

SABINE-NECHES ESTUARY

ECONOMIC IMPACTS OF RECREATIONAL ACTIVITIES AND COMMERCIAL FISHING

Prepared for the

TEXAS WATER DEVELOPMENT BOARD

by

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Sabine-Neches Estuary: Economic Impact of Recreational Activities and Commercial Fishing

I. Introduction

The primary objective of this study is to estimate regional and statewide economic impacts of estuarine dependent activities that generate income and employment in the Sabine-Neches estuary region. These include water-related recreational activities (travelers spend money in different sectors in the region) as well as the commercial fishing industry. Estimation of economic impacts of these uses of the bays and estuaries is crucial for sound water resource management. This study updates an earlier study (Fesenmaier et al., 1987) that estimated economic impacts of recreational activities and commercial fishing for six estuaries along the Texas Gulf Coast.

This report is one of six reports that provide estimates of the economic impacts of bay and estuarine dependent recreational activities and commercial fishing. Together these six reports provide regional and statewide economic impact estimates for the Texas Gulf Coast (Tanyeri-Abur et al., Economic Impact of Recreational Activities and Commercial Fishing, (1997a to 1997f)).

The Sabine-Neches estuary includes Hardin, Jefferson, and Orange counties (Figure I.1). In 1995, population in the area was 374,636, with the city of Beaumont as the largest urban population in the region. The 1993-1995 average employment was 119,831 and average wages paid were about \$3.2 billion (Table I.1). Most travel to the area is non water-related recreation and business, and the commercial fishing industry is

Figure I.1. Sabine - Neches estuary region

Sabine - Neches Region



small compared to other estuaries. The study area includes the Sabine Lake system. Blue crab is the most important seafood product for the bay fishing industry in the region.

Table I.1. Average quarterly wage and employment in the Sabine-Neches estuary region, 1993-1995.

Year	Wage (\$millions)	Employment (Jobs)
1993	3,021.27	116,864
1994	3,235.14	120,327
1995	3,346.49	122,304
3-Year Average	3,200.97	119,831

Source: Texas Workforce Commission (TWC)

Total travel expenditure, payroll, and employment for the Sabine-Neches estuary in 1995 are given in Table I.2. 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. Total travel expenditures in the region were \$208.6 million in 1995. Jefferson county alone accounted for about 80 percent total travel expenditures. Travel related employment in Jefferson county was 2,690 jobs compared to a total employment of 3,240 for the Sabine-Neches estuary region (Table I.2).

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.

Table I.2. Travel expenditures, payroll, and employment in the Sabine-Neches estuary region, 1995.

County	Travel Expenditures (\$millions)	Travel Payroll (\$millions)	Employment (jobs)
Hardin	8.96	1.4	100
Jefferson	166.58	40.12	2,690
Orange	33.1	6.08	450
TOTAL	208.64	47.6	3,240

Source: TDOC, 1996

II. Methodology

In the 1987 Fesenmaier study a 1979 Texas Input-Output model was updated and used to estimate economic impacts. The Texas model is no longer available in a current and regional format. The model used in the present analysis is IMPLAN, a large 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 input-output models, developed for each estuary, use the direct impact estimates from each of the bay related economic sectors as a starting point for estimating total economic impacts.

In the 1987 Fesenmaier study, an extensive survey was conducted to estimate direct impacts of estuarine dependent recreational activities. No survey was conducted for the present analysis. Instead, expenditure and recreational activity data provided 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 compiled by the TDOC. The D. K. S & A. Ltd. survey is by Metropolitan Statistical Area (MSA) or Designated Market Area (DMA). In this study the MSA's were used because the counties included in the MSA's provided the best correspondence with the counties included in the estuary region. The Beaumont-Port Arthur MSA data were used for travel expenditure breakdowns and share of business and leisure travel. Direct impacts of commercial fishing was estimated using data from the Texas Parks and Wildlife Department (TPWD), and the National Marine Fisheries Service (NMFS).

The input-output model calculates multipliers, which show the impact of an increase in the output of one sector on other sectors. Direct impacts estimated for each activity are then multiplied by these multipliers to estimate total impacts. There are several multipliers depending on the economic variable of interest:

- 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 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 results from a change in sales to 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 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 larger 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, which 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. Multipliers and detailed impacts are presented in Appendices II and III.

III. Recreation and Tourism

III.1. Estimation of Direct Impacts

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 for estimation of 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 from TDOC for the period 1987-1995 (Table III.1). Expenditures for 1987 were unusually large and were considered as an outlier in the data set. Expenditures for 1987 were therefore excluded

from the data to enable a more accurate projection of expenditures. 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, was 1.036 for the Sabine-Neches estuary, which represents an increase in expenditures of about 3.6 percent per year during the period. Assuming expenditures for water-related activities increased at the same rate, the 1987 estimate from the Fesenmaier study was used as a base and total expenditures by leisure travelers participating in water-related activities were projected for 1995 (see Appendix I). These expenditures were estimated as \$21.49 million for the Sabine-Neches estuary compared to \$16.14 million in 1987, an increase of about 33 percent for the period.

Table III.1. Total travel expenditures for the Sabine-Neches Estuary, 1987-1995.

Year	Expenditures (\$millions)
1987	317.26
1988	170.54
1989	172.24
1990	191.56
1991	209.22
1992	215.65
1993	211.90
1994	221.70
1995	208.64

Source: Texas Department of Commerce, 1996.

These changes in expenditures include inflation that occurred during the 1987 through 1995 period. An alternate projection was also made of recreational expenditures discounted for annual inflation using the Consumer Price Index. This projection more nearly estimates the real increase in expenditures that result from either more visitors or greater spending by the same number of visitors. In real terms, 1995 expenditures were estimated to be \$16.15 million. Hence, in real terms, recreational expenditures in the Sabine-Neches estuary region showed no change during the study period.

Direct impacts of water-related recreational activities by economic sector in the study area were estimated using average daily expenditure shares from D.K.S.&A Ltd (Table III. 2). The assumption is made here that the distribution of water-related 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 III.3).

Table III.2. Distribution of leisure expenditures per person per day, Beaumont-Port Arthur MSA, 1995.

Travel Expenditures		
Expenditure Category	\$/ person/ day	% of total
Transport	17.4	0.37
Lodging	2.6	0.06
Food	10.6	0.23
Shopping	3.6	0.08
Entertainment	4.5	0.10
Other	8.4	0.18
Total	47.1	1.00

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

Visitors to the area for all leisure purposes spent approximately \$47.1 per person per day in the Beaumont-Port Arthur MSA in 1995 (Table III.2). Out of this total, the majority of daily expenditures were for transportation and food. Using shares of each expenditure category, total regional expenditures were allocated to the major expenditure categories. Expenditures in these categories were then allocated to appropriate sectors that are represented by SIC's to be used in the input-output model to estimate secondary impacts. The allocation of estimated 1995 direct recreational expenditures (\$21.49 million) to Sabine-Neches regional economic sectors is shown in Table III.3.

Table III.3. Direct Impacts of bay and estuary recreation related sectors in the Sabine-Neches estuary region.

Expenditure category	Total (\$millions)	Corresponding Regional Economic Sector
Transport	7.94	Gas Service Stations
Lodging	1.19	Hotels and Motels
Food	4.84	Restaurants and Food Stores
Shopping	1.64	Miscellaneous Retail
Entertainment	2.05	Amusement, Theaters, etc
Other	3.83	Miscellaneous Retail
TOTAL	21.49	

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

It is estimated that leisure travelers participating in water-related activities spent \$7.94 million in the region for transportation, and about \$4.8 million for food related purchases (food restaurants and stores). Other businesses impacted by direct expenditures include hotels and motels, amusement services, and miscellaneous retail (Table III.3).

III.2. Visitation patterns and trends

Total number of leisure visitor days to the Sabine-Neches estuary 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 the Sabine-Neches estuary in 1995 were \$21.49 million and travelers spent \$47.1 per person per day, on average.

Dividing total expenditures by per-person expenditures yields an estimated average of 470,000 annual visits for bay and estuary related recreation activities in 1995.

III.3. Regional and Statewide Impacts

Estimated direct impacts presented in Table III.3 provide the basis for estimating total economic impacts of recreation related sectors in the Sabine-Neches estuary region. 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 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).

Estimated impacts of recreation related economic activities in the Sabine –Neches estuary region are presented in Table III.4. 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. These are calculated using economic impact multipliers for the Sabine-Neches estuary region given in Appendix II. It is estimated in total, that these sectors’ sales to final demand stimulated total regional business sales of over \$34 million, personal income of \$14 million, value-added of \$22 million and over 799 jobs in the Sabine-Neches region (Table III.4).

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 is a less desirable variable because it includes double counting of sales of products as they move through the production, processing, and marketing system.

Table III.4. Regional and statewide impacts of water-related recreational activities in the Sabine-Neches estuary region, 1995.

Economic Impact Variable	Total Impacts	
	Regional	State
Direct Impact (\$ mil)	21.49	21.49 ^a
Output (\$ mil)	34.39	41.08
Personal Income(\$ mil)	14.20	16.95
Value-Added (\$ mil)	22.14	26.24
Employment (jobs)	799	833

a/ State level economic impacts are derived from regional direct expenditures. They are generally larger in magnitude because they include secondary and tertiary impacts that occur outside the Sabine-Neches estuary region, but within the state.

Statewide impacts are slightly larger for all variables. Recreation related industries contribute 34 additional jobs and an additional \$2.75 million in personal income at the state level (Table III.4).

In constructing the model to estimate total impacts, it was not possible to develop a multiplier for tourism and recreation because expenditures from these activities are spread among several sectors. However, after the analysis, “pseudo-multipliers” may be constructed. Total impacts presented in Table III.4 are based on an estimated \$21.5 million annual expenditure by recreationists in the regional economy (Table III.3).

Therefore, it may be stated that, on average, each dollar of tourist and recreationist expenditures resulted in about \$1.60 in total output, \$0.67 of personal income, and \$1.03 of value-added in the Sabine-Neches estuary regional economy. In addition, an employment multiplier of about 37 jobs per million dollars of tourist and recreationist expenditures is indicated by the analysis.

IV. Commercial Fishing

The Sabine-Neches estuary includes the Sabine Lake Bay System (Figure I.1). Commercial fishing in the area is composed of two distinct activities: bay fishing (inshore) and gulf fishing (offshore). Bay fishing primarily consists of smaller boats that sell their catch at points of landing in the local area. Gulf fishing uses larger commercial boats that may fish over a wide expanse of the Gulf of Mexico. Gulf boats fishing the waters off the Sabine-Neches estuary may sell their catch locally or outside the region. Likewise, gulf boats fishing in areas remote from the Sabine-Neches estuary may land fish and shrimp in counties within the estuary.

The Sabine Lake system accounts for \$608 thousand in ex-vessel value of finfish, shellfish, and shrimp landings (estimated from Robinson, et al. 1996). The majority of this value is from blue crab. Ex-vessel landings, both from the Sabine Lake bay system and gulf fishing, account for about 5 percent of the Texas total for the 1993-1995 period. On the other hand, about \$16.7 million worth of fish and shrimp caught elsewhere lands in Jefferson County alone, which creates economic impacts in the region. The estimation of total value of landings for both cases is discussed below.

IV.1. Estimation of Direct Impacts

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, and 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 economic impacts created by this capacity. 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 account for economic impacts generated in the region from 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, this alternative was estimated where 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+offshore),
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a/ State level economic impacts are derived from regional direct expenditures. They are generally larger in magnitude because they include secondary and tertiary impacts that occur outside the Sabine-Neches estuary region, but within the state.

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The Sabine Lake system accounts for \$608 thousand in ex-vessel value of finfish, shellfish, and shrimp landings (estimated from Robinson, et al. 1996). The majority of this value is from blue crab. Ex-vessel landings, both from the Sabine Lake bay system and gulf fishing, account for about 5 percent of the Texas total for the 1993-1995 period. On the other hand, about \$16.7 million worth of fish and shrimp caught elsewhere lands in Jefferson County alone, which creates economic impacts in the region. The estimation of total value of landings for both cases is discussed below.

IV.1. Estimation of Direct Impacts

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, and 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 economic impacts created by this capacity. 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 account for economic impacts generated in the region from 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, this alternative was estimated where 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+offshore),
- III. total value of gulf and bay catch that land in the counties in the estuary, regardless of where caught.

IV.1.1. Direct impacts of offshore and inshore commercial fishing

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 were computed to represent a typical year. Direct impacts for the commercial fishing industry were estimated by total ex-vessel value of finfish, shellfish, and shrimp landed in the Sabine Lake bay system (inshore) and the allocation for gulf fishing based on the percentage weight of the Sabine Lake system of all bay system catch 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 county landings data used in scenario III, this assumption may not be true (Table IV.2).

Total value of output from commercial fishing in the Sabine-Neches region was estimated to be about \$890 thousand for 1995 (Table IV.1). This is total value of output for inshore and offshore commercial fishing in the region. Blue crab landings constituted about \$580 thousand of the inshore total of \$608 thousand for bay fishing in the Sabine Lake system (Robinson, et al.). Total value of output from offshore fishing was estimated to be about \$282 thousand (Table IV.1). These estimates are used as the direct impacts of commercial fishing within the Sabine-Neches estuary region for scenarios I and II for the Sabine -Neches estuary region.

Table IV.1. Ex-Vessel Value (Direct Impacts) of inshore and offshore landings for finfish, shrimp, and shellfish for the Sabine-Neches estuary region (1993-1995 average) .

	Inshore	Offshore	Total
	(\$)	(\$)	(\$)
Fish and shellfish (except shrimp)	592,297	197,350	789,650
Shrimp	15,700	84,600	100,300
Total	607,997	281,950	889,947

Source: Robinson et al., 1996

Direct impacts of commercial fishing in the Sabine-Neches estuary region were estimated as \$3.5 million in the 1987 study (Fesenmaier et al., 1987), compared to \$0.89 million in 1995, representing a decrease of 75 percent in current dollars. In order to compare the value of output from commercial fishing in real terms, direct impacts for 1987 and 1995 were deflated by the respective Producer Price Indices for those years. In real dollars, direct impacts of commercial fishing for the Sabine-Neches estuary were \$3.4 and \$0.7 million respectively, showing a decrease of about 79 percent from 1987 to 1995.

*IV.1.2. Direct Impacts of Sabine-Neches estuary Landings from Other
Gulf Grid Zones and Bay Systems*

As an alternative scenario, impacts of commercial fishing in the Sabine-Neches estuary region were estimated for total landings in the counties included in the estuary regardless of where the fish were caught. As mentioned earlier, estimated values of shrimp

and fish by county landed in the Sabine-Neches estuary region may be of more immediate significance in terms of current, direct impact to the regional economy within the time frame of this study. This estimate includes the value of shrimp and fish landed within the region during the time period studied irrespective of the area in the Gulf or bay system in which they were caught. For shrimp, these data were readily available from the NMFS. However, finfish and other shellfish landings are reported as Gulf total only.

To estimate finfish landings by county, percent shares of total shrimp landings by counties in the estuary were estimated and applied to total bay and gulf finfish and shellfish landings for the Gulf of Mexico. That is, it is assumed that finfish and shellfish landing pattern by county are the same as that of shrimp.

Table IV.2 shows estimated finfish and shrimp landed in the Sabine-Neches estuary region (Jefferson County) from anywhere in the Gulf of Mexico. The value of landings under this scenario is much larger compared to the value for inshore and offshore fishing because fish caught in all areas on the Gulf coast are included in this scenario. Total ex-vessel value of shrimp is \$15.2 million and with fish and other shellfish valued at \$1.5 million. Direct impacts for this scenario is about \$16.7 million (Table IV.2). These fish and shrimp caught in other areas are brought ashore in the Sabine-Neches estuary region and are sold and processed there, creating economic impacts in the region.

Table IV.2. Ex-vessel values of finfish, shellfish, and shrimp landed in Sabine-Neches estuary region from all bay systems and Gulf grid zones (1993-1995 average).

Sabine-Neches Landings (Jefferson County)			
Year	Fish and Shellfish	Shrimp	Total
	(\$)	(\$)	(\$)
1993	1,711,260	17,456,127	19,167,387
1994	1,142,382	13,474,317	14,616,699
1995	1,754,016	14,689,277	16,443,293
3-yr average	1,535,886	15,206,574	16,742,459

Source: Robinson, et. al.

The three scenarios considered in the model have the following direct impacts:

- I. Sabine bay System (inshore) catch: \$0.61 million
- II. Inshore + offshore catch: \$0.89 million
- III. Landings in Jefferson county: \$16.7 million

IV.2. Regional And Statewide Impacts of Commercial Fishing

Regional and statewide total impacts of commercial fishing in the area for all three scenarios are presented in Tables IV.3. and IV.4. Total impacts from inshore fishing are about \$850 thousand in output, accounting for 20 jobs in the region in 1995. Impacts of total commercial fishing under scenario II (inshore+offshore) total to \$1.24 million in output and \$870 thousand in value-added. Commercial fishing activity by both inshore and offshore fishing generates 29 jobs and a personal income of \$370 thousand in the Sabine-Neches estuary region (Table IV.3).

Table IV.3. Estimated total impacts of commercial fishing for scenarios I and II in the Sabine-Neches estuary region and Texas, 1995.

	Regional		Statewide	
	Inshore	Inshore+ offshore	Inshore	Inshore+ offshore
Output (\$ mil)	0.85	1.24	0.96	1.41
Personal Income (\$ mil)	0.26	0.37	0.30	0.44
Value-added (\$ mil)	0.60	0.87	0.66	0.97
Employment (jobs)	20	29	21	31

At the state level, impacts are estimated to be about \$1.41 million in total output and 31 jobs for scenario II (Table IV.3). Impacts are relatively small for the commercial fishing industry under this scenario, because only a small portion of the total Texas gulf catch comes from the Sabine-Neches estuary region. In terms of value-added, an additional \$100 thousand is generated in Texas but outside the Sabine-Neches estuary.

Impacts are much larger when the catch from all bay systems and Gulf areas that are landed in the estuary region is used as the estimate of direct economic impacts (Scenario III). In this scenario, regional output impacts are \$23 million and value-added impacts are more than \$16 million. This scenario generates an estimated total of 546 jobs and \$7 million in personal income (Table IV.4). At the state level, estimates are \$26.43 million in output, \$18.23 million in value-added and \$8.17 million in personal income. An estimated 585 jobs are supported by the value of fish and shrimp landings in the Sabine-Neches estuary region (Table IV.4)

Table IV.4. Estimated total impacts of commercial fishing in Jefferson County and Texas (scenario III), 1995.

	Regional	Statewide
Output (\$ mil)	23.21	26.43
Personal Income (\$ mil)	7.01	8.17
Value-added (\$ mil)	16.37	18.23
Employment (jobs)	546	585

V. Summary and Conclusions

The present study estimates economic impacts associated with bay and estuary related recreational activity and commercial fishing in the Sabine-Neches estuary region. To estimate these economic impacts of the bay and estuarine related activities, an input-output model was developed for the Sabine-Neches regional economy and Texas, using IMPLAN. This input-output model was used to estimate multipliers that show the impact of an increase in the sales to final demand of one sector on the value of output of other sectors of the economy (Appendix II). Total regional and state impacts were then estimated in terms of the total value of output, personal income, employment and value-added.

Travel expenditures in the region were about \$208 million in 1995, most of this being business travel (TDOC,1996). Only \$21.5 million of this was by travelers participating in water-related recreational activities such as recreational fishing, boating, swimming, birdwatching, and others.

Impacts of the commercial fishing industry were estimated for three different scenarios:

- I. Inshore catch
- II. Inshore+offshore catch
- III. Total commercial fish landed

The first two cases estimate the impacts of the productive capacity of the estuary region and estimates total value of output by area caught (i.e. within the estuary region). The third scenario includes total value of fish and shrimp actually landed in the estuary region regardless of where caught.

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 V.1. Estimated direct impacts or sales to final demand shown in Table V.I provide the basis for estimating total economic impacts of bay related sectors in the Sabine-Neches estuary region.

Table V.1. Direct impacts for recreational activities and commercial fishing in the Sabine-Neches estuary region (1995).

Sector	Direct Impacts (\$millions)
Total recreation	\$21.5
Commercial Fishing I (inshore only)	0.61
Commercial Fishing II (inshore+offshore)	0.89
Commercial Fishing III (by county landed)	16.7

It is estimated that bay and estuary recreation related sectors sales to final demand stimulated total regional business sales of about \$34 million, personal income of \$14.2 million, value-added of \$22 million, and around 799 jobs in the Sabine-Neches estuary region (Table V.2). For the case where fishing impacts are estimated by the sum of inshore and offshore landings, outputs impact of bay and estuary related sectors are estimated as \$1.2 million, along with a personal income impact of \$370 thousand, and employment impact of 29 jobs. These impacts are much larger for the case where commercial fish landings from all areas in the Gulf are considered. In this scenario, total employment impacts are 546, with a personal income impact of \$7.01 million, output impact of \$23 million and value-added impact of \$16.37 million (Table V.2).

From the results of this analysis, on average, each dollar of bay and estuary related tourist and recreationist expenditure resulted in about \$1.60 in total value of output, \$0.67 of personal income, and \$1.03 of value-added in the regional economy. In addition, an employment multiplier of about 37 jobs per million dollars of tourist and recreationist expenditures is indicated by the analysis.

Table V.2. Estimated total impacts of recreational activities and commercial fishing on the Sabine-Neches estuary region and Texas, 1995.

Economic Impact Variable	<u>Recreational Activities</u>		<u>Commercial Fishing (I)</u>		<u>Commercial Fishing (II)</u>		<u>Commercial Fishing (III)</u>	
	Regional	Texas	Regional	Texas	Regional	Texas	Regional	Texas
Output (\$mils)	34.39	41.08	0.85	0.96	1.24	1.41	23.21	26.43
Personal Income(\$mils)	14.20	16.95	0.26	0.30	0.37	0.44	7.01	8.17
Value-Added(\$mils)	22.14	26.24	0.60	0.66	0.87	0.97	16.37	18.23
Employment(jobs)	799	833	20	21	29	31	546	585

Statewide impacts represent estimated impacts of the recreational activity related sectors and commercial fishing in the Sabine-Neches estuary region on the rest of the state of Texas. Total statewide impacts can be interpreted as the regional impact plus the additional impact created elsewhere in the state by the sectors included in the study. For the Sabine-Neches estuary region, recreation related sectors are estimated to have an output impact of \$41 million and personal income impact of \$17 million with 833 jobs at the state level (including regional impacts). Statewide impacts for the inshore commercial fishing industry, are estimated to be about \$960 thousand in output and \$660 thousand in value-added with an employment impact of 21 jobs. For inshore+offshore fishing, statewide impacts are \$1.41 million for output and \$970 thousand for value-added. In terms of employment, 31 jobs are generated statewide . The third scenario for commercial fishing has an estimated output impact of \$26.43 million, value-added impact of \$18.23 million, personal income impact of \$8.17 million and a total employment impact of 585 jobs at the state level (Table V.2).

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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:

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

Given

$$\hat{X}_{1995} = \hat{b} \hat{m}^9 \quad (3)$$

$$\hat{X}_{1987} = \hat{b} \hat{m}^1 \quad (4)$$

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

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

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

Appendix II. Multipliers for the Sabine-Neches Estuary Region and Texas

TableII.1 Output Multipliers for the Sabine-Neches Estuary Region

Events	Sector	Direct Effects	Indirect Effects	Induced Effects	Total
1	Commercial Fishing	1	0.15	0.24	1.39
2	Food and Eating & Drinking	1	0.25	0.34	1.59
3	Automotive Dealers & Service Stations	1	0.21	0.39	1.61
4	Miscellaneous Retail	1	0.17	0.4	1.56
5	Hotels and Lodging Places	1	0.31	0.34	1.65
6	Amusement and Recreation Services	1	0.39	0.3	1.69

TableII.2 Employment Multipliers for Sabine-Neches Estuary Region

Events	Sector	Direct Effects	Indirect Effects	Induced Effects	Total
1	Commercial Fishing	27.64	1.31	3.75	32.7
2	Food and Eating & Drinking	31.3	2.98	5.34	39.62
3	Automotive Dealers & Service Stations	18.04	2.51	6.21	26.75
4	Miscellaneous Retail	43.49	1.96	6.3	51.75
5	Hotels and Lodging Places	24.17	5.04	5.35	34.57
6	Amusement and Recreation Services	19.89	5.85	4.67	30.41

TableII.3 Personal Income Multipliers for Sabine-Neches Estuary Region

Events	Sector	Direct Effects	Indirect Effects	Induced Effects	Total
1	Commercial Fishing	0.3	0.04	0.08	0.42
2	Food and Eating & Drinking	0.4	0.08	0.12	0.6
3	Automotive Dealers & Service Stations	0.48	0.07	0.14	0.7
4	Miscellaneous Retail	0.51	0.06	0.14	0.71
5	Hotels and Lodging Places	0.36	0.12	0.12	0.6
6	Amusement and Recreation Services	0.3	0.12	0.1	0.52

TableII.4 Total Value Added Multipliers for Sabine-Neches Estuary Region

Events	Sector	Direct Effects	Indirect Effects	Induced Effects	Total
1	Commercial Fishing	0.77	0.06	0.14	0.98
2	Food and Eating & Drinking	0.56	0.14	0.2	0.9
3	Automotive Dealers & Service Stations	0.73	0.13	0.24	1.1
4	Miscellaneous Retail	0.79	0.1	0.24	1.13
5	Hotels and Lodging Places	0.59	0.18	0.2	0.97
6	Amusement and Recreation Services	0.38	0.2	0.18	0.76

Table II.5 Output Multipliers for Texas

Event	Sector	Direct	Indirect	Induced	Total
1	Commercial Fishing	1	0.21	0.37	1.58
2	Food and Eating & Drinking	1	0.38	0.56	1.94
3	Automotive Dealers & Service Stations	1	0.28	0.62	1.90
4	Miscellaneous Retail	1	0.22	0.62	1.84
5	Hotels and Lodging Places	1	0.40	0.57	1.97
6	Amusement and Recreation Services	1	0.53	0.62	2.14

Table II.6 Employment Multipliers for Texas

Event	Sector	Direct	Indirect	Induced	Total
1	Commercial Fishing	28	2	5	35
2	Food and Eating & Drinking	29	4	8	42
3	Automotive Dealers & Service Stations	17	3	9	28
4	Miscellaneous Retail	41	2	9	52
5	Hotels and Lodging Places	20	6	8	34
6	Amusement and Recreation Services	20	8	9	37

Table II.7 Income Multipliers for Texas

Event	Sector	Direct	Indirect	Induced	Total
1	Commercial Fishing	0.30	0.06	0.13	0.49
2	Food and Eating & Drinking	0.42	0.12	0.20	0.73
3	Automotive Dealers & Service Stations	0.49	0.10	0.22	0.81
4	Miscellaneous Retail	0.52	0.08	0.22	0.81
5	Hotels and Lodging Places	0.39	0.15	0.20	0.75
6	Amusement and Recreation Services	0.40	0.19	0.22	0.81

Table II.8 Total Value Added Multipliers for Texas

Event	Sector	Direct	Indirect	Induced	Total
1	Commercial Fishing	0.77	0.10	0.22	1.09
2	Food and Eating & Drinking	0.58	0.20	0.33	1.11
3	Automotive Dealers & Service Stations	0.73	0.17	0.36	1.27
4	Miscellaneous Retail	0.79	0.13	0.36	1.29
5	Hotels and Lodging Places	0.61	0.23	0.34	1.17
6	Amusement and Recreation Services	0.48	0.29	0.36	1.13

Appendix III. Estimated Regional & Statewide Impacts for the Sabine- Neches Estuary

Table III.1 Regional Output Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (\$millions)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	4.84	1.21	1.65	7.7
Automotive Dealers & Service Stations	7.94	1.67	3.10	12.78
Miscellaneous Retail	5.88	1.00	2.35	9.17
Hotels and Lodging Places	1.19	0.37	0.40	1.96
Amusement and Recreation Services	1.64	0.64	0.49	2.77
Commercial Fishing (Inshore+Offshore)	0.89	0.13	0.21	1.24
Commercial Fishing (Inshore)	0.61	0.09	0.15	0.85
Commercial Fishing (Inshore+Offshore by County)	16.70	2.51	4.01	23.21

Table III.2 Regional Employment Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (Jobs)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	151	14	26	192
Automotive Dealers & Service Stations	143	20	49	212
Miscellaneous Retail	256	12	37	304
Hotels and Lodging Places	29	6	6	41
Amusement and Recreation Services	33	10	8	50
Commercial Fishing (Inshore+Offshore)	25	1	3	29
Commercial Fishing (Inshore)	17	1	2	20
Commercial Fishing (Inshore+Offshore by County)	462	22	63	546

Table III.3 Regional Personal Income Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (\$millions)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	1.94	0.39	0.58	2.9
Automotive Dealers & Service Stations	3.81	0.56	1.11	5.56
Miscellaneous Retail	3.00	0.35	0.82	4.17
Hotels and Lodging Places	0.43	0.14	0.14	0.71
Amusement and Recreation Services	0.49	0.20	0.16	0.85
Commercial Fishing (Inshore+Offshore)	0.27	0.04	0.07	0.37
Commercial Fishing (Inshore)	0.18	0.02	0.05	0.26
Commercial Fishing (Inshore+Offshore by County)	5.01	0.67	1.34	7.01

Table III.4 Regional Value Added Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (\$millions)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	2.71	0.68	0.97	4.36
Automotive Dealers & Service Stations	5.80	1.03	1.91	8.73
Miscellaneous Retail	4.65	0.59	1.41	6.64
Hotels and Lodging Places	0.70	0.21	0.24	1.15
Amusement and Recreation Services	0.62	0.33	0.30	1.25
Commercial Fishing (Inshore+Offshore)	0.69	0.05	0.12	0.87
Commercial Fishing (Inshore)	0.47	0.04	0.09	0.60
Commercial Fishing (Inshore+Offshore by County)	12.86	1.00	2.34	16.37

Table III.5 Statewide Output Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (Million\$)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	4.84	1.83	2.71	9.38
Automotive Dealers & Service Stations	7.94	2.22	4.90	15.05
Miscellaneous Retail	5.88	1.28	3.63	10.79
Hotels and Lodging Places	1.19	0.47	0.68	2.34
Amusement and Recreation Services	1.64	0.86	1.01	3.51
Commercial Fishing (Inshore+Offshore)	0.89	0.19	0.33	1.41
Commercial Fishing (Inshore)	0.61	0.13	0.23	0.97
Commercial Fishing (Inshore+Offshore by County)	16.70	3.50	6.23	26.43

Table III.6 Statewide Employment Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (Smillions)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	140	19	39	203
Automotive Dealers & Service Stations	135	24	71	222
Miscellaneous Retail	241	12	53	306
Hotels and Lodging Places	29	6	6	41
Amusement and Recreation Services	33	13	15	61
Commercial Fishing (Inshore+Offshore)	25	2	4	31
Commercial Fishing (Inshore)	17	1	3	21
Commercial Fishing (Inshore+Offshore by County)	468	33	84	585

Table III.7 Statewide Personal Income Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (Smillions)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	2.04	0.57	0.95	3.56
Automotive Dealers & Service Stations	3.92	0.79	1.71	6.42
Miscellaneous Retail	3.04	0.45	1.27	4.76
Hotels and Lodging Places	0.47	0.18	0.24	0.89
Amusement and Recreation Services	0.66	0.31	0.35	1.33
Commercial Fishing (Inshore+Offshore)	0.27	0.05	0.12	0.44
Commercial Fishing (Inshore)	0.18	0.03	0.08	0.30
Commercial Fishing (Inshore+Offshore by County)	5.05	0.94	2.17	8.17

Table III.8 Statewide Value Added Impact of Travel and Commercial Fishing for the Sabine-Neches Estuary (Smillions)

Sector	Direct Effects	Indirect Effects	Induced Effects	Total
Food and Eating & Drinking	2.81	0.97	1.60	5.38
Automotive Dealers & Service Stations	5.82	1.33	2.89	10.05
Miscellaneous Retail	4.65	0.77	2.14	7.56
Hotels and Lodging Places	0.73	0.27	0.40	1.40
Amusement and Recreation Services	0.78	0.47	0.60	1.85
Commercial Fishing (Inshore+Offshore)	0.69	0.09	0.20	0.97
Commercial Fishing (Inshore)	0.47	0.06	0.13	0.67
Commercial Fishing (Inshore+Offshore by County)	12.94	1.61	3.68	18.23