

**Economic Impacts of Alternative Regulatory Scenarios on the  
Florida Fresh Half Shell Oyster Industry**

**By**

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**Industry Report 10-1**

**April 2010**

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## **ACKNOWLEDGMENTS**

The authors are particularly grateful to the United States Department of Agriculture's Cooperative State Research, Education, and Extension Service (USDA- CSREES) for funding this study under USDA Grant No. 2004-34483-14575 entitled "Implementing Post Harvest Treatments in Commerce of Florida Oysters.". The authors would like to express their gratitude to the consulting members of the Florida oyster industry for their insights into the intricacies of oyster harvesting and processing requirements. They were especially helpful in the formative stages of this project. The authors also express thanks to faculty members of the Aquatic Food Products Lab of the Food Science and Human Nutrition Department, Institute of Food and Agriculture Sciences, University of Florida, Gainesville, Florida, for their time and assistance in completing this project. The authors thank our reviewers, Dr. Leslie Sturmer, Ms. Jennifer Clark, and Mr. David Heil for their helpful comments and suggestions. Many thanks offered to FRE Editor Ms. Carol Fountain for her detailed review of the manuscript.

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## EXECUTIVE SUMMARY

The purpose of this study was to examine the economic impacts of possible closures of the fresh half shell oyster market for varying time periods with the intention of protecting consumers from *V. vulnificus* infections. Economic impacts were estimated for harvesters, processors, and the overall economies of Franklin and Gulf Counties in Florida.

During the 2004 calendar year, 496 individuals harvested and sold Florida oysters. Of these, 448 sold only oysters (90%) while 48 sold oysters and some other saltwater species. Dockside revenues received by the 496 harvesters for oysters were estimated to total nearly \$3 million in 2004.

Approximately 50 percent of the harvesters accounted for over 90 percent of the oyster revenues. Examination of the 2000-2004 average oyster dockside revenues reveals seasonal total revenues of about 31 percent for May-September and 19 percent for June-August. There were 213 harvesters (42.9%) that did not operate during the May-September period. There were 262 (52.8%) that did not harvest oysters during the June-August period (Table 7).

Using average quantity of oyster landings for 2000-2004 and 2004 dockside prices, seven unique scenarios were examined to determine the economic impacts on harvesters, processors, and the overall economy of Franklin and Gulf Counties in Florida. Average landings for the five-year period were used to provide a more stable long-term average. Each scenario assumed a different combination of regulatory closures and post-harvest treated (PHT) oyster utilization (Table 8).

In conclusion, in the worst-case scenarios, closure of the fresh half shell market for five months or three months with minimal or no frozen PHT product replacement would cause economic losses to harvesters, processors, and the overall regional economy. Reductions in harvesters' dockside revenue and processors' F.O.B. gross revenues would be about 25 and 16 percent, respectively, for the five-month and three-month closures.

Replacement levels of 25 and 50 percent of historical fresh half shell sales with the frozen PHT product may be unrealistic with respect to the biological and logistical feasibility of accelerating the harvest of shellstock requirements for the closure periods to earlier months (i.e., March and April).

Even if 25 or 50 percent replacement levels are achievable in the marketplace and processors' gross F.O.B. revenues are increased, there are no assurances that these gross revenues will result in sustainable profitability to the processors. Furthermore, the large investment required for PHT processing and economies of scale may preclude all but a very few processors from participating in the frozen PHT market.

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## INTRODUCTION

The American oyster (*Crassostrea virginica*) has been a popular shellfish food since the discovery of the Americas, and can be found off the coasts of the Northern U.S.-Canadian Atlantic waters down to the Gulf of Mexico (Lutz et al. 2003; Lorio and Malone 1994). However, oyster aficionados have long adhered to the old adage "only eat oysters during the 'R' months." Although this maxim originated in the days before refrigeration become commonplace, it likewise holds true in modern times due to the prevalence of the bacteria *V. vulnificus*. The naturally occurring *V. vulnificus* is more prolific in warmer waters, such as Florida's Gulf Coast, particularly during the summer months of May, June, July, and August. Consumption of shellfish meats containing *V. vulnificus* can result in severe illness and loss of life for specific "at-risk" (Probably a good idea to provide using FDA as a source the average annual number of US cases ~30 to 35 and the average annual mortality rate ~50%).

The results of a 2000-01 nationwide consumer survey revealed that 43 percent of the respondents ate oysters occasionally, with an average rate of 2.6 times per month (Hanson et al. 2003). Consumers appear to recognize the risks associated with eating raw oysters, as nearly one-half of those who eat oysters rated them the "least safe" seafood relative to twelve alternative shellfish and finfish products. The researchers discovered that 43 percent of oyster consumers would eat more oysters if the depuration (process of flushing oysters with *V. vulnificus*-free water for a specified period of time prior to harvest) method was used on the product, with a mean willingness to pay an extra 34 cents per depurated oyster.

Flattery and Bashin (2003) conducted a survey prior to the release of intensified *V. vulnificus* consumer education efforts by the Interstate Shellfish Sanitation Conference (ISSC). The research established a baseline meant to indicate current levels of awareness, behaviors, and consumption patterns of raw oyster consumers. Nearly 2,000 telephone interviews were conducted from late 2001 through February 2002, with consumers located in California, Florida, Louisiana, and Texas being targeted. The authors concluded that 37 percent of at-risk consumers were eating raw oysters less often in an attempt to reduce their risk of illness; however, 42 percent of the at-risk groups were not changing their consumption behavior. Overall, they discovered that "misconceptions about how to reduce one's risk of *V. vulnificus* infection are widespread."

Shapiro et al. (1998) summarized data concerning *V. vulnificus* infections that occurred in Alabama, Florida, Louisiana, and Texas from 1988 through 1996. The data was sourced from the Gulf Coast Surveillance System, Centers for Disease Control and Prevention (CDC), which collects case information as provided on a volunteer basis by medical health professionals. The researchers discovered that *V. vulnificus* infections peaked in the warmer summer months, and that 79 percent of all cases were traced directly back to Louisiana and Florida sources of harvested oysters. In sum, the researchers suggested that while *V. vulnificus* cases were rare, the infection is "highly lethal" and that "restricting the use of oysters harvested in warm Gulf waters to cooked or other suitably processed products may significantly reduce morbidity and mortality."

The Florida *V. vulnificus* Risk Reduction Plan for Oysters was established in 2001 with the stated goal to assure a significant reduction in *V. vulnificus* septicemia illnesses

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through a combination of consumer education, processing incentives, and if necessary, processing controls (FDA 2007). This plan outlined specific administrative procedures, responsibilities, and goals for the state of Florida, along with any other states that had two or more confirmed annual cases of *V. vulnificus* illnesses traced back to oysters harvested or processed in Florida. The Florida Department of Health illness data revealed that consumption of contaminated Florida oysters resulted in an annual average of 8.8 illnesses reported during the 1995-99 baseline period that was established by the plan.

There are four post-harvest processing (PHP) options available to oyster processors: irradiation, cryogenic individual quick-freezing (IQF) followed by frozen storage, cool pasteurization, and hydrostatic pressure. The process of irradiating oysters has been in use by some U.S. processors for fifteen years. Low doses of gamma irradiation were proven to be "effective in reducing large concentrations of both pathogenic and non-pathogenic *Vibrios* to non-detectable levels" (Andrews, Jahncke, and Mallikarjunan 2003). This study also conducted consumer panels which provided evidence that the irradiated oysters did not possess significantly different sensory qualities relative to non-irradiated oysters, and shelf life was maintained beyond two weeks.

A 2003 report generated by the Division of Aquaculture, Florida Department of Agriculture and Consumer Services (FDACS) revealed the results of a survey concerning post-harvest treatment capacity among Florida Certified Shellfish Processors. A total of 41 processors who handled oysters completed the survey, which characterized any current and expected post-harvest treatment activities and any influencing factors and concerns related to this type of processing. Of these, only one firm had IQF technology in place, and seven stated that they were in the construction phase. Five firms indicated that they had plans to purchase post-harvest treated product from other dealers.

Three PHT technologies were evaluated by the Research Triangle Institute with respect to their ability to reduce *V. vulnificus* levels and the economic impacts associated with each treatment method (Muth et al. 2000). While this study found that oyster processors were interested in adopting these technologies to reduce *V. vulnificus* levels and allow for greater storability, concerns remained about consumer acceptance of treated oysters, adaptability of PHT across oyster species, and the accessibility of PHT facilities to low-volume processors unable to install independent equipment.

In a 2001 study conducted by the FDACS Bureau of Seafood and Aquaculture Marketing, panelists were offered a sample of three oysters served on the half shell, where either two had been treated by the freezing process to control *V. vulnificus* and one was a fresh oyster, or vice versa. Consumers accurately detected a difference between the samples in 37 cases (55% of the panelists). Interestingly, the researchers discovered that there was no significant preference expressed by this group, as 49 percent preferred the fresh oysters while 51 percent indicated that they preferred the previously frozen oysters.

## **The Industry**

The commercial oyster industry in Florida represents an important component of the overall commercial seafood industry. Florida is the fourth most important U.S. state in the production of Eastern oysters (*Crassostrea virginica*). The Gulf of Mexico (Gulf) region produces over 70 percent of the total U.S. supply of Eastern oysters. Florida typically produces approximately 8 percent of the total Gulf-region eastern oyster

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production. In addition, oysters are an important part of the complement of species commercially targeted in Florida. Oysters are the sixth most important species, in terms of dockside value, landed by the Florida commercial fishing industry. Over 95 percent of the total annual harvest of oysters in Florida comes from the Apalachicola Bay region adjoining Franklin and Gulf Counties. Given the relatively undiversified nature of the economies of these two counties, which are dominated by forestry and tourism, the commercial oyster fishery is an important addition to their economies.

Eastern oysters harvested in Florida comprise an important segment of the overall Gulf-region seafood sector. Oysters are processed as a shucked product, as well as being directed as shellstock into the lucrative half shell, raw consumption market. The oyster processing industry in Florida is comprised of firms that shuck and/or ship shellstock to markets within Florida and to markets throughout the United States. Florida oyster processors handle not only Florida-harvested oysters, but also oysters harvested from other states within the Gulf region. In fact, approximately 60 percent of the total volume of oysters processed in Florida comes from other Gulf-region states. Florida oysters are also utilized in further value-added processing, and enter the final retail and food service markets in a variety of product forms.

### **The Situation**

Oysters are consumed in a variety of product forms. However, one of the most popular and traditional ways to consume oysters is the "raw on the half shell" option. Oysters utilized in this manner are harvested from approved waters, sorted/washed and bagged/boxed by the processor, shipped at approved temperatures to the retail setting, and consumed raw by the final consumer. The entire process of moving oysters from the harvesting site to the final consumer is regulated by the National Shellfish Sanitation Program and the Interstate Shellfish Sanitation Program. This is due to the potential health risks associated with the possible consumption of a raw product taken from a natural, aquatic environment where pathogens may occur. Although a raw product, for most consumers the ingestion of raw oysters containing *V. vulnificus* poses very little, if any, health risk. However, for a very small segment of the consuming public, the ingestion of raw molluscan shellfish containing *V. vulnificus* carries with it significant health risks. For example, individuals with a compromised immune system may be at risk when consuming raw oysters containing *V. vulnificus*.

The U.S. Food and Drug Administration (FDA) has oversight responsibility concerning the regulation and monitoring of health and sanitation issues concerning raw molluscan shellfish consumption. Of particular interest to the FDA is the incidence of illness associated with a specific pathogen, *V. vulnificus*, which occurs naturally within marine environment. The ingestion of the *V. vulnificus* bacteria typically poses little risk of illness when consumed by a healthy adult with a normally functioning immune system. However, *V. vulnificus* septicemia illness can occur when raw oysters are consumed by an individual with a compromised immune system. Individuals with liver disease, low stomach acid, or undergoing chemotherapy are a subset of those individuals who may be at an increased risk of contracting *V. vulnificus* septicemia if they consume raw oysters. And since the levels of *V. vulnificus* within oysters are typically elevated during the months of the year when water temperatures are higher, such as May through September,

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the FDA and ISSC have begun focusing efforts to enhance safety assurance on that period during each year.

During the 1995-2004 period, there was an average of 8.9 reported cases of *V. vulnificus* septicemia in Florida resulting from the consumption of oysters harvested from all U.S. waters. However, during that same period, there were on average 3.1 (Florida) and 4.3 (U.S.) reported cases of *V. vulnificus* septicemia, respectively, resulting from the consumption of oysters harvested only from Florida waters. The FDA has determined that these illness levels are unacceptable and has established illness reduction targets that each source state must obtain. For example, the rate of confirmed shellfish-borne *V. vulnificus* septicemia illnesses reported collectively by California, Florida, Louisiana, and Texas from the consumption of commercially harvested raw or undercooked oysters must be reduced by an average of 60 percent from the average illness rate observed for 1995-1999 of 0.303 cases per million (unit of population). If this target is not achieved, the NSSP has a management plan that could, among other provisions, close shellfish growing areas for the purpose of harvesting oysters intended for the raw, half shell market when the average monthly maximum water temperature exceeds 75 degrees Fahrenheit. More specifically, the NSSP may require closure of shellfish growing areas for the purpose of harvesting oysters intended for the raw, half shell market from May through September, although a shorter closure period could possibly be considered (although, for year 2010 the ISSC has accepted new stringent time to refrigeration controls).

The purpose of this study is to examine the economic consequences of an NSSP or FDA-mandated closure during all or a portion of the May-September period. Such a closure would impact not only the harvesters, but also the shellfish processors; the local businesses that supply goods and services to the harvesting, wholesaling, and processing sectors; local restaurants; and other businesses within the region. Thus the benefits gained from illness reduction may come at a cost to the local economy. This study will examine the consequences to those sectors and develop estimates of the economic impact of several oyster harvesting closure scenarios. This information will help resource managers better understand the changes in economic activities that will result from the potential FDA or NSSP management provisions, so that economic and social health objectives can be appropriately incorporated into the decisions affecting the commercial oyster industry in Florida.

## **OBJECTIVES**

The overall purpose of this study was to examine the economic impacts of possible closures of the fresh half shell market for varying time periods with the intention of protecting consumers from exposure to *V. vulnificus* infections. Economic impacts were estimated for harvesters, processors, and the overall economies of Franklin and Gulf Counties located in the "Big Bend" area of the Florida Panhandle region, which represents the majority of oyster harvesting waters in the state.

The specific objectives were to (1) determine the average monthly oyster landings and dockside prices received by Florida's oyster harvesters during the 2000-04 time period; (2) compute the percentage of total harvested yields sold as fresh half shell versus shucked product; (3) review the harvest quantity and price data for seasonal trend patterns and variations; (4) determine the post-harvest processing capabilities of the

fishery; (5) estimate the internal and external impacts under various summer closure scenarios that are currently under consideration, and (6) estimate the internal and external economic impacts under various summer closure scenarios in combination with various levels of post-harvest treatment capacity. This information can be used to provide guidance to regulatory agencies and stakeholders that are involved with ensuring the availability and safety of oysters harvested from Florida's waters.

## PROCEDURES

In order to estimate the economic impacts associated with potential closures of the Florida oyster fisheries, Marine Fisheries Trip Ticket data for 2004 were collected from the Florida Fish and Wildlife Research Institute (FWRI). All individuals engaged on the commercial harvest of saltwater species from Florida waters are required to purchase an annual license from Florida Wildlife Commission. Upon the return of a fishing vessel to the docks, a trip ticket is issued, and harvested species type, volume, and price received is recorded. In 2004, the data revealed that more than 90 percent of harvesters brought in oysters exclusively on each trip, while less than 10 percent harvested both oysters and other saltwater species on a single trip (Table 1).

Table 1. Numbers of oyster harvesters with dockside revenues from oysters and all other saltwater species, 2004.

Source of Revenue	Number of Harvesters	Percent of Harvesters
Exclusively oysters	448	90.3
Oysters AND other saltwater species	48	9.7
Total oyster harvesters	496	100.0

Source: Compiled from 2004 Trip Ticket Data.

Major oyster processors were contacted so that accurate industry averages could be computed using actual data from the 2004 season. Processors were asked to estimate the percentage of fresh half shell versus shucked product, shucked yields by month, and monthly F.O.B. wholesale prices paid for fresh half shell and shucked oysters. Processors were also queried about their access to, and interest in, post-harvest processing facilities as well as the costs and prices associated with providing a PHP oyster to the half shell consumer market. These values were used to generate seasonal trends and served as the basis for the development of post-harvest processing capacity and suggested harvest limitations that might be considered to reduce the risk of consumer exposure to *V. vulnificus* infections.

Florida's oyster fishery relies on labor supplied by local residents; therefore any required harvest closure periods would result in economic impacts that resonate throughout the Franklin and Gulf Counties of Florida. To estimate these impacts, an input-output model was utilized using the IMPLAN software and databases (MIG). IMPLAN model parameters for employment, labor costs, and proprietor income were

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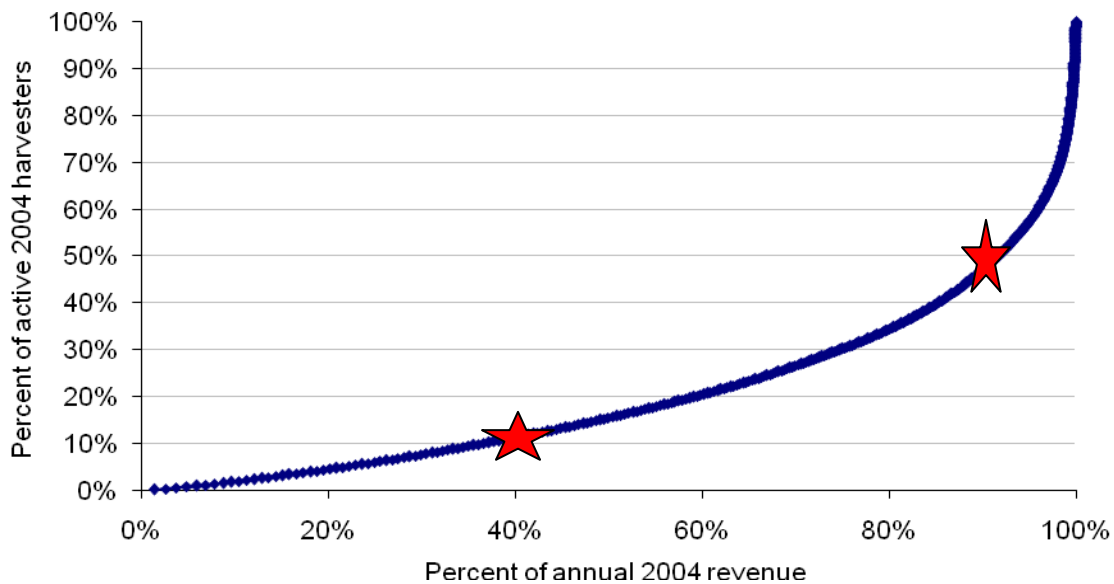
adjusted to conform to average values derived from trip ticket data, survey results, and industry-expert opinion.

## FINDINGS

### Overall Oyster Industry

In 2007, Florida oyster harvesters landed nearly 2.4 million pounds of product valued at almost \$5.4 million that were collected during 26,309 total trips (FFWC). Between 1994 and 2003, the waters off of Franklin and Gulf Counties supplied an average of 81.4 percent of the total oysters harvested in Florida, ranging from a high of 90.6 to a low of 67.6 percent in the years 2000 and 1996, respectively (Figure 1). In 2004, Florida harvested oysters were valued at nearly \$3 million, representing 96.4 percent of the total value of trips recorded by 496 harvesters (Table 2). This information highlights the importance of accurately measuring the economic value of proposed oyster fishery closures, as the majority of the economic impact in Florida will be confined to the participants and other input and support providers of Franklin and Gulf Counties.

Figure 1. Percent of active harvesters by percent of 2004 revenues.



To confirm the validity of the 2004 Trip Ticket oyster landings data, the number of 60-pound sacks recorded was plotted along with the average annual number of sacks harvested throughout Florida over the five-year period from 2000 to 2004 (Figure 2). The oyster reproductive cycle peaks in the summer months, resulting in smaller and less desirable meat qualities and relatively lower harvest rates relative to the winter and spring months. In addition to poorer meat quality, warmer summer waters are presumed to contribute to higher *V. vulnificus* infections. Strong jumps in harvested volumes occurred from October through December, as the oysters are collected and sold to the more

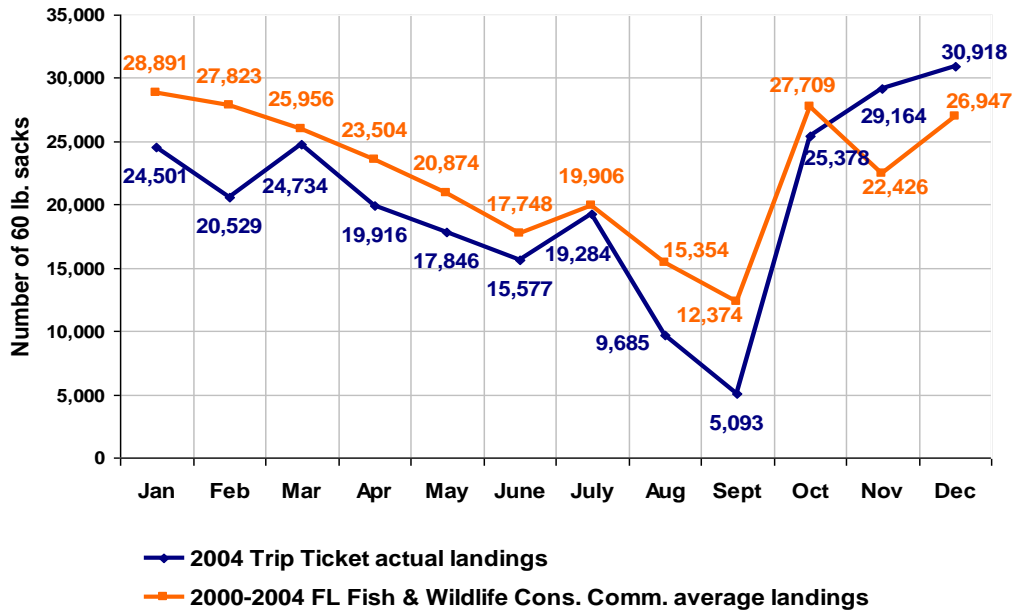
profitable half shell market. This seasonal peak from October through April also coincides with the influx of Florida's winter residents, "Spring Break" tourism activities, and holiday occasions.

Table 2. Oyster harvesters' total annual revenues from oysters and all other saltwater species, 2004.

Source of Revenue	Number of Harvesters	Percent of Harvesters	Revenues by Species (Dollars)	Percent of Total Revenues
Oysters	496	100.0	2,998,588	96.4
All other saltwater species	48	9.7	110,670	3.6
<b>Total, all species</b>	<b>496</b>	<b>100.0</b>	<b>3,109,258</b>	<b>100.0</b>

Source: Compiled from 2004 Trip Ticket Data. See Appendix Table 1 for detailed breakdown.

Figure 2. Reported commercial Florida oyster landings, 2004 and 2000-04 average.



As in other fisheries, 112 harvesters (22.3%) earned relatively low incomes of less than \$500 annually for Florida oysters harvested in 2004 (Table 3). Another 21 percent of harvesters reported gross incomes ranging from \$2,000 to \$4,999 during this same year. According to Trip Ticket data, only one harvester received between \$40,000 and \$49,999, while four others collected incomes ranging from \$30,000 to \$39,999 in 2004. In total, these five individuals represented only one percent of all licensed oyster harvesters that actively collected and sold product in 2004.

Table 3. Annual revenues from oysters received by Florida harvesters, 2004.

Gross Income (Dollars)	Number of Harvesters
40,000 – 49,999	1
30,000 – 39,999	4
20,000 – 29,999	23
10,000 – 19,999	86
5,000 – 9,999	80
2,000 – 4,999	104
1,000 – 1,999	45
500 – 999	41
< 500	112
<b>TOTAL</b>	<b>496</b>

Source: Compiled from 2004 Trip Ticket data.

To further delve into the division of 2004 dockside revenues paid to oyster harvesters, the 496 total individuals were split into 10 decile groups, each with about 50 harvesters (Table 4). The first decile group contained harvesters who received an approximate annual average of \$22,000 each, accounting for a total of \$1.1 million, or nearly 37 percent, of all revenues. The second decile group contained harvesters who earned an average of \$13,707 each in 2004, representing 22.4 percent of all revenues. Harvesters in the third and fourth decile groups earned an average of \$9,405 and \$6,221, respectively, in 2004, and combined with the first two deciles, these four groups represent 85 percent of total revenues. In sum, less than one-half of the total number of active harvesters in 2004 accounted for just over 90 percent of annual revenues (Figure 1).

Table 4. Analyses of 2004 dockside revenues paid to harvesters, by decile

Decile <sup>a</sup>	2004 Dockside Revenues			
	Approximate Mean (per harvester)	Total by Decile		
	(Dollars)	(Dollars)	(Percent)	(Cum. Pct.)
First	22,000	1,100,046	36.7	36.7
Second	13,707	671,640	22.4	59.1
Third	9,405	470,236	15.7	74.8
Fourth	6,221	311,034	10.4	85.2
Fifth	3,922	196,096	6.5	91.7
Sixth	2,566	128,300	4.3	96.0
Seventh	1,434	70,272	2.3	98.3
Eighth	625	31,255	1.0	99.3
Ninth	290	14,226	0.5	99.8
Tenth	110	5,484	0.2	100.0
<b>TOTALS</b>	<b>N.A.</b>	<b>2,998,588</b>	<b>100.0</b>	<b>N.A.</b>

<sup>a</sup>There were 496 total harvesters. Thus, there are approximately 50 harvesters in each decile.

## Summer Oyster Harvest

Because this study is primarily concerned with understanding the impacts of potential summer closures, the actual dockside revenues received by Florida harvesters were analyzed on a monthly basis (Table 5). Total oyster quantities sold in 2004 were 242,625 bags, each containing 60 pounds of oysters in the shell. December and November harvested quantities of 60-pound bags totaled 30,918 and 29,164, respectively, and together represented nearly \$789,000, or 26.3 percent, of 2004 revenues. October, January, and March oyster harvest totals each represented approximately 10 percent of annual revenues, with between 24,501 and 25,378 60-pound bags sold.

Overall, the lowest-grossing months were the months from May through September, with recorded September oyster harvests of just over 5,000 bags (2% of total annual harvest), representing the lowest month in 2004 (Table 5). Of these summer months, July's harvest of 19,284 bags accounted for just 7.6 percent of total 2004 revenues. Should the suggested summer closure period have occurred during the months of May through September in 2004, a total of 67,485 bags would not have been harvested, representing total revenue losses of nearly \$800 million, or 26.7 percent of annual revenues. If the closure period was limited to the three months of June, July, and August, quantities of 44,546 bags would not have been collected, and the oyster fishery would have lost \$523,575, or 17.5 percent, of 2004 revenues.

Table 5. Actual dockside revenues paid to Florida harvesters, by month, 2004.

Time Period	Quantities Sold (No. 60-lb. bags)	Total Revenue (Dollars)	Percent of Annual Revenue (Percent)
January	24,501	308,205	10.3
February	20,529	252,101	8.4
March	24,734	301,136	10.0
April	19,916	337,836	7.9
May	17,846	215,836	7.2
June	15,577	185,987	6.2
July	19,284	228,021	7.6
August	9,685	109,567	3.7
September	5,093	60,178	2.0
October	25,378	311,084	10.4
November	29,164	388,654	13.0
December	30,918	399,984	13.3
<b>TOTALS:</b>	<b>242,625</b>	<b>2,998,588</b>	<b>100.0</b>

Source: Compiled from 2004 Trip Ticket data. See Appendix Table 1 for detailed breakdown.

To further explore the summer oyster harvest situation relative to the 2004 data, total dockside revenues of those individuals who harvested product exclusively in the five- and three-month periods were analyzed (Table 6). Only 14 harvesters chose to collect and sell oysters during the five months of May through September, earning a total of \$6,503. When limited to the three months of June through August, the data revealed that nine individuals sold oysters for a total of \$2,503. As the summer oysters are not known to possess the preferred meat qualities desired by the half shell market, it was suspected that these summer-only harvesters might have sold their oysters as a shucked

product. Interestingly, only \$910 and \$287 were received by these summer-only harvesters for shucked oyster meats sold during the five- and three-month periods, respectively. This indicated that 86 percent of revenues received by these harvesters resulted from sales of their product for consumption in the half shell form.

Table 6. Total dockside revenues of Florida oyster harvesters who ONLY harvest during the five-month and three-month periods.

Closure Period	Number of Harvesters	Dockside Revenues	
		Total	Shucked Product Only <sup>a</sup>
(-----Dollars-----)			
Five months (May – September)	14	6,503	910
Three months (June – August)	9	2,053	287

<sup>a</sup> According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market. The analysis in this table also assumes that oysters sold for shucking command the same price as those going for the fresh half shell market.

Conversely, oyster harvesters that did not harvest any product during either of the two defined summer periods in 2004 would potentially be unaffected by either of the proposed hypothetical closures. Of the 496 license holders with 2004 landings, 213, or 42.9 percent, did not sell product during May through September (Table 7). This group earned nearly \$356 thousand in total revenues, representing about twelve percent of the oyster fishery earnings. There were 262, or 52.8 percent, of licensed harvesters with landings that chose not to go out to harvest oysters during the June through August summer months. The nine-month harvested volumes of these individuals accounted for almost \$550 thousand (18.3 percent) of 2004 revenues.

Table 7. Total dockside revenues of Florida oyster harvesters who DO NOT harvest during the five-month or three month periods.

Length of closure	Number of harvesters	Percent of total harvesters <sup>a</sup>	Total revenues	Percent of total revenues <sup>b</sup>
			(Dollars)	
Five months (May-September)	213	42.9	355,737	11.9
Three months (June – August)	262	52.8	549,657	18.3

<sup>a</sup> Percentage of total harvesters is based upon 496 SPL holders that had landings in 2004.

<sup>b</sup> The percentage of revenue is based upon total revenues of 2,998,583.

Source: Compiled from Trip Ticket data.

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## Summer Closure Scenarios

Various scenarios have been suggested by members of the oyster fishery and the ISSC as possible options that are designed to meet the goal of reducing *V. vulnificus* infections traced back to Florida harvested (Table 8). Scenario 1 describes the current situation as presented in the initial portion of this report, and does not include any summer closure periods or post-harvest process requirements or restrictions. This scenario is used as the benchmark by which all the other scenarios are compared. Scenarios 2 and 3 provide estimates of the potential losses incurred by the industry should the oyster fisheries close from May through September (five months) or from June through August (three months), respectively.

Table 8. Descriptions of various scenarios involving alternative closure periods for fresh shellstock sales and levels of substitution of PHT (frozen) shellstock for fresh half shell product.

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Scenario	Description
1	Current situation, no fresh half shell closures (benchmark scenario).
2	Fresh half shell closure for five months (May–September), no sales of PHT (frozen) product.
3	Fresh half shell closure for three months (June–August), no sales of the PHT (frozen) product.
4	Fresh half shell closure for five-month period, with 25 percent of average half shell sales replaced by the PHT (frozen) half shell product at a price of \$60.00 per case, or \$0.42 each, and frozen yields of 162 oysters per bushel of fresh product.
5	Fresh half shell closure for five-month period, with 50 percent of average half shell sales replaced by the PHT (frozen) half shell product at a price of \$60.00 per case, or \$0.42 each, and frozen yields of 162 oysters per bushel of fresh product.
6	Fresh half shell closure for three-month period, with 25 percent of average half shell sales replaced by the PHT (frozen) half shell product at a price of \$60.00 per case, or \$0.42 each, and frozen yields of 162 oysters per bushel of fresh product.
7	Fresh half shell closure for three-month period, with 50 percent of average half shell sales replaced by the PHT (frozen) half shell product at a price of \$60.00 per case, or \$0.42 each, and frozen yields of 162 oysters per bushel of fresh product.

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Scenarios 4 and 5 take the conditions included under the second case and allow for either a 25 or 50 percent substitution of post-harvest treated product released to the half shell consumer market during the closure months of May through September, respectively (Table 8). Expectations about the prices and yields for a post-harvest treated half shell oyster were provided by processors that have experience with the PHT oyster

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market. PHT half shell oysters were expected to sell for 42 cents apiece, and yields were assumed to average 162 frozen half shell oysters per bushel. These same market price and yield assumptions were used in Scenarios 6 and 7, which took the third case of closure months from June through August and allowed for either a 25 or 50 percent substitution of the PHT product for sale during the proposed closure months.

### Estimated Revenues of Summer Closure Scenarios

For the last four scenarios involving provision of the PHT product to the summer half shell consumer market, it was assumed that the additional oysters required to meet the estimated 25 and 50 percent substitution summer supplies were harvested, frozen, and stored during the months of March and April. Other assumptions included the use of average dockside revenues received by licensed oyster harvesters, during each of the months of 2004, and the average monthly oyster landings recorded by FWRI during the five-year period of 2000 to 2004. Average annual dockside revenues to oyster harvesters from 2000 to 2004 exceeded \$3.3 million. The average annual harvest during this period was 269,513 60-pound bags (Table 9).

Table 9. Scenario 1: Hypothetical dockside revenues paid to Florida harvesters, by month using average annual landings over the five-year period, 2000-04, and 2004 average monthly prices. <sup>a</sup>

Time Period	Quantities Sold (No. 60-lb. bags)	Total Revenue (Dollars)	Percent of Average Annual Revenue (Percent)
January	28,891	365,181	11.0
February	27,823	342,225	10.3
March	25,956	314,322	9.4
April	23,504	281,818	8.5
May	20,874	253,834	7.6
June	17,748	211,373	6.3
July	19,906	232,303	7.0
August	15,354	175,041	5.3
September	12,374	148,245	4.5
October	27,709	345,807	10.4
November	22,426	305,447	9.2
December	26,947	353,810	10.6
<b>GRAND TOTALS</b>	<b>269,513</b>	<b>3,329,404</b>	<b>100.0</b>

<sup>a</sup> Scenario 1 is the no fresh half shell closure, current situation. See Appendix Table 2 for detailed breakdown.

Using Scenario 1 as a benchmark, the five month summer closure under Scenario 2 would result in a 26.4 percent, or \$887 thousand, reduction in annual dockside revenues to harvesters (Table 10). The harvested quantity estimates were based on the assumption that average monthly harvests were limited to 14 percent of recorded average collection levels and sold strictly as a frozen shucked product. During this five-month period, the

largest harvest (2,922 bags), occurred in May, while the September harvest was reduced to 792 bags, which represented less than one percent of total 2004 dockside revenues. Scenario 3 applied the same assumptions of Scenario 2, except that the closure period was for only the three months, June, July and August (Table 11). Overall, for this three month closure scenario, average annual dockside revenues were reduced by 16 percent, or \$532 thousand, compared to the benchmark scenario.

Table 10. Scenario 2: Hypothetical dockside revenues paid to Florida harvesters, by month, using average annual landings over the five-year time period, 2000 – 2004, and 2004 average monthly prices. <sup>a</sup>

Time Period	Quantities Sold (No. 60-lb. bags)	Total Revenue (Dollars)	Percent of Average Annual Revenue (Percent)
January	28,891	365,181	14.9
February	27,823	342,225	14.0
March	25,956	314,322	12.8
April	23,504	281,818	11.5
May <sup>b</sup>	2,922	35,537	1.4
June <sup>b</sup>	2,485	29,592	1.2
July <sup>b</sup>	2,787	32,522	1.3
August <sup>b</sup>	2,150	24,506	1.0
September <sup>b</sup>	1,732	20,754	0.8
October	27,709	345,807	14.1
November	22,426	305,447	12.5
December	26,947	353,810	14.4
GRAND TOTALS	195,332	2,451,521	100.0
Percent change from Scenario 1	- 27.5	- 26.4	N.A.

<sup>a</sup> Scenario 2 is fresh half shell closure for five months (May-September), no sales of the PHT (frozen) product. See Appendix Table 2 for detailed breakdown.

<sup>b</sup> Months during which no fresh half shell sales are permitted. According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market. The analysis in this table also assumes that oysters sold for shucking command the same price as those going for the fresh half shell market.

Table 11. Scenario 3: Hypothetical dockside revenues paid to Florida harvesters, by month, using average annual landings over the five-year period, 2000-04, and 2004 average monthly prices. <sup>a</sup>

Time Period	Quantities Sold (No. 60-lb. bags)	Total Revenue (Dollars)	Percent of Average Annual Revenue (Percent)
January	28,891	365,181	13.1
February	27,823	342,225	12.2
March	25,956	314,322	11.2
April	23,504	281,818	10.1
May	20,874	253,834	9.1
June <sup>b</sup>	2,485	29,592	1.1
July <sup>b</sup>	2,787	32,522	1.2
August <sup>b</sup>	2,150	24,506	0.9
September	12,374	148,245	5.3
October	27,709	345,807	12.4
November	22,426	305,447	10.9
December	26,947	353,810	12.6
GRAND TOTALS	223,926	2,797,308	100.0
Percent change from Scenario 1	- 16.9	- 16.0	N.A.

<sup>a</sup> Scenario 3 is fresh half shell closure for three months (June-August), no sales of the PHT (frozen) product.

<sup>b</sup> Months during which no fresh half shell sales are permitted. According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market. The analysis in this table also assumes that oysters sold for shucking command the same price as those going for the fresh half shell market. See Appendix Table 2 for detailed breakdown.

Scenarios 4 and 5 evaluated the potential financial gains of releasing PHT frozen oysters at levels equal to 25 and 50 percent, respectively, of the average monthly amounts that are currently harvested and sold to the fresh half shell market during the months of May through September. Overall, replacing 25 percent of the fresh half shell market with PHT oysters during a five-month summer closure would result in an estimated 20 percent decrease in both the total number of bags sold and total revenue to the fishery relative to the benchmark scenario (Table 12). In Scenario 5, where 50 percent of the usual five-month summer harvest was replaced by PHT oysters, the industry would sustain 14 and 13 percent losses in quantities sold and total annual revenue, respectively (Table 13). It is important to note that in both Scenarios 4 and 5, it is assumed that fresh half shell consumers would accept the PHT product as a perfect substitute for raw oysters during the summer months. In addition, these figures are based on the feasibility of increasing harvested quantities in March and April for PHT processing and summer sales. It is also assumed that the industry would purchase sufficient equipment to treat and then store the PHT product.

Table 12. Scenario 4: Hypothetical dockside revenues paid to Florida harvesters, by month, using average annual landings over the five-year period, 2000-04, and 2004 average monthly prices. <sup>a</sup>

Time Period	Quantities Sold (No. 60-lb. bags)	Total Revenue (Dollars)	Percent of Average Annual Revenue (Percent)
January	28,891	365,181	13.7
February	27,823	342,225	12.8
March <sup>b</sup>	35,229	426,613	15.9
April <sup>b</sup>	32,778	392,997	14.7
May <sup>c</sup>	2,922	35,537	1.3
June <sup>c</sup>	2,485	29,592	1.1
July <sup>c</sup>	2,787	32,522	1.2
August <sup>c</sup>	2,150	24,506	0.9
September <sup>c</sup>	1,732	20,754	0.8
October	27,709	345,807	12.9
November	22,427	305,447	11.4
December	26,947	353,810	13.2
<b>GRAND TOTALS:</b>	<b>213,877</b>	<b>2,674,990</b>	<b>100.0</b>
Percent change from Scenario 1	- 20.3	- 19.7	N.A.

<sup>a</sup> Scenario 4 is fresh half shell closure for five-month period, with 25 percent of average fresh half shell sales replaced by the PHT (frozen) half shell product. See Appendix Table 2 for detailed breakdown.

<sup>b</sup> Months during which additional quantities of shellstock are harvested for sale during May-September as a PHT (frozen) product.

<sup>c</sup> Months during which no fresh half shell sales are permitted. According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market. The analysis in this table also assumes that oysters sold for shucking command the same price as those going for the fresh half shell market.

Table 13. Scenario 5: Hypothetical dockside revenues paid to Florida harvesters, by month, using average annual landings over the five-year period, 2000-04, and 2004 average monthly prices.<sup>a</sup>

Time period	Quantities sold (No. 60 lb. bags)	Total revenue (Dollars)	Percent of average annual revenue (Percent)
January	28,891	365,181	12.6
February	27,823	342,225	11.8
March <sup>b</sup>	44,501	538,904	18.6
April <sup>b</sup>	42,050	504,175	17.4
May <sup>c</sup>	2,922	35,537	1.2
June <sup>c</sup>	2,485	29,592	1.0
July <sup>c</sup>	2,787	32,522	1.1
August <sup>c</sup>	2,150	24,506	0.8
September <sup>c</sup>	1,732	20,754	0.7
October	27,709	345,807	11.9
November	22,426	305,447	10.5
December	26,947	353,810	12.2
<b>GRAND TOTALS:</b>	<b>232,422</b>	<b>2,898,460</b>	<b>100.0</b>
Percent change from Scenario 1	-13.8	-12.9	N.A.

<sup>a</sup> Scenario 5 is fresh half shell closure for five-month period, with 50 percent of average fresh half shell sales replaced by PHT (frozen) half shell product. See Appendix Table 2 for detailed breakdown.

<sup>b</sup> Months during which additional quantities of shellstock are harvested for sale during May-September as PHT (frozen) product.

<sup>c</sup> Months during which no fresh half shell sales are permitted. According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market. The analysis in this table also assumes that oysters sold for shucking command the same price as those going for the fresh half shell market.

The projected revenue changes resulting from the PHT replacement scenarios with a three-month fishery closure during June, July, and August (Scenarios 6 and 7) are presented in Tables 14 and 15, respectively. Not surprisingly, these shorter closure periods with PHT replacement resulted in smaller total revenue losses than PHT replacement with five-month closures (Scenarios 4 and 5). In Scenario 6, with 25 percent PHT replacement, the fishery would experience 12 and 13 percent losses in quantities sold and total annual revenue, respectively (Table 14). Where one-half of the normal fresh half shell market was replaced by PHT oysters in Scenario 7, the quantity sold diminished by almost 9 percent and total dockside revenues were reduced by nearly 8 percent (Table 15).

Table 14. Scenario 6: Hypothetical dockside revenues paid to Florida harvesters, by month, using average annual landings over the five-year period, 2000-04, and 2004 average monthly prices. <sup>a</sup>

Time Period	Quantities Sold (No. 60-lb. bags)	Total Revenue (Dollars)	Percent of Average Annual Revenue (Percent)
January	28,891	365,181	12.4
February	27,823	342,225	11.7
March <sup>b</sup>	31,654	383,329	13.1
April <sup>b</sup>	29,203	350,141	11.9
May	20,874	253,834	8.6
June <sup>c</sup>	2,485	29,592	1.0
July <sup>c</sup>	2,787	32,522	1.1
August <sup>c</sup>	2,150	24,506	0.8
September	12,374	148,245	5.1
October	27,709	345,807	11.8
November	22,426	305,447	10.4
December	26,947	353,810	12.1
<b>GRAND TOTALS:</b>	<b>235,323</b>	<b>2,934,638</b>	<b>100.0</b>
Percent change from Scenario 1	- 12.7	- 11.9	N.A.

<sup>a</sup> Scenario 6 is fresh half shell closure for three-month period, with 25 percent of average fresh half shell sales replaced by the PHT (frozen) half shell product. See Appendix Table 2 for detailed breakdown.

<sup>b</sup> Months during which additional quantities of shellstock are harvested for sale during June-August as a PHT (frozen) product.

<sup>c</sup> Months during which no fresh half shell sales are permitted. According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market. The analysis in this table also assumes that oysters sold for shucking command the same price as those going for the fresh half shell market.

Table 15. Scenario 7: Hypothetical dockside revenues paid to Florida harvesters, by month, using average annual landings over the five-year period, 2000-04, and 2004 average monthly prices. <sup>a</sup>

Time Period	Quantities Sold (No. 60 lb. bags)	Total Revenue (Dollars)	Percent of Average Annual Revenue (Percent)
January	28,891	365,181	11.9
February	27,823	342,225	11.1
March <sup>b</sup>	37,352	452,336	14.7
April <sup>b</sup>	34,901	418,465	13.6
May	20,874	253,834	8.3
June <sup>c</sup>	2,485	29,592	1.0
July <sup>c</sup>	2,787	32,522	1.1
August <sup>c</sup>	2,150	24,506	0.8
September	12,374	148,245	4.8
October	27,709	345,807	11.3
November	22,427	305,447	9.9
December	26,947	353,810	11.5
<b>GRAND TOTALS:</b>	<b>246,720</b>	<b>3,071,969</b>	<b>100.0</b>
Percent change from Scenario 1	- 8.5	- 7.7	N.A.

<sup>a</sup> Scenario 7 is fresh half shell closure for three-month period, with 50 percent of average fresh half shell sales replaced by the PHT (frozen) half shell product. See Appendix Table 2 for detailed breakdown.

<sup>b</sup> Months during which additional quantities of shellstock are harvested for sale during June-August as a PHT (frozen) product.

<sup>c</sup> Months during which no fresh half shell sales are permitted. According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market. The analysis in this table also assumes that oysters sold for shucking command the same price as those going for the fresh half shell market.

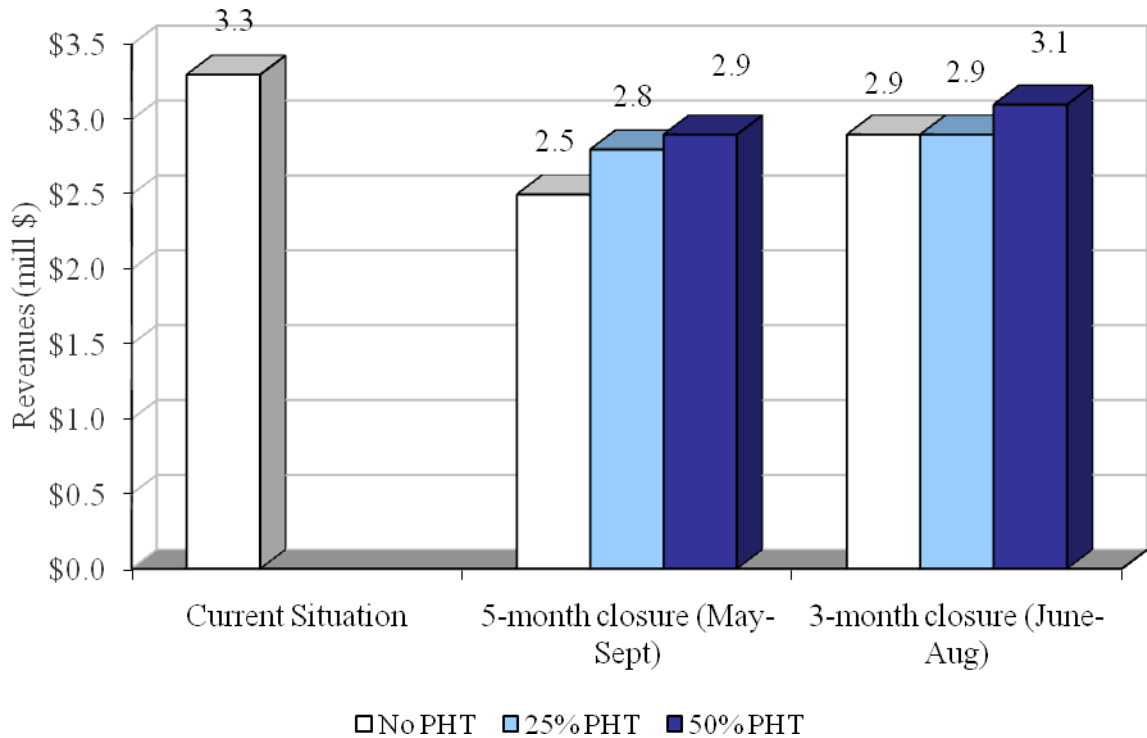
As anticipated by industry participants, five- or three-month summer closures of fresh oysters would result in significant industry losses. Dockside revenues resulting from the five- and three-month closures were estimated to decline by 26 and 16 percent, respectively (Table 16, Figure 4). The actual F.O.B. gross revenues lost by the oyster fisheries under Scenarios 2 and 3 were estimated to equal \$1,226,526 and \$888,944, respectively. While the quality of the fresh half shell product harvested during the summer is known to be inferior to oysters harvested during the cooler months, it is important to emphasize that these scenarios were developed using historical F.O.B. prices paid for this exact product type and quality.

Table 16. Hypothetical total dockside and F.O.B. gross revenues from all Florida oyster products harvested under various scenarios.

Scenario	Total Dockside Revenues	$\Delta\%$ <sup>a</sup>	Total F.O.B. Gross Revenues	$\Delta\%$ <sup>a</sup>
	(Dollars)	(Percent)	(Dollars)	(Percent)
Scenario 1 (Current, no fresh half shell closure)	3,329,404	0.0	5,789,123	0.0
Scenario 2 (5-mo. fresh half shell closure)	2,451,521	- 26.4	4,342,597	- 25.0
Scenario 3 (3-mo. fresh half shell closure)	2,797,308	- 16.0	4,900,179	- 15.4
Scenario 4 (5-mo. fresh half shell closure, 25% replacement w/PHT)	2,674,990	- 19.7	5,594,398	- 3.4
Scenario 5 (5-mo. fresh half shell closure, 50% replacement w/PHT)	2,898,460	- 12.9	6,846,200	+ 18.3
Scenario 6 (3-mo. fresh half shell closure, 25% replacement w/PHT)	2,934,638	- 11.9	5,669,458	- 2.1
Scenario 7 (3-mo. fresh half shell closure, 50% replacement w/PHT)	3,071,969	- 7.7	6,438,736	+ 11.2

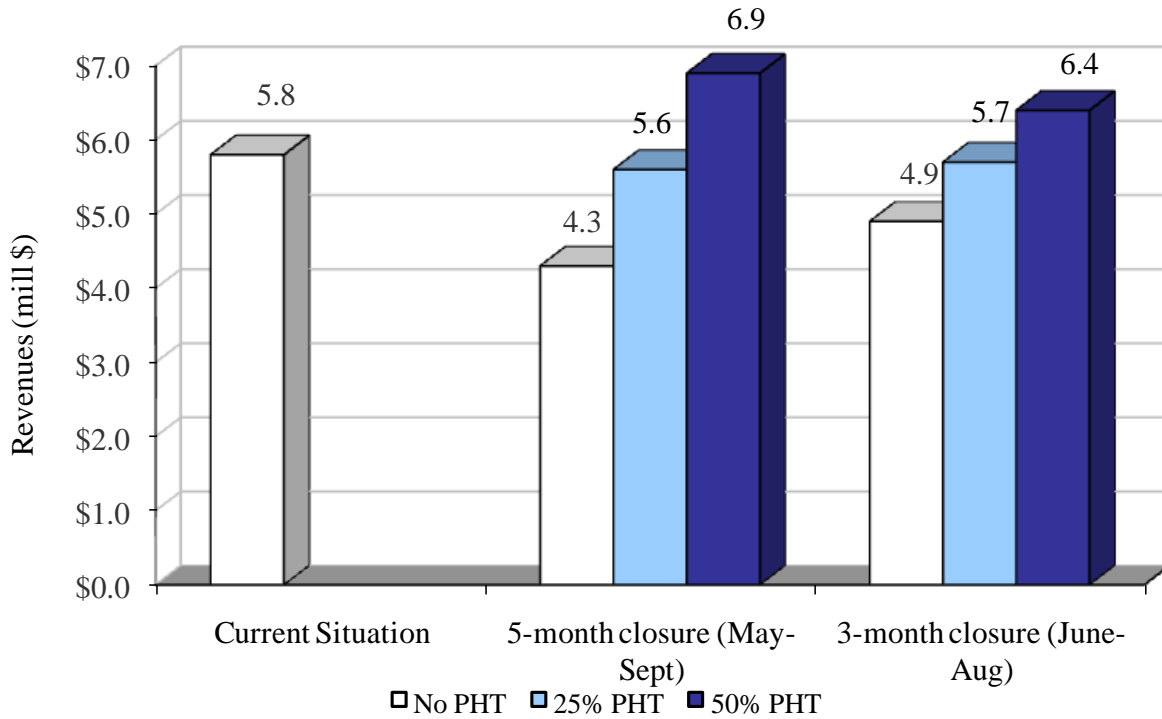
<sup>a</sup> Percent change relative to Scenario 1.

Figure 3. Total dockside revenues for all types Florida oysters harvested under current situation and various hypothetical closure and replacement scenarios.



Consideration of the potential for replacement of fresh half shell product with PHT oysters produced some interesting results. Again, it is important to reiterate that these replacement scenarios were based on the following assumptions: (1) that consumers would accept the PHT oysters as replacements; (2) that the industry would be able to harvest the additional volume in March and April; (3) that this industry had the processing capabilities, storage facilities, and labor available to meet the requirements of PHT processing; and (4) that the relatively higher prices the market would pay for this relatively safer substitute would hold at the current levels. Under these conditions, results indicated that in two of the four proposed scenarios, total F.O.B. gross revenues would actually increase (Table 16, Figure 4). In particular, Scenario 5 (where fresh half shell harvesting was shut down from May through September and PHT replacement oysters were sold at levels equivalent to 50 percent of historical levels during this time) resulted in an 18.3 percent increase in F.O.B. revenues over the current no-closure scenario (Scenario 1). However, total dockside revenues earned by oyster harvesters were estimated to drop from 8 to 20 percent relative to the historical earnings achieved with no summer harvest restrictions.

Figure 4. Total F.O.B. revenues for all types Florida oysters harvested under current situation and various hypothetical closure and replacement scenarios.



#### Estimated Employment of Summer Closure Scenarios

The traditional oyster fishery is labor-intensive. Oysters are typically harvested using hand-tools (tongs) from small boats in shallow coastal waters. On board, undersized oysters are hand-culled back into the water to help maintain future stock. The remaining harvestable oysters are temporarily packed in burlap bags. Once onshore, the oysters are sorted, cleaned, and packed or processed, also by hand, in preparation for shipment to their final destination. Oysters intended for the shucked market are typically processed in a central location and immediately packaged and frozen for resale. In the case of the half shell market, the majority of processors do not pre-shuck the oysters, as this is done by the final retail or consumer outlet. For processors that have adopted the PHT technology and invested in the necessary freezing and storage equipment, additional labor must be hired and investments in training incurred.

Estimated labor requirements for the six alternative PHT scenarios are shown in Table 17. Estimated harvester numbers for each scenario were based on data provided by the Florida Fish and Wildlife Conservation Commission. Average employment and revenue data were used to estimate employment by shellstock and shucking operations for six alternative scenarios. It is estimated that all six closure scenarios would result in fewer oyster harvesters and workers in shellstocking operations. The greatest reductions in employment would occur for the five-month closure without PHT replacement in

Scenario 2. The smallest reduction in worker numbers occurs in Scenario 7, the three-month closure with PHT replacement. It is estimated that Scenario 7 would lead to about a 6 percent reduction in the number of oyster industry workers, compared to a 20 percent reduction under Scenario 2.

Table 17. Hypothetical annual labor requirements based upon average landings, 2000-04, adjusted for various closure periods and production levels of PHT (frozen) oysters.

Scenario	Gross F.O.B. Values  (Dollars)	Type of Labor			Total
		Harvesters <sup>a</sup>	Shellstock <sup>b</sup>	Shucking <sup>b</sup>	
		(------ Employees -----)			
Scenario 1 (Current, no fresh half shell closure)	5,789,123	233	199	198	630
Scenario 2 (5-mo. fresh half shell closure)	4,342,597	169	135	198	502
Scenario 3 (3 mo. fresh half shell closure)	4,900,179	194	160	198	552
Scenario 4 (5 mo. fresh half shell closure, 25% replacement w/PHT)	5,594,398	185	151	198	534
Scenario 5 (5 mo. fresh half shell closure, 50% replacement w/PHT)	6,846,200	201	167	198	566
Scenario 6 (3 mo. fresh half shell closure, 25% replacement w/PHT)	5,669,458	204	170	198	572
Scenario 7 (3 mo. fresh half shell closure, 50% replacement w/PHT)	6,438,736	214	179	198	591

<sup>a</sup> Full-time harvester equivalents (FTEs) are based upon the average quantities harvested in Florida over the five-year period, 2000-2004, as reported by the Florida Fish and Wildlife Conservation Commission and the following assumptions: (1) that 75 percent of the dockside value accrues to labor (Anderson et. al. 1996) and (2) a full-time harvester earned the equivalent of the annual minimum wage (\$10,712) in 2004.

<sup>b</sup> Estimated labor employed at 37 firms selling shellstock ranged from 4 to 6, and averaged slightly over 5 persons per firm; labor at processing firms (shuckers) were estimated to average about 14 employees, but the numbers estimated for individual firms varied widely, depending on the size of operation.

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## Estimated Secondary Impacts/Contributions of Summer Closure Scenarios

Secondary economic impacts or contributions of alternative oyster harvesting and processing scenarios were estimated using a regional economic input-output model of Franklin and Gulf Counties that was constructed using the IMPLAN Pro software and databases.<sup>1</sup> The IMPLAN model was based on 2003 economic data which were collected by various federal and state government agencies, including the U.S. Department of Commerce and U.S. Department of Labor. Details on IMPLAN software and databases can be found at <http://www.implan.com>.

The estimated gross revenues calculated for each scenario were entered into the IMPLAN model as new economic activity for the Fishing Industry (Sector 16) and the Seafood Product Preparation and Packing Industry (Sector 71).<sup>2</sup> The economic relationships embodied in these IMPLAN sectors are based on national data for all types of fishing and seafood processing activities in the United States. Because of the special nature of Florida's oyster industry, these national economic relationships are not completely appropriate for this analysis. Consequently, the model was modified to better represent Florida's oyster industry. These modifications included increasing the share of value-added components in the harvesting/fishing sector production function to 75 percent of total revenues, and similarly, setting the value-added share of the seafood processing production sector's production function to 70 percent of total revenues. Also, the average revenues and compensation per worker for IMPLAN sectors 16 and 71 were adjusted to match actual local industry averages (Table 17).

The types of economic impacts or contributions estimated using the input-output models include output, value-added, labor income, other property income, indirect business taxes, and employment. These contributions can occur through direct, indirect, or induced effects. The total economic contributions of an event or activity equal the sum of these direct, indirect, and induced contributions. Output contributions represent the total value of revenues or expenditures associated with an activity. Value-added measures the labor income, other property income, and indirect business taxes derived from these revenues. Labor income represents earnings by employees and proprietors of oyster businesses. Other property type income represents corporate profits in addition to payments for rents, royalties, dividends, and interest. Indirect business taxes include excise, property, and sales taxes, as well as licenses and fees paid by businesses, but not taxes on profits or income. The estimated number of annual full-time, part-time, and seasonal jobs resulting from an industry's activity is represented by Employment impacts. Each of these measures represents a different way of assessing the importance or contribution of an economic activity to a region.

For purposes of this analysis, it was assumed that all oysters sold from Gulf and Franklin Counties were harvested by operations based inside the two counties and that

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<sup>1</sup> When the economic importance of an industry or activity is evaluated under these assumptions, it is more appropriate to refer to the estimated economic impacts as economic contributions (Watson, Wilson, Thilmany, and Winter 2007).

<sup>2</sup> Oyster revenues were deflated to 2003 price levels to match the IMPLAN model year data using Bureau of Labor Statistics price indices. Once the secondary economic contributions were estimated, they were then "re-inflated" back to 2004 levels, using the same indices.

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these oysters were all sold to buyers located outside the area. The consequence of these assumptions is that all oyster revenues can be treated as "new" dollars for the economy of Gulf and Franklin Counties. In input-output analysis, new dollars generate secondary economic impacts or contributions through indirect and induced effects. Direct effects are generated by all revenues and jobs created by an industry regardless of their origin. These direct effects (total F.O.B gross revenues) were estimated in the previous section. Indirect economic effects or contributions occur when oyster harvesters and processors purchase goods and services required to carry out their business from local suppliers. Additional revenues and jobs are created for the local economy when this occurs. Induced effects occur when oyster business owners and employees spend their earnings from harvesting and processing activities for personal consumption in the local economy. Again, additional jobs and revenues are generated in local consumer related businesses that fulfill these demands. The total economic contributions of industry activity for the local area equal to the sum of these direct, indirect, and induced effects.

Summary output contributions of the seven summer closure scenarios are presented in Table 18. The scenarios are presented along individual table rows, with direct, indirect, induced, and total impacts given in separate columns. The percent change in output contributions from benchmark Scenario 1 is given in the last column of Table 18. Estimated value-added, labor income, other property income, indirect business taxes, and employment impacts are provided in Appendix Tables 3 through 9.

The benchmark closure scenario had an estimated total economic output contribution of \$13.7 million on the two-county economy in 2004. This was generated by a direct impact of \$5.59 million in revenues. This means that oyster sales for the two-county area have a total multiplier effect of about 2.36. This is a relatively large multiplier effect, but one that is not uncommon for labor intensive industries like oyster fisheries. About 54 percent of the secondary contributions of oyster sales were generated by indirect effects and 46 percent by induced effects (Table 18). This relationship roughly holds for all the scenarios. In comparison to the benchmark, Scenarios 2 and 3 result in a 25.6 and 15.8 percent reduction in total output impacts or contributions to the area's economy, respectively, due to the five- and three-month closures during the warmer months. For Scenario 4, the five-month closure with 25 percent PHT replacement results in a total output contribution was just 3.5 percent below the benchmark. With a 50 percent PHT replacement during a five-month closure (Scenario 5), the total impact of the industry is actually estimated to increase, by 18.7 percent above the benchmark, to \$16.2 million. In Scenario 6, the three-month closure with 25 percent PHT replacement is estimated to result in a 2.1 percent decrease in economic contribution to the area. In proportion to Scenario 5, the three-month closure with a 50 percent PHT replacement in Scenario 7 is estimated to generate an output contribution of \$15.2 million, which is 11.5 percent higher than benchmark Scenario 1.

Table 18. Summary of economic output impacts from all Florida oyster products harvested under various scenarios.

Scenario	Summary Impacts			Total	$\Delta\%$ <sup>a</sup>
	Direct	Indirect	Induced		
	(----- Million Dollars -----)			(Percent)	
Scenario 1 (Current, no fresh half shell closure)	5.789	4.255	3.612	13.655	N.A.
Scenario 2 (5 mo. fresh half shell closure)	4.343	3.107	2.705	10.155	- 25.6
Scenario 3 (3 mo. fresh half shell closure)	4.900	3.549	3.055	11.504	- 15.8
Scenario 4 (5 mo. fresh half shell closure, 25% replacement w/PHT)	5.594	4.100	3.490	13.184	- 3.5
Scenario 5 (5 mo. fresh half shell closure, 50% replacement w/PHT)	6.846	5.094	4.274	16.214	+ 18.7
Scenario 6 (3 mo. fresh half shell closure, 25% replacement w/PHT)	5.669	4.160	3.537	13.366	- 2.1
Scenario 7 (3 mo. fresh half shell closure, 50% replacement w/PHT)	6.439	4.770	4.019	15.228	+ 11.5

<sup>a</sup> Percent change relative to Scenario 1.

## CONCLUSIONS

The economic impacts or contributions of six alternative oyster harvesting closure/treatment scenarios were evaluated in this study for Franklin and Gulf Counties in Florida for the purpose of determining the most economically favorable approach to reducing human illness caused by *V. vulnificus* bacteria found in fresh oysters harvested from Gulf of Mexico waters in the summer months. As calculated in the benchmark scenario (Scenario 1), the oyster industry employed 496 harvesters who earned annual revenues of just about \$3 million in 2004. Should the industry be forced to close for the five warm-season months (from May through September), harvester and processor revenues would be reduced by 26 and 25 percent, respectively, and would have a negative economic impact on the oyster industry in Franklin and Gulf Counties in Florida. Using post-harvest treatments (PHT) to treat and store oysters caught in cooler months of the year has the potential to mitigate some of the negative economic consequences of harvesting closures.

Although the development and use of post-harvest treatments (PHT) to store oysters caught in cooler months of the year has the potential to mitigate some of the negative economic consequences of harvesting closures, the benefits of PHT may be

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difficult to realize because of higher F.O.B. prices required to recover higher processing and storage costs for PHT oysters. An additional issue is the degree of market acceptance by seafood wholesalers, retailers, and consumers accustomed to a fresh half shell product at lower prices. A definitive assessment of the market potential for frozen PHT oysters could not be made by this study because of anomalies in the supply chain for fresh half shell oysters caused by hurricanes in 2004 and 2005.

While the opportunity to replace the lost fresh half shell shares with a PHT product represents an alternative revenue source, any estimated economic impacts or contributions are dependent on the underlying assumptions, which require additional research to establish the validity of these results. In particular, the ability of fisheries to sustain additional harvested volumes in the proposed months of March and April without incurring severe stock depreciations has not been established. Another concern is the difficulty of realizing the estimated sales levels for the PHT product due to higher F.O.B. prices necessitated by processing and storage costs. Marketing acceptance of the PHT product by wholesalers, retailers, and consumers is a valid concern of the oyster industry members. Even if estimated PHT oyster sales levels are achievable, there is no assurance that gross revenues will result in sustainable profitability to the processors. Finally, the large investment required for PHT processing facilities and likely significant economies of scale in the operation of these facilities could limit the adoption of this technology by the industry.

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## REFERENCES

- Andrews, L. M. Jahncke, and K. Mallikarjunan. 2003. Low dose gamma irradiation to reduce pathogenic *vibrios* in live oysters (*Crassostrea virginica*). *Journal of Aquatic Food Product Technology* 12(3):71-82.
- FDA. 2007. *History of the National Shellfish Sanitation Program. NSSP Guide for the Control of Molluscan Shellfish*. <http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/Seafood/FederalStatePrograms/NationalShellfishSanitationProgram/UCM061549>
- Flattery, J. and M. Bashin. 2003. *A Baseline Survey of Raw Oyster Consumers in Four States*. [http://www.issc.org/client\\_resources/Education/BaselineSurvey.pdf](http://www.issc.org/client_resources/Education/BaselineSurvey.pdf)
- Florida Aquaculture. 2003. *Special Issue: Interstate Shellfish Sanitation Conference* [Issue 25]. Division of Aquaculture, Florida Department of Agricultural and Consumer Services, Tallahassee, FL (July).
- Hanson, T., L. House, S. Sureshwaran, B. Posadas, and A. Liu. 2003. Opinions of U.S. consumers toward oysters: Results of 2000-2001 survey. Bulletin 1133, Division of Agriculture, Forestry and Veterinary Medicine, Mississippi State University, Mississippi State, MS (July).
- Lorio, W. and S. Malone. 1994. The cultivation of American oysters (SRAC Publication #432). Southern Regional Aquaculture Center, Louisiana State University, Baton Rouge, LA (October).
- Lutz, C.G., P. Sambidi, and R.W. Harrison. 2003. Oyster industry profile. Agricultural Marketing Resource Center, Iowa State University, Ames, IA (September).
- Minnesota IMPLAN Group (MIG). 2004. *IMPLAN Pro, Economic Impact and Social Accounting Software, and Data*. Stillwater, MN. <http://www.implan.com>.
- Muth, M.K., D.W. Anderson, S.A. Karns, Brian C. Murray, and J.L. Domanico. 2000). *Economic Impact of Requiring Post-harvest Treatment of Oysters: Final Report* [RTI Project #7466.000]. Research Triangle Institute, Center for Economics Research, Research Triangle Park, NC (March).
- Shapiro, R.L. S. Altekruise, B. Hutwagner, R. Bishop, R. Hammond, W. Wilson, B. Ray, S. Thompson, R.V. Trauxe, and P.M. Griffin. 1998. The role of Gulf Coast oysters harvested in warmer months in *Vibrio vulnificus* infections in the United States, 1988-1996. *The Journal of Infectious Diseases* 178(3): 752-759.
- Steinback, S. 2004. Using ready-made regional input-output models to estimate backward-linkage effects of exogenous output shocks. *Review of Regional Studies* 34(1): 7-71. <http://www.economy.okstate.edu/rrs/issue.asp?volume=34&issue=1>
- Watson, P., J. Wilson, D. Thilmany, and S. Winter. 2007. Determining economic contributions and impacts: What is the difference and why do we care? *Journal of Regional Analysis and Policy* 37(2): 140-146. <http://www.jrap-journal.org/pastvolumes/2000/v37/F37-2-6.pdf>

Appendix Table 1. Hypothetical monthly F.O.B. sales of Florida fresh half shell and shucked oysters using average annual landings over the five-year period, 2000-04, and 2004 prices.

Time Period	Quantities Sold							Total Revenue <sup>a</sup> (Dollars)
	Fresh Half shell			Shucked				
	(60 lb. bag)	(Percent) <sup>b</sup>	(Dollars)	(60-lb. bag)	(Gallons) <sup>c</sup>	(Percent) <sup>b</sup>	(Dollars)	
January	24,846	10.7	484,501	4,045	3,286	12.1	147,886	632,387
February	23,928	10.3	466,594	3,895	3,165	11.6	142,420	609,014
March	22,322	9.6	435,275	3,634	2,952	10.8	132,860	568,135
April	20,214	8.7	394,169	3,291	2,674	9.8	120,313	514,482
May	17,952	7.7	350,065	2,922	1,553	5.7	72,193	422,258
June	15,263	6.6	297,626	2,485	1,320	4.8	61,379	359,005
July	17,119	7.4	333,823	2,787	1,481	5.4	68,844	402,667
August	13,205	5.7	257,494	2,150	1,142	4.2	53,102	310,597
September	10,642	4.6	207,518	1,732	920	3.4	42,796	250,313
October	23,830	10.3	471,827	3,879	3,152	11.6	146,563	618,389
November	19,287	8.3	381,876	3,140	2,551	9.4	118,621	500,497
December	23,174	10.0	458,848	3,773	3,065	11.2	142,531	601,379
ANNUAL	231,781	100.0	4,539,616	37,732	27,261	100.0	1,249,507	5,789,123

<sup>a</sup> Revenues based upon F.O.B. prices of 19.50 and 19.80 per 60-lb. bag of shellstock for the January-September and October-December, respectively, for the Fresh half shell product, and 45.00 and 46.50 per 8-lb. gallon for the January-April and May-December periods, respectively, for shucked product. Prices are based upon data obtained from four major oyster processors in Florida for the 2004 calendar year. According to major Franklin County-based dealers, approximately 14 percent of the local oyster harvest is shucked, with the remainder going to the half shell market.

<sup>b</sup> Percentages are based upon the average annual totals.

<sup>c</sup> Yields of 4.25 pints and 6.50 pints per 60-lb. bag of shellstock were used for the May-September and October-April periods, respectively, to estimate shucked product quantities. These yields represent the average reported by four major oyster processors in Florida in the 2004 calendar year.

Source: The quantity harvested in Florida five-year period 2000-2004 was reported by the Florida Fish and Wildlife Conservation Commission.

Appendix Table 2. Hypothetical annual F.O.B. gross revenues from all Florida oyster products under various closure scenarios with partial replacement of fresh half shell product with PHT (frozen) product.

Scenario <sup>a</sup>	Annual Sales and Revenues <sup>b</sup>		
	Sales (60-lb. bags)	Sales Units (Physical Units)	Gross Revenues (Dollars)
Scenario 1 (Current)			
Fresh half shell	231,781	231,781 bags	4,539,616
Shucked	37,732	27,261 gals.	1,249,507
Totals	269,513	N.A.	5,789,123
Scenario 2 (5-mo. closure)			
Fresh half shell	157,600	157,600 bags	3,093,090
Shucked	37,732	27,261 gals.	1,249,507
Totals	195,332	N.A.	4,342,597
Scenario 3 (3-mo. closure)			
Fresh half shell	186,194	186,194 bags	3,650,672
Shucked	37,732	27,261 gals.	1,249,507
Totals	223,926	N.A.	4,900,179
Scenario 4 (5-mo. closure, 25% replacement w/PHT)			
Fresh half shell	157,600	157,600 bags	3,093,090
PHT half shell	18,545	20,863 cases	1,251,801
Shucked	37,732	27,261 gals.	1,249,507
Totals	213,877	N.A.	5,594,398
Scenario 5 (5-mo. closure, 50% replacement w/PHT)			
Fresh half shell	157,600	157,600 bags	3,093,090
PHT half shell	37,090	41,727 cases	2,503,603
Shucked	37,732	27,261 gals.	1,249,507

Scenario <sup>a</sup>	Annual Sales and Revenues <sup>b</sup>		
	Sales	Sales Units	Gross Revenues
	(60-lb. bags)	(Physical Units)	(Dollars)
Totals	232,422	N.A.	6,846,200
Scenario 6 (3-mo. closure, 25% replacement w/PHT)			
Fresh half shell	186,194	186,194 bags	3,650,672
PHT half shell	11,397	12,821 cases	769,278
Shucked	37,732	27,261 gals.	1,249,507
Totals	235,323	N.A.	5,669,458
Scenario 7 (3-mo. closure, 50% replacement w/PHT)			
Fresh half shell	186,194	186,194 bags	3,650,672
PHT half shell	22,794	25,643 cases	1,538,556
Shucked	37,732	27,261 gals.	1,249,507
Totals	246,720	N.A.	6,438,736

<sup>a</sup> Scenarios are all based upon the average quantities harvested over the 5-year period 200-2004 (FWC) and estimated 2004 F.O.B. prices for fresh half shell and shucked products. PHT (frozen) oyster prices are estimated for 2005.

<sup>b</sup> Annual sales and revenues are based upon the following information. Yields of 4.25 pints and 6.50 pints per 60-lb. bag of shellstock were used for the May-September and October-April periods, respectively, to estimate shucked product quantities. These yields represent the average reported by four major oyster processors in Florida in the 2004 calendar year. Yields of PHT (frozen) oysters are based upon a 250 count, 60 lb. bag, with a packout of 65 percent, or approximately 162 per 60-lb. bag. Revenues based upon F.O.B. prices of 19.50 and 19.80 per 60-lb. bag of shellstock for the January-September and October-December, respectively, for the half shell product, and 45.00 and 46.50 per 8-lb. gallon for the January-April and May-December periods, respectively, for shucked product. Prices are based upon data obtained from four major oyster processors in Florida for the 2004 calendar year. Prices for PHT (frozen) oysters were estimated to range from \$55.00 to \$65.00 per case of 144. Revenue calculations are based upon the mid-point price of \$60.00 per case, or \$0.42 cents per oyster.

Appendix Table 3. Summary of economic output impacts from all Florida oyster products harvested under Scenario 1.<sup>a</sup>

Summary Impacts	Summary Impacts			
	Direct	Indirect	Induced	Total
	(Million Dollars)			
Output	5.789	4.255	3.612	13.655
Value added	1.722	3.023	2.300	7.045
Labor income	1.338	2.300	1.301	4.939
Business taxes	0.029	0.114	0.230	0.373
Jobs	397	517	49	962

Implicit Multipliers	Implicit Multipliers			
	Direct	Indirect	Induced	Total
Output	1.000	0.735	0.624	2.359
Total value added	1.000	1.756	1.336	4.092
Labor income	1.000	1.720	0.972	3.692
Indirect business taxes	1.000	3.944	7.913	12.856
Employment	1.000	1.302	0.123	2.423

<sup>a</sup> Scenario 1 is the no fresh half shell closure, current situation.

Appendix Table 4. Summary of economic output impacts from all Florida oyster products harvested under Scenario 2.<sup>a</sup>

Summary Impacts	Summary Impacts			
	Direct	Indirect	Induced	Total
	(Million Dollars)			
Output	4.343	3.107	2.705	10.155
Value added	1.348	2.207	1.723	5.278
Labor income	1.047	1.677	0.975	3.699
Business taxes	0.023	0.085	0.172	0.280
Jobs	334	376	36	746

Implicit Multipliers	Implicit Multipliers			
	Direct	Indirect	Induced	Total
Output	1.000	0.715	0.623	2.338
Total value added	1.000	1.637	1.278	3.916
Labor income	1.000	1.601	0.931	3.532
Indirect business taxes	1.000	3.748	7.569	12.317
Employment	1.000	1.126	0.108	2.234

<sup>a</sup> Scenario 2 is fresh half shell closure for five months (May – September), no sales of PHT (frozen) product.

Appendix Table 5. Summary of economic output impacts from all Florida oyster products harvested under Scenario 3.<sup>a</sup>

Summary Impacts	Summary Impacts			Total
	Direct	Indirect	Induced	
	(Million Dollars)			
Output	4.900	3.549	3.055	11.504
Value Added	1.492	2.521	1.946	5.959
Labor Income	1.159	1.917	1.100	4.177
Business Taxes	0.025	0.096	0.194	0.316
Jobs	358	430	41	829

Implicit Multipliers	Implicit Multipliers			Total
	Direct	Indirect	Induced	
Output	1.000	0.724	0.623	2.348
Total Value Added	1.000	1.690	1.304	3.994
Labor Income	1.000	1.654	0.949	3.603
Indirect Business Taxes	1.000	3.835	7.722	12.557
Employment	1.000	1.201	0.115	2.316

<sup>a</sup> Scenario 3 is fresh half shell closure for three months (June – August), no sales of PHT (frozen) product

Appendix Table 6. Summary of economic output impacts from all Florida oyster products harvested under Scenario 4.<sup>a</sup>

Summary Impacts	Summary Impacts			Total
	Direct	Indirect	Induced	
	(Million Dollars)			
Output	5.594	4.100	3.490	13.184
Value added	1.671	2.913	2.223	6.807
Labor income	1.299	2.216	1.257	4.772
Indirect business taxes	0.028	0.111	0.222	0.361
Jobs	388	498	47	933

Implicit Multipliers	Implicit Multipliers			Total
	Direct	Indirect	Induced	
Output	1.000	0.724	0.623	2.348
Total value added	1.000	1.690	1.304	3.994
Labor income	1.000	1.654	0.949	3.603
Indirect business taxes	1.000	3.835	7.722	12.557
Employment	1.000	1.201	0.115	2.316

<sup>a</sup> Scenario 4 is fresh half shell closure for five-month period, with 25 percent of average fresh half shell sales replaced by PHT (frozen) half shell product.

Appendix Table 7. Summary of economic output impacts from all Florida oyster products harvested under Scenario 5.<sup>a</sup>

Summary Impacts	Summary Impacts			Total
	Direct	Indirect	Induced	
	(Million Dollars)			
Output	6.846	5.094	4.274	16.214
Value added	1.995	3.619	2.722	8.336
Labor income	1.550	2.756	1.539	5.845
Indirect business taxes	0.034	0.136	0.272	0.441
Jobs	443	620	58	1,121

Implicit Multipliers	Implicit Multipliers			Total
	Direct	Indirect	Induced	
Output	1.000	0.724	0.623	2.348
Total value added	1.000	1.690	1.304	3.994
Labor income	1.000	1.654	0.949	3.603
Indirect business taxes	1.000	3.835	7.722	12.557
Employment	1.000	1.201	0.115	2.316

<sup>a</sup> Scenario 5 is fresh half shell closure for five-month period, with 50 percent of average fresh half shell sales replaced by PHT (frozen) half shell product.

Appendix Table 8. Summary of economic output impacts from all Florida oyster products harvested under Scenario 6.<sup>a</sup>

Summary Impacts	Summary Impacts			Total
	Direct	Indirect	Induced	
	(Million Dollars)			
Output	5.669	4.160	3.537	13.366
Value added	1.691	2.955	2.252	6.899
Labor income	1.314	2.249	1.274	4.836
Indirect business taxes	0.029	0.112	0.225	0.365
Jobs	392	505	48	944

Implicit Multipliers	Implicit Multipliers			Total
	Direct	Indirect	Induced	
Output	1.000	0.724	0.623	2.348
Total value added	1.000	1.690	1.304	3.994
Labor income	1.000	1.654	0.949	3.603
Indirect business taxes	1.000	3.835	7.722	12.557
Employment	1.000	1.201	0.115	2.316

<sup>a</sup> Scenario 6 is fresh half shell closure for three-month period, with 25 percent of average fresh half shell sales replaced by PHT (frozen) half shell product.

Appendix Table 9. Summary of economic output impacts from all Florida oyster products harvested under Scenario 7.<sup>a</sup>

Summary Impacts	Summary Impacts			Total
	Direct	Indirect	Induced	
	(Million Dollars)			
Output	6.439	4.770	4.019	15.228
Value added	1.890	3.389	2.559	7.838
Labor income	1.468	2.580	1.447	5.496
Indirect business taxes	0.032	0.128	0.256	0.415
Jobs	425	580	54	1,060

Implicit Multipliers	Implicit Multipliers			Total
	Direct	Indirect	Induced	
Output	1.000	0.724	0.623	2.348
Total value added	1.000	1.690	1.304	3.994
Labor income	1.000	1.654	0.949	3.603
Indirect business taxes	1.000	3.835	7.722	12.557
Employment	1.000	1.201	0.115	2.316

<sup>a</sup> Scenario 7 is fresh half shell closure for three-month period, with 50 percent of average fresh half shell sales replaced by PHT (frozen) half shell product.