# TRINITY-SAN JACINTO ESTUARY

## ECONOMIC IMPACTS OF RECREATIONAL ACTIVITIES AND COMMERCIAL FISHING

Prepared for the

TEXAS WATER DEVELOPMENT BOARD

by

Ayşen Tanyeri-Abur, Lonnie Jones, and Hong Jiang

Department of Agricultural Economics
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# Trinity-San Jacinto 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 Trinity-San Jacinto 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 Trinity-San Jacinto estuary includes Galveston, Brazoria, Chambers, Fort Bend, Harris, and Liberty counties with Houston and Galveston as the largest metropolitan areas (Figure I.1). In 1995, population in the area was 3,904,277. 1993-1995 average employment was about 1.5 million and average wages paid were $46.7 billion (Table I.1).

Figure I.1. Trinity - San Jacinto estuary region

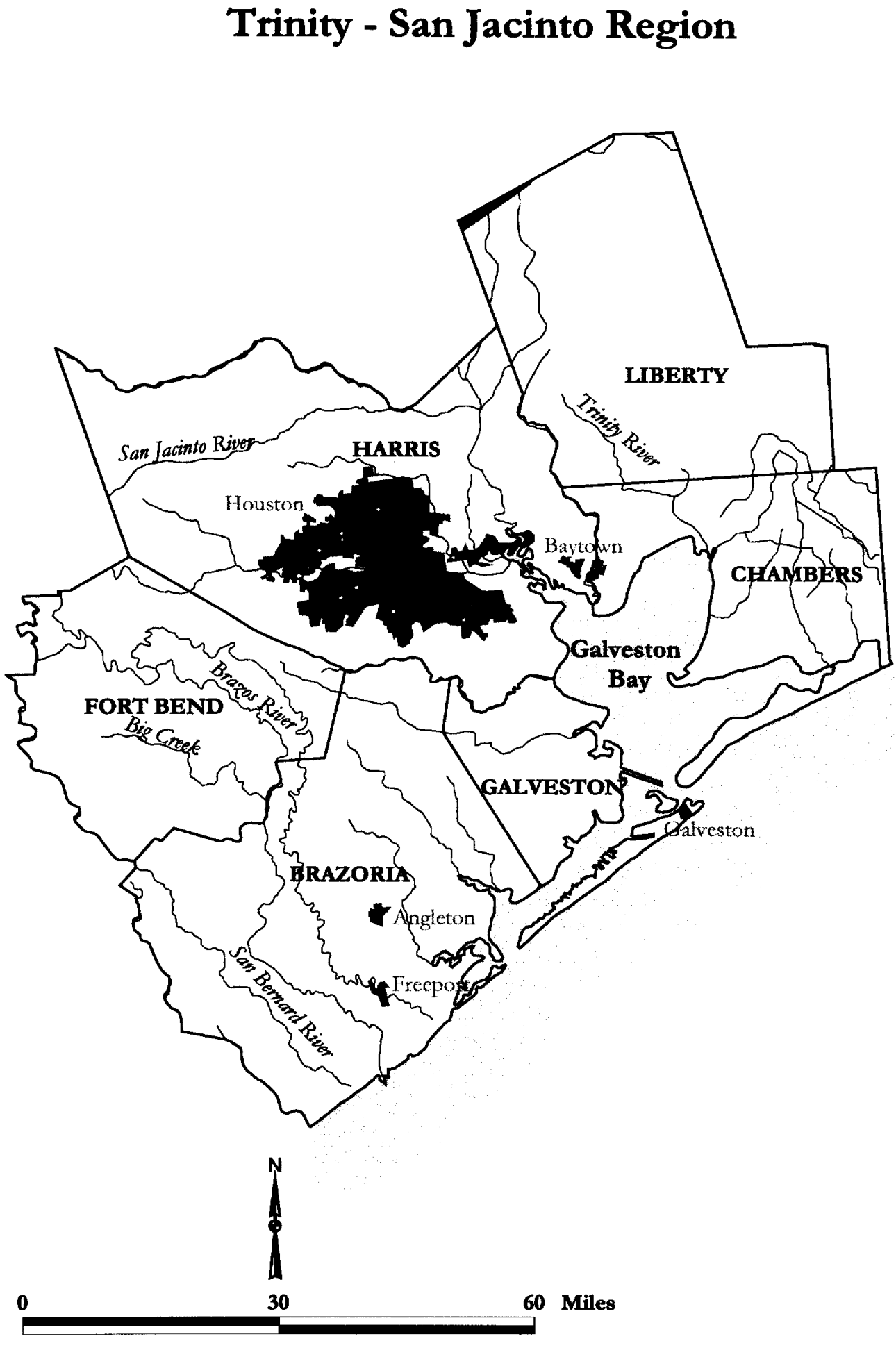

Table I.1 Average Quarterly Wage and Employment in the Trinity-San Jacinto estuary region, 1993-1995

| Year | Wage | Employment |
|---|---|---|
| | ($millions) | (Jobs) |
| 1993 | 44,544.74 | 1,466,445 |
| 1994 | 46,316.61 | 1,503,047 |
| 1995 | 49,312.00 | 1,538,617 |
| 3-Year Average | 46,724.45 | 1,502,703 |

Source: Texas Workforce Commission (TWC)

The commercial fishing industry is one of the largest in the state, which includes landings in the Galveston bay system. The Galveston bay system alone brings in about 37 percent of all white shrimp and 90 percent of all oysters caught in Texas bays (Robinson, et al. 1996).

Given the two metropolitan areas, most travel to the area is non water-related recreation and business. Total travel expenditure, payroll, and employment for the Trinity-San Jacinto 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 $4.8 billion in 1995. Harris County alone accounted for about $4.3 billion and employed about 80 thousand people in travel related sectors (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 Trinity-San Jacinto Estuary, 1995.

| County | Travel Expenditures ($millions) | Travel Payroll ($millions) | Employment (jobs) |
|---|---|---|---|
| Brazoria | 90.7 | 18.4 | 1,370 |
| Chambers | 10.68 | 1.86 | 130 |
| Fort Bend | 50.00 | 11.21 | 7900.79 |
| Galveston | 353.59 | 75.53 | 582 |
| Harris | 4,315.13 | 1,766.31 | 7,9503 |
| Liberty | 41.29 | 7.74 | 600 |
| TOTAL | 4,861.39 | 1,881.05 | 88,240 |

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

Expenditures in the six categories shown in Table III.3 were 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 bay and estuary related recreational expenditures ($421.92 million) to Trinity-San Jacinto regional economic sectors is shown in Table III.4.

Table III.4. Direct Impacts of bay and estuary recreation related sectors in the Trinity-San Jacinto estuary region

| Expenditure category | Total ($millions) | Corresponding Regional Economic Sector |
|---|---|---|
| Transport | 127.30 | Gas Service Stations |
| Lodging | 37.39 | Hotels and Motels |
| Food | 97.37 | Restaurants and Food Stores |
| Entertainment | 50.35 | Amusement, Theaters,etc |
| Other | 25.75 | Miscellaneous Retail |
| Shopping | 83.76 | Miscellaneous Retail |
| TOTAL | 421.92 | |

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

It is estimated that leisure travelers participating in water-related activities spent $127 million in the region for transportation, and about $97.4 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 III.4).

### III.2. Visitation patterns and trends

Total number of leisure visitor days to the Trinity-San Jacinto 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 1995 for each MSA in the Trinity-San Jacinto estuary region were divided by expenditures per day for each MSA. Visitation to each MSA and total visitation for the region is shown in Table III.5 .

Table III.5. Visitation by MSA in the Trinity-San Jacinto estuary region, 1995 (for bay and estuary related recreation only).

| | Galveston MSA | Brazoria MSA | Houston MSA | Total |
|---|---|---|---|---|
| Visitation (Number of visits) | 373,794 | 219,179 | 6,297,313 | 6,890,286 |

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

Total number of visits to the Houston MSA were about 6.3 million visits compared to only 373 and 219 thousand to the Brazoria and Galveston MSA's. This implies that travelers to the Houston MSA participate widely in bay and estuary related activities even after all business and non-water-related recreational travel were accounted for (Table III.5).

### III.3. Regional and Statewide Impacts

Estimated direct impacts presented in Table III.4 provide the basis for estimating total economic impacts of recreation related sectors in the Trinity-San Jacinto 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 Trinity-San Jacinto estuary region are presented in Table III.6. 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 Trinity-San Jacinto 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 $757 million, personal income of about $325 million, value-added of $491 million and over 15,287 jobs in the Trinity-San Jacinto region (Table III.6).

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.6. Regional and statewide Impacts of water-related recreational activities in the Trinity-San Jacinto estuary, 1995.

| | Total Impacts | |
|---|---|---|
| Economic Impact Variable | Regional | State |
| Direct Impact ($ mil) | 421.92 | 421.92[a] |
| Output ($ mil) | 757.69 | 812.40 |
| Personal Income($ mil) | 324.50 | 331.65 |
| Value-Added ($ mil) | 491.15 | 510.94 |
| Employment (jobs) | 15,287 | 16,483 |

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 Trinity-San Jacinto estuary region, but within the state.

Statewide impacts are slightly larger for all variables. Recreation related industries contribute 1,200 additional jobs and an additional $2.75 million in personal income elsewhere in the state (Table III.6).

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.6 are based on an estimated $421.92 million annual expenditure by recreationists in the regional economy (Table III.4). Therefore, it may be stated that, on average, each dollar of tourist and recreationist expenditures resulted in about $1.79 in total output, $0.77 in personal income, and $1.16 of value-added in the Trinity-San Jacinto estuary regional economy. In addition, an

employment multiplier of about 36 jobs per million dollars of tourist and recreationist expenditures is indicated by the analysis.

## IV. Commercial Fishing

The Trinity-San Jacinto estuary includes the Galveston 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 Trinity-San Jacinto estuary may sell their catch locally or outside the region. Likewise, gulf boats fishing in areas remote from the Trinity-San Jacinto estuary may land fish and shrimp in counties within the estuary.

The Galveston bay system accounts for $15.7 million in value of finfish, shellfish, and shrimp landings (estimated from Robinson, et al. 1996). Landings both from the Galveston bay system and gulf fishing account for about 30 percent of the Texas total for the 1993-1995 period. On the other hand, about $42 million worth of fish and shrimp caught elsewhere lands in Brazoria, Galveston, Chambers, and Harris counties, which creates economic impacts in the region. The estimation of total value of landings for all 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 value of finfish, shellfish, and shrimp landed in the Galveston system (inshore) and the allocation for gulf fishing based on the percentage weight of the Galveston bay 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 comparison with the county landings data used in scenario III, this assumption may not be true (TableIV.2).

Total value of output from commercial fishing in the Trinity-San Jacinto region was estimated to be about $61.8 million 1995 (Table IV.1). This is total value of output for inshore and offshore commercial fishing in the region. Eastern Oyster landings constituted about $7 million of the inshore total of $15.7 million for bay fishing in the Galveston system (Robinson, et al.). Total value of output from offshore fishing was estimated to be about $46 million (Table IV.1). These estimates are used as the direct impacts of commercial fishing within the Trinity-San Jacinto estuary region for scenarios I and II.

Direct impacts of commercial fishing in the Trinity-San-Jacinto estuary region were estimated as $63.6 million in the 1987 study (Fesenmaier et al., 1987), compared to $61.8 million in 1995, representing a decrease of about 2.8 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 Trinity-San-Jacinto estuary were $61.6 and $49.5 million respectively, showing a decrease of about 20 percent from 1987 to 1995.

Table IV.1. Value (Direct Impacts) of inshore and offshore landings for finfish, shrimp, and shellfish for the Trinity-San Jacinto estuary (1993-1995 average)

| | Inshore | Offshore | Total |
|---|---|---|---|
| | ($) | ($) | ($) |
| Fish and shellfish (except shrimp) | 7,652,619 | 2,549,806 | 10,202,425 |
| Shrimp | 8,074,234 | 43,519,845 | 51,594,079 |
| Total | 15,726,853 | 46,069,651 | 61,796,504 |

Source: Robinson et al., 1996

### *IV.1.2. Direct Impacts of Trinity-San Jacinto estuary Landings from Other Gulf Grid Zones and Bay Systems*

As an alternative scenario, impacts of commercial fishing in the Trinity-San Jacinto 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 Trinity-San Jacinto 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 Trinity-San Jacinto estuary region (Brazoria, Chambers, Galveston, and Harris counties) from any bay system or Gulf grid zone in the Gulf of Mexico. The fish and shrimp caught in other areas are brought ashore in the Trinity-San Jacinto estuary region and are sold and processed there, creating economic impacts in the region. Total value of commercial fish landings in the four coastal counties of the region is $42.8 million (Table IV.3). Most landings are in Galveston and Brazoria counties representing more than half of the value of all shrimp landings

Table IV.2. Values of finfish, shellfish, and shrimp landed in Trinity-San Jacinto estuary region from all bay systems and Gulf grid zones (1993-1995 average) ($)

| Totals | Brazoria | | Chambers | | Galveston | | Harris | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | fish | shrimp | fish | shrimp | fish | shrimp | fish | shrimp | Fish+shrimp ($) |
| | | | | | ($) | | | | |
| 1993 | 1,264,502 | 12,920,704 | 18573 | 189,778 | 1,375,989 | 14,05,9890 | 341,058 | 3,484,939 | 33,657,426 |
| 1994 | 1,646,470 | 19,548,301 | 49644 | 589,414 | 1,900,792 | 22,567,822 | 372,011 | 4,416,840 | 51,093,289 |
| 1995 | 1,786,611 | 14,998,859 | 73081 | 613,526 | 2,344,903 | 19,685,798 | 429,552 | 3,606,157 | 43,540,483 |
| 3 yr aver | 1,580,687 | 15,822,621 | 46378 | 464,239 | 1,875,248 | 18,771,170 | 383,215 | 3,835,979 | 42,779,537 |

Source: Robinson, et al. 1996 and NMFS 1997

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

I. Galveston bay System (inshore) catch: $15.7 million

II. Inshore + offshore catch: $61.8 million

III. Landings in Brazoria, Chambers, Galveston, and Harris counties: $42.8 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 $23.4 million in output, accounting for 429 jobs in the region in 1995. Impacts of total commercial fishing under scenario II (inshore+offshore) total to $92.08 million in output and $64.89 million in value-added. Commercial fishing activity by both inshore and offshore fishing generates 1,688 jobs and a personal income of $27.19 million in the Trinity-San Jacinto estuary region (Table IV.3).

Table IV.3. Estimated total impacts of commercial fishing under for scenarios I and II in the Trinity-San Jacinto estuary and Texas, 1995.

| | Regional | | Statewide | |
|---|---|---|---|---|
| | Inshore (scenario I) | Inshore+ offshore (scenario II) | Inshore (scenario I) | Inshore+ offshore (scenario II) |
| Output ($ mil) | 23.39 | 92.08 | 24.85 | 97.82 |
| Personal Income ($ mil) | 6.91 | 27.19 | 7.68 | 30.23 |
| Value-added ($ mil) | 16.49 | 64.89 | 17.14 | 67.47 |
| Employment (jobs) | 429 | 1,688 | 550 | 2,163 |

At the state level, impacts are estimated to be about $92.82 million in total output and 2,163 jobs for scenario II (Table IV.3). In terms of value-added, an additional $5 million is generated in Texas but outside the Trinity-San Jacinto estuary. Impacts of commercial fish landings from all bay systems and Gulf areas (Scenario III) are presented in Table IV.5. In this scenario, regional output impacts are $63.77 million and value-added impacts are more than $44.94 million. This scenario generates an estimated total of 1,169 jobs and $18.83 million in personal income (Table IV.4).

Statewide impacts of Scenario III are $63.23 million in output, $43.61 million in value-added and $19.54 million in personal income. An estimated 1,398 jobs are supported by the value of fish and shrimp landings in the Trinity-San Jacinto estuary region and elsewhere in the state (Table IV.4).

Table IV.4 Estimated regional and statewide total impacts of commercial fishing by total commercial fish landed from all areas (scenario III), 1995.

| | Regional | Statewide |
|---|---|---|
| Output ($ mil) | 63.77 | 67.74 |
| Personal Income ($ mil) | 18.83 | 20.94 |
| Value-added ($ mil) | 44.94 | 46.72 |
| Employment (jobs) | 1,169 | 1,498 |

## V. Summary and Conclusions

The present study estimates economic impacts associated with bay and estuary related recreational activity and commercial fishing in the Trinity-San Jacinto estuary region. To estimate these economic impacts of the bay and estuarine related activities, an input-output model was developed for the Trinity-San Jacinto 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 $4.8 billion in 1995, most of this being business travel (TDOC,1996). About $421.9 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 Trinity-San Jacinto estuary region.

Table V.1 Direct Impacts for Recreational Activities and Commercial Fishing in The Trinity-San Jacinto estuary region.

| Sector | Direct Impacts ($millions) |
|---|---|
| Total recreation | 421.9 |
| Commercial Fishing I (inshore only) | 15.7 |
| Commercial Fishing II (inshore+offshore) | 61.8 |
| Commercial Fishing III (by county landed) | 42.8 |

It is estimated that, bay and estuary recreation related sectors sales to final demand stimulated total regional business sales of about $757 million, personal income of $324.5 million, value-added of $491 million, and around 15,287 jobs in the Trinity-San Jacinto estuary region (Table V.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 were estimated as $92.8 million, along with a personal income impact of $27.19 million, and employment impact of 1,688 jobs in the region. For the case where commercial fish

Table V.2 Estimated Total Impacts of Recreational Activities and Commercial Fishing on the Trinity-San Jacinto estuary region and Texas, 1995.

| Economic Impact Variable | Recreational Activities | | Commercial Fishing (I) | | Commercial Fishing (II) | | Commercial Fishing (III) | |
|---|---|---|---|---|---|---|---|---|
| | Regional | Texas | Regional | Texas | Regional | Texas | Regional | Texas |
| Output ($mils) | 757.69 | 812.40 | 23.39 | 24.85 | 92.08 | 97.82 | 63.77 | 67.74 |
| Personal Income($mils) | 324.50 | 331.65 | 6.91 | 7.68 | 27.19 | 30.23 | 18.83 | 20.94 |
| Value-Added($mils) | 491.15 | 510.94 | 16.49 | 17.14 | 64.89 | 67.47 | 44.94 | 46.72 |
| Employment(jobs) | 15,287 | 16,483 | 429 | 550 | 1,688 | 2,163 | 1,169 | 1,498 |

landings from all areas in the Gulf are considered, total employment impacts are 1,169, with a personal income impact of $18.8 million, output impact of $63.8 million and value-added impact of $44.9 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 $1.79 in total value of output, $0.77 of personal income, and $1.16 of value-added in the regional economy. In addition, an employment multiplier of about 36 jobs per million dollars of tourist and recreationist expenditures is indicated by the analysis.

Statewide impacts represent estimated impacts of the recreational activity related sectors and commercial fishing in the Trinity-San Jacinto 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 Trinity-San Jacinto estuary region, the recreation related sectors were estimated to have an output impact of $812.4 million and personal income impact of $331.7 million with 16,483 jobs at the state level (including regional impacts). Statewide impacts for commercial fishing including both inshore and offshore fishing activity were $98 million for output with a value-added impact of $67 million . In terms of employment, 2,163 jobs were created statewide for this scenario. For the scenario where landings from all other areas were considered, estimated output impact was $67.7 million, with a value-added impact of $46.72 million, personal income impact of $20.94 million and a total employment impact of 1,498 jobs at the state level (Table V.2).

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## Appendix I. Methodology for Estimation of Projected Travel Expenditures

$$X = b\, m^{t} \qquad (1)$$

Where:

$X$ = total travel expenditures

$b$ = constant

$m$ = growth rate

t = years

The estimated equation is:

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

Given

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

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

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 Trinity-San Jacinto Estuary Region

### TableII.1 Output Multipliers for the Trinity-San Jacinto Estuary Region

| Events | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Commercial Fishing | 1 | 0.20 | 0.29 | 1.49 |
| 2 | Food and Eating & Drinking | 1 | 0.30 | 0.46 | 1.77 |
| 3 | Automotive Dealers & Service Stations | 1 | 0.26 | 0.52 | 1.79 |
| 4 | Miscellaneous Retail | 1 | 0.21 | 0.52 | 1.72 |
| 5 | Hotels and Lodging Places | 1 | 0.36 | 0.47 | 1.83 |
| 6 | Amusement and Recreation Services | 1 | 0.43 | 0.57 | 2.00 |

### TableII.2 Employment Mutilipers for the Trinity-San Jacinto Region

| Events | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Commercial Fishing | 21.63 | 1.68 | 4.01 | 27.31 |
| 2 | Food and Eating & Drinking | 29.10 | 3.22 | 6.42 | 38.73 |
| 3 | Automotive Dealers & Service Stations | 15.23 | 2.82 | 7.26 | 25.3 |
| 4 | Miscellaneous Retail | 39.65 | 2.22 | 7.20 | 49.07 |
| 5 | Hotels and Lodging Places | 19.01 | 5.01 | 6.54 | 30.56 |
| 6 | Amusement and Recreation Services | 21.17 | 6.18 | 7.96 | 35.31 |

### TableII.3 Personal Income Multipliers for the Trinity-San Jacinto Estuary Region

| Events | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Commercial Fishing | 0.27 | 0.06 | 0.11 | 0.44 |
| 2 | Food and Eating & Drinking | 0.43 | 0.10 | 0.17 | 0.7 |
| 3 | Automotive Dealers & Service Stations | 0.50 | 0.10 | 0.19 | 0.79 |
| 4 | Miscellaneous Retail | 0.52 | 0.07 | 0.19 | 0.78 |
| 5 | Hotels and Lodging Places | 0.40 | 0.14 | 0.17 | 0.71 |
| 6 | Amusement and Recreation Services | 0.49 | 0.17 | 0.21 | 0.87 |

### TableII.4 Total Value Added Multipliers for the Trinity-San Jacinto Estuary Region

| Events | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Commercial Fishing | 0.77 | 0.10 | 0.18 | 1.05 |
| 2 | Food and Eating & Drinking | 0.59 | 0.18 | 0.28 | 1.05 |
| 3 | Automotive Dealers & Service Stations | 0.73 | 0.16 | 0.32 | 1.22 |
| 4 | Miscellaneous Retail | 0.79 | 0.13 | 0.32 | 1.23 |
| 5 | Hotels and Lodging Places | 0.61 | 0.21 | 0.29 | 1.11 |
| 6 | Amusement and Recreation Services | 0.54 | 0.25 | 0.35 | 1.14 |

**TableII.5 Output Multipliers for Texas State**

| Event | Sector | Direct | Indirect | Induced | Total |
|---|---|---|---|---|---|
| 1 | Commercial Fishing | 1 | 0.2097 | 0.3731 | 1.5828 |
| 2 | Food and Eating & Drinking | 1 | 0.3782 | 0.5604 | 1.9386 |
| 3 | Automotive Dealers & Service Stations | 1 | 0.2792 | 0.6166 | 1.8958 |
| 4 | Miscellaneous Retail | 1 | 0.2183 | 0.6169 | 1.8352 |
| 5 | Hotels and Lodging Places | 1 | 0.3964 | 0.5687 | 1.9651 |
| 6 | Amusement and Recreation Services | 1 | 0.5251 | 0.6169 | 2.1421 |

**TableII.6 Employment Multipliers for Texas State**

| 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 |

**TableII.7 Income Multipliers for Texas State Estuary**

| Event | Sector | Direct | Indirect | Induced | Total |
|---|---|---|---|---|---|
| 1 | Commercial Fishing | 0.3026 | 0.0564 | 0.1302 | 0.4892 |
| 2 | Food and Eating & Drinking | 0.4209 | 0.1183 | 0.1956 | 0.7348 |
| 3 | Automotive Dealers & Service Stations | 0.4939 | 0.0993 | 0.2152 | 0.8084 |
| 4 | Miscellaneous Retail | 0.5165 | 0.077 | 0.2153 | 0.8089 |
| 5 | Hotels and Lodging Places | 0.3923 | 0.1548 | 0.1985 | 0.7456 |
| 6 | Amusement and Recreation Services | 0.4049 | 0.1887 | 0.2153 | 0.8089 |

**TableII.8 Total Value Added Multipliers for Texas State**

| Event | Sector | Direct | Indirect | Induced | Total |
|---|---|---|---|---|---|
| 1 | Commercial Fishing | 0.7746 | 0.0966 | 0.2205 | 1.0917 |
| 2 | Food and Eating & Drinking | 0.5809 | 0.2002 | 0.3312 | 1.1123 |
| 3 | Automotive Dealers & Service Stations | 0.7335 | 0.168 | 0.3644 | 1.266 |
| 4 | Miscellaneous Retail | 0.7906 | 0.1309 | 0.3646 | 1.2861 |
| 5 | Hotels and Lodging Places | 0.6104 | 0.2262 | 0.3361 | 1.1727 |
| 6 | Amusement and Recreation Services | 0.4774 | 0.2859 | 0.3646 | 1.128 |

## Appendix III. Estimated Regional & Statewide Impacts for the Trinity-San Jacinto Estuary

**TableIII.1 Regional Output Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary ($millions)**

| Number | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Food and Eating & Drinking | 97.37 | 29.21 | 44.79 | 172.34 |
| 2 | Automotive Dealers & Service Stations | 127.30 | 33.10 | 66.20 | 227.87 |
| 3 | Miscellaneous Retail | 109.51 | 23.00 | 56.95 | 188.36 |
| 4 | Hotels and Lodging Places | 37.39 | 13.46 | 17.57 | 68.42 |
| 5 | Amusement and Recreation Services | 50.35 | 21.65 | 28.70 | 100.70 |
| 6-inshore+Offshore | Commercial Fishing | 61.80 | 12.36 | 17.92 | 92.08 |
| 6-inshore | Commercial Fishing | 15.70 | 3.14 | 4.55 | 23.39 |
| 6-by County Landed | Commercial Fishing | 42.80 | 8.56 | 12.41 | 63.77 |

**Table III.2 Regional Employment Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary (Jobs)**

| Number | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Food and Eating & Drinking | 2833 | 314 | 625 | 3771 |
| 2 | Automotive Dealers & Service Stations | 1939 | 359 | 924 | 3221 |
| 3 | Miscellaneous Retail | 4342 | 243 | 788 | 5374 |
| 4 | Hotels and Lodging Places | 711 | 187 | 245 | 1143 |
| 5 | Amusement and Recreation Services | 1066 | 311 | 401 | 1778 |
| 6-inshore+Offshore | Commercial Fishing | 1337 | 104 | 248 | 1688 |
| 6-inshore | Commercial Fishing | 340 | 26 | 63 | 429 |
| 6-by County Landed | Commercial Fishing | 926 | 72 | 172 | 1169 |

**TableIII.3 Regional Personal Income Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary($millions)**

| Number | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Food and Eating & Drinking | 41.87 | 9.74 | 16.55 | 68.16 |
| 2 | Automotive Dealers & Service Stations | 63.65 | 12.73 | 24.19 | 100.57 |
| 3 | Miscellaneous Retail | 56.95 | 7.67 | 20.81 | 85.42 |
| 4 | Hotels and Lodging Places | 14.96 | 5.23 | 6.36 | 26.55 |
| 5 | Amusement and Recreation Services | 24.67 | 8.56 | 10.57 | 43.80 |
| 6-inshore+Offshore | Commercial Fishing | 16.69 | 3.71 | 6.80 | 27.19 |
| 6-inshore | Commercial Fishing | 4.24 | 0.94 | 1.73 | 6.91 |
| 6-by County Landed | Commercial Fishing | 11.56 | 2.57 | 4.71 | 18.83 |

**TableIII.4 Regional Value Added Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary ($millions)**

| Number | Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|---|
| 1 | Food and Eating & Drinking | 57.45 | 17.53 | 27.26 | 102.24 |
| 2 | Automotive Dealers & Service Stations | 92.93 | 20.37 | 40.74 | 155.31 |
| 3 | Miscellaneous Retail | 86.51 | 14.24 | 35.04 | 134.70 |
| 4 | Hotels and Lodging Places | 22.81 | 7.85 | 10.84 | 41.50 |
| 5 | Amusement and Recreation Services | 27.19 | 12.59 | 17.62 | 57.40 |
| 6-inshore+Offshore | Commercial Fishing | 47.59 | 6.18 | 11.12 | 64.89 |
| 6-inshore | Commercial Fishing | 12.09 | 1.57 | 2.83 | 16.49 |
| 6-by County Landed | Commercial Fishing | 32.96 | 4.28 | 7.70 | 44.94 |

**TableIII.5 Statewide Output Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary ($millions)**

| Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|
| Food and Eating & Drinking | 97.37 | 36.83 | 54.57 | 188.76 |
| Automotive Dealers & Service Stations | 127.30 | 35.54 | 78.49 | 241.34 |
| Miscellaneous Retail | 109.51 | 23.91 | 67.56 | 200.97 |
| Hotels and Lodging Places | 37.39 | 14.82 | 21.26 | 73.48 |
| Amusement and Recreation Services | 50.35 | 26.44 | 31.06 | 107.85 |
| Commercial Fishing (Inshore+Offshore) | 61.80 | 12.96 | 23.06 | 97.82 |
| Commercial Fishing (Inshore) | 15.70 | 3.29 | 5.86 | 24.85 |
| Commercial Fishing (Inshore+Offshore by County) | 42.80 | 8.98 | 15.97 | 67.74 |

**Table III.6 Statewide Employment Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary (Jobs)**

| Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|
| Food and Eating & Drinking | 2824 | 389 | 779 | 4090 |
| Automotive Dealers & Service Stations | 2164 | 382 | 1146 | 3564 |
| Miscellaneous Retail | 4490 | 219 | 986 | 5695 |
| Hotels and Lodging Places | 748 | 224 | 299 | 1271 |
| Amusement and Recreation Services | 1007 | 403 | 453 | 1863 |
| Commercial Fishing (Inshore+Offshore) | 1730 | 124 | 309 | 2163 |
| Commercial Fishing (Inshore) | 440 | 31 | 79 | 550 |
| Commercial Fishing (Inshore+Offshore by County) | 1198 | 86 | 214 | 1498 |

**Table III.7 Statewide Personal Income Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary ($millions)**

| Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|
| Food and Eating & Drinking | 40.98 | 11.52 | 19.05 | 71.55 |
| Automotive Dealers & Service Stations | 62.87 | 12.64 | 27.39 | 102.91 |
| Miscellaneous Retail | 56.56 | 8.43 | 23.58 | 88.58 |
| Hotels and Lodging Places | 14.67 | 5.79 | 7.42 | 27.88 |
| Amusement and Recreation Services | 20.39 | 9.50 | 10.84 | 40.73 |
| Commercial Fishing (Inshore+Offshore) | 18.70 | 3.49 | 8.05 | 30.23 |
| Commercial Fishing (Inshore) | 4.75 | 0.89 | 2.04 | 7.68 |
| Commercial Fishing (Inshore+Offshore by County) | 12.95 | 2.41 | 5.57 | 20.94 |

**Table III.8 Statewide Value Added Impact of Travel and Commercial Fishing for the Trinity-San Jacinto Estuary ($millions)**

| Sector | Direct Effects | Indirect Effects | Induced Effects | Total |
|---|---|---|---|---|
| Food and Eating & Drinking | 56.56 | 19.49 | 32.25 | 108.30 |
| Automotive Dealers & Service Stations | 93.37 | 21.39 | 46.39 | 161.16 |
| Miscellaneous Retail | 86.58 | 14.33 | 39.93 | 140.84 |
| Hotels and Lodging Places | 22.82 | 8.46 | 12.57 | 43.85 |
| Amusement and Recreation Services | 24.04 | 14.40 | 18.36 | 56.79 |
| Commercial Fishing (Inshore+Offshore) | 47.87 | 5.97 | 13.63 | 67.47 |
| Commercial Fishing (Inshore) | 12.16 | 1.52 | 3.46 | 17.14 |
| Commercial Fishing (Inshore+Offshore by County) | 33.15 | 4.13 | 9.44 | 46.72 |