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**Impacts of Recreational and Commercial Fishing and Coastal
Resource-Based Tourism on Regional and State Economies**

by

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1. Introduction

This study estimates the regional and statewide economic impacts of recreational and commercial fishing and bay and estuary related recreational activities in the six bay and estuary systems along the Texas Gulf Coast.

The study area covers six individual Texas bay and estuaries, including the Sabine-Neches estuary, the Trinity-San Jacinto estuary, the Lavaca-Tres Palacios estuary, the Guadalupe estuary, the Nueces-Mission-Aransas estuary, and the Laguna Madre estuary. Separate analyses were conducted for each estuary to estimate direct and total economic impacts of the recreation-related and commercial fishing sectors. In the Texas Water Development Board definition of estuaries, some counties are included in more than one estuary. To avoid double counting, a summary analysis was conducted separately for the Texas Gulf Coast region to estimate aggregate impacts.

The estuaries along the Texas Gulf Coast vary in terms of their size, population, and economic activity. Table 1.1 presents population, wage and employment data in the six estuaries. The smallest estuary regions are the Lavaca-Tres Palacios and the Guadalupe, in terms of population and employment. The Trinity-San Jacinto estuary region is the largest in terms of economic activity as well as population, since both the cities of Houston and Galveston are included in this area. There are 26 counties included in the six bay and estuary systems that include several large metropolitan areas. In 1995, the population for all 26 counties was 5,155,700 people.

Table 1.1 Average population, quarterly wage and employment in the six estuary systems along the Texas Gulf Coast, 1993-1995 average

Estuary	Population (persons)	Wage (\$mils)	Employment (jobs)
Sabine Neches	374,636	3,201	119,831
Trinity-San Jacinto	3,904,277	46,24	1,502,703
Lavaca-Tres Palacios	172,805	1,128	50,094
Guadalupe	159,701	974	55,526
Nueces-Mission-Aransas	456,854	3,809	498,853
Laguna Madre	1,200,820	6,187	622,279

Source: TWC and Texas State Data Center, 1997

Average travel expenditures for 1993-1995 in the region were \$6.2 billion (Texas Department of Commerce, TDOC, 1996). Table 1.2 shows travel expenditures and employment for the six estuaries. These figures include business and leisure travel expenditures spent within the area for all kinds of business and leisure activities, including bay and estuary related recreation. Eighty-seven percent of travel spending was in Harris, Cameron, Nueces, Galveston and Jefferson counties. Given some of the major metropolitan areas in these counties, most of the travel expenditures in the area are not for water-related recreation and business. Nevertheless, these coastal areas are also attractive destinations for water-based recreational activities.

Table 1.2 Travel expenditures and employment in the six estuaries, 1995.

Estuary	Expenditures	Employment
	(\$mils)	(jobs)
Sabine Neches	209	3,240
Trinity-San Jacinto	4,861	88,240
Lavaca-Tres Palacios	101	1,480
Guadalupe	155	2,290
Nueces-Mission-Aransas	573	9,930
Laguna Madre	1,220	21,290

Source: TDOC, 1997

Commercial fishing activity in the bays and estuaries along the Texas Gulf Coast consists of bay (inshore) and gulf (offshore) fishing. Inshore commercial fishing for the Texas Gulf Coast was valued at \$37.8 million for the 1993-1995 period. The Galveston Bay system was the largest in terms of value of output, at about \$15 million. Ex-vessel value of output from inshore and offshore fishing during the same time period was \$175.4 million (Robinson, et al. 1996).

References and comparisons to the 1987 Fesenmaier study are made within the body of the report. The two studies were conducted using different data sources and models. Therefore, the comparisons should be interpreted with care.

In the following section, the methodology used in estimating economic impacts is defined. Section 3 describes the estimation of direct impacts of water-related recreation and commercial fishing for each estuary in detail. Section 4 summarizes the results and presents total impacts for all the estuary regions. The final section summarizes the report and makes recommendations for further research.

2. Methodology

Eight input-output models were developed for this analysis using IMPLAN. The IMPLAN model is a computer algorithm of a system of equations, each representing a sector of the economy and identifying the interrelationships among sectors (Olsen, et al., 1993). The system shows the interdependence of all sectors of the economy by capturing the intermediate sales among sectors, as well as sales to households, exports and other components of final demand. Using IMPLAN, input-output models may be developed for any county in the US or, by aggregation within the database, any group of counties to form a regional impact analysis.

The eight models developed for this study included: (1) one regional model for each of the six bay and estuary regions, (2) one regional model for all the 26 counties along the Texas Gulf Coast, and (3) one model for the Texas economy to capture statewide impacts.

In the 1987 Fesenmaier study (Fesenmaier et al., 1987), an extensive survey of recreation participants was conducted to estimate direct impacts of estuarine-dependent recreational activities. No survey of participants was conducted for the present analysis. Instead, expenditure and recreational activity data compiled by the Texas Department of Commerce (TDOC) along with updated information from the 1987 survey were used to estimate direct impacts of recreational activities in the region. The TDOC data include a travel survey conducted by D.K. Shifflett and Associates Ltd. (D.K.S.&A Ltd.) along with total travel expenditures from 1987 to 1995 by county.

The D.K.S.&A. Ltd. survey uses Metropolitan Statistical Area (MSA) or Designated Market area (DMA). In this study, the MSA data were used because these counties included the best correspondence

with the counties included in the estuary region. The per person daily expenditure shares for seven MSA's along the Texas Gulf Coast were used to break down travel expenditure and estimate the share of business and leisure travel in the Texas Gulf Coast region. Direct impacts of commercial fishing were estimated using data from the Texas Parks and Wildlife Department (TPWD) and the National Marine Fisheries Service (NMFS).

An input-output model calculates multipliers, which show the impact of a change in the output of one sector on the output requirements of other sectors. Direct impacts estimated for each activity are then multiplied by these factors to estimate total impacts. The model provides several multipliers for each of the economic variables. These are:

1) The output multiplier, which is an estimate of the change in total output (business sales) by all sectors within the regional economy that results from a change in sales to the final demand by one particular sector in the economy.

2) The employment multiplier, which estimates the change in total employment (all jobs) throughout the regional economy that result from a change in sales to the final demand by a given sector.

3) The total income multiplier, which is an estimate of the change in total household income from all sources (wages, salaries, profits, and rents) resulting from a change in sales to the final demand of a given sector.

4) The value-added multiplier, which is an estimate of the change in total, regional economic returns from the employment of all resources of production in the economy from a change in sales to final demand by a given sector. Value-added is the same as the value of all goods and services produced within the study area. It is analogous to Gross Domestic Product as reported at the national level. Hence, value-added within a region may be referred to as gross regional product.

Multiplier estimates are expressed as the impact on a selected economic variable of a one dollar change in final demand. It is assumed that the functional relationship to final demand is linear so the multiplier may be used to estimate the impact of increased or decreased sales to final demand by any given sector in the economy.

The notion of multipliers rests on the difference between the initial effect of a change in final demand and total effects of that change. Total effects can be defined as the sum of direct and indirect effects (which does not include the effects generated by the increase in household incomes), or direct, indirect, and induced effects (which includes the effect of increased household incomes on the economy) (Miller and Blair, 1985). Impact estimates in this study include the effect of increased household incomes along with direct and indirect impacts.

Like any economic model, input-output analysis is limited by its assumptions and by the accuracy of the endogenous equations, as well as the data on exogenous variables that drive the model. Input-output analysis is limited by several assumptions. These include (1) categorization of individual firms by their primary products, (2) the linearity of all equations in the model, (3) the assumption of proportionality of output to inputs, and (4) fixed prices and technology.

Input-output analysis is also limited in terms of the use and interpretation of its results. In some cases, attempts are made to use input-output results as a means of evaluating and justifying public, or private, expenditures on projects. That is, the results are used as benefit-cost assessments. These uses of input-output models are incorrect. Input-output models are limited to providing information on secondary impacts of some economic activity. While this is most useful for planning purposes, it does not answer questions as to the feasibility or justification of the activity itself. Those questions are best answered using cost-benefit analysis.

Results of the study are presented in terms of total output, income, value-added and employment impacts, both at the regional and state levels.

3. Direct Impacts of Bay and Estuary Related Recreation and Commercial Fishing

3.1 Estimation of Travel Expenditures

Recreation and tourism-related activities provide economic benefits to the economy of the region where these activities occur as well as throughout Texas. These economic impacts can be classified into direct and secondary impacts. Impacts on a regional or state economy are typically indicated by total output value, employment or total income resulting from sales to final demand by a given sector of the economy. Estimation of economic impacts for recreational activities is not so straightforward, since the direct impacts (expenditures) are not organized within an economic sector but may be distributed over several sectors of the economy. Recreational activities such as boating, fishing, birdwatching, and others do not have immediately measurable economic values such as sales or payrolls. However, contribution to local businesses is significant as participants in these activities generate local income by recreational spending. Direct impacts for recreational activities are represented by estimated total expenditures by leisure travelers. These direct impacts also have secondary impacts on regional and state economies. To estimate secondary impacts of these activities, direct expenditures are allocated to the sectors in which money is spent, according to the Standard Industrial Classification (SIC) to match up with the input-output model. Secondary impacts are estimated to be the direct recreational expenditures multiplied by the input-output multiplier.

Since no survey was conducted for this study, the choice of methodology to estimate direct impacts was dictated by availability of data and a desire for a consistent methodology for all six estuaries. An estimate of total expenditures by leisure travelers participating in water-related activities was obtained by using direct impact estimates from the 1987 Fesenmaier survey and projecting them to 1995. Projections were made using a trend function developed from total expenditure data for all estuary regions along the Texas Gulf Coast and the Texas Gulf Coast Region from TDOC for the period 1987-1995 (Table 3.1). Total travel expenditures were regressed using a trend function defined as:

$$X = b m t$$

Where:

X = total travel expenditures

b = constant

m = growth rate

t = years

The estimate for m , the growth rate, varied from 1.04 to 1.08 among the estuaries, which represent increases in expenditures of about 4 to 8 % per year during the period. Travel expenditures presented in Table 3.1 include all expenditures for travel, including business travel.

Travel expenditures vary from one region to the other. The Trinity-San Jacinto region has the largest travel expenditures among all the other estuary regions. This is partly because Houston and Galveston are included in this region and they account for a large number of business and other leisure travel as well as water-related travel. Along the Texas Gulf Coast, travel expenditures were about \$6.5 billion in 1995 (Table 3.1).

Assuming expenditures for water-related activities increased at the same rate as total travel related expenditures, the 1987 estimates for water-related expenditures for each estuary from the Fesenmaier study were used as a base and total expenditures by leisure travelers participating in water-related activities were projected for 1995 (see Appendix I).

Estimated expenditures in 1995 and expenditures from the 1987 study are shown in Table 3.2. The

estimated changes in nominal expenditures include inflation that occurred during the 1987 through 1995 period. To estimate real change, an alternate projection was made of bay and estuary-related recreational expenditures discounted for annual inflation using the Consumer Price Index (CPI). This projection more nearly estimates the real increase in expenditures that result from more visitors or greater spending by the same number of visitors. Table 3.2 shows the real change in expenditures compared to estimated nominal expenditures in 1995.

Table 3.1. Total travel expenditures for the Six Estuary Regions and the Texas Gulf Coast, 1987-1995.

Year	Expenditures						
	Sabine-Neches	Trinity-San Jacinto	Lavaca-Tres Palacios	Guadalupe	Nueces-Mission-Aransas	Laguna Madre	Texas Gulf Coast*
	(\$millions)						
1987	317	3,555	134	137	360	698	4,800
1988	171	3,593	73	110	381	800	4,705
1989	172	3,147	77	86	321	701	4,155
1990	192	3,592	91	125	427	946	4,907
1991	209	3,861	98	138	469	1,032	5,293
1992	216	3,988	101	144	508	1,103	5,507
1993	212	4,317	97	145	520	1,152	5,879
1994	222	4,573	104	151	563	1,233	6,239
1995	209	4,861	101	155	573	1,220	6,504

Source: Texas Department of Commerce, 1996.

*Note that Texas Gulf Coast figures is not the sum of the rows, since some counties are in two estuaries. A separate model was constructed for the Coast to avoid double counting.

Bay and estuary-related expenditures show little real change from 1987 to 1995 in most regions. In fact, for some estuary regions, there has been virtually no change during the period. The largest growth was in the Laguna Madre estuary region, where water related expenditures grew 39 % from 1987 to 1995. Real expenditures in the Trinity-San Jacinto estuary region grew from \$294 million in 1987 to \$341 million in 1995, a 16% increase. In the Sabine-Neches, Lavaca-Tres Palacios, and Guadalupe estuaries, expenditures have changed very little (Table 3.2).

Table 3.2 Bay and estuary related recreational travel expenditures for the six estuaries along the Texas Gulf Coast

Estuary	Expenditures			
	Nominal		Real	
	1987	1995	1995 (1987 dollars)	Real % change
	(\$millions)			
Sabine Neches	16	21	16	no change
Trinity-San Jacinto	294	422	341	16%
Lavaca-Tres Palacios	41	60	45	4%
Guadalupe	5	7	5	no change
Nueces-Mission-Aransas	198	315	207	5%
Laguna Madre	119	222	164	39%
Texas Gulf Coast	587	867	606	3%

Source: Fesenmaier et al., 1987 and TDOC, 1996

3.2 Estimation of Direct Impacts of Bay and Estuary Related Recreational Activities

To estimate direct impacts of water-related tourism in the region, total expenditures needed to be broken down into sectors. This was done by using daily expenditure allocations for leisure travelers in the MSA's within each of the estuary regions. Per person daily expenditures for all six estuaries are shown in Table 3.3. For the Texas Gulf Coast region, the average of these daily expenditures was used. Per person daily expenditures for bay and estuary-related recreational activities throughout the Texas Gulf Coast was estimated as \$64, which is the average of per person per day expenditures for the MSA's along the Texas Gulf Coast (Table 3.3). Daily expenditures of travelers to each MSA varied in 1995. Travelers to the Galveston MSA spent about \$90 per day, compared to \$39 per day in the Brazoria MSA (Table 3.3).

Table 3.3. Leisure expenditures per person per day for each of the MSA's along the Texas Gulf Coast, 1995.

MSA	Travel Expenditures \$/ person/day
Beaumont-Port Arthur	47
Galveston	90
Houston	60
Brazoria	39
Victoria	66
Corpus Christi	69
Brownsville-Harlingen-San Benito	79
Average expenditures	64

Source: D.K.S.&A Ltd., 1996

To estimate direct impacts of recreational expenditures on each sector, a weighted average of daily expenditure shares for different sectors for the six estuaries was then used as an estimate of expenditure shares for the whole region. In the 1987 study, the same expenditure shares were used for each estuary and for the whole region. Given the availability of more detailed data for this study, an estimate of average daily expenditure pattern for the region was possible. Projected bay and estuary-related expenditures were allocated to the different sectors based on expenditure patterns from TDOC and D.K.S.&A. Ltd. The distribution into expenditure categories is shown in Table 3.4. The assumption is made here that the distribution of water-related travel expenditures to the various sectors is the same as that for all leisure travel. Expenditures by sector were then allocated to the corresponding sector in the input-output model for the purpose of estimating secondary impacts (Table 3.4).

Table 3.4. Bay and estuary related travel expenditures by expenditure category in the Texas Gulf Coast region, (\$ millions), 1995

Expenditure Category	Sabine-Neches	Trinity-San Jacinto	Lavaca-Tres Palacios	Guadalupe	Nueces-Mission	Laguna Madre	Texas Gulf	Corresponding Regional Economic Sector
Transport	8	127	15	2	83	65	248	Gas Service Stations
Lodging	1	3	8	1	52	26	104	Hotels and Motels
Food	5	97	16	2	69	48	196	Restaurants and Food Stores
Shopping	2	50	4	1	33	22	93	Amusement, Theaters, etc
Entertainment	2	26	7	.15	9	9	39	Miscellaneous Retail
Other	4	84	16	2	69	52	187	Miscellaneous Retail
Total	21	422	60	7	315	222	867	

Source: Estimated from TDOC and D.K.S.&A Ltd., 1996

*Note that Texas Gulf Coast figures is not the sum of the rows as some counties are in two estuaries, so a separate model was constructed for the Coast to avoid double counting.

It is estimated that leisure travelers participating in water-related activities spent \$248 million in the region for transportation, and about \$196 million for food-related purchases (food stores and restaurants). Other businesses impacted by direct expenditures include hotels and motels, amusement services, and miscellaneous retail (Table 3.4).

3.3 Visitation for Bay and Estuary Related Recreation

Total number of leisure visitor days to the six estuary regions and the Texas Gulf Coast were estimated using projected 1995 expenditures and data on daily expenditures by travelers from the D.K.S.&A Ltd. survey. Total leisure travel expenditures for 1995 for the Texas Gulf Coast were divided by expenditures per day for the region, resulting in an estimated 13,478,227 visits to the Texas Gulf Coast region in 1995 (Table 3.5). Largest number of visitor days in water-related recreational activities were in the Trinity-San Jacinto, Nueces-Mission Aransas and the Laguna Madre estuary regions. For the Trinity-San Jacinto estuary, expenditures for three MSA's were used, so in estimating visitation, each MSA's share in the total Trinity-San Jacinto visitation could be distinguished. Total number of visitor days for the Houston MSA were about 6.3 million visits compared to only 373,794 and 219,179 thousand to the Brazoria and Galveston MSA's (Table 3.5).

Table 3.5. Total number of visitor days for water related activities in the Six Estuaries and the Texas Gulf Coast, 1995.

Region	Number of Visitor Days
Sabine-Neches Estuary	470,000
Trinity-San Jacinto (total)	6,890,286
Galveston MSA	373,794
Brazoria MSA	219,179
Houston MSA	6,297,313
Lavaca-Tres Palacios	904,538
Guadalupe	104,992
Nueces-Mission Aransas	4,567,489
Laguna Madre	2,807,351
Texas Gulf Coast*	13,478,227

Source: Estimated from D.K.S.&A Ltd. and TDOC.

*Note that Texas Gulf Coast figures is not the sum of the rows as some counties are in two estuaries, so a separate model was constructed for the Coast to avoid double counting.

3.4 Recreational Fishing in the Texas Gulf Coast

Sport-fishing is a popular recreational activity in Texas. According to the National Survey of Fishing, Hunting, and Wildlife Associated Recreation (administered by the U.S. Fish and Wildlife Service) in 1996, Texas was third after California and Florida in sport fishermen expenditures with a total of about \$2.9 billion. These expenditures were by both fresh and salt water fishing activity as well as expenditures on equipment and other items not related directly to trips. A recent study estimated the economic impact of recreational fishing in Texas as \$6.37 billion in output and 80,282 in employment (Maharaj, 1996). Saltwater fishing accounted for \$1.9 billion of the total output impact.

Since no survey was carried out for the present study, an attempt was made to draw estimates of expenditures and participation based on other research. Along with the Maharaj study, data from the TDOC,

TPWD, results of the 1987 Fesenmaier study were used to estimate recreational and fishing visitation and expenditures in 1995 for the Texas Gulf Coast region. However, it should be noted that all these surveys and studies were conducted at different times, using different methodologies, so the results are not directly comparable. This exercise is only intended to provide some insight into the trends associated with recreational fishing in the region.

In 1996, 31% of all expenditures (including equipment and other expenses) were by saltwater fishermen (Table 3.6). Assuming trip expenditures (spending during trips for food, lodging and transportation) were distributed in the same manner, saltwater fishermen spent \$370 million during their fishing trips. Hence, these expenditures by sport fishermen would constitute about 43% of all recreational expenditures in 1995 as estimated in the present study (Table 3.4). In 1987, 62% of total recreational expenditures was by sport fishermen.

Table 3.6. Distribution of Total Expenditures and Trip Expenditures by Type of Fishermen, 1996.

Type of Fishermen	Total Expenditures (\$ millions)	Trip expenditures (\$ millions)	% share of trip expenditures
Freshwater	1,916,488,984	825,601,217	69
Saltwater	887,612,938	369,190,703	31
Total	2,869,558,423	1,194,791,920	

Source: Maharaj, 1996.

Note: Sum of total expenditures will not be equal due to an inability to assign some expenditures to fresh or salt water.

Estimates for visitation were derived using data for saltwater stamp sales trends. These trends were used to project visitation in 1995 using the results from the 1987 Fesenmaier et al. study. Table 3.7 shows number of saltwater stamp sales in Texas for 1987-1995. The projected growth rate of stamp sales was about 1% per year.

In 1987, recreational fishermen made 6,032,892 visits to the Texas Gulf Coast (Table 3.8). Using the growth rate, visitation in 1995 was projected as 6,729,976. Visitation and expenditures estimated in 1987 in the Fesenmaier et al. study are given in Table 3.8.

Table 3.7 Saltwater Stamp Sales in Texas, 1987-1995.

Year	Number of Saltwater Stamps
1987	520,699
1988	569,648
1989	566,132
1990	585,391
1991	576,108
1992	561,299
1993	574,359
1994	615,535
1995	605,093

Source: TPWD, 1998.

Table 3.8 Visitation and Expenditures by Recreational Fishermen, 1987.

Estuary	Visitation	% share of total	Trip expenditures	% share of total
	(visits)		(\$millions)	
Sabine-Neches	250,420	66	11	69
Trinity-San Jacinto	3,638,816	54	171	58
Lavaca-tres Palacios	555,972	86	36	88
Guadalupe	77,551	73	4	78
Nueces-Mission-Aransas	1,667,683	64	129	65
Laguna Madre	740,818	58	68	57
Texas Gulf Coast	6,032,892	59	364	62

Source: Fesenmaier, et al., 1987.

3.5 Direct Impacts of Commercial Fishing in the Six Estuary Regions and the Texas Gulf Coast

Total value of commercial fishing in the area was estimated using data from Robinson, et al. and the National Marine Fisheries Service (NMFS). These data were used to estimate the total value of inshore and offshore finfish and shellfish, as well as inshore shrimp. Since offshore landings for shrimp are reported only as a total for the state of Texas, a weighted allocation scheme (explained below) was developed to allocate the total to each estuary. This approach represents the production capacity of the estuary system and associated economic impacts. In other words, it represents the economic impacts generated by fish and shrimp caught in bay and estuary waters, which reflects the potential economic impact of fish and shrimp spawned from estuaries.

However, from a current economic point of view, it is important to differentiate economic impacts generated in the region from the output from commercial fishing activity elsewhere that land in the counties within the estuary. Fish and shrimp unloaded in a particular region will generate economic impacts in that region, through direct sales or processing, regardless of where they are caught. In this study, landings by county were used as an indicator of economic impacts. For commercial shrimp, data from NMFS were used. These data include shrimp landings by bay system, gulf zones, and by county landed.

In estimating direct impacts, three distinct scenarios were considered:

- I. bay system only (inshore catch),
- II. bay and gulf catch (inshore and offshore),
- III. total value of gulf and bay catch that land in the counties in the estuary, regardless of where they were caught.

Total value of output from commercial fishing in the region was used as an estimate of direct impacts for this industry. In addition, since landings from one year to the other may differ significantly, an average of landings in 1993, 1994, and 1995 was computed to represent a typical year. For each estuary region, direct impacts for the commercial fishing industry were estimated by the total ex-vessel value of finfish, shellfish, and shrimp landed in the corresponding bay systems (inshore), and the allocation for gulf fishing based on the percentage weight of each bay system in all catches along the Texas Gulf coast. Data from Robinson, et al., 1996, were used in developing weights and estimating direct impacts. This procedure is consistent with that of the 1987 study and assumes that the Texas offshore shrimp catch is landed in the same pattern as the

bay catch. As is shown by the comparison with the data used in scenario III, this assumption may not be true (Table 3.9).

The Texas Gulf Coast includes the seven bay systems including Sabine Lake and the Galveston, Matagorda, San Antonio, Aransas, Corpus Christi, Upper Laguna Madre, and Lower Laguna Madre bay systems. The commercial fishing industry is largest in the Trinity-San Jacinto estuary region. Some estuaries that have a relatively low catch attributable to their bays from both inshore and offshore fishing, have a sizeable commercial fishing industry when landings from all Gulf areas are considered (such as the Sabine-Neches estuary region in Table 3.9).

Direct impacts of commercial fishing in the Texas Gulf Coast region were estimated as \$205 million in the 1987 study (Fesenmaier et al., 1987), compared to \$175 million in 1995, representing a decrease of about 15% in current dollars (Table 3.9). In order to compare the value of output from commercial fishing in real terms, direct impacts for 1987 and 1995 were deflated by the Producer Price Indices (PPI) for those years. In real dollars, direct impacts of commercial fishing in 1987 and 1995 were \$199 and \$141 million respectively, showing an even larger decrease of about 29% from 1987 to 1995.

Table 3.9. Direct Impacts of Commercial Fishing for the six estuaries

Estuary	Inshore (Scenario I)	Inshore+offshore (Scenario II)	All landings (Scenario III)
	(\$mils)	(\$mils)	(\$mils)
Sabine Neches	1	1	17
Trinity-San Jacinto	16	62	43
Lavaca-Tres Palacios	8	45	23
Guadalupe	3	15	50
Nueces-Mission-Aransas	8	49	29
Laguna Madre	1	2	63
Total	37	175	225

Source: Estimated from Robinson, et al., 1996.

Direct impacts of commercial fishing were largest overall for the Trinity-San-Jacinto estuary region. In the Sabine-Neches and Guadalupe estuary regions, scenario III direct impacts were much higher than the inshore+offshore direct impacts because these estuaries include large metropolitan areas with higher consumption and processing (Table 3.9).

4. Statewide and Regional Impacts of Bay and Estuary Related Recreational Activities and Commercial Fishing

Estimated direct impacts presented in sections 3.2 and 3.5 provide the basis for projecting total economic impacts of recreation-related sectors and commercial fishing. Sales to recreational travelers participating in water-related activities by these sectors constitute initial impacts that stimulate demand for goods and services from other sectors of the economy through secondary and tertiary rounds of market exchanges. This “ripple effect” in the regional economy leads to a total impact that is larger than original sales transactions. The input-output model used in this study provides a methodology by which these successive rounds of impacts are aggregated into a total for regional and state economies (Leontief). Employment, personal income, and value-added are the most useful economic variables to use in comparing the relative contribution

of bay and estuary recreation related sectors. Output or total regional business sales are a less desirable variable because it includes double counting of sales of products as they move through the production, processing, and marketing system.

This section presents estimated regional and statewide impacts of recreation and commercial fishing in the six estuaries of Texas. The results are presented for all six estuaries and the Texas Gulf Coast region together, in order to make it easier to compare and contrast.

4.1. Regional and Statewide Impacts of Bay and Estuary Related Recreation in the Six Estuary Regions and the Texas Gulf Coast Region

Estimated impacts of recreation-related economic activities in the six estuary regions and the Texas Gulf Coast are given in Table 4.1. Estimates of total impacts are given for total regional output, personal income, value-added, and employment for each of the six recreation-related economic sectors.

Along the Texas Gulf Coast, the recreation-related sector generated 32,168 jobs at the regional level and 33,529 jobs statewide. Since most of these sectors are composed of labor intensive businesses, employment impact is significant. Among the six estuary regions, the Trinity-San Jacinto and Nueces-Mission-Aransas estuary regions had the greatest employment impacts where recreation-related sectors generated between 15,287 and 12,438 regional jobs, respectively (Table 4.1). Output impacts varied among regions from \$11 million in the Guadalupe Estuary region to \$758 million in the Trinity-San Jacinto region. Output impacts for the Gulf Coast were \$1.57 billion in the region and \$1.65 billion statewide. Value-added impacts were about \$1 billion in the Gulf Coast region (Table 4.1).

4.2 Regional and Statewide Economic Impacts of Commercial Fishing in the Six Estuary Regions and the Texas Gulf Coast Region

Total impacts of estimated commercial fishing for the three scenarios are presented in Tables 4.2, through 4.4. Direct impacts of commercial fishing (Table 3.9) were used to estimate total impacts using multipliers obtained from the input-output models developed for each of the estuary regions and the Texas Gulf Coast.

Estimated total regional and statewide economic impacts of inshore fishing for the six estuaries and the Gulf Coast are presented in Table 4.2. Inshore commercial fishing had an output impact of \$57 million in the region and \$59 million statewide. Among the estuaries, the Trinity-San Jacinto estuary region had the largest output impact with \$23 million. The smallest total impacts from offshore fishing were for the Sabine-Neches estuary region with only \$1.0 million in regional economic impacts. Regional value-added impacts ranged from \$16 million for the Trinity-San-Jacinto Estuary region to \$1.0 million for the Sabine-Neches Estuary region.

For the Gulf Coast region, the impacts were \$40 million for regional value-added impacts and \$17 for regional personal income impacts. Statewide, these impacts for the Gulf Coast were about \$41 million and \$18 million respectively, for value-added and personal income. Inshore commercial fishing generated 1,190 jobs in the Gulf Coast region and 1,309 jobs statewide (Table 4.3).

Total impacts of inshore and offshore commercial fishing in the six estuaries and the Gulf Coast region are presented in Table 4.4. Regional impacts of inshore and offshore commercial fishing combined generated \$265 million in output, \$80 million in personal income, \$185 million in value-added, and 5,558 jobs for the Texas Gulf Coast region. Impacts were larger statewide.

Impacts of commercial fishing for scenario III (landings from all areas of the Gulf) are presented in Table

Table 4.1 Estimated Regional and Statewide Economic Impacts of Bay and Estuary Related Recreational Activities in the Six Estuaries and the Texas Gulf Coast Region, 1995.

	Output (\$millions)		Personal Income (\$millions)		Value-Added (\$millions)		Employment (jobs)	
	Regional	State	Regional	State	Regional	State	Regional	State
Sabine Neches	34	41	14	17	22	26	799	833
Trinity-San Jacinto	758	812	325	332	491	511	15,287	16,483
Lavaca-Tres Palacios	95	115	37	47	60	72	2,381	2,435
Guadalupe	11	13	4	5	7	8	275	283
Nueces-Mission-Aransas	545	606	216	246	340	380	12,438	12,546
Laguna Madre	388	425	153	174	243	269	8,938	9,020
Texas Gulf Coast	1,565	1,655	651	674	999	1,040	32,168	33,529

Table 4.2 Estimated Regional and Statewide Total Economic Impacts of Inshore Commercial Fishing in the Six Estuaries and the Texas Gulf Coast Region, 1995.

Estuary	Output (\$mils)		Income (\$mils)		Value-added (\$mils)		Employment (jobs)	
	Regional	State	Regional	State	Regional	State	Regional	State
Sabine Neches	1	1	.26	.3	1	1	20	21
Trinity-San Jacinto	23	25	7	7	16	17	429	550
Lavaca-Tres Palacios	11	12	4	4	8	9	317	317
Guadalupe	4	5	1	2	3	3	107	112
Nueces-Mission-Aransas	13	14	4	4	9	10	258	312
Laguna Madre	2	3	1	1	2	2	52	56
Texas Gulf Coast	57	59	17	18	40	41	1,190	1,309

Estimated from Robinson et al., 1996.

Table 4.3 Estimated Regional and Statewide Economic impacts of inshore+offshore commercial fishing in the six estuaries and the Texas Gulf Coast Region, 1995.

Estuary	Output (\$mils)		Income (\$mils)		Value-added (\$mils)		Employment (jobs)	
	Regional	State	Regional	State	Regional	State	Regional	State
Sabine Neches	1	1	.37	.44	1	1	29	31
Trinity-San Jacinto	92	98	27	30	65	67	1,688	2,163
Lavaca-Tres Palacios	63	72	20	22	45	50	1,847	1,847
Guadalupe	20	23	6	7	15	16	497	518
Nueces-Mission-Aransas	71	78	21	24	50	54	1,427	1,726
Laguna Madre	4	4	1	1	2	3	78	84
Texas Gulf Coast	265	276	80	85	185	191	5,558	6,111

Table 4.4 Regional and Statewide Impacts of All Landings (scenario III) in the Six Estuaries and in the Gulf Coast Region, 1995.

Estuary	Output (\$mils)		Income (\$mils)		Value-added (\$mils)		Employment (jobs)	
	Regional	State	Regional	State	Regional	State	Regional	State
Sabine Neches	23	26	7	8	16	18	546	585
Trinity-San Jacinto	64	68	19	21	45	47	1,169	1,498
Lavaca-Tres Palacios	31	36	10	11	22	25	917	917
Guadalupe	68	80	21	25	49	55	1,690	1,761
Nueces-Mission-Aransas	43	47	12	14	30	32	851	1,029
Laguna Madre	93	100	28	31	65	69	2,041	2,206

4.4. These impacts are distributed differently among estuaries compared to scenario II impacts. The Laguna Madre estuary has a much greater impact in all variables compared to impacts under scenario II. Under this scenario, commercial fishing generates 2,041 jobs in the Laguna Madre estuary region and about \$65 million in value-added in the region. In the Trinity-San Jacinto Estuary region, on the other hand, economic impacts are lower with 1,169 jobs created in the region under scenario III versus 1,688 jobs under scenario II, (Tables 4.3 and 4.4).

5. Summary and Conclusions

This study estimates economic impacts associated with bay and estuary-related recreational activity and commercial fishing in the Texas Gulf Coast region. To estimate these economic impacts, input-output models were developed for each bay and estuary region, the Texas Gulf Coast regional economy, and Texas, using IMPLAN. Multipliers derived from the input-output models were then used to estimate secondary impacts for each recreation-related sector and commercial fishing.

As a first step in developing the input-output model and estimating economic impacts, direct impacts of bay and estuarine related sectors were estimated. Direct impacts (sales to final demand) were estimated for recreational travel-related sectors and commercial fishing. A summary of direct impacts by sector is shown in Table 5.1. Estimated direct impacts or sales to final demand (shown in Table 5.1) provide the basis for estimating total economic impacts of bay-related sectors in the Texas Gulf Coast region.

Table 5.1 Direct Impacts for Recreational Activities and Commercial Fishing in The Texas Gulf Coast region.

Sector	Direct Impacts (\$millions)
Total recreation	867
Commercial Fishing I (inshore only)	37
Commercial Fishing II (inshore+offshore)	175

5.1 Texas Gulf Coast Regional Impacts

It is estimated that bay and estuary recreation-related sectors sales to final demand stimulated total regional business sales of about \$1.6 billion, personal income of \$651 million, value-added of \$999 million, and around 32,168 jobs in the Texas Gulf Coast region (Table 5.2). For the case where fishing impacts are estimated by the sum of inshore and offshore landings, output impact of bay and estuary related sectors was estimated as \$265 million, along with a personal income impact of \$80 million, and employment impact of 5,558 jobs in the region (Table 5.2).

Table 5.2 Estimated Total Impacts of Recreational Activities and Commercial Fishing on the Texas Gulf Coast region and Texas, 1995.

Economic Impact Variable	<u>Recreational Activities</u>		<u>Commercial Fishing (scenario I)</u>		<u>Commercial Fishing (scenario II)</u>	
	Regional	Texas	Regional	Texas	Regional	Texas
Output (\$mils)	1,565	1,655	57	59	265	276
Pers. Income (\$mils)	651	674	17	18	80	85
Value-Added (\$mils)	999	1,040	40	41	185	191
Employment (jobs)	32,168	33,529	1,190	1,309	5,558	6,111

5.2 Statewide Impacts

Statewide impacts represent the estimated effects of the recreational activity related sectors and commercial fishing in the Texas Gulf Coast region on the rest of the state. Total statewide impacts can be interpreted as the regional impact plus the additional effects created elsewhere in the state by the sectors included in the study. For the Texas Gulf Coast region, the recreation related sectors were estimated to have an output impact of \$1,655 million and personal income impact of \$674 million with 33,529 jobs at the state level (including regional impacts).

Statewide impacts for commercial fishing, including both inshore and offshore fishing activity, were \$276 million for output with a value-added impact of \$185 million. In terms of employment, 6,111 jobs were created statewide for this scenario.

The estimated impacts developed in this study show a “snapshot” in time of the magnitude of the recreational and tourism and the commercial fishing industries in the Texas Gulf Coast. These industries clearly have significant impact on both the coastal and Texas economies. However, comparisons with the similar study conducted in 1987 reveal that the two activities are following different trends. While tourism and recreational use of the bays and estuaries continue to increase, the commercial fishing industry is declining both in terms of fish landings and value.

5.3 Future Research

Several areas of future research were identified in this study. Perhaps the greatest limitation encountered was a lack of data on bay and estuary-related tourism as well as recreation visitation and expenditures in the region. The data used to estimate impacts of tourism and related industries was the most current and complete available. Nevertheless, no data sources were found that provided information oriented directly to the objectives of the study. There is a need to collect current primary data in this industry by surveying recreational and commercial fisherman and tourists.

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Appendix I. Methodology for Estimation of Projected Travel Expenditures

$$X = b m^t \quad (1)$$

Where:

X = total travel expenditures

b = constant

m = growth rate

t = years

The estimated equation is:

$$\tilde{X} = 169 (1.036)^t \quad (2)$$

Given

$$\tilde{X}_{1995} = \tilde{b} \tilde{n} \quad (3)$$

$$\tilde{X}_{1987} = \tilde{b} \tilde{n}' \quad (4)$$

Where \tilde{X}_{1987} is the 1987 Fesenmaier estimate.

Solving for \tilde{X}_{1995} , from (3) and (4)

$$\tilde{X}_{1995} = m^8 (\tilde{X}_{1987})$$