., p. 90.

TABLE 18

VALUE OF CARGO TO PORT ECONOMIES,
DEEP-DRAFT TEXAS PORTS
1968

PORT	GENERAL CARGO	TANKER CARGO	GRAIN	ORE	TOTAL
Brownsville	$ 10,718,817	$ 16,221,908	$ 3,788,664	$ 60,624	$ 30,790,013
Port Isabel	392,164	1,295,739	60,899	---	1,748,802
Corpus Christi	60,761,588	71,105,003	9,204,842	9,859,677	150,931,110
Freeport	73,535,059	2,815,573	---	---	76,350,632
Galveston	23,822,316	297,069	5,879,624	2,660	30,001,669
Houston	442,050,225	113,949,006	48,257,768	3,540,533	607,797,532
Texas City	87,950,011	52,294,002	---	34,640	140,278,653
Sabine Pass	321,277	526,887	---	---	848,164
Port Arthur	28,426,517	91,656,287	1,142,399	---	121,225,203
Beaumont	100,315,941	105,729,879	8,601,769	---	214,647,589
Orange	23,746,519	682,592	639,960	8,076	25,077,147
TOTAL	$852,040,434	$456,573,945	$77,575,925	$13,506,210	$1,399,696,514

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 19

VALUE OF CARGO TO PORT ECONOMIES,
DEEP-DRAFT TEXAS PORTS
1970*

PORT	GENERAL CARGO	TANKER CARGO	GRAIN	ORE	TOTAL
Brownsville	$ 11,154,305	$ 16,925,598	$ 3,944,289	$ 63,042	$ 32,087,234
Port Isabel	408,097	1,351,947	63,401	---	1,823,445
Corpus Christi	63,230,233	74,189,466	9,582,944	10,252,941	157,255,584
Freeport	76,522,670	2,937,710	---	---	79,460,380
Galveston	24,790,178	309,955	6,121,138	2,766	31,224,037
Houston	460,009,998	118,901,015	50,240,028	3,681,751	632,832,792
Texas City	91,523,278	54,562,463	---	36,021	146,121,762
Sabine Pass	334,330	549,743	---	---	884,073
Port Arthur	29,581,440	95,632,245	1,189,325	---	126,403,010
Beaumont	104,391,615	110,316,335	8,955,100	---	223,663,050
Orange	24,711,302	712,202	666,248	8,398	26,098,150
TOTAL	$886,657,446	$476,388,679	$80,762,473	$14,044,919	$1,457,853,517

* 1970 estimates of value of cargo based on 1968 tonnage figures.

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 20

VALUE OF CARGO TO PORT ECONOMIES
OF SHALLOW-DRAFT TEXAS PORTS
1968 AND 1970

PORT	1968		1970*	
	GENERAL CARGO	TANKER CARGO	GENERAL CARGO	TANKER CARGO
Port Lavaca	$ 79,040,311	$ 3,293,466	$ 82,251,591	$ 3,436,333
Anahuac	2,354,462	---	2,450,120	---
Trinity River to Liberty	6,763,467	---	7,038,255	---
Double Bayou	111,646	---	116,182	---
Cedar Bayou	766,846	501,264	798,002	523,009
Sweeny (San Bernard River)	5,004,450	4,121,301	5,207,773	5,343,458
Palacios	1,468,585	---	1,528,251	---
Rockport	6,184	---	6,435	---
Aransas Pass	205,884	24,335	214,249	25,390
Port Mansfield	329,418	12,483	342,802	13,024
Rio Hondo - Harlingen	1,122,811	1,299,563	1,168,429	1,355,937
Long Mott (Guadalupe River to Victoria)	32,594,175	146,760	33,918,424	153,126
Chocolate Bayou	---	3,335,909	---	3,473,946
TOTAL	$129,768,239	$13,735,081	$135,040,513	$14,324,223

* 1970 estimates of value of cargo based on 1968 tonnage figures.

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 21

VALUE OF CARGO TO PORT ECONOMIES
IN THE PRIMARY MARINE REGIONS
1968

PRIMARY REGIONS	GENERAL CARGO	TANKER CARGO	GRAIN	ORE	TOTAL
Region I					
Major Ports	$780,167,854	$367,951,299	$64,521,523	$ 3,585,910	$1,216,226,586
Shallow-draft Ports	16,469,458	8,958,468	---	---	25,427,926
TOTAL REGION I	$796,637,312	$376,909,767	$64,521,523	$ 3,585,910	$1,241,654,512
Region II					
Major Ports	$ 71,871,570	$ 88,622,651	$13,054,405	$ 9,920,302	$ 183,469,928
Shallow-draft Ports	113,298,785	4,776,609	---	---	118,075,394
TOTAL REGION II	$185,171,355	$ 93,399,260	$13,054,405	$ 9,920,302	$ 301,545,322
TOTAL REGION	$981,808,667	$470,309,027	$77,575,928	$13,506,212	$1,543,199,834

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 22

VALUE OF CARGO TO PORT ECONOMICS
IN THE PRIMARY MARINE REGIONS
1970*

PRIMARY REGIONS	GENERAL CARGO	TANKER CARGO	GRAIN	ORE	TOTAL
Region I					
Major Ports	$ 811,864,814	$383,921,657	$67,171,841	$ 3,728,938	$1,266,687,250
Shallow-draft Ports	17,138,585	9,340,406	---	---	26,478,991
TOTAL REGION I	$ 829,003,399	$393,262,063	$67,171,841	$ 3,728,938	$1,293,166,241
Region II					
Major Ports	$ 74,792,636	$ 92,467,012	$13,590,635	$10,315,984	$ 191,166,267
Shallow-draft Ports	117,901,932	4,983,813	---	---	122,885,745
TOTAL REGION II	$ 192,694,568	$ 97,450,825	$13,590,635	$10,315,984	$ 314,052,012
TOTAL REGION	$1,021,697,967	$490,712,888	$80,762,476	$14,044,922	$1,607,218,253

* 1970 estimates of value of cargo based on 1968 tonnage figures.

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 23

DIRECT EMPLOYMENT AND SALES
OF MARINE TRANSPORT AND SHIPBUILDING
IN THE TEXAS MARINE REGION AND THE REST OF TEXAS
1969

AREA	ACTIVITY	DIRECT EMPLOYMENT	DIRECT SALES
Primary Marine Regions I & II	Ship-Building and Repairing[1]	6,451	$126,096,048
	Boat Building and Repairing[2]	565	6,048,300
	Deep Sea, Domestic, Canal & Local Water Transportation[3]	3,621	214,990,026
	Marine Cargo Handling & Other Transport Services[4]	4,752	41,720,759
	Freight Forwarding and Related Services[5]	2,068	36,322,000
	Subtotal	17,457	$425.177.133
Secondary Marine Region III	Marine Transport Related Activity	393	6.315.000
Rest of Texas	Marine Transport Related Activity	479	7,978,000
	TOTAL	18,329	$439.470.133

[1]Includes S.I.C. 3731 only.

[2]Includes S.I.C. 3732 only.

[3]Includes S.I.C. 4411, 4421, 4422, 4423, 4431, 4441, 4452, 4453, 4454 and 4459.

[4]Includes S.I.C. 4463, 4464, 4469.

[5]Includes S.I.C. 4721, 4782, 4783, 4789.

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

offshore mineral industries, and coastwise and foreign ocean transport. Total direct sales in 1969 amounted to nearly $215 million and more than 3,600 employees. Marine cargo handling and related activities generated employment for more than 4,700 persons and sales of more than $41 million. The total direct sales generated by all activities for Texas amounted to more than $430 million and total direct employment was more than 18,300. The multiplier influence of these sales and employment will be discussed in the evaluation chapter of this report.

CHAPTER V

COMMERCIAL FISHERIES

The United States is the leading world market for fishery products and ranks fifth in total world commercial fishery output. Texas accounts for a major portion of total United States fishery output. The state specializes in producing shrimp for world and local markets. This chapter will assess the importance and structure of the Texas fishery industry and analyze factors influencing the impact of commercial fisheries activity in Texas on the state and national economy.

1. Economics of the Fishery Industry: Overview of United States and Texas Activity

Total catch of finfish and shellfish in the United States in 1969 was 4.29 billion pounds. Shrimp was the most valuable fishery in the country in 1969 and accounted for 24 percent of the total United States ex-vessel value for all species.[1] More than 317 million pounds of shrimp (heads-on) landed were valued at $123 million. Most of the shrimp were produced in the Gulf of Mexico and landed in Texas and Louisiana.

The United States fishing industry currently ranks fifth behind Japan, Peru, Russia and China in total volume of catch. Exports of all fishery products from the United States rose from $67.8 million in 1968 to $104.5 million in 1969. Imports however, in 1969 were 12.9 billion pounds or slightly more than three times the total domestic catch. The total value of the United States fishery production in 1969 was $518 million; the total value of all fishery imports, however, was more than $844 million. United States fishermen thus accounted for only 33 percent of the total United States fishery supply in 1969. This import/export imbalance resulted in a balance of payments deficit of $739.8 million in 1969.

Although commercial fisheries are not considered a vital United States industry the reliance on foreign fishery supplies and the resulting adverse effect on the United States balance of payments has stimulated increasing concern for this "declining" industry.

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[1] Fisheries of the United States...1969, Bureau of Commercial Fisheries, U. S. Department of the Interior (Washington, D. C., March, 1970), p. 16.

Recent studies have shown, for example, that between 1957 and 1967, the average annual increase in shrimp imports was 19.09 percent.[2]

Edible fishery products characterized by relatively high income elasticities have been the major import items. An income elasticity for a commodity refers to the relative response in the demand for a commodity resulting from a relative change in income. An income elasticity of one would imply that demand for a fishery product grew in the exact proportion to the increase in consumer income. Sample income elasticities are shown in Table 24. The table indicates that with the exception of oysters, fishery products with high income elasticities have experienced relatively high import growth. Shrimp had an income elasticity, for example, of 1.43. Tuna and flounder with the highest income elasticities had the highest increase in landings that tended to result in lower import rates.

TABLE 24

INCOME ELASTICITIES AND ANNUAL PERCENT CHANGES IN IMPORTS FOR SELECTED FISHERY PRODUCTS IN THE UNITED STATES 1957-1967

PRODUCT	ANNUAL PERCENT CHANGE IN UNITED STATES LANDINGS	INCOME ELASTICITIES	ANNUAL PERCENT INCREASE IN IMPORTS
Shrimp	2.50	1.43	19.09
Oysters	-1.95	.25	50.22
Menhaden	-3.10	1.39	65.82
Tuna	3.43	2.50	8.77
Flounder	3.85	1.76	12.97

SOURCE: Frederick W. Bell, The Factors Behind the Different Growth Rates of U. S. Fisheries. Working Paper No. 13, Bureau of Commercial Fisheries, United States Department of the Interior, 1969. p. 7.

[2]Frederick W. Bell, The Factors Behind the Different Growth Rates of the U. S. Fisheries. Working Paper No. 13, Bureau of Commercial Fisheries. United States Department of the Interior, (Washington, D. C., 1969), p. 7.

Prices for fish, and particularly shrimp since 1950 have increased considerably. Retail shrimp prices, for example, have increased 72 percent since 1950 while the total fish price index showed a 37 percent gain. Shellfish consumption in addition, has risen from 1.6 pounds per capita in 1946 to 2.6 pounds in 1965. Of the one pound increase, approximately one-half is shrimp.[3] The rapid growth of shrimp prices accompanied by increased per capita consumption indicates strong increases in the demand for shrimp since 1950.[4] An increase in domestic demand at a more rapid rate than domestic supply has increased the ex-vessel price for fresh shrimp and has made the United States market attractive for foreign shrimp and shrimp products. Rising ex-vessel prices have also stimulated investment by firms in shrimp fishing vessels. Ex-vessel price is the dockside price paid the vessel owner for fresh shrimp. The only processing that has occurred is the heading process (removal of the head and thorax) and has been accomplished by the vessel's crew while at sea.[5]

Texas plays a major role in the United States fishery industry. Shrimp, the most valuable domestic fishery, constitutes the major commercial fishery product in the state. Texas has consistently been the primary shrimp-producing state in the nation. The exception occurred in 1969 when Louisiana shrimp landings led all five Gulf states.

Preliminary figures for five Gulf states for 1969 indicated a shrimp catch of 129.8 million pounds. Table 25 shows the annual volume of shrimp landed from 1964-1969 for the five states bordering the Gulf of Mexico.

After the record catch in 1967 of 64.2 million pounds, Texas showed decreases in 1968 and 1969. With shrimp landings of 44.5 million pounds in 1969, Texas landings comprised 34 percent of the total landings in the states bordering the Gulf of Mexico. Brown shrimp account for the greater portion of the shrimp catch on an annual basis and the greatest concentration of brown shrimp are found off the Texas coast in an area extending below Freeport south to Brownsville. Diminishing catches of brown shrimp in 1968 and 1969 were the main factor for reduced shrimp landing in these years in Texas.

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[3]Donald P. Cleary, Demand and Price Structure for Shrimp, Working Paper No. 15, Bureau of Commercial Fisheries, United States Department of the Interior, (Washington, D. C., 1969), p. 3.

[4]Ibid., p. 7.

[5]Victor Arnold, An Analysis to Determine Optimum Shrimp Fishing Effort by Area, Working Paper No. 40, Bureau of Commercial Fisheries, United States Department of the Interior, (Washington, D. C., 1970), pp. 1 and 3.

TABLE 25

GULF SHRIMP LANDINGS BY STATE
1964-1969

STATE	HEADS-OFF WEIGHT (Million Pounds)					
	1964	1965	1966	1967	1968	1969*
Florida	27.9	27.1	21.3	17.8	20.2	17.6
Alabama	4.6	6.0	6.6	9.0	9.6	9.4
Mississippi	4.0	5.2	4.7	6.0	6.3	5.5
Louisiana	38.1	39.8	39.6	47.5	42.8	52.8
Texas	41.6	48.3	43.8	64.2	52.3	44.5
TOTAL	116.2	126.4	116.0	144.5	111.2	129.8

* Preliminary

SOURCE: Shellfish Situation and Outlook, April, 1970, Bureau of Commercial Fisheries, U. S. Department of the Interior, Washington, D. C.

Diversity of species, pounds and value of finfish and shellfish, produced in Texas in 1967 and 1968 are indicated in Table 26. Finfish and shellfish landed in 1967 were 138,227,000 pounds with an increase to 147,720,900 pounds in 1968. Values were $49,721,579 and $49,549,627 in 1967 and 1968, respectively.

Analysis of the Texas Fishing Industry requires assessment of the location and internal structure of the production, processing and mass distribution components of the industry. These general activities are encompassed by the following Standard Industrial Classification (S.I.C.) numbers and categories.

S.I.C. Number	Category
0912	Finfish
0913	Shellfish
0919	Miscellaneous Marine Products
0989	Fish Hatcheries, Farms and Preserves

TABLE 26

POUNDS AND VALUE OF TEXAS CATCH OF FINFISH AND SHELLFISH
1967 AND 1968

SPECIES	1967 POUNDS	1967 VALUE	1968 POUNDS	1968 VALUE
FINFISH				
Buffalofish	47,000	$ 6,580	---	$ ---
Cabio(Ling)	8,600	989	23,900	2,886
Catfish and Bullheads	5,200	1,560	---	---
Croaker	134,200	8,503	138,600	5,823
Drum:				
Black	1,061,600	132,702	677,400	87,054
Red (Redfish)	767,500	192,703	924,900	215,469
Flounders (Unclassified)	244,700	62,264	336,200	75,438
Garfish	52,000	2,600	---	---
Groupers	76,100	8,540	93,000	9,646
Jewfish	200	25	---	---
King Whiting (Kingfish)	158,800	9,216	119,900	6,116
Menhaden	23,019,900	262,427	51,073,400	674,242
Mullet	27,800	1,420	27,500	1,437
Pompano	5,400	2,495	4,000	1,811
Sea Catfish (Gafftopsail)	106,200	9,762	73,800	5,679
Sea Trout:				
Spotted	1,520,900	371,239	1,871,300	419,150
White	43,600	4,378	20,000	2,043
Sheepshead (Salt-Water)	199,200	17,809	193,000	16,312
Snapper, Red	1,408,600	462,473	1,127,500	366,843
Spanish Mackerel	200	23	3,000	331
Warsaw	9,500	1,144	7,400	866
Unclassified:				
For Food	187,000	11,472	194,800	10,519
For Bait, Reduction, and Animal Food	77,600	2,206	79,000	3,287
TOTAL FINFISH	29,161,800	$ 1,572,530	56,988,600	$ 1,904,952

TABLE 26 (Continued)

POUNDS AND VALUE OF TEXAS CATCH OF FINFISH AND SHELLFISH
1967 AND 1968

SPECIES	1967 POUNDS	1967 VALUE	1968 POUNDS	1968 VALUE
SHELLFISH				
Crabs, Blue	2,624,800	222,702	4,083,600	329,253
Oysters	3,553,000	1,570,181	3,302,000	1,444,614
Shrimp (Heads-on):				
Brown and Pink	92,989,700	41,383,348	63,951,200	35,713,553
White	9,884,700	4,971,481	19,206,600	10,130,009
Other	1,300	318	177,700	26,023
Squid	11,700	1,019	11,200	1,223
TOTAL SHELLFISH	109,065,200	$48,149,049	90,732,300	$47,644,675
GRAND TOTAL	138,227,000	$49,721,579	147,720,900	$49,549,627

SOURCE: Texas Landings, 1968, Bureau of Commercial Fisheries, U. S. Department of the Interior, Washington, D. C. and Texas Parks and Wildlife Department, Austin, Texas.

S.I.C. Number	Category
2031	Canned and Cured Fish and Sea Foods
2032	Canned Specialties
2036	Fresh or Frozen Packaged Fish and Sea Foods
5046	Fish and Sea Foods, Wholesale Distribution
5421	Fish (Sea Food Markets), Retail

The following sections will assess the bio-economic factors influencing the Texas Fishery industry and its impact on the Texas economy.

2. Locational Structure and Bio-Economic Factors Influencing Texas' Major Fishery Activities

Analysis of Texas' commercial fisheries is fundamentally a study of the shrimping industry which accounts for more than 90 percent of the total state activity. Economic analysis of the fishing industry in general is complicated by the open access, mobility, life cycle and seasonality characteristics of the resource.

Shrimp constitute a common property resource element of the Gulf. No user has exclusive rights to the resource nor can he prevent others from sharing in its exploitation.[5] Legal exclusion, however, of foreign producers is enforced over a 12-mile fishing zone from the United States coast. Mobility of fish population and the attendant daily requirement for search time constitute other unique factors in the fishing industry. Most of the fish produced are caught on the continental shelf.

Before 1950, shrimp fishing was concentrated in the northern Gulf of Mexico in sounds, bays, bayous and adjacent coastal waters of the Gulf States out to a distance of ten miles. Following discovery of distant offshore shrimp fishing grounds after 1950, the Gulf fishery extended from the Florida Keys around the Gulf Coast of the United States and Mexico to the eastern tip of the Yucatan Peninsula.[6] The expansion of these fishable areas also had two major effects on the spatial distribution of the shrimp industry: (1) Shrimp fleets located at new port sites and the competition among individual producers exploiting inshore waters eased; (2) Competition for mobile fish populations intensified at distant sites which, in turn, shifted investment patterns from smaller to larger vessels that were physically capable of fishing for extended periods of time and generally increasing per vessel landings.[7]

The 1,080 mile Texas coastline is characterized by large estuaries and lagoon areas critical for post-larval shrimp growth during their lifecycle. Shrimp use the lagoon areas and estuaries for food and shelter before returning to deeper waters in the Gulf. These areas supply much of the young shrimp produced off Texas annually.

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[5] H. Scott Gordon, "The Economic Theory of a Common Property Resource: The Fishery," Journal of Political Economy, Vol. 62, (April, 1954), pp. 124-142.

[6] Arnold, op. cit., p. 3.

[7] Ibid., p. 5.

Figure 16 indicates the spatial distribution of shrimp landing points and fishing areas in the Gulf of Mexico.[8] The greatest concentrations of brown shrimp occur off the central and lower coast of Texas. White shrimp occur in greatest quantities in an area extending from Freeport northward along the coast to New Orleans. Pink shrimp concentrations are located off the central and lower coast of Texas, Florida's Dry Tortugas and Mexico's Campeche Banks.

Table 27 lists the major estuarine and lagoon regions of Texas and shows the comparative value of finfish and shellfish caught for each region for 1967 and 1968. Also shown are the value of catches from the Gulf of Mexico; the area outside the estuarine and lagoon habitats. The comparative values clearly indicate that although the estuaries and lagoons are important as nurseries for young shrimp, the dominant catches of mature shrimp occur outside of these regions in the deeper Gulf waters.

Table 28 gives the volume and value of shrimp landed in Texas by month in 1968. The cyclical aspect of shrimp harvesting varies among the species and it is this seasonality which makes shrimping a year around business. In 1968, the greatest landings of brown shrimp occurred from July through October; pink and Brazilian shrimp landings were greater in the period of February through May; and white shrimp mainly were harvested from August through November. Of the total volume of shrimp landed in Texas in 1968, brown shrimp comprised over 70 percent of the total volume.

Vessels from Texas ports now roam all known fishing grounds over the Gulf of Mexico, in the Carribean and off South America. The spatial distribution of major shrimp landing points and the 1969 landings and value of landings are shown in Figure 17. The figure shows the importance of the marine growth core areas in Primary Marine Regions I and II as primary shrimp production landing points.

Table 29 shows the volume and value of shrimp landed in Texas in 1968 for Primary Marine Regions I and II, including a geographical break-out by county and by city. Volume and value of shrimp landings in Marine Region II were more than double those in Marine Region I in 1968. In Marine Region II, combining Brownsville and Port Isabel shrimp landings reflect the importance of these two areas. With over 18 million pounds of shrimp landed worth $17.9 million, the two cities are focal centers of fisheries activities. Both Table 29 and Figure 17 indicate that the major portion of shrimp landings are located in Primary Marine Region II.

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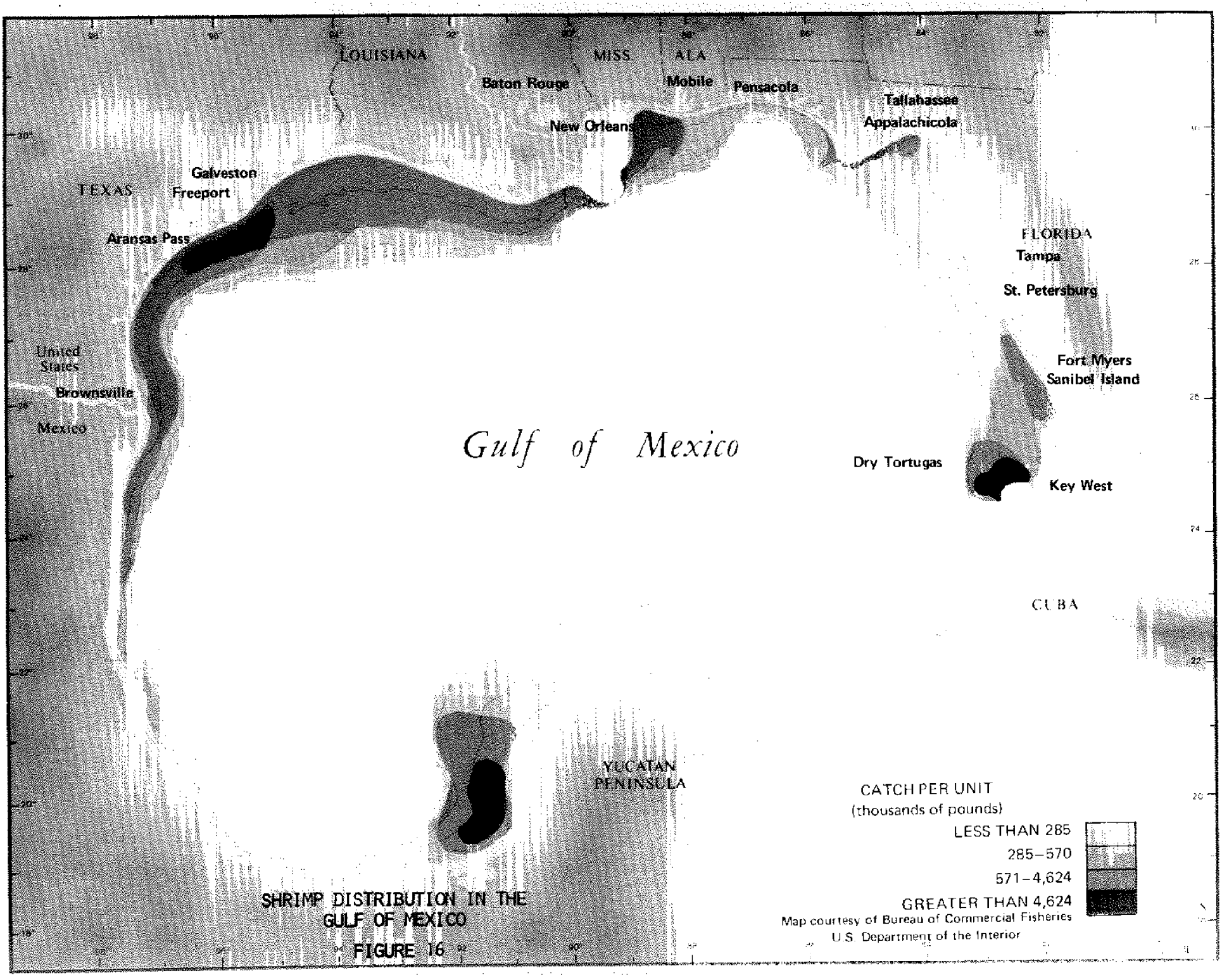
[8] Gulf of Mexico Shrimp Atlas, Bureau of Commercial Fisheries, U. S. Department of the Interior (Washington, D. C., 1969), p. 5.



SHRIMP DISTRIBUTION IN THE GULF OF MEXICO

FIGURE 16

TABLE 27

REGION AND VALUE OF TEXAS CATCH OF FINFISH AND SHELLFISH
1967 AND 1968

REGION	FINFISH		SHELLFISH	
	1967	1968	1967	1968
Gulf of Mexico	$ 847,888	$1,194,611	$44,612,969	$42,524,527
Sabine Lake	8,167	11,661	72,375	97,822
Galveston and Trinity Bays	115,585	65,663	1,962,741	2,573,317
Matagorda, East Matagorda and Lavaca Bays	63,409	95,563	701,041	1,046,413
San Antonio, Mesquite, Espiritu Santo Bays and Green Lake	60,811	36,933	479,585	485,488
Aransas and Copano Bays	58,110	91,560	158,640	640,694
Corpus Christi and Nueces Bays	43,332	21,205	160,394	228,827
Baffin Bay and Upper Laguna Madre	177,661	150,802	---	46,312
Central and Lower Laguna Madre	159,827	236,954	1,304	1,275
TOTAL	$1,534,790	$1,904,952	$48,149,049	$47,644,675

SOURCE: Texas Landings, Respective years, Bureau of Commercial Fisheries, U. S. Department of the Interior, Washington, D. C. and Texas Parks and Wildlife Department, Austin, Texas.

TABLE 28

POUNDS AND VALUE OF MONTHLY LANDINGS OF SHRIMP IN TEXAS FOR 1968*

MONTH	SHRIMP (HEADS-OFF)							
	BROWN		PINK AND BRAZILIAN[1]		WHITE[2]		TOTAL	
	POUNDS	VALUE IN DOLLARS	POUNDS	VALUE IN DOLLARS	POUNDS	VALUE IN DOLLARS	POUNDS	VALUE IN DOLLARS
January	1,175,200	$ 1,086,645	272,400	$ 247,528	162,600	$ 106,074	1,610,200	$ 1,440,247
February	1,342,200	1,300,499	605,200	557,111	82,900	35,327	2,030,300	1,892,937
March	802,200	864,574	352,200	313,909	182,500	108,483	1,336,900	1,286,966
April	900,700	987,560	481,500	453,079	321,100	300,384	1,703,300	1,741,023
May	1,184,900	1,226,246	363,600	366,077	437,100	530,909	1,985,600	2,123,232
June	1,828,100	1,451,053	219,200	200,689	307,600	379,272	2,354,900	2,031,014
July	8,414,600	5,273,253	26,200	23,439	350,600	445,955	8,791,400	5,742,647
August	7,672,700	6,377,811	---	---	1,429,300	911,818	9,102,000	7,289,629
September	4,437,000	4,486,455	1,300	1,092	3,108,100	2,307,713	7,546,400	6,795,260
October	4,150,300	4,639,151	1,600	1,630	3,625,800	2,933,697	7,777,700	7,574,478
November	3,220,600	3,475,701	170,200	172,996	1,936,800	1,394,875	5,327,600	5,043,572
December	1,912,100	2,008,625	215,600	208,760	629,900	691,195	2,757,600	2,908,580
TOTAL	37,040,600	$33,177,573	2,709,000	$2,546,310	12,574,300	$10,145,702	52,323,900	$45,869,585

[1]Includes 11,500 pounds of Royal Red shrimp valued at $10,330.

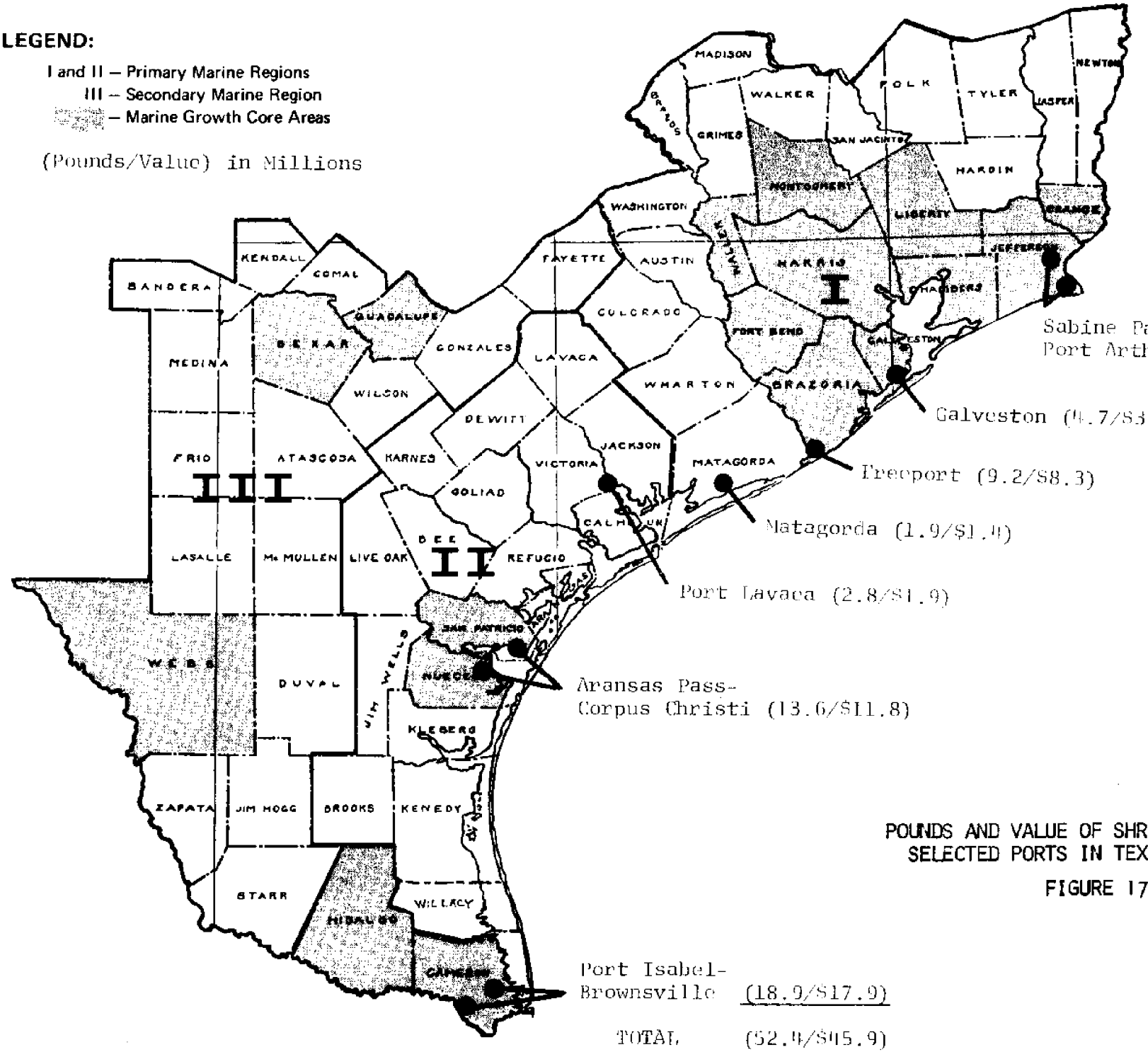
[2]Includes 102,500 pounds of Seabobs valued at $15,693.

SOURCE: Texas Landings, 1968, Bureau of Commercial Fisheries, U. S. Department of the Interior, Washington, D. C.

LEGEND:

I and II — Primary Marine Regions
III — Secondary Marine Region
— Marine Growth Core Areas

(Pounds/Value) in Millions



POUNDS AND VALUE OF SHRIMP LANDED AT SELECTED PORTS IN TEXAS FOR 1968

FIGURE 17

TABLE 29

VOLUME AND VALUE OF SHRIMP
LANDED IN TEXAS FOR 1968*

MARINE REGION	COUNTY	LOCATION	POUNDS	VALUE
PRIMARY MARINE REGION I				
	Brazoria	Freeport	9,171,700	$8,295,814
	Galveston	Galveston	3,190,400	$2,640,225
	Galveston-Harris	Baytown Kemah Port Bolivar San Leon Seabrook	1,562,000	$1,136,805
	Jefferson	Port Arthur Sabine Pass	1,305,500	$ 791,844
	Matagorda	Matagorda Palacios	1,867,100	$1,447,023
REGION I TOTAL			17,096,700	$14,311,711
PRIMARY MARINE REGION II				
	Aransas and Nueces	Aransas Pass Corpus Christi Fulton Beach Rockport	13,611,500	$11,742,920
	Calhoun	Port Lavaca Port O'Connor Seadrift	2,749,600	$1,876,053
	Cameron	Brownsville	8,598,000	$8,002,902
		Port Isabel	10,268,100	$9,935,999
REGION II TOTAL			35,227,200	$31,557,874
MARINE REGIONS I AND II GRAND TOTAL			52,323,900	$45,869,585

*Heads-Off Shrimp
SOURCE: Texas Landings, 1968, Bureau of Commercial Fisheries, U. S. Department of Interior, Washington, D. C.

These location structures and scales of activity represent major indicators of the overall economic impact of the Texas fishery. Special attention, however, must be given to the Texas shrimping fleet to provide a sound understanding of the importance of this industry. Discussed in the following sections are characteristics of the shrimping fleet and the overall direct economic impact for production, processing, and wholesale-retail trade of the fisheries activities in Texas.

3. General Structural Aspects of the Texas Shrimping Fleet

Shrimping constitutes an industry where entry can occur with a medium sized investment but where skill of the boat captain and sustained efforts by the entire crew are sensitive criteria in the success or failure of the operation. The total fishing effort offshore Texas includes both Texas and non-Texas based fleets that follow the seasonal pattern and mobility of the shrimp. Most of the non-Texas boats come from Florida and vary in size, crews, and in on-board capabilities.

Table 30 shows the designated home ports and number of shrimp vessels operating off the Texas Gulf Coast in 1967. Statistics indicate that 833 shrimp vessels from the other four states bordering the Gulf of Mexico operated off the Texas coast and 1,669 Texas shrimp vessels were operational. Total shrimp vessels active in the Gulf of Mexico in 1967 were 2,502.

Personnel figures vary, but the average shrimp vessel is operated by three men: captain, rigger and header. With 2,502 vessels reported, a conservative estimate can be made that employment in shrimp vessels in the Gulf of Mexico was 7,506 in 1967.

Table 31 gives detailed data for Texas shrimp vessels for 1967. Included are vessels categorized by length, shrimp landings (volume and value) and tonnage. In 1967, a total of 1,669 shrimp vessels were reported and the average shrimp landing per vessel was 46,204 pounds worth $34,279. Average shrimp vessel tonnage was 60.6 tons and the average vessel length for all vessels was 57.3 feet. Using the previously mentioned ratio of three men per vessel, it can be estimated that Texas shrimp vessel employment was 5,007 in 1967.

Size expansion in shrimp vessels tend to provide economies of scale to the shrimper as greater areal-search flexibility and boat capacity are achieved. In addition to greater mobility and more "working time" on the various shrimping grounds, these ships contain larger storage and freezing capabilities. Large vessels may spend more days at sea per year, be more productive per day and receive

TABLE 30

HOME PORTS OF SHRIMP VESSELS
OPERATING OFF THE TEXAS GULF COAST IN 1967

STATE	COUNTY/ PARISH	NUMBER OF VESSELS
ALABAMA		
	Baldwin	2
	Mobile	67
	TOTAL	69
FLORIDA		
	Monroe	138
	Collier	2
	Lee	216
	Hillsborough	203
	Franklin	9
	Escambia	2
	Charlotte	2
	TOTAL	572
LOUISIANA		
	Jefferson	12
	Lafourche	68
	Terrebone	23
	St. Mary	50
	Vermillion	25
	Cameron	12
	TOTAL	190
MISSISSIPPI		
	Jackson	1
	Harrison	1
	TOTAL	2
TEXAS		
	Jefferson	49
	Galveston	177
	Harris	105
	Brazoria	276
	Matagorda	50
	Calhoun	38
	Aransas	435
	Nueces	71
	Cameron	468
	TOTAL	1,669

FIVE STATE GRAND TOTAL OF VESSELS -- 2,502

SOURCE: Bureau of Commercial Fisheries, U. S. Department of the Interior, Galveston, Texas.

TABLE 31

TEXAS SHRIMP VESSEL DATA FOR 1967

CATEGORY	VESSEL LENGTH BELOW 60 FT.	60-70 FT.	OVER 70 FT.	TOTAL
Number of Vessels	792	813	64	1,669
Shrimp Landed (lbs.)*	26,159,499	46,710,061	4,244,513	77,114,073
Average Landing				
Per Vessel (lbs.)	33,029	57,453	66,320	
All Vessels (lbs.)				46,204
Value of Shrimp Landed	$18,701,505	$35,207,682	$3,302,719	$57,211,906
Average Value				
Per Vessel	$ 23,613	$ 43,305	$ 51,605	
All Vessels				$ 34,279
Vessel Tonnage				
Average Vessel	39.7	76.6	117.1	
Average All Vessels				60.6
Vessel Length (Ft.)				
Average Vessel	49.1	64.0	74.9	
Average All Vessels				57.3

* Heads Off

SOURCE: Bureau of Commercial Fisheries, U. S. Department of the Interior, Galveston, Texas, and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

higher prices on the average.[9] These factors also generate potential externalities. For example, vessel fishing a particular portion of a fishing ground immediately subsequent to another large-sized vessel is a case in which an externality is being absorbed by the second vessel incurs additional costs per unit of catch because of the

[9]Frederick W. Bell, "The Relation of the Production Function to the Yield on Capital for the Fishing Industry," Recent Developments and Research in Fisheries Economics. Edited by F. W. Bell and J. E. Hazelton (Dobbs Ferry, N. Y.; Oceana Publications, Inc., 1967), p. 114.

decrease in the available fish supply caused by the first vessel's effort.[10] External economics can result from the improvement in port facilities by cooperatives that are organized to handle the new scale of activity. Size expansion consequently has numerous linkage effects on the industry.

The 1,669 vessels comprising the Texas shrimp fleet have a fixed asset value in excess of $133 million, and annual construction of new shrimp vessels in the Gulf states steadily adds to the shrimp fleet. Shrimp vessel construction in the Gulf of Mexico for the past three years has totaled 1,120 vessels of which 441 have been constructed in Texas. Table 32 gives the total number of new shrimp vessels built in Texas, estimated construction costs per running foot and per vessel and total estimated value of new shrimp vessel construction in Texas from 1967 to 1969.

TABLE 32

CONSTRUCTION AND ESTIMATED VALUE
OF NEW SHRIMP VESSELS IN TEXAS*
1967-1969

YEAR	NUMBER OF VESSELS	ESTIMATED CONSTRUCTION COSTS		
		PER RUNNING FOOT	PER VESSEL (AVERAGE LENGTH 60 FEET)	TOTAL ESTIMATED VALUE
1967	129	$1,200	$72,000	$ 9,288,000
1968	162	1,300	78,000	12,636,000
1969	150	1,400	84,000	12,600,000

* Steel vessels

SOURCE: Bureau of Commercial Fisheries, U. S. Department of the Interior, Galveston, Texas and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

[10] Arnold, op. cit., p. 9.

Financial support for shrimp vessel construction and maintenance in Texas has been provided by the federal government through two programs: The Fisheries Loan Fund and the Federal Fishing Vessel Mortgage and Loan Insurance Program. Both programs are designed to strengthen the domestic fishing industry. Table 33 indicates cities in Texas where funds were furnished and the number and amount of fishery loans and insurance mortgages awarded since the programs were implemented. Aransas Pass and Brownsville rank as the major beneficiaries of the federal assistance programs with total loan and mortgage amounts of $2,786,790 and $2,357,361 respectively. Shrimp vessel owners in Freeport have received $835,985 and $871,900 has been distributed to other cities along the coast of Texas.

TABLE 33

FEDERAL FISHERIES LOANS AND INSURANCE MORTGAGES
FOR SHRIMP VESSEL OWNERS IN TEXAS
March, 1970

CITIES	FISHERIES LOANS		INSURANCE MORTGAGES		TOTAL AMOUNT
	NUMBER	AMOUNT	NUMBER	AMOUNT	
Brownsville	26	$ 623,276	29	$1,734,085	$2,357,361
Aransas Pass	14	278,399	40	2,508,391	2,786,790
Freeport	18	266,538	N.A.	569,447	835,985
Other Cities	27	748,175	N.A.	123,725	871,900
TOTAL	85	$1,916,388	69	$4,935,648	$6,852,036

N.A. - Not Available

SOURCE: Branch of Loans and Grants, Bureau of Commercial Fisheries, U. S. Department of the Interior, Washington, D. C.

Another new component of the shrimping industry has been from commercial fish farming. With a relatively flat coastal plain merging into the estuaries and lagoons of the Gulf of Mexico, the land area of the Texas coast requires minimal physical changes to provide ponds for shrimp raising and catfish production. Although shrimp are not being grown for commercial sales today, a number of agencies are conducting experiments to determine if shrimp can be raised as a commercial crop.

Bureau of Commercial Fisheries personnel have been researching the dynamics of shrimp growth and reproduction for years. Biologists of the Texas Parks and Wildlife Department conduct periodic surveys to determine population densities, survival rates, migrations and habitat requirements. Several shrimp ponds have been developed in the Angleton area under the Sea Grant Program of Texas A&M University to determine the feasibility of commercial shrimp farming. Although much additional research is needed before shrimp can be farmed for commercial purposes, the potential rewards appear to be promising. Future food production from commercial shrimp farming may make an important contribution to the needs of our growing population.

Several other innovations recently introduced indicate that shrimping vessels and their operations may benefit from the application of new technologies. The venerable wooden shrimp vessel is giving way to vessels constructed of steel. Although steel vessels cost approximately 25 percent more than wooden vessels to build, the original disadvantage is overcome through the long term advantages of longer vessel life, lower insurance costs, and reduced maintenance and repair costs. Other manufacturers are bidding for a future share of the shrimp vessel market by introducing vessels built of aluminum, ferro-concrete and fiberglass-reinforced plastic.

Another innovation is the experimentation and testing of electrified trawls to increase shrimp catches. Development of an electric shock to force shrimp from burrows upward into nets is promising, but much testing remains before such a technique can be classified as an effective method worthy of use by the shrimping industry.

Catfish are now being produced in Texas. A recent survey reported that 128 individuals were raising commercial catfish on approximately 3,500 acres. Most of the commercial operations are located in two areas: Winnie and Sinton, Texas. Forty producers sell fingerlings for restocking, 21 operators sell broodstock and 62 catfish farmers sell to the markets.[11]

With average prices for live catfish ranging from 35 to 40 cents per pound and processed fish from 75 cents to 85 cents per pound, industry is being attracted by the profit potential. Currently, Dow Chemical Company at Freeport is conducting intensive research in catfish farming through a 1,900-acre lake fed by fresh water from the Brazos River. Anticipated production for the first catfish crop by Dow is estimated to be approximately 48,000 pounds. An estimated two million pounds of fish would need to be produced before a processing plant would be economically feasible.

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[11] Fishing Gazette, Vol. 87, No. 5, (New York, May, 1970), p. 108.

4. Direct Economic Impact of Fisheries in Texas

Fishing activity includes the production, processing and wholesale and retail trade activities. Previous sections of this chapter have emphasized the production aspect of fishing. To arrive at the direct employment and sales impact of the commercial fisheries activities in Texas, an understanding of the processing and distribution activity is necessary.

Fish processing in Texas indicates the close relationship between volume and value of species caught in the Gulf of Mexico. In effect, an analysis of shrimp processing is an analysis of fisheries processing in Texas.

In 1968, 163 firms reported fishery processing activities in the Texas Primary Marine Regions: 81 firms in Marine Region I and 82 firms in Marine Region II.[12] Table 34 gives the number and location of firms processing fishery products in Texas in 1967 and 1968. With 43 firms operating, Cameron County led all other counties in 1968, followed by Galveston and Aransas Counties, respectively. Fishery processing plants in Texas are located at Palacios, Brownsville and Sabine Pass.

A concise overview of species processed by the 163 firms and the comparative value accruing for 1967 and 1968 is presented in Table 35. The magnitude of the value of shrimp processing is evident with shrimp constituting 93 percent of the total fisheries value in 1967 and 92 percent in 1968. From 1967 to 1968, value of shrimp processing declined for fresh and frozen raw headless, peeled and deveined and other processed shrimp while breaded shrimp increased in value by over $2.5 million. Preliminary figures from the Bureau of Commercial Fisheries for 1969 indicate a valuation for fisheries processing in Texas of $81.2 million with peak employment of 5,464 for 157 processing firms.

As the cycle of processing fishery products is completed, distribution of these products becomes paramount. As might be expected, most wholesale dealers in fishery products are located in close proximity to the processing firms. A total of 152 wholesale dealers were in business in the study area in 1968. Brownsville, with 22, had the greatest number of wholesale dealers, followed by Freeport with 14 firms and Port Isabel with 13 firms.

In addition, 29 operations were categorized as cold storage warehouses for fishery products in Texas. Amarillo, Austin and Fort Worth each had a facility, Dallas had three warehouses and the remaining 23 warehouses were located in the Texas Marine Region.

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[12] Annual Processed Fishery Products Report, Bureau of Commercial Fisheries, U. S. Department of the Interior (Galveston, Texas, 1968).

TABLE 34

NUMBER AND LOCATION OF FIRMS
PROCESSING FISHERY PRODUCTS IN TEXAS
1967 and 1968

MARINE REGION	COUNTY	LOCATION	NUMBER OF FIRMS 1967	1968
PRIMARY MARINE REGION I				
	Brazoria	Brazoria	1	1
		Freeport	13	13
	Chambers	Anahuac	3	2
		Smith Point	2	2
	Galveston	Crystal Beach	2	3
		Galveston	12	12
		Gilchrist	1	1
		Kemah	2	1
		Port Bolivar	6	5
		San Leon	4	3
		Texas City	1	1
	Harris	Baytown	2	2
		Houston	9	8
		Seabrook	6	6
	Jefferson	Beaumont	1	1
		Port Arthur	3	4
		Sabine Pass	5	4
	Matagorda	Matagorda	5	5
		Palacios	5	6
REGION I TOTAL			83	81
PRIMARY MARINE REGION II				
	Aransas	Aransas Pass	9	9
		Austwell	2	2
		Fulton	2	2
		Rockport	2	4
	Calhoun	Port Lavaca	7	8
		Port O'Connor	1	1
		Seadrift	3	3

TABLE 34 (continued)

NUMBER AND LOCATION OF FIRMS
PROCESSING FISHERY PRODUCTS IN TEXAS
1967 and 1968

MARINE REGION	COUNTY	LOCATION	NUMBER OF FIRMS 1967	1968
	Cameron	Brownsville	22	23
		Harlingen	4	4
		Port Isabel	15	16
	Hidalgo	McAllen	1	1
		San Carlos	1	1
	Nueces	Corpus Christi	3	3
		Flour Bluff	1	1
		Port Aransas	1	1
		Robstown	1	1
	San Patricio	Ingleside	1	1
	Willacy	Port Mansfield	1	1
REGION II TOTAL			77	82
MARINE REGIONS I AND II GRAND TOTAL			160	163

SOURCE: Bureau of Commercial Fisheries, U. S. Department of the Interior, Galveston, Texas.

TABLE 35

TEXAS FISHERIES PROCESSING DATA
1967 AND 1968

PROCESSING OF SPECIES	VALUE (F.O.B. PLANT) 1967	1968
Oysters, Shucked	$ 1,849,008	$ 1,752,406
Shrimp		
Raw Headless	41,161,861	34,694,842
Breaded	24,866,376	27,464,797
Peeled and Deveined	16,436,627	16,091,706
Other Processing*	3,107,881	2,000,370
	85,572,745	80,251,715
Other Species**	4,443,168	4,969,429
TOTAL	$91,864,921	$86,973,550

* Includes shrimp canned, peeled and cooked, salad mix and stuffed.

** Includes codfish, crabmeat, menhaden, breaded oysters and stuffed flounder.

SOURCE: Bureau of Commercial Fisheries, U. S. Department of the Interior, Galveston, Texas.

Fishery shipments from Texas for retail distribution and sales are nationwide with a major portion of the shipments concentrated in the midwest and southwest.

Direct employment and sales impact for 1969 of commercial fisheries activities in Texas is provided in Table 36. An estimated 5,233 persons were employed in fish catching in 1969 and total sales were more than $50 million. Processing firms employed 5,464 persons and generated more than $81 million in sales. Distribution activities employed 1,830 persons and generated more than $87 million in sales. Total estimated direct employment was 12,527 and total direct sales were $218.9 million for the fisheries industries in Texas in 1969.

TABLE 36

DIRECT EMPLOYMENT AND SALES IMPACT
OF THE FISHERIES INDUSTRIES IN TEXAS
1969

AREA	FISHERIES INDUSTRY	DIRECT EMPLOYMENT	DIRECT SALES
PRIMARY MARINE REGIONS I AND II			
	Fisheries Catch Operations*	5,233	$ 50,009,000
	Processing Firms	5,064	66,200,000
	Distribution: Wholesale and Retail	1,271	62,436,600
SECONDARY MARINE REGION III			
	Distribution: Wholesale and Retail	162	7,590,253
REST OF TEXAS			
	Processing Firms	400	15,000,000
	Distribution: Wholesale and Retail	397	17,745,100
FISHERIES TOTAL		12,527	$218,980,953

* Includes finfish, shellfish, shell dredging and live bait shrimp sales.

SOURCE: Bureau of Commercial Fisheries, U. S. Department of the Interior, Galveston, Texas and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

CHAPTER VI

MARINE RECREATION AND TOURISM

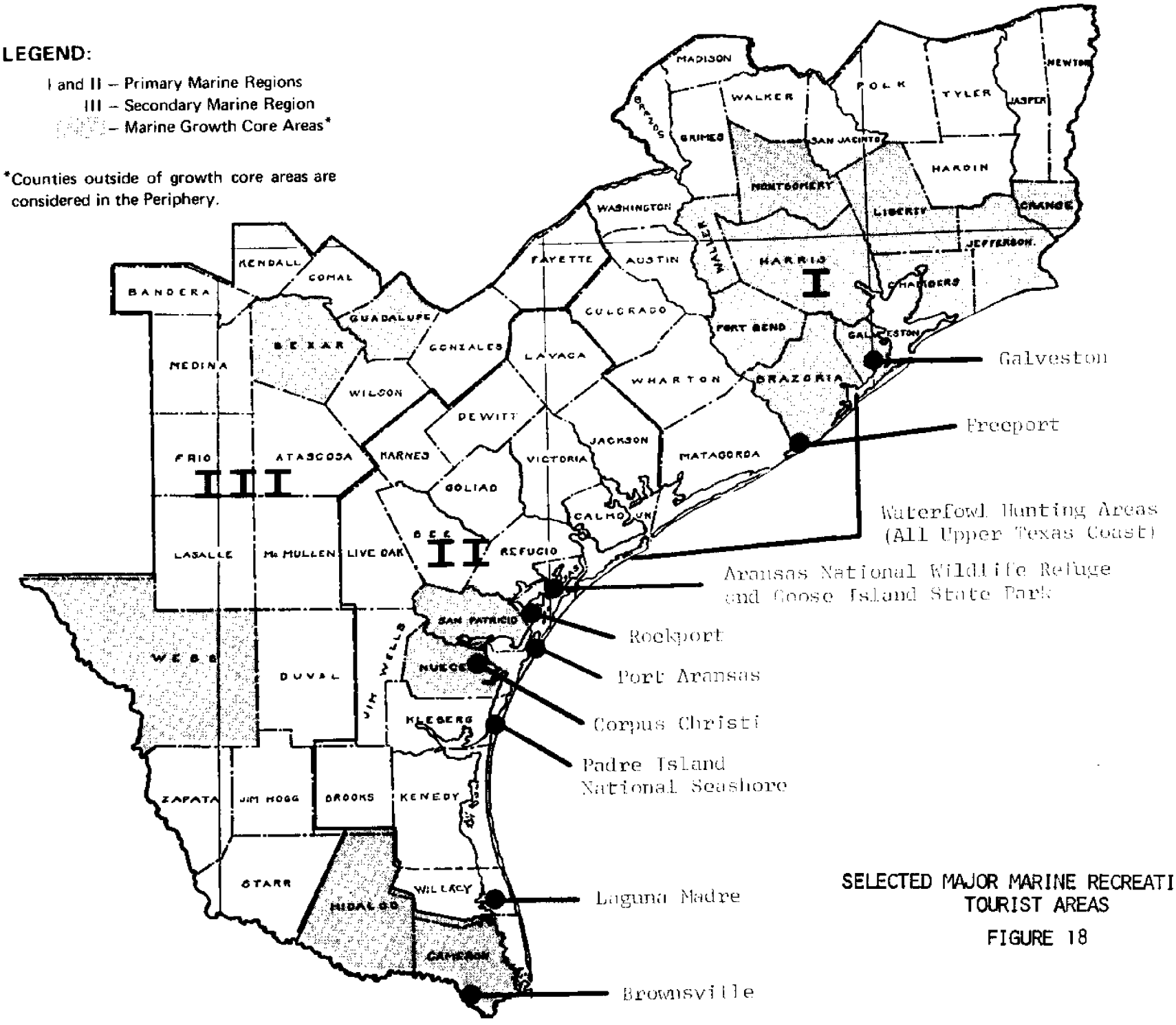
Increasing urbanization, leisure time, mobility and disposable income has stimulated a major role for marine recreation and tourism activities in the Texas economy. The influence of the Texas marine environment extends along the Gulf Coast and far into the mid-section of the United States. This section will provide a general economic analysis of marine recreation and tourism industries in Texas and indicate their interrelationships with the state's marine resources. Generalized estimates of marine impact will also be provided.

I. Recreation and Tourism in Texas: The Role of the Marine Environment

Recreation and tourism activities in Texas run into the billions of dollars annually. With more than 75 percent of the state's population living within a four and one-half hour drive from the coast and with large numbers of out-of-state tourists visiting coastal locations, the Texas marine environment clearly dominates much of the state's leisure-time activities.

Marine recreation and tourism activities constitute a vital part of the economic base of virtually all major urban and medium size communities along the Texas coast. The development of coastal recreation-oriented communities have absorbed most of the Gulf Coast recreational demand generated by the population concentrations in the southern half of Texas. Various marine recreational and tourism growth points can be identified along the Texas coast. The regional delineation of the Texas Marine Region as outlined in this report indicates the location of the marine recreation and tourism growth core points. The most prominent of the growth points are located near the major port cities. In Primary Marine Region I, they include Galveston Island, Freeport and Port Arthur; and for Primary Marine Region II at the Padre Island-Corpus Christi area, Port Aransas and Brownsville area. The location of these growth points and selected marine recreational sites are shown in Figure 18.

Although major marine recreation points are located near large coastal urban centers, several significant points are located in the underdeveloped coastal pockets or the periphery of the Texas Marine Region. In these rural and quasi-rural areas, marine recreation and tourism has been a major economic growth stimulus. In spite of some seasonal imbalance in marine recreation demand, these coastal communities in the periphery depend year-round on marine recreation



SELECTED MAJOR MARINE RECREATION AND TOURIST AREAS

FIGURE 18

and tourism activity for growth. Marine recreation offers a major economic opportunity for revitalization of certain rural areas of the country.[1]

The marine-related attractions along the Texas coast are highly diversified. Texas has 1,081 miles of shoreline and more than 301 miles of beach shoreline. The remainder of the coastal margin is bluff shore, 421 miles; marsh shore, 359 miles; public recreation areas, 5 miles; and restricted shore areas, 18 miles.[2] In addition, Texas has almost continuous offshore barrier islands paralleling the mainland shore. These barrier islands include Padre Island, Matagorda Island, Matagorda Peninsula, and St. Joseph's Island. Padre Island extends for 113 miles and is the longest barrier island in North America.[3] Eighty miles of the island are now used as a national seashore. With the exception of the Brazos Delta, the mainland is separated from the barrier islands by shallow coastal lagoons that vary in width from three to six miles.[4] The coastal beaches, bays, estuaries, the shallow coastal lagoons and the deeper Gulf of Mexico waters constitute major attractions along the Texas coast. Texas bays, attractive for sportfishing, include Galveston, Matagorda, San Antonio, Espirito, Copano, Lavaca, Aransas, Nueces, Corpus Christi, Baffin and the Laguna Madre.[5] Most of the popular recreational fishing bays are contiguous to Primary Marine Region II. Finfish for sportsfishing along the Texas coast include redfish, flounder, speckled trout and black drum.

The Texas coast is also prominent among coastal areas of the United States as a wintering ground for migratory birdlife. There are more than 1.8 million acres of wetlands in the gulf coastal area. Most of the wetlands above Matagorda Bay to Louisiana are marshed

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[1] Robert A. Harper, Theodore H. Schmudde and Frank H. Thomas, "Recreation Based Economic Development and the Growth Point Concept," Land Economics, Vol. 42, (February, 1966), pp. 95-101; and Warren C. Robinson, "The Simple Economics of Public Outdoor Recreation," Land Economics, No. 1, Vol. 63, (February, 1967), pp. 71-83.

[2] Shoreline Recreation Resources of the United States. Report of the Outdoor Recreation Resources Review Commission to the President and Congress, Report No. 4 (Washington, D. C., 1962), p. 131.

[3] Henry Berryhill, "The Coastal Margin: Its Nature and Uses," Law and the Coastal Margin. (College Station: Texas A&M University, Sea Grant Program, 1970), p. 17.

[4] The Report of the United States Study Commission - Texas, Part II, Resources and Problems. (Washington, D. C., 1962), p. 121.

[5] Ibid.

while the remaining wetlands are mostly sounds and bays containing water less than three feet deep. These areas of the Gulf Coast region contain more than 60 percent of the waterfowl habitat of the state. About 61 percent of the ducks and 80 percent of the geese wintering in the United States remain in the Primary Marine Region.[6]

Several national wildlife refuges are also located along the Texas coast. The Aransas National Wildlife Refuge (see Figure 18), is a seasonal sanctuary for many birds, including the rare whooping crane. Coastal areas under state supervision include Velasco, Brazos Island, Indianola, Port Isabel, Goose Island, and Mud Island state parks. A portion of Galveston Island has also recently been purchased for a state park facility. State owned coastal lands - the beach areas, the islands in coastal waters, the lands beneath the bays, inlets and other inland waters - total more than 1.5 million acres.

Marine recreation and tourism activities are unique in that they are resource based activities. Other types of outdoor recreation have been classified as user-oriented and intermediate recreation areas. User-oriented areas are like city parks or playgrounds; they are readily accessible to users. Intermediate areas are like state parks or federal reservoirs; they are within short distance and usually are smaller than typical resource based areas.[7] The opportunity to participate in these activities is provided by a mix of public and private entities that combined their inputs with the natural resource supply of the Gulf of Mexico. Both state and federal agencies operate parks and beaches. Private firms benefit from the input of the marine environment. Operators of beach hotels, motels, marinas, tourist cabins, bath houses, restaurants and the developments of coastal real estate exist because of the scale of marine recreation and tourism activities along the coast. Mobile home, pleasure boat and related dealers depend upon the attraction of the marine environment to some extent for their volume of activity.

Some of the Standard Industrial Classification numbers and categories that cover the major types of marine recreation and tourism activities along the coast include the following:

S.I.C. Number	Category
3799	Boat trailers
4459	Marine excursion boats
4469	Marinas, yacht basins

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[6] Ibid.

[7] Marion Clawson and Jack L. Knetsch, Economics of Outdoor Recreation, (Baltimore: The Johns Hopkins Press, 1966), pp. 37-38.

S.I.C. Number	Category
5591	Boat dealers
5592	Household trailer dealers
7011	Tourist cabins, camps, courts, motels, hotels
7021	Tourist homes
7032	Recreational camps, hunting camps
7949	Bath houses, bathing beaches, houseboat rentals, recreational associations, yacht clubs, rental of beach chairs and accessories

Other categories include marine-oriented construction, maintenance, beach supplies at sporting stores, and numerous activities interconnected with virtually all service and major portions of manufacturing activity on the Texas coast.

2. Demand Factors Influencing the Impact of Marine Recreation and Tourism Activities

The demand for marine recreation and tourism activities consists of a hybrid of economic and non-economic factors that include considerations of the price system along with aesthetic values. Coastal leisure time activities are not only unique because of their specialized marine resource input, but since consumption of marine recreation must occur at the site of the activity, marine recreation and tourism results in a more diversified array of product-demand factors. Joint production and joint demand are characteristic of the marine-related industries. The output of marine beach areas requires some "fixed" addition in output of marine facilities. The demand for offshore swimming creates a derived demand for sun tan lotion, beach blankets, chairs, and swim suits.[8] Demand for recreation along the Texas coast depends to a large extent on the following key factors:

a. Population (urban-non-urban ratio)
b. Disposable income
c. Leisure time available
d. Time-distance required to make the trip to marine recreation site (location) and quality of roads to sites
e. Mix of activities available at the site

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[8] Economic Studies of Outdoor Recreation. Study Report 24, Outdoor Recreation Resources Review Commission. (Washington, D. C., 1962) pp. 13-39.

f. Congestion and cleanliness at the site
g. Prices of recreation and tourism activities
h. The relative expenditures of close substitutes to marine recreation activity
i. Socio-economic factors such as occuption, education, age, and race
j. Growth in marine recreational technology
k. Aesthetic quality and visual beauty of sites
l. Complementary attractions proximate to marine recreational sites.

An urban-oriented source of population with no major water-recreational outlet other than a trip to the coast provides the basic demand of marine recreation and tourism facilities. Disposable income and leisure time have been found to be highly significant in influencing demand for various marine recreational forms.[9] The amount of leisure time or "discretionary time" available to pursue marine recreational activities results from either a reduction in the work week, increases in paid holidays, increases in paid vacations or increases in paid sick leave. Most of the leisure time gained since the turn of the century has been through shortened work weeks. As productivity of the labor force and wages have risen, part of the increase in income has been used to pursue more leisure time activities. The major coastal industries of petroleum refining, petrochemicals, metals fabrication, foods and related manufacturing activity have experienced some of the highest productivity rates in recent decades. The disposable income and discretionary time represented by the labor force are important sources of demand for recreation and tourism activities. The general rise nationwide in leisure time, however, is equally relevant to the local and non-local sources of demand for marine recreation and tourism activities.

The role of disposable income is particularly important in influencing derived demands for motorboats, sailboats, mobile home units in private marine-resort and community areas, and various types of swimming gear and supplies. An indication of the demand for pleasure boats, for example, is given in Table 37. The table indicates that Primary Marine Region I, the major population and industrial center on the Texas coast, registered more than 68,300 pleasure boats in 1969. This amounted to more than two-thirds of all pleasure craft in the Texas Marine Region.

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[9] Tourism and Recreation, Arthur D. Little, Inc., prepared for Economic Development Administration, U. S. Department of Commerce, (Washington, D. C., 1967); and An Econometric Model for Predicting Water-Oriented Outdoor Recreation Demand. Economic Research Service, U. S. Department of Agriculture. (Washington, D. C., 1969).

TABLE 37

BOATS REGISTERED IN THE TEXAS MARINE REGION
1969

TEXAS MARINE REGION	NUMBER OF PLEASURE BOATS	TOTAL NUMBER OF BOATS
Primary Marine Region I	68,362	71,936
Primary Marine Region II	16,678	18,408
Secondary Marine Region III	15,289	15,873
TOTAL	100,329	106,217

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

Table 38 provides an indication of the income group participation in boating in the United States for the 1964-1965 period. There is a high correlation between higher income groups and participation in boating activity.

TABLE 38

BOATING PARTICIPANTS BY FAMILY INCOME
IN THE UNITED STATES*
1964-65

FAMILY INCOME	PERCENT PARTICIPATING**
Under $3,000	10
$3,000-$6,000	25
$6,000-$8,000	31
$8,000-$10,000	41
$10,000-$15,000	45
$15,000-$25,000	50
$25,000 and over	34

* Persons 12 years of age or older.

** Includes sailing and motor boating.

SOURCE: "The 1965 Survey of Outdoor Recreation Activities" Bureau of Outdoor Recreation, Table H, October, 1967. U. S. Department of the Interior, Washington, D. C.

Outboard motor boat sales in Texas have averaged more than six percent of the national market.[10] Table 39 gives the occupations of purchasers of outboard motors in the United States by percent as derived from Bureau of Census data for 1959. With the largest demand for pleasure boats coming from skilled, clerical, professional and managerial workers, a strong correlation appears evident between higher income groups and outboard motor purchasers. With minor shifts, it is not unreasonable to assume that similar relationships persist today.

TABLE 39

OCCUPATIONS OF PURCHASERS OF OUTBOARD MOTORS IN THE UNITED STATES 1959

OCCUPATION	PERCENT OF EMPLOYED BUYERS
Professional	14.9
Managers, Proprietors	14.8
Clerical, sales	16.7
Skilled workers	29.6
Semi-skilled	11.2
Farmers	4.0
Service workers	7.1
Factory labor	1.7
TOTAL	100.0

SOURCE: Outboard Boating Club of America, Chicago, Illinois.

[10] Charles T. Clark, Recreational Boating in Texas. (Austin: Bureau of Business Research, The University of Texas, 1961). pp. 14-17.

The high popularity of house-trailers in the Texas Marine Region is indicated by the comparison of the percentage change from 1960 to 1969 in Table 40. House trailers are used extensively as permanent or seasonal homes. Percentage changes are compared to population growth changes. The demand for this type of low cost, mobile housing has increased more rapidly than the population growth which has remained relatively stable. Other major factors such as the high cost of conventional homes and high interest rates have also affected the move to mobile homes.

TABLE 40

PERCENTAGE CHANGE OF HOUSE-TRAILERS AND POPULATION BETWEEN 1965 AND 1969 IN STANDARD METROPOLITAN STATISTICAL AREAS OF THE TEXAS MARINE REGION

SMSA	PERCENT CHANGE			
	1960 to 1965		1965 to 1969	
	HOUSE-TRAILER REGISTRATION	POPULATION	HOUSE-TRAILER REGISTRATION	POPULATION
Beaumont-Port Arthur-Orange	59	2	186	3
Brownsville-Harlingen	- 16	- 6	84	- 2
Corpus Christi	28	1	75	5
Galveston-Texas City	114	10	183	5
Houston	50	14	141	16
Laredo	119	11	34	3
McAllen-Pharr-Edinburg	57	- 1	68	2
San Antonio	24	12	66	8
Total non-SMSA's	21	-24	80	1
Total Texas	19	8	104	7

SOURCE: Motor Vehicles Division, Texas Highway Department, Austin, Texas.

The demand for "second homes" and in turn the demand for coastal real estate, in Texas constitutes a more direct growth influence on marine recreation and tourism activities. Many of these second homes are yachts, cabin cruisers, and houseboats.[11] Boat owners are the prime market target for second homes and since Texas has the highest boats-per capita rate in the nation, the growth in second home coastal industries has risen rapidly. Coastal developers are investing several hundred million dollars in shoreline lots, homes, apartment dwellings and other forms of second homes. The most developed areas along the coast, which have been accomplished mainly by private investments, are located along the shoreline bays.

Out-of-state visitors to Primary Region II indicate the mix of activities, reasonable access to the site, climate, cleanliness, and the overall natural beauty of the site as major factors influencing demand for coastal marine recreation.[12]

Most of the out-of-state visitors come from California, Florida, Louisiana, Oklahoma, Missouri and Illinois. Their preferences for coastal marine recreation were ranked as follows:

a. Fishing and hunting
b. Climate
c. Swimming
d. Padre Island
e. Boating and sailing
f. Surfing
g. Scenery
h. Water skiing
i. Golf and tennis
j. Birds and wildlife.

Other desired activities include vacation home development, underwater recreation (glass bottom boats), sight-seeing, pleasure driving, local commercial entertainment, local industry attractions and use of local historical and archeological sites.[13]

As an indication of the demand for local area facilities, 55 percent of the visitors to Texas stayed at motels, 21 percent at private homes, 9 percent camped, 7 percent lived in trailers, 4 percent stayed at hotels and 4 percent elsewhere.

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[11]Brad Andrews, "Home Sweet Second Home," Texas Parade. (May, 1969) p. 15.

[12]Economic Background and Area Resources: Coastal Bend Region of Texas. Coastal Bend Regional Planning Commission, November, 1967.

[13]Clare A. Gunn, Texas Marine Resources: The Leisure View. (College Station: Texas A&M University Sea Grant Program, 1970) pp. 7-8.

As a major alternative use of land on the coastal margin, marine recreation and tourism activities often come in conflict with other land-use demands along the coast. The issue of competing uses of coastal land is significantly relevant to be discussed in a separate section.

3. Land-Use Conflicts and Marine Recreation and Tourism Activity

The value of location on or near the Texas coast is indicated by the multiple land-use requirements of alternative coastal industries. The problem of land-use conflicts between marine leisure oriented activities and other industries such as offshore oil and gas, shipbuilding, port and harbor activity, commercial fishermen, and other non-marine recreation-related activity stems from the similarity of their location requirements. The locational attributes of alternative sites along the Texas coast are attractive to both marine land developers and offshore service industries.

The low sloping coastal elevation is an important locational asset for ports and transshipment point locations. Coastal marshlands are usable for spoil disposal areas, marine hunting and fishing sites, or as wildlife preserve areas. Locations for the offshore mineral service and petrochemical industry particularly in the Primary Marine Region I exert strong demands for space along the coast. Oil refining and petrochemical activities desirous of locating away from air and water pollution conscious urban centers to relatively underdeveloped points near the coast (and new sources of raw materials) represent powerful competitors for coastal land.

Locational requirements for marine activities are more specialized. Unlike some competing users, the output of marine leisure time activity is not transportable in the sense that the product of offshore mining is moved to an intermediate production site onshore. Consumption and production occur at the same site and almost instantaneously. In these cases, the consumer need only have transportation access to shoreline sites. Public and private agencies provide consumers with the opportunity to participate in the activities (or flow of services) that essentially begin once the consumer decides what he will do at a site. The "price" of these public activities, consequently to the consumer would be activities he has foregone to utilize his time for marine recreation and the travel, food, and other basic costs incurred.

For activities developed for private consumption, such as motels, beach resorts, coastal housing developments and marinas, more conventional location factors emerge. These include proximity, the desire for privacy, and other leisure-oriented amenities. Tourist location theory emphasizes the mixed options facing consumers given their time, budget constraint, and the distance to sites. The

selection of the site visited as opposed to other similar sites depends upon the attributes of these sites.[14]

Major location factors for marinas, for example, are proximity to boat-owners' residence to minimize costs of travel and time, and the desire to cluster or locate near other marinas to take advantage of external economies. External economies result from the development of resources, roads, utility facilities, and a common labor market which can be shared among marinas.[15]

The resolution of these conflicts often requires litigation or cooperative agreements. In Corpus Christi Bay, oil companies are not allowed to drill any closer than one mile from shore and wells must be clustered in tracts.[16] Well-head structures must be well protected, freshly painted and lighted to protect nightime navigators. Possibly the most prominent example of cooperation between industry and marine recreation and tourism activities in the United States is the THUMS project off Long Beach, California. THUMS, formed by the first initials of Texas, Humble, Union, Mobil, and Shell, built four artificial islands around oil platforms off Long Beach. When viewed from shore, the islands appear to have slender apartment buildings with pastel balconies, hundreds of palm trees, slices of cylinders and cones, and lighted waterfalls at night come from these balconies.[17]

These unique considerations as to recreational location are important toward assessing the overall demand and demand impact. The following section will discuss the general economic impact of marine recreation and tourism activities on Texas.

4. Impact Analysis of Marine Recreation and Tourism Facilities and Activities

Information as to the impact of marine recreation and tourism activities includes data on state and federal beach and park areas, Texas Highway Department estimates of out-of-state tourists and

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[14] Edvin von Boventer, "Land Values and Spatial Structure: Agricultural, Urban and Tourist Location Theories," Regional Science Association Papers, Vol. XVIII, (1967), pp. 231-242.

[15] Gale H. Lyon, Dean F. Tuthill and William B. Matthews, Jr., Economic Analysis of Marinas in Maryland, (College Park: Agricultural Experiment Station, University of Maryland, (1969), p. 9.

[16] Robert Conwell, "Tourism in the Coastal Zone," Texas Marine Resources and the Sea Grant Program. (College Station: Texas A&M University, 1969), p. 69.

[17] Ibid., p. 69-70.

estimates from individual community reports along with survey information on particular S.I.C. recreation-oriented codes. Precise employment and sales impact figures are difficult to determine due to the transient nature of the expenditure flow and the nature of the expenditures such as clothing, foods, beverages and drugs and gasoline in the Texas Marine Region. Some general indicators of impact, however, can be obtained.

Both the local demand for marine-related recreation and tourism and the demand from out-of-state visitors (external demand) are extremely important to the Texas economy. More than 16.2 million out-of-state tourists spent over $1 billion in 1969.[18]

Eighteen percent of the visitors stated the "coastal area" or coastal cities as their destination. Assuming a constant ratio between percentage of tourists in Texas' coastal areas and level of expenditures, Table 41 shows that more than $190 million was spent by out-of-state visitors in coastal areas in 1969. The same percentage is assumed for 1964-1967 to provide an estimate of out-of-state tourist demand for coastal sites. Houston and San Antonio were listed as major attractions by out-of-state tourists. Corpus Christi officials estimated that tourism generated $135 million annually.

TABLE 41

NUMBER AND EXPENDITURES OF OUT-OF-STATE TOURISTS VISITING THE TEXAS COAST

YEAR	NUMBER OF TOURISTS	TOTAL EXPENDITURES
1964	2,116,260	$ 94,453,020
1965	2,283,840	110,366,640
1966	2,548,260	130,292,460
1967	2,735,640	145,434,960
1968	2,983,680	182,916,000
1969	2,925,000	190,800,000

SOURCE: Travel and Information Division, Texas Highway Department. Austin, Texas.

[18] Marine Resources Activities in Texas. (College Station: Texas A&M University, 1969) p. 111.

Approximately 700,000 persons visited the National Seashore at Padre Island in 1969 with 41,000 of these visitors being campers. This represented an increase of 50 percent from 1968.

State operated Goose Island, one of the more developed state parks, had 320,000 visitors in 1968. Lake Corpus Christi, in the area, had more than 714,000 visitors. Port Isabel registered 14,700 visitors. Most of these visitors were Texas area residents. The Wildlife Refuge areas along the coast also attracted more than 70,000 visitors in 1969. Assuming that an average of $10 was spent by each of these tourists and that an average of two days was spent at these sites, the direct expenditures generated by these public recreation points were more than $36 million in 1969. This does not include, however, monies generated by sportsfishing and related activities.

Total employment impact of all marine recreational activities is complicated by definitional problems in ascribing employment in various services activities as marine-recreation related. The fact that the marine influenced climate of the Texas coast draws tourists generates an intangible factor in ascribing precise figures. Only general estimates can be derived. Three general categories for employment and sales have been derived. They include marine services and tourist accommodations such as beach houses, motels, hotels and tourist cabins; marinas, excursion boats and yacht basins; and pleasure boat manufacturers and dealers and house trailer dealers. Table 42 shows that total direct employment generated by these activities was 3,985 in 1969 in the Primary Marine Regions. Total direct sales amounted to more than $55.5 million. These activities exclude the vast indirect impact on service industries located in the marine recreational points.

TABLE 42

DIRECT EMPLOYMENT IN SELECTED MARINE RECREATION AND TOURISM INDUSTRIES IN THE PRIMARY MARINE REGIONS
1969

CATEGORY	EMPLOYMENT	SALES
Marine Services and Tourist Accommodations[1]	2,500	$13,278,000
Marinas, Excursion Boats, Yacht Basins[2]	100	1,980,000
Boat Manufacturers and Dealers, House Trailers[3]	1,385	40,282,500
TOTAL	3,985	$55,540,500

[1]Includes S.I.C. 7011, 7949 (all contiguous coastal counties excluding Harris County).

[2]Includes identified firms in S.I.C. 4469 and 4459.

[3]Includes identified firms in S.I.C. 3732, 3799,5591, and 5592.

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

CHAPTER VII

OTHER INDUSTRIES

Previous chapters of this report have described the involvement and economic contribution of marine industries comprising offshore activities, marine transportation, fisheries and recreation and tourism. These activities are supplemented by other industries in Texas including Federal and state governmental departments and agencies, and academic and research institutions participating in marine-related activities.

Monies generated from these activities are dominated by investments from Federal sources. This chapter will provide an analysis of marine-related investments arising from Federal, state, academic and research institutions in Texas.

1. Role of the Federal Government in Marine-Related Activities in Texas

Five Federal departments have been identified as sponsors of marine-related research in Texas. These five departments -- Commerce, Defense, Interior, State and Transportation -- expended over $91 million in the coastal zone of Texas during Fiscal Year 1968. Two other Federal agencies -- National Aeronautics and Space Administration and National Science Foundation -- spent an additional $3.2 million during the same period of time.

Table 43 shows the individual expenditures in Texas for Fiscal Year 1968 for each department and agency. Department of Defense activities contributed approximately $40 million of the total Federal investment of $94 million. And of the $40 million invested by the Department of Defense in Texas, over $34 million was concerned with marine activities sponsored by the U. S. Army Corps of Engineers. General construction and operation and maintenance (dredging and flood control) accounted for $33.3 million of the expenditures and general and special investigations accounted for the balance.

TABLE 43

SUMMARY OF FEDERAL GOVERNMENT EXPENDITURES,
MARINE RELATED ACTIVITIES IN THE STATE OF TEXAS,
FY 1968

DEPARTMENT OR AGENCY	EXPENDITURES
Department of Commerce	$13,385,510
Department of Defense	40,000,021
Department of Interior	15,742,400
Department of State	13,378,697
Department of Transportation	9,045,507
National Aeronautics & Space Administration	2,000,000
National Science Foundation	1,286,000
TOTAL	$94,838,135

SOURCE: Federal Outlays in Texas 1968. Federal Information Exchange System, Office of Economic Opportunity, U. S. Department of Commerce, Washington, D. C.

Specific data detailing Federal expenditures in Texas for Fiscal Year 1969 were not available for this study. However, departmental and agency estimated Federal expenditures for marine-related activities were available for Fiscal Years 1969, 1970 and 1971, and these figures provide significant clues for evaluating future expenditures in marine activities in Texas. Table 44 gives estimated Federal marine sciences budget figures for Fiscal Years 1969 and 1970, and the President's budget for Fiscal Year 1971.

Although major dollar commitments are retained by the Department of Defense, important increases are estimated on a consistent basis for the National Science Foundation, Department of Commerce, and the Department of Transportation for Fiscal Years 1970 and 1971. Total budget increases from Fiscal Year 1969 to 1971 are $69.7 million for marine science activities with the greater increase, $51.1 million, occurring in Fiscal Year 1970.

TABLE 44

FEDERAL MARINE SCIENCES BUDGET
(millions of dollars)

DEPARTMENT OR AGENCY	ESTIMATED FISCAL YEAR 1969	ESTIMATED FISCAL YEAR 1970	PRESIDENT'S BUDGET, FISCAL YEAR 1971
Department of Defense	$259.7	$263.8	$239.7
Department of the Interior	80.8	98.5	95.0
National Science Foundation	34.9	40.7	63.0
Department of Commerce	38.1	49.2	58.9
Department of Transportation	19.8	31.3	42.6
Atomic Energy Commission	10.6	10.0	9.7
Department of Health, Education, and Welfare	7.3	7.0	9.0
Department of State	6.9	7.7	8.4
Agency for International Development	1.5	2.6	2.6
Smithsonian Institution	1.9	1.9	2.4
National Aeronautics and Space Administration	1.9	1.8	1.8
TOTAL	$463.4	$514.5	$533.1

SOURCE: Marine Science Affairs - Selecting Priority Programs, Annual Report of the President to the Congress on Marine Resources and Engineering Development, April, 1970, Washington, D. C.

Distribution of Federal marine science funds to major oceanographic laboratories in Fiscal Year 1969 indicates seven West Coast institutions (including the Universities of Alaska and Hawaii) received $39.0 million for research activities, 10 East Coast laboratories were awarded $29.2 million, and one Gulf Coast institution (Texas A&M University) received $2.1 million for oceanographic research.

The relatively low level of funds directed to the State of Texas and the Gulf Coast area is clarified by an analysis of the number of research and development projects awarded to each state. Out of 1,564 Federally supported grants and 1,025 Federal-State-in-house projects, 15 states account for 1,251 and 895 projects, respectively,

for Fiscal Year 1968. Table 45 gives the 15 states participating in Fiscal Year 1968 marine science research and development projects and ranks each according to the total number of projects. Of the 15 most active states, Texas ranks last with 64 projects.

TABLE 45

MARINE SCIENCE RESEARCH AND DEVELOPMENT PROJECTS
FISCAL YEAR 1968

LOCATION	FEDERALLY SUPPORTED GRANTS	FEDERAL-STATE IN-HOUSE PROJECTS	TOTAL PROJECTS
California	280	116	396
District of Columbia	22	323	345
Massachusetts	197	31	228
New York	154	16	170
Florida	119	37	156
Washington	81	69	150
Oregon	96	23	119
Alaska	26	64	90
Maryland	31	46	77
Rhode Island	37	38	75
Connecticut	39	31	70
Hawaii	26	44	70
Michigan	48	22	70
North Carolina	43	23	66
Texas	52	12	64
	1,251	895	2,146

SOURCE: Marine Research, Fiscal Year 1968, National Council on Marine Resources and Engineering Development, Washington, D. C.

Texas is participating in the National Science Foundation's Sea Grant Program which has designated institutional awards to Texas A&M University for marine resource development for the past two years. Table 46 indicates the academic institutions receiving awards and the level of funding for Fiscal Years 1969 and 1970. Growth of the Federal Sea Grant Program is apparent with university support rising from $2.5 million in Fiscal Year 1969 to $4.8 million in Fiscal Year 1970.

TABLE 46

UNIVERSITY AWARDS FROM THE NATIONAL SCIENCE FOUNDATION'S SEA GRANT PROGRAM

UNIVERSITY	AWARDS	
	FISCAL YEAR 1969	FISCAL YEAR 1970
Oregon State	$553,000	$792,000
Texas A&M	475,000	750,000
Rhode Island	477,200	685,000
Wisconsin	376,000	620,000
Washington	229,000	500,000
Hawaii	435,400	474,900
Miami	--	600,000*
Michigan	--	380,000*

*Initial award

SOURCE: "Marine Affairs in Texas," A report for 1968-69, Sea Grant Program, Texas A&M University, College Station, Texas and National Science Foundation Sea Grant Program, Washington, D. C.

Federal government activities in marine research and development programs in Texas cover a broad spectrum in addition to administration and supervision of all phases of industrial activity. Besides defense and water safety protection activities by military organizations, Federal involvement ranges from offshore leasing, management of wildlife refuges and parks, custom controls, financial assistance for fishing vessel construction, air and water pollution investigations, oil spill controls, to flood and hurricane protection.

The offshore mineral industry is a major example of government influence in marine activity. By the end of 1968, nearly $4.5 billion had been paid to the Federal government as a result of oil and gas operations on the Outer Continental Shelf. Of this total, approximately $3.29 billion has been paid in bonuses, $978 million in royalties, and $90 million in rentals.[1] Offshore activity thus accounts for the major share of all Federal revenues from mineral leases. Of the 1,417 Federal leases issued since 1954, 531 have been productive.[2] Of these, 518 were located off Louisiana, 10 off Texas, and 3 off the coast of California.[3]

[1] Petroleum and Sulfur on the U. S. Continental Shelf. op. cit. p. 15.

[2] Ibid.

[3] Ibid.

Immense as the present role of the Federal government is, the future role should be considerably greater. The rapid pace of urbanization, an increasing population with higher incomes and leisure time for recreation, and expanding industrial development have intensified the demands for use of the coastal margin. Emphasis for the future will be placed on effective planning and controlled development of the coastal zone to obtain maximum benefits for all users.[4] Five reasons supporting this position are as follows:

A. The pressures of population growth and economic development impose an increasing number of conflicting demands upon the finite resources of the coastal zone.

B. Estuaries, marshlands, and other parts of the coastal zone contain extremely valuable habitats for fish and wildlife which move beyond State boundaries; such areas are vital to the life support of a major part of the Nation's commercial and sport fisheries harvest; such areas, particularly the estuaries, constitute ecological systems which are susceptible to destruction and disruption by man.

C. Continued uncoordinated development activities in the coastal zone pose an immediate threat of irreversible harm to the coastal zone and its resources and a loss of the benefits it offers.

D. The coastal zone is a valuable area for multiple economic, recreational, and resource uses.

E. The interest in the coastal zone extends to the citizens of all states, and is not limited to the citizens in the coastal states.

2. Marine-Related Activities of the State of Texas, Academic and Research Institutions

Texas does not provide a single department or agency with full responsibility directed to management and development of marine-related activities.[5] In spite of this circumstance, most of the departments or agencies of Texas are involved, to some degree, in marine-related activities. After the establishment of the Planning Agency Council for Texas (PACT) in 1965 by the 59th Texas Legislature, a centralized structure to coordinate long-range planning on many levels was formed in 1967 when the Governor was named as the Chief

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[4] Marine Science Affairs - Selecting Priority Programs, Annual Report of the President to the Congress on Marine Resources and Engineering Development, (Washington, D. C., April, 1970), pp. 34-35.

[5] Marine Resources Activities in Texas, Industrial Economics Research Division, Texas Engineering Experiment Station, (College Station, Texas A&M University, August, 1969), p. 150.

Planning Officer of the State. This structure was the Interagency Natural Resources Council with membership drawn from the following departments and agencies:

General Land Office
Texas Air Control Board
Texas Industrial Commission
Texas Railroad Commission
Texas Highway Department
Texas Parks and Wildlife Department
Texas Soil and Water Conservation Board
Texas Water Development Board
Texas Water Quality Board
Texas Water Rights Commission

The Bureau of Economic Geology of the University of Texas at Austin and Texas A&M University have a representative on the Council as non-voting members.

Currently, the preliminary planning to develop a Coastal Resources Plan by the Interagency Natural Resources Council has been placed under the direction of a Project Coordinator who is responsible for the development of a comprehensive investigative program of the Texas Gulf Coast. Emphasis is to be placed on the bays and estuaries and pertinent information to produce recommendations for beneficial growth and use of the coastal zone.

Table 47 shows the annual budgets of selected state agencies in Texas for Fiscal Year 1968. Although it is generally recognized that a portion of each agency's budget is directed to marine-related activities, the exact amount is not available and, therefore, has not been extracted from the total budget.

Academic and non-profit research institutions in Texas maintain numerous projects directed to research and development of marine resources. Total funding from these two sources for Fiscal Year 1968 for marine research activities in Texas exceeded $6 million.

Fifteen academic institutions were involved in 185 separate marine-related projects in Texas during Fiscal Year 1968.[6] These research operations were supported by expenditures totalling an estimated $5,357,892. With 82 projects and expenditures of $2,865,724, Texas A&M University was the leading institution in the number of projects and dollars designated for oceanographic research in Texas. Adding to the impetus of the Texas A&M University oceanographic program is the approval of the Board of Directors for detailed planning for the construction of a new 14-story Oceanography-Meteorology Building. Estimated cost of the multi-story building is approximately $7 million.

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[6] Ibid. p. 47

TABLE 47

BUDGETS OF SELECTED AGENCIES IN TEXAS
FOR FY 1968

AGENCY	ANNUAL BUDGET
General Land Office	$ 1,649,937*
Texas Air Control Board	15,477
Texas Employment Commission	24,368,132
Texas Industrial Commission	309,416
Texas Parks and Wildlife Commission	15,793,234
Texas Railroad Commission	4,470,206**
Texas Soil and Water Conservation Board	420,831
Texas State Department of Health	19,888,827
Texas State Highway Department	531,892,196
Texas Water Development Board	3,704,683
Texas Water Quality Board	2,929,542
Texas Water Rights Commission	767,357
TOTAL	$606,209,838

* Includes Veterans' Land Board Special Fee Fund of $238,138.

** Comprised of $234,397 from General Revenue Funds and $4,235,809 from the Railroad Commission Operating Fund.

SOURCE: General and Special Laws of the State of Texas, 60th Legislature, 1967, Austin, Texas.

During Fiscal Year 1968, five non-profit research organizations operating in Texas reported expenditures of approximately $787,000 for marine-related research and development.[7] These five research organizations were:

Gulf States Marine Fisheries Commission
Gulf Universities Research Corporation
Southwest Center for Advanced Studies*
Southwest Research Institute
The Marine Biomedical Institute

*Effective September, 1969, the Center became the University of Texas at Dallas.

[7] Ibid. p. 65.

During this period of time, the Southwest Research Institute with a budget of $450,000 was the largest marine research organization in Texas. Gulf Universities Research Corporation recently received a $100,000 federal grant to plan an environmental study program for the Gulf of Mexico. Estimated cost of the study over the next decade is approximately $150 million. Headquartered in Galveston, the research organization is a consortium of 17 universities and 21 major corporations located in the five Gulf Coast states.

A survey of Federal and State of Texas governmental departments and agencies indicates these two sectors generated direct employment of 5,200 and Federal government expenditures totaling about $95 million for Fiscal Year 1968. Table 48 gives the combined Federal-State employment and the Federal expenditures for 1968.

TABLE 48

GOVERNMENTAL EMPLOYMENT AND EXPENDITURES
IN MARINE-RELATED ACTIVITIES IN TEXAS
FY 1968

SOURCE	EMPLOYMENT	EXPENDITURES
Federal	5,200*	$94,838,135
State of Texas	--	**
TOTAL	5,200	$94,838,135

* Combined Federal and State of Texas: includes employment for customs officials, parks and recreation personnel, U. S. Coast Guard, U. S. Army Corps of Engineers and other defense-related military units.

** Not Available

SOURCE: Federal Outlays in Texas 1968, Federal Information Exchange System, Office of Economic Opportunity, U. S. Department of Commerce, Washington, D. C., and Industrial Economics Research Division, Texas A&M University, College Station, Texas.

CHAPTER VIII

ECONOMIC IMPACT EVALUATION

Economic impact is measurable in a variety of ways. In previous chapters, the economic impact has been measured in terms of employment, sales and investment. Total sales and total employment directly generated by industries, however, provide only a partial impact estimation. The overall economic impact must also account for the indirect re-spending cycle stimulated by direct sales and the indirect employment generated by the growth stimulus of direct employment. Sales and employment multipliers provide useful estimates of the combined direct and indirect impact of sales and employment in the marine-related industries. The following sections will provide estimates of multipliers for the major marine industry groups and evaluate their overall economic importance to the Texas economy.

1. Summary of Direct Employment and Sales Impact of Marine Industries

A summary of the direct employment and sales impact of marine industries is presented in Table 49 which indicates that Texas marine industries generated more than $1.6 billion in direct sales and employed more than 63,000 persons in 1969. These direct figures should be considered conservative estimates due to unavoidable low estimates of direct sales and employment in marine recreation and tourism, the exclusion of data from several industrial activities such as desalination, educational institutions, and research and development groups and the unavailability of state government expenditures for marine activities. It should be noted that several previous reports have estimated 50,000 persons, including both marine and non-marine related groups, as being directly employed by Port of Houston activity. Although port systems generate employment in several non-marine activities such as trucking, rail transport, and warehousing, these activities are considered as resulting from the multiplicative impact of the basic marine-related activity. Companies producing products or services specifically for marine activities such as the offshore construction industry have been included since they are considered as having more direct activity consistent with the definition of marine industries used in Chapter I. Definitional adjustments are considered to account for the scale differences in employment by other reports. For this report, the incorporation of the derived or indirect activities will be accounted for by the size of the multiplier impact.

The shift-share analysis and the location quotient study of Chapter II indicated that industry groups including the major marine activities experienced relatively faster employment growth and were relatively self-sufficient activities. Location quotients implied

TABLE 49

DIRECT IMPACT OF MARINE INDUSTRIES IN TEXAS
1969

INDUSTRY	DIRECT SALES	DIRECT EMPLOYMENT
Offshore Mineral	$ 972,796,000	23,617
Marine Transportation	439,470,133	18,329
Commercial Fisheries	218,980,953	12,527
Marine Recreation and Tourism	55,540,500	3,985
Federal and Other	*	5,200
TOTAL	$1,686,787,586	63,658

* Not Applicable

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

also that much of the marine activity has an export (non-Texas) emphasis. The extensive system of Texas ports and the worldwide orientation of the Houston-based offshore industries reinforces this evaluation. Export demand was also found to be highly important to the commercial fisheries and marine recreation and tourism activities. Increased concentration of major oil companies activities in the Primary Marine Region I reinforces these estimates. Total direct estimates of sales derived also are consistent with more extensive economic projection studies of Gulf Coast activity.[1] Complete accounting of the growth stimulus requires application of appropriate multipliers to assess the overall economic impact of marine resources and industries.

2. Multiplier Analysis of Total Economic Impact of Marine Industries

General sales (or income) and employment scale of multipliers reflect the economic structure and activity in an area. The income stream

[1] Franklin V. Walker, "Projection of the Gulf Coast Regional Output," Papers and Proceedings of the Regional Science Association, Vol. 3, (1957), p. 266-284.

into the Texas economy generated by sales of the marine industries stimulates additional expenditures and expanded employment by dependent activities. Total direct sales of marine industries in Texas amounted to $1.6 billion in 1969. However, not all the money received from sales of local output flows into the local income stream. A portion of this money "leaks" out of the regional economy and hence tends to reduce the overall multiplicative impact. These basic direct leakages include capital consumption allowances, corporate overhead, profits, purchases from outside the region, and sales outside the region. The leakages occur in both the direct marine-related industries and in the dependent non-marine industries. Explanation of leakages can clarify the multiplicative influence of these industries.

Capital consumption allowances are a measure of the declining asset value of a firm's investment in plant and equipment. To offset this declining value, an equal amount of money is withdrawn from total sales revenues and used to buy other assets. These funds do not necessarily provide any direct flow of new income into the study area.

Profits are another direct leakage. Many of the firms engaged in marine activity are major national or worldwide corporations with exploration, mining and trade activities scattered over a wide area. Profits flowing to these corporations are partly used to pay taxes to the federal government, to pay dividends to stockholders of the firms, and to finance additional acquisitions and expansions. Profits before taxes should also be deducted from the total sales figure before arriving at the local income flow generated by the industry's sales.

Inputs purchased from outside the area are another key leakage. Some portion of revenues from sales are used to purchase supplies, equipment, raw materials and other inputs. The propensity to import goods and services from sellers outside the study area reduces the income and employment stream accruing locally.

Several assumptions need to be made regarding the extent of the direct leakages for each of the marine industry groups. The complexity and diversity of firms within the offshore industries group alone require special consideration. Previous studies of the profits, capital consumption allowances, and other leakages of the oil and gas industry and supporting manufacturing industry indicate that profits of these corporations averaged eight percent of sales; capital consumption allowances averaged five percent of total sales; and purchases from outside the area were estimated at ten percent of total sales.[2] Applying the sum of these adjustments

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[2]Elbert V. Bowden, E. Anthony Copp, John Lewis, "An Economic Growth Analysis and Projections Model for the Houston-Galveston Bay Area," preliminary unpublished manuscript, (College Station: Texas A&M University, 1969).

to total sales of offshore industries as shown in Table 50 for 1969 yields a basic income flow of $749,053,920. Many of the firms in marine transport activity are also national and international in scope. Based on published reports, previous studies, and interviews, estimates of the leakages of profits, capital consumption allowances, and outside purchases of the major transport group can be assumed for the entire marine transport group. The adjusted total basic income, given an estimated 20 percent leakage factor, for marine transport activities was estimated at $351,576,107. Total sales for marine transport industries were shown in Table 23. Commercial fisheries have a lower leakage factor than marine transport industries, particularly regarding purchases of supplies and equipment. The majority of supplies and equipment for shrimp production and processing firms comes from within Texas. By allocating a leakage factor of 15 percent, total adjusted basic income was $186,133,811. Marine recreation and tourism adjustments are minimized in this report due to the conservative estimates of marine sales and to the difficulty of obtaining meaningful leakage estimates. Assuming a leakage factor of ten percent, total basic income in 1969 was $49,986,450. Total adjusted basic income accruing to the Texas economy was $1,336,750,288 for 1969.

Numerous studies have been conducted to estimate "multipliers" of various marine activities. The basis of most of the multipliers derives from the Keynesian income-employment theory. Industries are typically segregated as to the "basic" or "growth thrust" units of the economy and other study area activities are viewed as deriving their growth influences from the sales, investment and employment impact of these leading industries.

Applied to regional analysis, the Keynesian income equation is

$$Y = aC + bI + cG + g(X-M)$$

where C stands for consumption, I for investment, G for government expenditures, and (X-M) for export earnings. The parameters a, b, c, and g indicate regional income generated for each amount of expenditure over each category. Assuming consumption as a function of income,

$$C = kY$$

where k equals the regional propensity to consume. The equation for income can be rewritten as

$$Y = akY + gX$$

where investment and current government expenditures are autonomously determined. Solving for Y,

$$Y = \frac{gX}{(1-ak)}$$

TABLE 50

ESTIMATED TOTAL ECONOMIC IMPACT OF MARINE RESOURCES AND INDUSTRIES
1969

INDUSTRY	EMPLOY-MENT	BASIC INCOME (000)	MULTI-PLIER	INDIRECT EMPLOY-MENT	INDIRECT SALES (000)	TOTAL DIRECT AND INDIRECT EMPLOYMENT	TOTAL DIRECT AND INDIRECT SALES (000)
Offshore Mineral	23,617	$ 749,054	2.50	59,042	$1,872,635	82,659	$2,625,689
Marine Transportation	18,329	351,576	2.00	36,658	703,152	54,987	1,054,728
Commercial Fisheries	12,527	186,134	.75	9,435	139,600	21,962	325,734
Marine Recreation and Tourism	3,985	49,986	3.50	13,947	174,951	17,932	224,937
Federal and Other	5,200	*	1.00	5,200	*	10,400	*
TOTAL	63,658	$1,336,750		124,282	$2,890,338	187,940	$4,231,088

* Not Applicable

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

where the factor $\frac{1}{(1-ak)}$ is the regional multiplier. This is, however, only a short run multiplier and can be expanded for long run estimates that account for induced regional imports, savings for increments of income, reductions in government transfer payments and increases in governmental tax outlays.

The long-run relationship then becomes

$$Y = \frac{gX}{(1 - ak - bk' - ck'')}$$

where the long run multiplier is

$$\frac{1}{(1 - ak - bk' - ck'')}$$

where k' equals the propensity to invest and k" equals the propensity of regional government to spend.[3] Approximations to this multiplier have been estimated as the ratio of change in total income of employment to a change in basic income or employment where basic refers to export-oriented activity.[4]

In this report, the multiplier estimates account for the core-periphery influence of marine-related industry outlined in Chapter I. Marine growth points stimulate employment and incomes throughout their periphery and Texas. The high volume of activity accounted for by the core area of Primary Marine Region I indicates the area is the leading marine-growth complex of Texas. Most of the multiplicative influence is stimulated from this area.

Given the adjusted income figures, the induced effects of export sales, the local demand influences, the overall inter-industry linkages, and considering the results of previous studies of marine activity, the individual multipliers can be estimated. Where the assumptions of growth-induced export sales and employment are not consistent with apparent linkage effects, upward or downward adjustments have been made. The estimated marine-industry multipliers are provided in Table 50 with the resulting re-spending impact of both incomes and employment. The income-employment multiplier is assumed as a constant. Multipliers for the offshore industries and the marine transport industries were calculated on weighted

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[3]Eric Shenker, The Port of Milwaukee, An Economic Review, op. cit., pp. 200-203. Identical statements are in Isard, Methods of Regional Analysis, op. cit., and Harry W. Richardson, Regional Economics, op. cit.

[4]G. L. Leven, "Measuring the Economic Base," Papers and Proceedings of the Regional Science Association, Vol. 2, 1956 and Isard, op. cit., pp. 190-192.

industry component averages of export-based Keynesian multipliers, to be 2.50 and 2.00, respectively. This means that direct offshore marine activities generated two and one-half times their level of employment and sales. Marine transport activities generated twice the direct level of employment and sales. Commercial fisheries generated less than an equal direct amount of employment and sales into the Texas economy. Thus employment of 100 direct commercial fishery employees generated additional employment for 75 dependent workers. Recreation and tourism were estimated to have the highest multiplier. It should be noted that if the conservative estimates of employment and sales used were expanded by additional data, the marine recreational multiplier could range from 4.00 to 5.00. For lack of available data, government activity was assumed to have a multiplier of 1.00. Each federal and state employment category was assumed to generate one additional job or dollar sale.

Results from the table indicate the total economic impact of marine industries in terms of sales was more than $4.2 billion and the total employment impact was 187,940. The major impact of these industries was not in their direct influence but in their indirect impact on the Texas economy. Commercial fisheries was the singular exception where the direct impact was greater. The offshore mining, exploration, production and service industries generated the major amount of sales and employment followed closely by marine transport activity. These two activities alone accounted for more than 70 percent of the economic impact of marine activity in Texas.

CHAPTER IX

ANALYSIS OF FUTURE IMPACT OF MARINE INDUSTRIES ON TEXAS

Urban-industrial concentrations and the growth of megalopi along the Texas coast will be largely influenced by the expansion of the area's marine industrial complex. Some of the factors influencing the future growth of marine industries include:

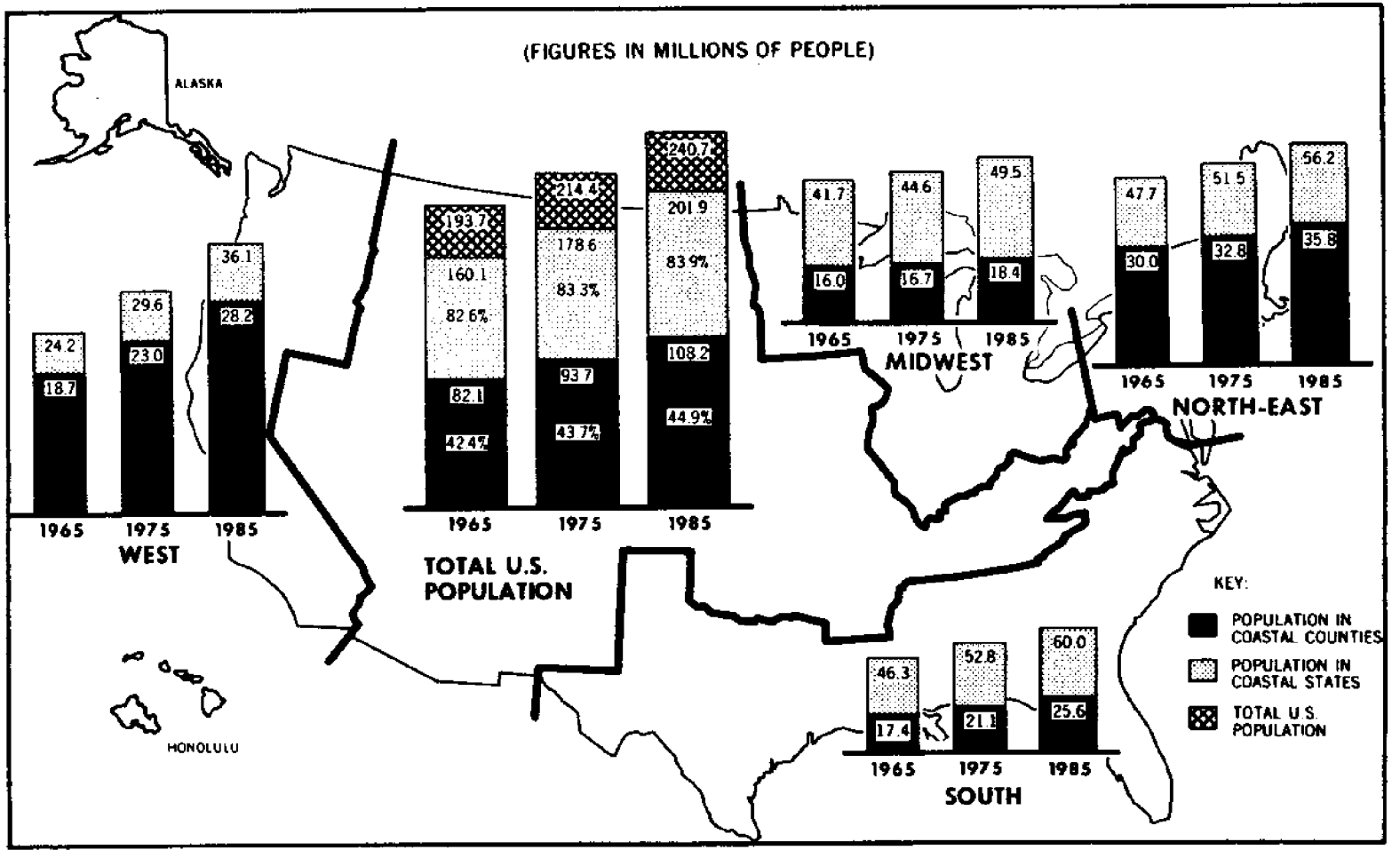
a. Population growth on the Texas coast
b. New geophysical knowledge of the Gulf of Mexico
c. New technology in marine activities
d. Growth in regional income
e. Increased leisure time
f. United States and world demand for marine products and services
g. Government policy.

The following section will analyze the relative importance of these and other factors affecting the future growth of major marine industries and estimate the growth of these industries to the year 2000.

1. Total Population and Employment Growth in the Texas Marine Region to the Year 2000

Population growth along the Texas Gulf Coast area has risen to more than 40 percent of the total state population. The experience of Texas in this regard is similar to other shoreline areas of the United States. Figure 19 provides a comparison of past and expected population growth in coastal states. By 1985, the South is expected to have 42 percent of its total population in coastal counties. The Texas share of this coastal population concentration is shown in Table 51 which indicates that the population in the Texas Marine Region is expected to be approximately seven million people, representing an increase from 1970 to 2000 of 55.8 percent.

Estimates of total employment and percent of annual increase for the Texas Marine Region are provided in Table 52. From 1970 to 2000 the employment is expected to increase by 63.2. Employment projections for individual industry groups are provided in Table 53. Manufacturing, trades and services will provide the major sources of employment by the year 2000. Government employment and contract construction will rank fourth and fifth as leading employment groups by 2000.



POPULATION GROWTH IN NATION'S COASTAL ZONE

FIGURE 19

TABLE 51

POPULATION OF THE TEXAS MARINE REGION

YEAR	POPULATION	PERCENT INCREASE
1940	2,306,737	--
1950	3,068,516	33.0
1959	3,886,505	26.7
1962	4,206,760	8.2
1970	4,457,150	6.0
1980	5,148,566	15.5
1990	5,989,750	16.3
2000	6,943,745	15.9

SOURCE: Preliminary Report on Economic Projections for Selected Geographic Areas, United States Water Resources Council, Office of Business Economics, U. S. Department of Commerce, Washington, D. C., 1968 and the Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 52

TOTAL EMPLOYMENT OF THE TEXAS MARINE REGION

YEAR	TOTAL EMPLOYMENT	PERCENT INCREASE
1950	1,106,984	--
1960	1,379,117	24.6
1970	1,642,986	19.1
1980	1,957,266	19.1
1990	2,262,622	15.6
2000	2,680,983	18.5

SOURCE: Preliminary Report on Economic Projections for Selected Geographic Areas, United States Water Resource Council, Office of Business Economics, U. S. Department of Commerce, Washington, D. C., 1968 and the Industrial Economics Research Division, Texas A&M University, College Station, Texas.

TABLE 53

EMPLOYMENT BY INDUSTRY FOR THE TEXAS MARINE REGION

INDUSTRY	1950	1960	1970	1980	1990	2000
TOTAL EMPLOYMENT	1,106,988	1,379,122	1,642,986	1,956,684	2,262,622	2,680,983
Agriculture, Forestry, and Fisheries	155,705	112,162	94,187	83,420	72,071	64,311
Mining	31,099	37,307	48,015	52,477	54,417	56,551
Contract Construction	95,342	103,402	126,294	148,022	168,198	195,552
Manufacturing	168,470	229,842	277,129	329,800	384,411	446,782
Transportation, Communication, and Public Utilities	92,742	103,965	109,125	118,049	125,324	128,040
Wholesale and Retail Trade	230,754	295,589	336,881	391,104	440,865	503,042
Finance, Insurance, and Real Estate	34,251	55,067	70,616	88,852	105,924	131,629
Services	207,765	303,669	415,936	555,228	692,871	906,077
Government	90,860	138,119	164,803	189,732	218,541	248,999

SOURCE: Preliminary Report on Economic Projections for Selected Geographic Areas, United States Water Resources Council, Office of Business Economics, U. S. Department of Commerce, Washington, D. C., 1968 and the Industrial Economics Research Division, Texas A&M University, College Station, Texas.

The extent to which marine-related industries will account for the employment growth and the factors affecting the economic structure and growth rates of these industries in the future will be discussed in the following sections.

2. Factors Affecting Future Growth of Offshore Industries

The increasing demand for energy supplies, the economic feasibility of technological breakthroughs, geological conditions, and general economic and political factors will be major influences on the growth of the offshore industries.

To meet consumption demands and to maintain a minimum 15-year supply ratio of world reserves to annual production during the next 20 years, the international petroleum industry must find at least 615 billion barrels of crude. By way of comparison, total cumulative world production of crude oil through 1968 amounted to 210 billion barrels. Total reserves are estimated at 260 billion barrels, representing a 34-year supply at the 1968 rate of consumption.[1] This staggering demand will require huge capital investments by these industries to cover the increasing offshore and onshore production. The offshore industry has experienced few problems in obtaining capital. A substantial portion is raised from the public based on an individual firm's credit, a factor constituting one of the great strengths in offshore growth.[2] Approximately $18 billion has been invested worldwide by the offshore petroleum industry including $13 billion by United States firms.[3] Cumulative investment by the world offshore industry by 1980 is expected to reach $55 billion. Expenditures could be expanded further as offshore companies probe in deeper waters. Capital expenditures to develop and produce a 50-million barrel model offshore field, for example, under existing conditions in the Gulf of Mexico will more than double when moving from 100 to 600-foot water. At 1,000 feet, exploration costs are estimated to be double that of 100-foot depths.[4] Costs for platforms alone range beyond $5 million. The rate of offshore investment activity is expected to continue to

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[1] "World Demand to Reach 100 Million BPD by 1990," World Oil, Vol. 170, No. 2, (February, 1970), p. 61.

[2] Industry and Technology: Keys to Oceanic Development. Panel Report of the Commission on Marine Science, Engineering and Resources, Vol. 2, (Washington: Government Printing Office, 1968), p. v. 9.

[3] Richard J. Howe, "Petroleum Operations in the Sea--1980 and Beyond," Ocean Industry, (August, 1968), p. 30.

[4] Dale E. Basye, "Forecast for the Seventies--Offshore," The Oil and Gas Journal, (November, 1969), p. 195.

increase at about 18 percent annually.[5] The majority of the United States investment will be initiated by Texas-based offshore firms. The Primary Marine Region of Texas is the current location of the headquarters of 70 percent of all offshore-related firms in the United States. Addition of firms located in the rest of the state raises the total to 80 percent. Intensified concentration of offshore firms and rising investment activities seem to indicate a major reliance on offshore sources of crude oil and natural gas. Offshore fields currently produce 17 percent of the world's output of oil and by 1980, more than one-third of all world oil will come from offshore operations. Offshore natural gas production will also expand. Concern by the Federal Power Commission of impending natural gas shortages has focused attention on offshore supplies.[6] Estimates of the natural gas requirements of the United States from 1975 to 1990 are provided in Table 54. The table indicates that industrial and residential requirements will nearly double by 1990. Total demand will increase from 30 billion cubic feet to more than 46 billion cubic feet.

The major mineral produced off the coast of Texas and Louisiana has been natural gas. Less than half of all currently leased lands in the Gulf of Mexico have been explored. Many geologists feel that further exploration on the outer continental shelf off Texas and Louisiana will lead primarily to more natural gas discoveries. Recent discoveries of oil and gas potential in deeper waters of the Gulf of Mexico and in various world wide locations will tend to intensify the continuing shift of geophysical activity to offshore areas. This activity means increased business for Texas-based firms. The demand for geophysical services from the economic viewpoint is actually the demand for information to sufficiently reduce the risk and uncertainties of major offshore investments. Consequently, offshore ventures of the future are likely to be big-business operations. Small firms will not be at parity with major firms to secure information and make the sizable offshore investment.[7] The structure of offshore mining and production industries is thus likely to continue to be oligopolistic - competition in the United States will exist among few major firms. Growth of the offshore firms will not only be internal, but acquisition through merger with complementary or conglomerate concerns will continue to be a major growth technique. Recent acquisition of Norness Shipping by the Zapata Offshore Company is a classic example of this trend. Merger activity among major petroleum companies with substantial

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[5] Ibid., p. 197.

[6] Clyde La Motte, "Gas-Oil Activity Will Soar in 1970's," Ocean Industry, (February, 1970), p. 8.

[7] James W. McKie, "Market Structure and Uncertainty in Oil and Gas Exploration," Quarterly Journal of Economics, (1960), pp. 543-71.

TABLE 54

UNITED STATES NATURAL GAS REQUIREMENTS*
1975-1990

YEAR	FIRM			INTER-RUPTIBLE	FIELD USE	OTHER USES	TOTAL
	RESI-DENTIAL	COM-MERCIAL	INDUS-TRIAL				
1975	5,980	2,446	9,836	6,283	3,653	2,070	30,268
1980	6,945	2,985	11,816	7,295	3,317	2,342	34,700
1985	7,993	3,666	14,327	8,422	3,046	2,665	40,119
1990	9,163	4,504	17,378	9,727	2,919	2,995	46,686

* Billion cubic feet. All requirements in 1,000 BTU per cubic foot except field use.

SOURCE: Future Natural Gas Requirements of the United States. Prepared by the Future Requirements Committee under the Auspices of the Gas Industry Committee, Denver Research Institute, University of Denver, Vol. No. 3, September, 1969.

offshore interests such as the more than $2 billion asset combination of Union, Sun, Atlantic and Phillips also are indicative of industrial concentration in the overall petroleum and gas complex of industries.[8]

Technology adaptability in oil, gas and other mineral activity also will continue to be a major factor to the growth rates of offshore industries. Evaluation of technological improvements for offshore exploration and development in progressively deeper waters on the Continental Shelf of the United States have opened vast new geographical areas for exploration. Improved geophysical techniques, advanced geological concepts and applications of new methods for deeper drilling have all permitted exploration down to depths not

[8]Economic Concentration: Economic Report on Corporate Mergers, Manufacturing and Mining. Hearings before the Subcommittee on Antitrust and Monopoly of the Committee on the Judiciary, United States Senate, 91st Congress, 1st Session, (Washington, D. C., 1969).

possible a few years ago.[9] Exploratory drilling now occurs in depths greater than 10,000 feet offshore while existing development capabilities are at about 300-600 feet.

The shift to offshore oil and gas production requires new structural engineering technology to account for the forces of the marine environment on unprotected fixed or semi-fixed offshore structures. The self-contained platform which contains all of the necessary materials and equipment for drilling as well as personnel housing has been the mainstay for drilling prolific proven areas.[10] However, the uncertainties of the number of wells to be drilled from a single location that might otherwise cover the structural platform costs are a deterrent to self-contained platforms. The use of fully or semi-automated structures often called the minimum self-contained platform may increase in the future. This trend will have to await solution to major drilling problems. Government regulations to control oil spills may also effect the manpower-investment ratio of these facilities in the future. Drilling innovations such as mobile drill units like the jack-up drill barge, floating drilling vessels and semi-submersible floating drilling vessels have been developed and accepted. Floating vessels have been and are likely to continue to be used to drill wildcat wells. Submarine completion of oil and gas wells has been stimulated by the high cost of platforms and government policy requirements. This technique is considered by some industry experts to be the major approach to offshore activity in the future. Current technology for undersea mining operations is limited. One of the major employment growth components of the offshore industry in the future will be the demand for marine services. Demand for workover and service rigs is expected to experience growth of more than 120 percent over the next five years and continue to remain high over the next two decades.[11] Increased offshore activities will also require more integrated offshore storage, transportation and logistics. Demand for supply barges, storage barges, pipeline laying vessels, utility vessels and helicopters should expand greatly over the next three decades. The increasing profitability of such ventures and the total national concern for the resource potential off the nation's shorelines should continue to make these ventures financially attractive.[12]

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[9] Impact of New Technology on the U. S. Petroleum Industry, 1946-65. National Petroleum Council. (Washington: National Petroleum Council, 1967), p. 2.

[10] Ibid., p. 209.

[11] "Gulf Workover Need Grows: 120 Percent Job Increase Seen by 1974," OFFSHORE. (February, 1970), p. 42.

[12] Edward G. Erickson, "Crude Oil Prices, Drilling Incentives and the Supply of New Discoveries," Natural Resources Journal, Vol. 10 (January, 1970), p. 51.

The likelihood of commercial success in offshore mining of resources other than oil, natural gas and sulfur, however, do not appear as promising over the next 20 years. All other presently exploited ocean minerals including tin, diamonds, sand, gravel, magnesium, bromine and gold represent less than 30 percent of the total value of mineral resources recovered from the ocean. At present the most important potential ocean mineral resources are phosphorite, a high grade fertilizer available in great quantities on the continental shelves, and manganese nodules, porous spherical concretions containing varying quantities of nickel, cobalt, and copper.[13] Manganese nodules are widely distributed over the ocean floor, but existing deep water dredging capabilities to exploit it are limited. Manganese nodules of economic interest are found at depths from 12,000 to 18,000 feet.

The future growth rate of offshore industries in Texas will consequently be more dependent on oil, gas and sulfur. Rapid expansion of offshore employment in exploration, drilling, workover and other activities is expected to represent an increasing percentage of the total mining activities in Texas over the next 30 years.

3. Future Growth Trends in Marine Transport and Shipbuilding Activities

Marine transport and shipbuilding activity in Texas may experience some revolutionary changes in location, structure distribution, and scale of traffic over the next 30 years. Some of the factors influencing these changes can be summarized as:

a. World demand for Texas oriented import-export commodities
b. Changes in ocean-transport flows
c. Economies of scale from technological changes in general cargo, bulk commodity, and container ships and barges
d. Rate of diffusion of containers in ocean transport and other integrated transport systems
e. Government policy toward the United States shipping industry
f. Government policy toward port and harbor development
g. Labor
h. Hinterland influence of ports
i. General economic environment of the United States.

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[13] Philip E. Sorensen and Walter J. Mead, "A Cost-Benefit Analysis of Ocean Mineral Resource Development: The Case of Manganese Nodules," American Journal of Agricultural Economics. (December, 1968), p. 1611.

Much of the discussion concerning the future of ports and harbors in the United States has tended to focus on the "container revolution" and the advent of supertankers. In addition, attention has been on the relatively minor presence of the United States in the merchant fleets of the world. Although 90 percent of the nation's foreign trade cargo moves by sea, United States flag vessels carry less than six percent of this total.[14] Figure 20 shows the trends in the fleet size and deadweight tonnage of merchant fleets of the world. The figure shows that the United States had less than 1,000 privately owned ships in 1969. Japan and the United Kingdom, by comparison, had approximately 1,800. Liberia led all nations in total tonnage. Recent government concern for an increased role for United States shipping on the high seas indicates that shipbuilding activities will experience high growth rates in the future. Texas shipbuildings activity presently tends to focus on repair, conversion and construction of barges, oceanographic research vessels, tugboats, trawlers, and structures and vessels for the offshore oil and gas industry. The new emphasis on merchant fleet ships should provide an opportunity for diversification toward more conventional shipbuilding activity. For example, Texas shipyards may attract general cargo and container shipbuilding business away from the bigger shipyards that get the contracts for the supertankers. These potential spillover effects for the Texas shipbuilding industry may also be boosted by the outside possibility that Todd Shipyards of Galveston may be the site of supertanker construction.[15]

The Regional Export Expansion Council of Texas is assessing the feasibility of a bulk commodity terminal in the offshore area of Primary Marine Region I near Freeport. Major oil companies in the area have also considered the economies and diseconomies to be derived from such a facility. The issue of terminal location and distribution economies is largely tied to technological advances in shipping, technological substitution between major Texas ports and harbors as unloading points for major superships due to draft and width conditions, and conventional and innovative alternative uses of marine pipeline connections. Transfer of cargo at offshore terminals could be accomplished from large ships to smaller, more maneuverable vessels with lower drafts destined to various ports or through pipelines to the storage and processing facilities onshore.[16] Such regional loading and unloading facilities will tend to take the

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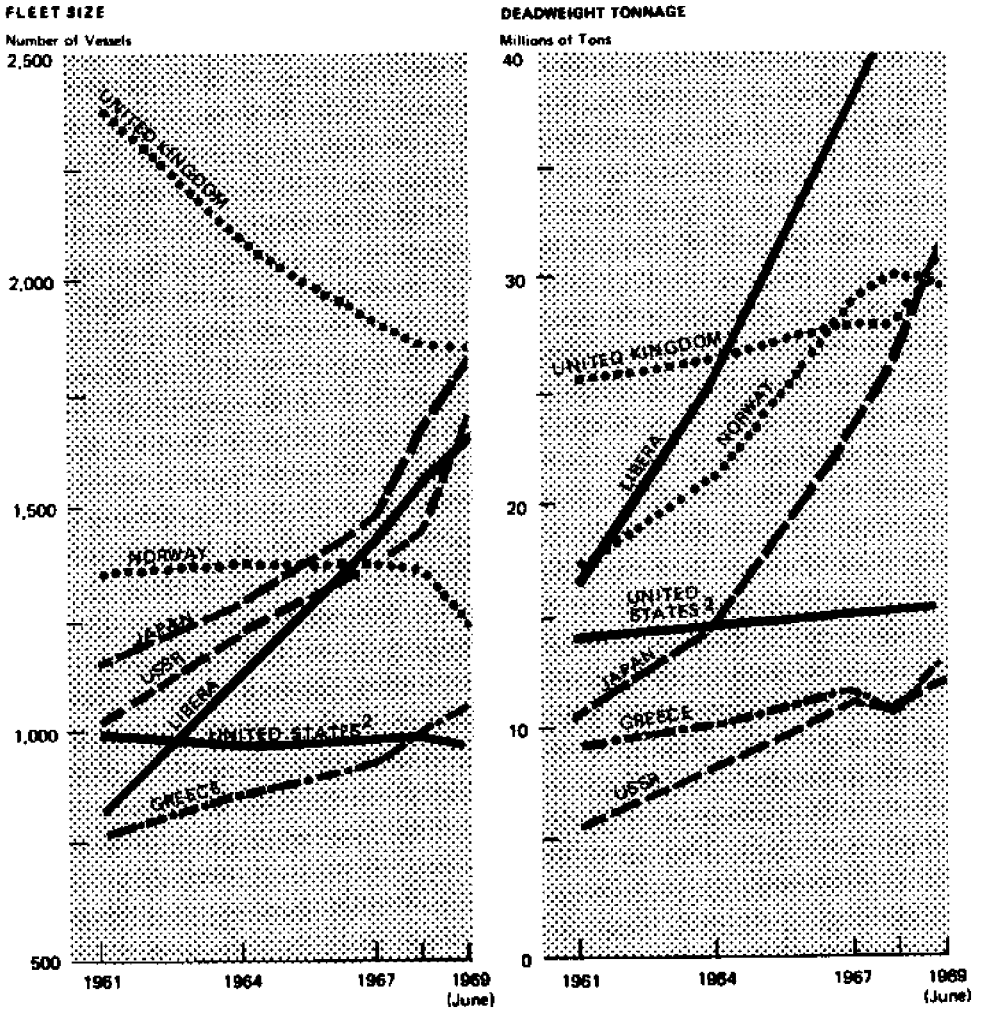
[14] Marine Science Affairs - Selecting Priority Programs. op. cit. p. 51.

[15] Al Prince, "SS Manhattan's Voyage Could Result in Building Supertankers in Galveston," The Houston Post, (September 18, 1969).

[16] Casimir J. Kray, "Superships Effect on Waterway Depth and Alignments," Journal of the Waterways and Harbors Division, Proceedings of the American Society of Civil Engineers, (May, 1970), p. 501.



1 Oceangoing steam and motor ships of 1000 gross tons or more. Excludes ships operating exclusively on inland waterways and special ships such as channel ships, icebreakers, military ships, etc.

2 Only privately-owned U.S. ships are included. U.S. government ships, excluding the reserve fleet, rose from 64 vessels in 1961 to 171 vessels in 1967 but this largely reflects activation of reserve ships for war duty.

MERCHANT FLEETS OF THE WORLD

FIGURE 20

pressure off port systems for dredging requirements. Joint offshore terminal and pipeline facilities on the United States East Coast capable of handling the giant tankers in world oil trade are being planned by three major domestic oil companies. This activity may reduce the potential for a Texas offshore terminal; however, alternative use demands may make such a system economically feasible. Slurry pipelines offer one alternative. The potential for employment of slurry pipelines is greatest where no well-developed transport facilities exist.[17] Some commercial slurries currently operating include coal, gilsonite, limestone, gold tailings, iron concentrates, copper tailings and sulphur.

Slurry pipelines from offshore terminal points can also have a fundamental impact on industrial location factors onshore. In the case of ore concentrates, for example, a steelmaker cannot only consider smaller regional steel mills not dependent on deep water harbors, but also can forego the cost of installing an expensive blast furnace and related equipment.[18] It should be noted, however, that slurry pipelines themselves do not offer a competitive threat to water carriers. Ocean and inland water carriers enjoy an economic advantage over all competitive forms of transportation.[19]

Development of ports and harbors in Texas over the next 30 years will largely be tied to the problems posed by new technology and transport capability. One major problem will be the demand for greater depths of harbors and channels in the face of significant physical obstacles to further deepening in many areas. Another problem stems from the need for new or greatly modified onshore supporting or service facilities. The anticipated requirements for deepening harbors and channels stems from the projected size of petroleum tankers and other bulk commodity ships over the next 30 years. Projected vessel sizes and related characteristics to the year 2000 are provided in Table 55. Average deadweight of the world tanker fleet is projected to be less than 95,000 tons while some ships may vary up to one million tons. Deadweight per ton identifies a ship's total carrying capacity including internal provisions, at salt water, summer load line immersion. Actual

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[17] E. J. Wasp and W. L. J. Fallow, "Some Aspects of Slurry Pipeline Economics and Applications," Papers - 10th Annual Meeting, Transportation Research Forum. (Oxford, Indiana: Richard B. Cross Co., 1969), p. 304.

[18] "Slurried Mineral Ore System," Ocean Industry, Vol. 4 (November, 1969), p. 39.

[19] Peter J. Manno, "Outlook for Pipelining Solids," Papers - 8th Annual Meeting, Transportation Research Forum. (Oxford, Indiana: Richard B. Cross Co., 1967), p. 387.

TABLE 55

PROJECTED VESSEL CHARACTERISTICS
1970 to 2000

TYPES OF CARRIERS	1970	1980	1990	2000
General Cargo or Container Ships				
Maximum DWT* in World Fleet	25,500	33,500	43,500	50,000
Length (feet)	850	930	1.010	1.050
Beam (feet)	108	117	127	132
Depth (feet)	74	80	85	88
Draft (feet)	36	39	40	40
Average DWT in World Fleet	8,168	8,583	9,043	9,350
Dry Bulk Carriers				
Maximum DWT in World Fleet	105,000	185,000	317,000	400,000
Length (feet)	870	1,040	1,230	1,325
Beam (feet)	125	152	183	198
Depth (feet)	71	84	99	106
Draft (feet)	48	57	66	71
Average DWT in World Fleet	14,750	18,750	23,575	27,350
Tankers				
Maximum DWT in World Fleet	300,000	760,000	1,000,000	1,000,000
Length (feet)	1,135	1,460	1,570	1,570
Beam (feet)	186	252	276	276
Depth (feet)	94	129	142	142
Draft (feet)	72	98	104	104
Average DWT in World Fleet	39,825	76,225	90,000	94,325

* Deadweight Tons

SOURCE: Department of Transportation, 1968, Assistant Secretary for Policy Development, Washington, D. C.

cargo capacity is slightly less. A 50,000 ton deadweight tanker can carry about 47,000 tons of crude petroleum. Dry bulk carriers in 2000 may reach a maximum size of 400,000 tons. The implications for Texas ports, harbors and channel development lies in depth requirements. During the 1940's, the T-2 (16,000 tons) was used as a yardstick in determining that a depth of 35 feet was required at major United States ports. Tankers of 35,000 tons required 40-foot depths and necessitated further enlargements of harbors and channels.[20] The quantum jump from the T-2 equivalent has been produced by the two closings of the Suez Canal. Only increased tanker size could compensate for the difference in mileage between the Suez Canal passage of 6,200 miles from the Middle East to the United Kingdom and the Cape of Good Hope route of 11,000 miles.[21] The largest tankers in service presently require at least 63 feet in depth. At present there are only three port locations in the United States where a vessel in the 100,000 deadweight size range can be fully loaded at berth; petroleum berths at Los Angeles and Long Beach, and a grain berth at Seattle.[22] The advantage of these huge ships is obtained through economies of scale in reduction of per unit cost. Since an increase in speed does not produce the cost-saving result that an increase in ship size does, the former is of lesser importance to these vessels.[23] Although high speed is an economical factor, present studies indicate that an appreciable increase of speed over 17 knots for the superships is not likely to occur.

The problems attendant with increased ship size for Texas ports result from the fact that none of the state's ports are capable of handling a ship with a greater draft requirement of 37 feet. Offshore tanker moorings, container and bulk cargo terminal installations constructed in deep, easily accessible waters could alleviate the present and potential congestion at port sites.[24]

Assuming these options are not implemented, the problems of future harbor and channel width and depth expansion in Texas are massive and costly. Problems include those of maneuverability, depth expansion, spoil disposal, mooring, special deep water berths, special portside terminal requirements, and the indirect impact on

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[20] Harbor and Port Development, A Problem and An Opportunity. op. cit., p. 11 and 17.

[21] A. J. Tucker, "Boom in Tankers Ahead," Ocean Industry. Special Report on Tankers and Terminals, (January, 1970), p. 35.

[22] Port and Harbor Development. op. cit., p. 18.

[23] Kray, op. cit., p. 500.

[24] Ibid., p. 501.

the local environment. In addition, the contour of the Continental Shelf poses special cost difficulties for Texas and Gulf coast ports. A Corps of Engineers report notes that along the Gulf, the Continental Shelf gets progressively wider as it reaches out to sea moving northeastward from the Mexican border. Hence the further east the port, the longer its entrance channel must be extended into the Gulf. At Port Isabel the natural 50-foot depth is only two miles offshore; at Galveston it is 11 miles; and at Sabine Pass it is 28 miles offshore. The report notes that if the offshore channel at Sabine Pass were to be deepened by only four feet, the approach channel would have to be extended for a distance of 14 miles. In addition to channel trenching costs, the lengthening of approach channels sometimes necessitates the costly extension of protective stone jetties.[25]

Increasingly important factors to port expansion will be the demand for spoil disposal areas and the attendant ecological impacts of material excavation and disposal. Increased land-use conflicts may result as current spoil disposal area capacity is approached and as the competition for land proximate to ports by industrial and residential activity is increased. This may force ports to consider offshore disposal or retention dikes where feasible. Additional constraints based on ecological factors will also increase in the future. Dredging, for example, poses dangers of salt water intrusion into fresh water estuaries. Port officials may be faced with stricter governmental standards based fundamentally on the ecological impact of spoil disposal. These criteria may tend to reduce the feasibility of extended port expansion projects.

The above considerations relate to the potential growth of huge bulk commodity ships and their influence on port and harbor development. General cargo traffic, however, is more important to Texas port systems as a high revenue-generating activity. Key development factors relate to the innovation diffusion of the container and its influence on the import-export flows of Texas ports.

A major advantage of the container is rapid ship turnaround; less than one day at a modern container berth. The standardized container is a box eight feet by eight feet by forty feet with or without wheels. Potential savings from containerization appear to include:

a. Reduced use of manpower for handling at all intermediate terminals
b. Reduction in non-labor costs of handling at intermediate terminals
c. Shippers' carry costs for time in transit (shortening of total transit time)

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[25]Port and Harbor Development. op. cit., p. 20-21.

d. Vehicle time required for loading and unloading
e. Reduction in loss of goods
f. Reduction in paperwork and simplification in applicable rates.[26]

Introduction of the container in view of the apparent cost savings would seem to indicate a tremendous increase in port traffic. Problems do arise, however, in containerization for Texas ports. Facilities to handle containers require huge capital outlays and special equipment is needed to handle the 40-foot containers. Facilities include an open quay with an apron at least 30-feet wide plus at least 10 to 20 acres of land adjacent to the quay that can serve as the marshalling area for inbound and outbound containers.[27] Although mobile, heavy-lift cranes are currently used at conventional piers, shore-based cranes designed specifically for containers are also necessary. One container berth may require three to five million dollars to build. The Port of Galveston, for example, is spending $9.2 million on a barge consolidation terminal, berths for special ships, and a 15-acre barge fleeting station.[28] The Port of Houston provides the only container service by any Gulf Coast port in 1970. Dockside facilities include a Paceco Portainer crane of 27-ton capacity, one 50-ton electric gantry crane, a 35-ton electric gantry crane and four mobile 82-ton cranes.[29] Marshalling yards at Houston have a capacity for more than 800 containers. High initial capital investment is thus necessary for containerization.

Other apparent or potential problems emerge from the diffusion of containerization. Since a substantial amount of the cost savings of containerization are due to a reduction in labor requirements at all terminal or interface points other than the true origin and destination, it is to be expected that labor will act to protect its interests. Rapid ship turnaround means fewer labor hours worked. Labor will, therefore, tend to object to cost-cutting or

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[26]Ralph E. Rechel, "Institutional Factors to be Considered in Forecasting the Rates of Implementation of New Technology," Papers - 10th Annual Meeting, Transportation Research Forum. (Oxford, Indiana: Richard B. Cross Co., 1969), p. 155-156.

[27]Eric Schenker, "The Effects of Containerization on Great Lakes Ports," Special Report No. 2. Center for Great Lakes Studies, The University of Wisconsin-Milwaukee, (February, 1968), p. 3.

[28]"Galveston, America's Newest Container Port," Port of Galveston. Galveston Wharves, (March, 1970), p. 13.

[29]"Houston, The Pioneer Container Port, Ready Today for Unlimited Shipments," Port of Houston Magazine. (April, 1970), p. 19.

labor-discarding.[30] Other problems such as changes in terminal configurations, standardization, customs procedures, commodity adaptations, ownership, maintenance, rates and interface with rail and truck modes may tend to slow down, but will not shift the direction of change toward containers in the future.[31]

Several preliminary generalizations concerning Texas ports result from the above considerations. Ports with the greatest balance of trade will receive the majority of the container traffic. This balanced trade requirement stems from the nature of the container innovation - that the container is essentially a "load center" device. Container economics forces concentration of traffic at a limited number of selected ports.[32] Containers will move through regular route operations to maximize advantages of the expensive container ships. This may tend to "regionalize" the flow of major traffic to certain Texas ports and force smaller ports into specializing in non-container, barge-oriented operations of transshipped general cargo and bulk goods over the next 30 years. Route expansions may occur as competition increases among container lines. Estimates of the future role of container traffic are not generally available. The Port of Houston has estimated that by 1975, one-half of the foreign trade general cargo, or two and one-half million tons, will be moving in containers over its wharves.[33] Increased traffic in bulk commodities will depend on the expansion capabilities of ports. Development of an offshore terminal, however, may tend to relieve most Texas ports of a costly expansion program to compete in bulk commodities trade.

4. Future Growth Factors of Texas Commercial Fisheries

Commercial fisheries of Texas are clearly oriented to the production of shrimp and oysters from bays and estuaries along the coast and from the Gulf of Mexico. The future of Texas fisheries is likely to remain primarily in the production and processing of shrimp from the Gulf.

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[30] "Automation - The Outlook for the Longshore Worker," Statement by the International Longshoreman's Association, AFL-CIO, in Statements Relating to the Impact of Technological Change, Appendix, Vol. VI, Technology and the American Economy. National Commission on Technology, Automation and Economic Progress. (February, 1966), p. 154.

[31] Gayton E. Germane, "Impact of Containerization on Ocean Transportation: Dimensions of the Problem," Papers - 8th Annual Meeting, Transportation Research Forum. (Oxford, Indiana: Richard B. Cross Co., 1967).

[32] Schenker, Special Report No. 2. op cit., p. 8.

[33] "Houston, the Pioneer Container Port..." op. cit., p. 19.

Major factors affecting the future growth and development of the Texas fishing fleets and processing plants are:

a. The rate of technological innovation
b. Availability of a skilled or semi-skilled labor force
c. Economies of scale from larger size fishing vessels and collateral arrangements on fuel, ice and other supplies
d. The availability of resource information and reliable forecasts to cut search time for fish and improve scheduling and equipment use
e. Applicability of new technologies toward efficient harvesting
f. Adoption of economic management systems which will discourage over-capitalization and overbuilding of vessels for harvesting limited resources
g. Government policy toward the fishing industry
h. Demand for shrimp.[34]

Much of the success of the fishery industry has resulted from the increased United States demand for shrimp. Chapter V noted that the income elasticity for shrimp was 1.43 which meant that the percentage increase in consumption demand for shrimp was greater than the percentage increase in income by consumers. This income elasticity relationship implies that shrimp may be a "normal" or "superior" good, meaning that shrimp may be considered a relative luxury food item in the food expenditures of consumers.[35] Between 1936 and 1968, United States per capita consumption of shrimp increased over 400 percent. Between 1950 and 1968 per capita consumption increased by 114 percent. Assuming that shrimp prices do not increase faster than the general consumer price level, per capita consumption is projected to increase 53 percent between 1968 and 1975, and 103 percent between 1968 and 1980.[36] Production forecasts of fresh and frozen processed shrimp by product type and by area from 1970 to 1985 are provided in Table 56. The table indicates that breaded shrimp will account for 55 percent of total processed shrimp output in 1985.

One of the modern innovations emerging in commercial fishing includes the shift to steel, fiberglass and aluminum trawlers. The lower maintenance costs of these vessels are their primary advantage to the shrimping industry. In addition, the emphasis on

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[34] Marine Science Affairs, op. cit., p. 87-88.

[35] C. E. Ferguson, Microeconomic Theory, (Homewood, Illinois: Richard D. Irwin, Inc., 1969, revised), p. 88.

[36] Cleary, "Demand and Price Structure for Shrimp," op. cit., p. 45.

TABLE 56

PROJECTIONS OF FRESH AND FROZEN PROCESSED SHRIMP PRODUCTION BY PRODUCT TYPE AND BY AREA 1970 to 1985

AREA	RAW	PEELED	BREADED	TOTAL	WEIGHTED AVERAGE PRICE (PER POUND)
	(Thousand Pounds)				
Southern Texas					
1970	12,264	11,086	37,395	60,745	$1.028
1975	13,493	16,036	49,430	78,959	1.035
1980	14,447	21,805	61,178	97,430	1.043
1985	15,599	27,261	73,892	116,752	1.047
Central and Northern Texas					
1970	15,131	1,534	4,539	21,204	0.915
1975	16,647	2,219	6,000	24,866	0.916
1980	17,825	3,018	7,426	28,269	0.918
1985	19,246	3,773	8,969	31,988	0.919

SOURCE: Demand and Price Structure for Shrimp, 1969, Donald P. Cleary, Division of Economic Research, Bureau of Commercial Fisheries, U. S. Department of the Interior, Washington, D. C.

recovery of shrimping "by-products" called trash fish to supplement the income-potential of the total fishing effort will tend to increase the profitability and growth of this industry. Heretofore, shrimpers have extracted the shrimp from their seine hauls and discarded the "trash" fish. Recognition of the value of these by-products should result in shrimpers becoming multiple-product entities where profit disadvantages of one product can be offset by income from more profitable catches.

5. Factors Affecting Future Growth of Marine Recreation and Tourism Activities

The rise in disposable per capita income and leisure time and the increased mobility of participants will be the major factors influencing demand for marine recreation and tourism activity in Texas. As persons take more of their productivity-based income increases in more leisure time activity, the pressure of outdoor marine recreation on the Texas coast from local and non-local persons will greatly increase.

Consumer preferences with regard to leisure time use are difficult to measure. Dimensions of future leisure can be indicated under varying assumptions as to growth in productivity, preferences between goods and leisure, or even between marine-oriented leisure activity and non-marine leisure time activity. Three major considerations in assessing the allocation between goods and leisure time are:

a. Total amount of free time made available by the anticipated improvements in output per manpower
b. Allocation of the different forms of leisure
c. Impact of the distribution of leisure.

An indication of the United States growth in leisure time has recently been estimated by the federal government.[37] Noting that two-thirds of this century's productivity gains have been taken in the form of goods and one-third in free time, and given certain assumptions regarding population growth of the gross national product (GNP) and other economic indications, the report estimates in Table 57 that more than 30 billion hours will be released for non-working activity by 1985. The table is based on the following assumptions: between 1963-85, the growth rate of the GNP will be 4.1 to 4.2 percent per year; population will grow by 1.5 percent annually; and unemployment will average 4.5 percent. Leisure time may be increased by reduction of the work week, increased vacation time, holidays, or other methods. Given the allocation of two-thirds to goods and services and one-third to leisure, GNP is projected to rise to more than a trillion dollars by 1980 and to $1.3 trillion by 1985. Per capita GNP would increase to more than $4,400 by 1980 and to nearly $5,000 in 1985. Assuming certain increases in vacation time, work week reduction and productivity gains through re-training for alternative jobs, more than 30 billion hours would be released for non-working time.

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[37] The Employment Impact of Technological Change. Report of the National Commission on Technology, Automation and Economic Progress, Appendix, Vol. II. (Washington: U. S. Government Printing Office, 1966), p. 362.

TABLE 57

POSSIBLE ALLOCATION OF GOODS AND LEISURE IN UNITED STATES PROJECTED TO 1985

YEAR	GROSS NATIONAL PRODUCT (Billions)	PRODUCTIVITY (Billions)	VALUE OF GOODS (2/3 OF PRODUCTIVITY)	VALUE OF LEISURE (1/3 OF PRODUCTIVITY)	PER CAPITA GNP	LABOR FORCE RE-TRAINED ANNUALLY (Percent)	ADDITIONAL VACATION (Weeks)	REDUCTION IN THE WORKWEEK (Hours)	HOURS RELEASED FOR NON-WORKING TIME (Millions)
1966	$ 649.0	$ 19.7	$ 13.1	$ 6.6	$3,247	1	---	---	1,507
1967	670.8	40.8	27.2	13.6	3,315	1	1/2	---	3,016
1968	696.3	62.4	41.6	20.8	3,388	1	1	---	4,483
1969	713.7	82.7	51.1	31.6	3,426	1	1	1/2	6,667
1970	743.5	107.0	71.3	35.7	3,519	1	1	2/3	7,336
1975	888.9	254.5	170.0	84.5	3,933	1	1	2 1/3	15,036
1980	1,095.0	464.2	309.0	155.2	4,413	4.25	1	2 1/2	23,303
1980*	1,095.0	464.2	309.0	155.2	4,413	1	2 1/2	2 1/2	23,303
1985	1,321.8	697.7	465.0	232.7	4,928	6.9	1	2 1/2	30,862
1985*	1,321.8	697.7	465.0	232.7	4,928	1	4	2 1/2	30,862

* Alternative assumptions for percentage of re-trained labor force and length of vacation.

Note: GNP projections and employment data from National Planning Association, Report, No. 65-1, March, 1965. Labor force data for other computations taken from Manpower Report of the President, March, 1965, p. 248, table E 2.

SOURCE: Juanita M. Kreps and Joseph J. Spengler, "The Leisure Component of Economic Growth," The Employment Impact of Technological Change, Washington, D. C.

Projections and other government forecasts indicate that Texas is expected to have a labor force of no less than six million and possibly up to eight million by the year 2000.[38] More than 2.6 million will be employed in the Texas Marine Region. A summary of the expected decrease in hours worked by industry groups from 1960 to the year 2000 is presented in Table 58 as a general indicator of the release in leisure time expected among different occupational activities in the future.

With more than 40 percent of the population, employment and personal income forecast to be accounted for by the Texas Marine Region in the year 2000, a staggering potential demand for the outdoor marine recreation facilities of Texas is apparent. Increased mobility via air and user-operator vehicles of out-of-state residents will also intensify the use of these facilities and the demand for marine recreation production such as outboard motorboats. skiis, underwater diving equipment, surfboards, sportsfishing equipment, tourist cabins and alternative accommodations along the coast. This means new business for Texas in the future and the growth of marine recreation and tourism that could easily rival the petrochemical manufacturing complex of Texas in economic importance over the next 30 years.

6. Government Roles in the Future of the Texas Marine Environment

Government involvement permeates every phase of marine industrial activity in Texas. All indicators point to an increased government role in the future development of the Texas coast.

Offshore industries must purchase leases on offshore areas from the government and pay royalties on their production; port systems must account for their imports and exports and require federal assistance for port expansion; commercial fishermen look to federal subsidies for fleet expansion; and the federal and state government provides national seashore and state parks areas for coastal visitors. The government itself uses coastal facilities for defense related activity. Examples include the naval base at Corpus Christi and the bombing-practice range on Padre Island.

Concern of both state and federal government is now concentrated on the socio-economic and ecological trends and conflicts in the area described as the "coastal zone." The State of Texas, following support by federal legislation, has initiated preliminary efforts to develop a comprehensive coastal resources plan for the Texas

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[38] Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation, ORRRC Report No. 23, Reports to the Outdoor Recreation Resources Review Commission. (Washington: Government Printing Office, 1962), p. 42.

TABLE 58

ESTIMATES OF DECREASES IN HOURS WORKED
BY MAJOR INDUSTRY DIVISION*
1960-2000

INDUSTRY DIVISION	DECREASE DUE TO-- INCREASED VACATIONS (Annual Hours per Employee)	INCREASED HOLIDAYS	REDUCED WORKWEEK	TOTAL DECREASE IN HOURS WORKED**
Mining	40	12	328	395
Contract Construction	51	14	349	432
Manufacturing	37	15	324	395
Transportation and Public Utilities	29	12	328	390
Wholesale and Retail Trade	51	13	323	411
Finance, Insurance, and Real Estate	37	11	323	395
Service and Miscellaneous	47	15	273	354
Government	42	11	296	374
Agriculture	18	11	373	468
WEIGHTED AVERAGE ALL DIVISIONS	45	14	325	406

* For analytical purposes, additional time for vacations and holidays should more appropriately be used in terms of days and weeks; additional time from reduction in hours worked (resulting from a shorter workday or week) should be used in terms of hours.

** Total includes, in addition to the reduction in average workweek and additional time for vacations and holidays, some allowance for a growth in miscellaneous leave (sick leave, military leave, administrative leave).

SOURCE: Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation, 1962, ORRRC, Report No. 23, Reports to the Outdoor Recreation Resources Review Commission, Washington, D. C.

Gulf Coast region which is being conducted by the Interagency Natural Resources Council.[39] Management of the nation's coastal resources through state agencies, where feasible, thus appears to be the trend. The government's presence has always been influential along the coast, but the deliberate, regional planning role of coastal areas is a relatively modern phenomena for Texas government.

Of particular importance is the government interest in subsidizing expansion in various marine industries, particularly fishing and shipbuilding; in funding marine-related research projects at educational institutions and with joint ventures with private industry; and concern for marine ecology particularly in regard to air and water pollution. Sensitivity of the government and the public to oil spill problems generated by offshore drilling incidents or by the mishaps near the coast by huge tankers is also a relatively novel phenomena. Industrial and residential pollution of the bays and estuaries where rich harvests of oysters and shrimp once occurred has resulted in off-limits zones for vessels operating in coastal areas.

To reduce oil spills, the government will introduce stricter rules for offshore industries and provide closer surveillance of tanker movements near coastlines. Implementation and enforcement of new regulations will require more personnel and equipment to be used by government and industry. Possible requirements may be installation of radar port systems to control ship traffic and help prevent collisions that would have serious consequences. The Coast Guard will also be provided with new powers to control vessel traffic on inland waters and establish new safety requirements for onshore and offshore activity.[40] These and other programs promise an increased interacting role for government in the Texas marine environment in the future.

7. General Observations and Estimates of Future Employment Scale of Marine Industries

Previous chapters and sections of this report tend to lead to the following summary observations:

a. Marine-related industries are a mixture of older and established activities (fishing, shipping) with relatively new and pioneering industries (offshore mining, underwater technology).

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[39] Coastal Zone Management Conference. Hearings before the Subcommittee on Oceanography of the Committee on Merchant Marine and Fisheries, House of Representatives, 91st Congress, 1st Session. (Washington: Government Printing Office, 1969), p. 179.

[40] "How Nixon Plans to Reduce Oil Spills," Ocean Industry, (July, 1970), p. 18.

b. The growth thrust influence of offshore industries is likely to result in increasing shifts of economic activity in the Texas Marine Region toward marine-dependent products and services.

c. The Texas Marine Region is likely to remain one of the world's major offshore manufacturing complexes.

d. Technological advances in deeper water mining of oil and gas will provide a great expansion stimulus for Texas offshore industries.

e. Texas ports and harbors are faced with critical investment decisions concerning their expected role in Texas and world trade. Shifts in world transport systems for commodities important to Texas international and domestic trade may result in a re-allocation of the current economic hierarchy of ports along the Texas coast over the next 30 years.

f. Future marine recreation and tourism activities in Texas will require increased Federal and state investment to secure and maintain coastal recreation outlets. Private industry output of "second homes," coastal tourist accommodations, boats and other marine supplies and services should soar over the next 30 years, given the expected increases in leisure time and income.

g. The government role and presence along the Texas coast is going to increase considerably. In particular, controls and subsidies for port operations, offshore mining, commercial fishing, shipbuilding and air and water pollution under the guise of protection of the area's ecology will increase. Although the Federal input along the Texas coast is large, the Texas coastal economy does not rely heavily on Federal defense-related or other activity as a source of growth. The Federal presence, however, will increasingly be felt in the form of constraints on marine industries or grants and subsidies to marine industries and marine research and development activity.

To provide an approximation of the future scale of marine industries in the Texas Marine Region, the conservative assumption can be made that the ratio of current marine-related employment among economic activities to non-marine activities will remain the same over the next 30 years. Given this strict assumption, Table 59 provides the expected direct employment impact of marine industries in the Texas Marine Region to the year 2000. The table indicates that more than 90,000 persons are expected to be directly employed in marine activities in the Texas Marine Region by the year 2000. Marine transportation and offshore mineral industries will account for more than 56,000 of these employees.

TABLE 59

ESTIMATES OF MARINE-RELATED EMPLOYMENT GROWTH
BY INDUSTRY GROUPS IN THE TEXAS MARINE REGION
TO THE YEAR 2000

INDUSTRY	DIRECT EMPLOYMENT 1969	ESTIMATED DIRECT EMPLOYMENT 2000	PERCENT INCREASE
Offshore Mineral*	22,857	31,600	38.3
Marine Transportation	17,850	24,600	37.8
Fisheries	11,730	18,100	54.3
Marine Recreation and Tourism**	3,895	8,600	120.8
Government	5,200	7,900	51.9
TOTAL	61,622	90,800	

* Offshore Mineral includes S.I.C. 1300 series and marine construction, marine supplies and equipment and services. See Chapter III.

** Marine Recreation and Tourism includes only coastal tourist and other accommodations and services exclusive of Harris County. See Chapter VI.

SOURCE: Industrial Economics Research Division, Texas A&M University, College Station, Texas.

APPENDIX A

TEXAS MARINE REGIONS
(Counties)

PRIMARY MARINE REGION I

Austin
Brazoria
Brazos
Chambers

Colorado
Fort Bend
Galveston
Grimes

Hardin
Harris
Jasper
Jefferson
Liberty

Madison
Matagorda
Montgomery
Newton

Orange
Polk
San Jacinto
Tyler

Walker
Waller
Washington
Wharton

PRIMARY MARINE REGION II

Aransas
Bee
Brooks
Calhoun

Cameron
DeWitt
Goliad
Hidalgo

Jackson
Jim Wells

Karnes
Kenedy
Kleberg
Lavaca

Live Oak
Nueces
Refugio
San Patricio

Victoria
Willacy

SECONDARY MARINE REGION III

Atascosa
Bandera
Bexar
Comal

Duval
Fayette
Frio
Gonzales
Guadalupe

Jim Hogg
Kendall
LaSalle
McMullen

Medina
Starr
Webb
Wilson
Zapata

APPENDIX B

STANDARD INDUSTRIAL CLASSIFICATIONS FOR
MARINE INDUSTRIES IN TEXAS

I. Non Manufacturing Category

S.I.C.

0912	Finfish
0913	Shellfish
0919	Miscellaneous Marine Products
0989	Fish Hatcheries, Farms & Preserves
1311	Crude Petroleum & Natural Gas
1321	Natural Gas Liquids
1381	Drilling Oil & Gas Wells
1382	Oil & Gas Field Exploration Services
1389	Oil & Gas Field Services, NEC*
1442	Construction Sand & Gravel
1446	Industrial Sand
1477	Sulfur
1481	Non-metallic Minerals (Except Fuel) Services
1621	Heavy Construction, Except Highway & Street Construction
4011	Railroads, Line Haul Operations
4013	Switching & Terminal Companies
4041	Railway Express Service
4212	Local Trucking & Draying, Without Storage
4213	Trucking, Except Local
4214	Local Trucking & Storage, Including Household Goods
4225	General Warehousing & Storage
4226	Special Warehousing & Storage, NEC
4411	Deep Sea Foreign Transportation
4421	Transportation to & Between Non-contiguous Territories
4422	Coastwise Transportation
4423	Intercoastal Transportation
4441	Transportation on Rivers & Canals
4452	Ferries
4453	Lighterage
4454	Towing & Tugboat Services
4459	Local Water Transportation, NEC
4463	Marine Cargo Handling
4469	Water Transport Services, NEC
4612	Crude Petroleum Pipelines
4712	Freight Forwarding
4721	Arrangement of Transportation
4782	Inspection & Weighing Services Connected with Transportation
4783	Packing & Crating
4789	Services Incidental to Transportation, NEC
4922	Natural Gas Transmission
4923	Natural Gas Transmission & Distribution
4925	Mixed, Mfg. of L.P. Gas Production and/or Distribution

* NEC - Not Elsewhere Classified

I. Non Manufacturing Category (Cont'd.)

S.I.C.

5046	Fish & Seafoods, Wholesale
5063	Electrical Apparatus & Equipment, Wholesale
5065	Electronic Parts & Equipment
5082	Construction & Mining Machinery & Equipment
5084	Industrial Machinery & Equipment
5085	Industrial Supplies
5088	Transportation Equipment & Supplies, Except Motor Vehicles
5091	Metals & Minerals, NEC
5092	Petroleum & Petroleum Products
5098	Lumber & Construction Materials, (Sand)
5421	Fish to Seafood Markets
5541	Marine Service Stations (Gasoline Service Stations)
5591	Boat Dealers
5952	Sporting Goods Stores
5982	Fuel & Ice Dealers
6332	Stock Fire, Marine, & Casualty Insurance Co.
6333	Mutual Fire, Marine, & Casualty Insurance Co.
6339	Fire, Marine & Casualty Carriers, NEC
6792	Oil Royalty Companies
7391	Commercial Research & Development Laboratories
7392	Business, Management, Administrative & Consulting Services
7399	Business Services, NEC
7699	Repair Shops & Related Services
8221	Colleges, Universities & Prof. Schools (Marine Schools)
8911	Engineering & Architectural Services

Federal Government

9101	Fisheries
9113	Crude Petroleum & Natural Gas
9144	Water Transportation

II. Manufacturing Category

S.I.C.

2031	Canned & Cured Fish & Seafoods
2036	Fresh & Frozen Packaged Fish & Seafoods
2812	Alkalies & Chlorine
2813	Industrial gases
2815	Dyes
2816	Inorganic pigments
2818	Industrial organic chemicals, NEC
2819	Industrial inorganic chemicals, NEC
2821	Plastics Materials, Synthetic Resins
2851	Paints, varnishes, Lacquers, Enamels, & Allied Products
2892	Explosives
2899	Chemicals & Chemical Preparations, NEC
2911	Petroleum Refining
2992	Lubricating Oils & Greases
3079	Miscellaneous Plastic Products
3295	Minerals & Earths, Ground or Otherwise Treated
3312	Blast Furnaces, Steel Works & Rolling Mills
3357	Drawing & Insulating of Nonferrous Wire
3362	Brass, Bronze, Copper, Copper Base Alloy Castings
3391	Iron & Steel Forgings
3429	Hardware, NEC
3441	Fabricated Structural Steel
3443	Fabricated Plate Work (Boiler Shops)
3449	Miscellaneous Metal Works
3471	Electroplating, Plating, Polishing, Anodizing & Coloring
3479	Coating, Engraving, & Allied Services, NEC
3491	Metal Shipping Barrels, Drums, Keys, & Pails
3494	Valves & Pipe-fittings, Except Plumbers Brass Goods
3498	Fabricated Pipe & Fabricated Pipe Fittings
3499	Fabricated Metal Products, NEC
3519	Internal Combustion Engines, NEC
3531	Construction Machinery & Equipment
3533	Oil Field Machinery & Equipment
3533	Oil Field Machinery & Equipment
3537	Industrial Trucks, Tractors, Trailers & Stackers
3561	Pumps, Air & Gas Compressors, & Pumping Equipment
3567	Industrial Process Furnace & Ovens
3573	Electronic Computing Equipment
3599	Miscellaneous Machinery, Except Electrical
3673	Transmitting, Industrial, & Special Purpose Electron Tubes
3681	Storage Batteries
3731	Ship Building & Repairing
3732	Boat Building & Repairing
3811	Engineering, Laboratory & Scientific & Research Instruments & Associated Equipment
3821	Mechanical Measuring & Controlling Instruments, Except Automatic Temperature Controls

APPENDIX C

REGION I, CORE REGION: COMPONENTS OF EMPLOYMENT CHANGE, 1940-1950

INDUSTRY	EMPLOYMENT IN 1940	EMPLOYMENT IN 1950	EMPLOYMENT IN 1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	1940-1950 CHANGES RELATED TO INDUSTRIAL MIX (P)	1940-1950 CHANGES RELATED TO DIFFERENTIAL SHIFT (D)	1940-1950 TOTAL CHANGE
1 Agriculture	26,120	17,589	15,133	6,967	-11,651	-3,843	-8,527
2 Forestry & Fisheries	584	917	532	156	-61	241	336
3 Mining	10,991	13,626	18,553	2,933	-2,783	2,487	2,637
4 Contract Construction	22,715	48,696	52,246	6,055	9,194	10,730	25,979
5 Food & Kindred Products Manufacturing	8,266	10,464	13,436	2,205	98	-104	2,199
6 Textile Mill Products	962	1,033	716	257	-183	-3	71
7 Apparel Manufacturing	1,306	1,825	1,848	350	84	86	520
8 Lumber, Wood Products, Furniture	6,330	7,878	5,180	1,688	1	-143	1,546
9 Printing & Publishing Manufacturing	4,099	6,020	8,053	1,093	351	476	1,920
10 Chemicals & Allied Products Manufacturing	1,477	13,436	28,214	394	343	11,225	11,962
11 Electrical & Other Machinery Manufacturing	9,359	12,288	23,215	2,496	6,335	-5,903	2,928
12 Motor Vehicles & Equipment Manufacturing	444	584	632	118	108	-88	138
13 Other Transportation	2,468	2,949	4,256	658	754	-931	481
14 Equipment Manufacturing & Other Miscellaneous Manufacturing	34,429	61,624	70,867	9,180	2,140	15,874	27,194
15 Railroads & Railway Express	9,896	13,273	10,758	2,639	-453	1,190	3,376
16 Trucking & Warehousing	6,514	6,887	11,699	1,736	792	-2,157	371
17 Other Transportation	11,989	16,742	17,823	3,196	3,889	-2,333	4,752
18 Communications	2,891	7,036	7,560	771	1,542	1,830	4,143

REGION I, CORE REGION: COMPONENTS OF EMPLOYMENT CHANGE, 1940-1950
(Continued)

INDUSTRY	EMPLOYMENT IN 1940	1950	1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
19 Utilities & Sanitary Service	4,641	9,231	13,129	1,238	816	2,536	4,590
20 Wholesale Trade	11,236	22,167	33,733	2,997	4,178	3,753	10,928
21 Food & Dairy Products Stores	12,101	16,180	20,639	3,227	-1,371	2,224	4,080
22 Eating & Drinking Places	12,596	19,767	19,444	3,361	3,074	741	7,176
23 Other Retail Trade	33,049	52,386	69,848	8,811	3,984	6,543	19,338
24 Finance, Insurance & Real Estate	12,642	19,976	31,422	3,372	506	3,457	7,335
25 Hotels & Other Personal Services	17,354	21,225	24,193	4,628	-2,859	2,104	3,873
26 Private Households	32,280	25,488	29,220	8,607	-18,235	2,836	-6,792
27 Business & Repair Services	7,150	12,184	18,864	1,907	1,770	1,359	5,036
28 Entertainment, Recreational Services	3,273	4,312	5,127	873	-66	233	1,040
29 Medical & Other Professional Services	21,613	40,249	77,409	5,764	3,756	9,117	18,637
30 Public Administration	7,381	14,340	20,127	1,968	3,152	1,838	6,958
31 Armed Forces	1,129	4,272	3,253	301	2,360	482	3,143
32 Industry Not Reported	4,290	6,174	36,302	1,144	-198	938	1,884
TOTAL	341,575	510,818	693,431	91,090	11,367	66,795	169,252

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965.

REGION I, CORE REGION: COMPONENTS OF EMPLOYMENT CHANGE, 1950-1960

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
1 Agriculture	2,722	-9,489	4,311	-2,456
2 Forestry & Fisheries	141	-375	-151	-385
3 Mining	2,110	-6,161	8,977	4,926
4 Contract Construction	7,539	-2,486	-1,503	3,550
5 Food & Kindred Products Manufacturing	1,619	1,402	-51	2,970
6 Textile Mill Products	160	-398	-79	-317
7 Apparel Manufacturing	283	-119	-140	24
8 Lumber, Wood Products, Furniture	1,218	-2,033	-1,884	-2,699
9 Printing & Publishing Manufacturing	932	1,080	20	2,032
10 Chemicals & Allied Products Manufacturing	2,080	2,100	10,596	14,776
11 Electrical & Other Machinery Manufacturing	1,902	3,824	5,202	10,928
12 Motor Vehicles & Equipment Manufacturing	90	-107	66	49
13 Other Transportation	456	2,562	-1,711	1,307
14 Equipment Manufacturing & Other Miscellaneous Manufacturing	9,542	2,013	-2,308	9,247
15 Railroads & Railway Express	2,054	-6,327	1,758	-2,515
16 Trucking & Warehousing	1,067	979	2,766	4,812
17 Other Transportation	2,591	-2,132	621	1,080
18 Communications	1,088	0	-564	524
19 Utilities & Sanitary Service	1,429	-96	2,565	3,898
20 Wholesale Trade	3,431	-847	8,980	11,564

REGION 1. CORE REGION: COMPONENTS OF EMPLOYMENT CHANGE, 1950-1960
(Continued)

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
21 Food & Dairy Products Stores	2,506	-2,826	4,782	4,462
22 Eating & Drinking Places	3,061	-1,789	-1,593	-321
23 Other Retail Trade	8,110	1,002	8,349	17,461
24 Finance, Insurance & Real Estate	3,092	4,955	3,397	11,444
25 Hotels & Other Personal Services	3,287	-2,375	2,056	2,968
26 Private Households	3,945	367	-580	3,732
27 Business & Repair Services	1,887	874	3,919	6,680
28 Entertainment, Recreational Services	669	-596	744	817
29 Medical & Other Professional Services	6,231	17,098	13,829	37,158
30 Public Administration	2,221	1,707	1,860	5,788
31 Armed Forces	659	2,288	-3,968	-1,021
32 Industry Not Reported	957	11,982	17,190	30,129
TOTAL	79,079	16,077	87,456	182,612

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965.

REGION I: COMPONENTS OF EMPLOYMENT CHANGE, 1940-1950

INDUSTRY	EMPLOYMENT IN 1940	1950	1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
1 Agriculture	71,834	43,416	30,572	19,156	-32,043	-15,528	-28,415
2 Forestry & Fisheries	882	1,315	899	234	-92	295	437
3 Mining	13,693	18,029	22,361	3,653	-3,468	4,152	4,337
4 Contract Construction	26,534	55,406	59,476	7,073	10,739	11,055	28,867
5 Food & Kindred Products Manufacturing	8,897	11,492	14,935	2,373	104	115	2,592
6 Textile Mill Products	1,153	1,290	999	309	-218	49	140
7 Apparel Manufacturing	1,317	1,855	2,005	353	84	102	539
8 Lumber, Wood Products, Furniture	13,275	15,716	10,593	3,542	1	-1,105	2,438
9 Printing & Publishing Manufacturing	4,368	6,400	8,600	1,165	373	492	2,030
10 Chemicals & Allied Products Manufacturing	1,698	13,780	28,641	453	394	11,241	12,088
11 Electrical & Other Machinery Manufacturing	9,477	12,545	23,564	2,529	6,414	-5,878	3,065
12 Motor Vehicles & Equipment Manufacturing	451	646	643	120	109	-38	191
13 Other Transportation	2,495	3,050	4,534	665	762	-874	553
14 Equipment Manufacturing & Other Miscellaneous Manufacturing	34,918	62,856	73,519	9,310	2,171	16,456	27,937
15 Railroads & Railway Express	11,234	14,644	11,660	2,997	-513	927	3,411
16 Trucking & Warehousing	7,085	7,676	12,726	1,890	862	-2,162	590
17 Other Transportation	12,555	17,810	18,633	3,346	4,078	-2,167	5,257
18 Communications	3,218	7,781	8,265	857	1,718	1,988	4,563

REGION I: COMPONENTS OF EMPLOYMENT CHANGE, 1940-1950
(Continued)

INDUSTRY	EMPLOYMENT IN 1940	1950	1960	1940-1950 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
19 Utilities & Sanitary Service	5,083	10,418	14,505	1,354	894	3,086	5,334
20 Wholesale Trade	12,323	23,973	35,791	3,289	4,582	3,779	11,650
21 Food & Dairy Products Stores	14,267	19,049	23,671	3,804	-1,616	2,595	4,783
22 Eating & Drinking Places	14,216	22,575	22,406	3,794	3,469	1,103	8,366
23 Other Retail Trade	37,987	59,778	79,264	10,128	4,581	7,084	21,793
24 Finance, Insurance & Real Estate	13,504	21,267	33,586	3,601	539	3,622	7,762
25 Hotels & Other Personal Services	19,525	23,766	26,964	5,209	-3,219	2,251	4,241
26 Medical & Other Professional Services	38,657	30,341	34,530	10,308	-21,838	3,214	-8,316
27 Business & Repair Services	8,456	14,016	20,736	2,256	2,091	1,215	5,562
28 Entertainment, Recreational Services	3,758	4,772	5,616	1,002	-75	89	1,016
29 Medical & Other Professional Services	27,165	48,399	89,123	7,244	4,723	9,271	21,238
30 Public Administration	9,358	16,904	23,089	2,496	3,998	1,054	7,548
31 Armed Services	1,129	4,415	3,555	301	2,360	625	3,286
32 Industry Not Reported	5,382	7,928	39,690	1,434	-250	1,360	2,544
TOTAL	435,894	603,308	785,151	116,245	-8,286	59,468	167,427

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965.

REGION I: COMPONENTS OF EMPLOYMENT CHANGE, 1950-1960

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
1 Agriculture	6,721	-23,424	3,857	-12,846
2 Forestry & Fisheries	200	-539	-80	-419
3 Mining	2,793	-8,151	9,690	4,332
4 Contract Construction	8,579	-2,829	-1,679	4,071
5 Food & Kindred Products Manufacturing	1,779	1,541	124	3,444
6 Textile Mill Products	198	-496	4	-294
7 Apparel Manufacturing	286	-120	-14	152
8 Lumber, Wood Products, Furniture	2,433	-4,057	-3,499	-5,123
9 Printing & Publishing Manufacturing	992	1,147	60	2,199
10 Chemicals & Allied Products Manufacturing	2,133	2,155	10,574	14,862
11 Electrical & Other Machinery Manufacturing	1,942	3,905	5,174	11,021
12 Motor Vehicles & Equipment Manufacturing	100	-117	16	-1
13 Other Transportation	470	2,651	-1,638	1,483
14 Equipment Manufacturing & Other Miscellaneous Manufacturing	9,732	2,054	-1,119	10,667
15 Railroads & Railway Express	2,266	-6,979	1,730	-2,983
16 Trucking & Warehousing	1,188	1,090	2,769	5,047
17 Other Transportation	2,757	-2,267	333	823
18 Communications	1,202	0	-718	484
19 Utilities & Sanitary Service	1,612	-109	2,583	4,086
20 Wholesale Trade	3,710	-917	9,021	11,814

REGION I: COMPONENTS OF EMPLOYMENT CHANGE, 1950-1960
(Continued)

INDUSTRY	1950-1960 CHANGES RELATED TO REGIONAL SHARE (R)	INDUSTRIAL MIX (P)	DIFFERENTIAL SHIFT (D)	TOTAL CHANGE
21 Food & Dairy Products Stores	2,952	-3,327	5,003	4,628
22 Eating & Drinking Places	3,496	2,042	-1,617	-163
23 Other Retail Trade	9,254	1,144	9,088	19,486
24 Finance, Insurance & Real Estate	3,294	5,276	3,750	12,320
25 Hotels & Other Personal Services	3,680	-2,660	2,175	3,195
26 Private Households	4,696	437	-944	4,189
27 Business & Repair Services	2,170	1,006	3,542	6,718
28 Entertainment, Recreational Services	741	-660	768	849
29 Medical & Other Professional Services	7,493	20,561	12,667	40,721
30 Public Administration	2,618	2,012	1,554	6,184
31 Armed Forces	680	2,366	-3,908	-862
32 Industry Not Reported	1,229	15,386	15,147	31,762
TOTAL	93,396	4,037	84,413	181,846

SOURCE: Growth Patterns in Employment by County, 1940-1950 and 1950-1960. Vol. 6, Southwest. Washington, D. C., 1965.

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