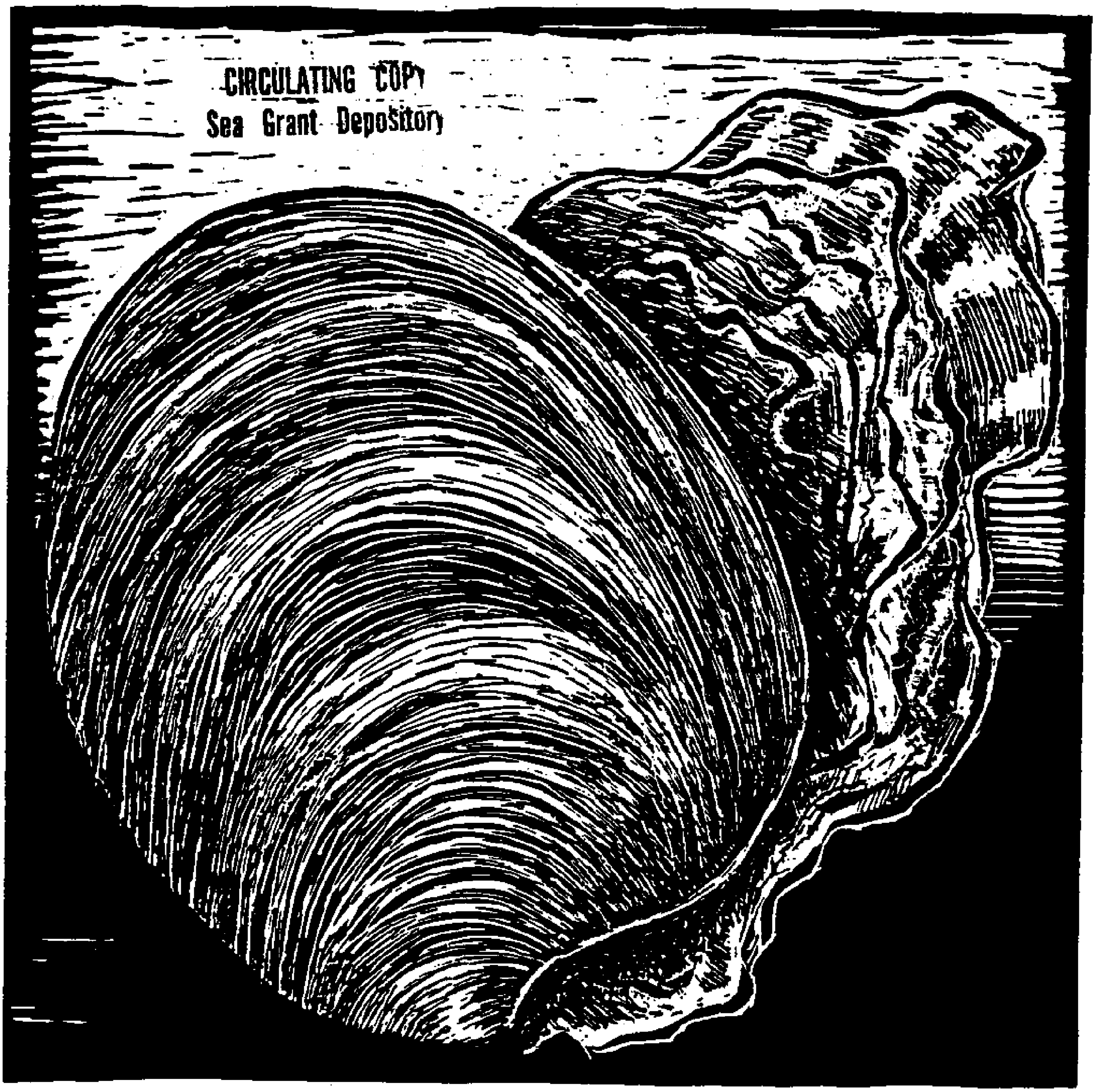

SHELLFISH IN GEORGIA: RESOURCE DESCRIPTION AND ECONOMIC SIGNIFICANCE OF THE SHELLFISH HARVESTING AND PROCESSING SECTORS

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ABSTRACT

This study provides economic information about the production of shellfish in Georgia and the economic impacts of the shellfish harvesting and processing sectors on the state's economy. During September 1985, shellfish harvesters and processors were surveyed. Data on production costs and returns were collected as well as shellfish processing costs and returns. Economic impacts on Georgia's economy were projected using previous marine input-output studies. During the 1984-85 season, shellfish harvesters and processors spent $2.3 million to operate, created over $8 million in total generated economic activities, and generated total income impacts of over $9 million.

PREFACE

The salt marshes of Georgia and South Carolina are unique among those of the South Atlantic Bight. The extreme tidal range, high velocities of currents, and high rates of deposition of fine sediments form marshes with predominantly soft mud and very steep creek banks. Common features of the creek banks are levees which create a very narrow band of intertidal area between the lower extent of the salt marsh vegetation (Spartina) and mean low water. This narrow intertidal band contains 86% of the oyster resource in Georgia waters (Harris, 1980). The clam resource is also mostly limited to this intertidal area (Walker and Rawson, 1985).

Shellfish also are found in the subtidal area of the coast, but distribution is limited to areas of freshwater influxes, e.g., rivers (Harris, 1980). Recent oyster resource assessments by the Georgia Department of Natural Resources (GA DNR) confirmed earlier assessments which indicate little recruitment to the oyster populations and, hence, little potential for economic development.

Ecological research has documented that intertidal oysters are densely populated in the southeast Atlantic (Dame, 1976; Bahr, 1981). In this intertidal zone, oyster spat are mixed throughout the water and require only substrate (to attach to) to form a new reef. Current work indicates that the distribution of intertidal oyster reefs is affected by a complex relationship between tidal current velocity, substrate, and the location within the tidal stream meander (Stevens, 1983).

Growth rates of oysters in Georgia waters exceed 2.5cm per year (Galtsoff and Luce, 1930). At this rate an oyster can reach market size in less than three years. Research also indicates rapid growth rates of hard clams (2.5cm thickness in 18 months) with survival rates of 85% under farming conditions (Walker, 1984). Although natural populations of clams exist in commercial quantities in Georgia waters, recruitment levels are unknown. There is no indication whether or not the natural population can sustain commercial harvesting. On the basis of field observations, GA DNR personnel feel that commercial oyster harvesters can expect to harvest 2 U.S. bushels (8.75lbs of meats) per square meter under cultivation practices (Stevens, 1986).

A major problem with the oyster resource in Georgia is overcrowding due to overset by the spat. This results in long, thin-shelled oysters known as "coon oysters" (Galtsoff, 1964). To produce more valuable, marketable oysters, a commercial harvester must decrease the population density, and this is a difficult, labor-intensive task. Low-cost mechanical means, such as dragging fencing over reefs at high tide, have been used, but these methods can destroy a large percentage of oysters.

Harvesting methods in Georgia require intensive labor which reduces profitability. In addition, a consistent, willing labor force is often hard to find. Under existing Georgia law, hand-held implements may be used to harvest oysters and clams without permission from GA DNR. Mechanical tongs may be used to harvest clams only. Hand-held implements include, but are not limited to, rakes, bull rakes, hammers, wedges, and hand tongs. Dredges, either rock or escalator, must be permitted by GA DNR. The permits are very stringent, and dredging is limited to subtidal areas due to the disruption caused by dredges. Commercial harvesting is permitted through issuance of GA DNR Master Collecting Permits. Such permits are issued only to persons having legal harvest rights.

The tidal range of Georgia's salt marshes averages 6 to 7 feet but can be 10 feet or higher with strong winds. The high tidal amplitude produces strong tidal currents and shoaling which limits the kinds of implements that can be used for harvesting shellfish from vessels. Bull rakes that are typically used along subtidal flats in other states cannot be used effectively in the intertidal areas of Georgia. Therefore, nearly all commercial harvesting is done at low tide utilizing clam rakes or other simple, hand-held implements. This further limits the time for harvesting. Weather and low tides occurring too late or too early in the day can keep shellfishermen from work.

The typical shellfish harvester utilizes a small boat (15 to 20ft) and a rake to harvest clams, or a hammer and gloves to harvest oysters. The shellfish are placed in baskets or drums and transferred to bags or baskets with shellfish tags at the dock. The harvester visits the shellfish reef on a falling tide and works until he can no longer find marketable shellfish, or until the floodtide forces him to leave.

The State of Georgia participates in the National Shellfish Sanitation Program and delineates areas of the coast for shellfish harvest on the basis of water quality. Areas have been classified as "approved" for direct consumption, "closed" for harvest of any type, "restricted" for transplanting, and "unapproved" for waters of unknown water quality. Approximately 59% of the state's coast has been classified, with a majority of this area designated as approved. As in many coastal states, the combination of population growth and development of the coastline has created problems for the commercial shellfisherman. Degradation of water quality from sewage systems has closed harvest areas, and coastal development competes for the resource space by permanently reducing the resource habitat. Presently, the GA DNR is drafting guidelines to assess the potential impacts of coastal development on shellfish resources. Stringent conditions will be placed on development within approved, restricted, and unapproved waters.

The shellfish resource is managed by the state on the basis of harvest rights outlined in early legislation. One of the greatest problems facing the shellfish industry and the state's shellfish program is the question of harvest rights. In few instances are harvest rights clear. Although the Riparian Rights Act passed in 1902 defined ownership of harvest rights, Crown and State Grants may supersede the 1902 Act. In some areas designated "approved," harvest rights cannot be resolved and, therefore, the resource cannot be harvested. Furthermore, since the resource may not belong to the state but to private individuals, GA DNR cannot designate the resource for public recreational harvest. This issue will also determine the priority for future sampling of unapproved waters with the potential to support commercial harvesting. To date, there has been little information about the economic structure and importance of commercial ventures that utilize the shellfish resource in Georgia. This report contains an economic evaluation of commercial harvesting and processing businesses in Georgia. Its purpose is to assist state policymakers and fisheries managers concerned with shellfish management and coastal zone management decisions.

INTRODUCTION

Between 1889 and 1923, oyster harvesters in Georgia gathered approximately one million lbs of oyster meats annually, worth about $6.1 million in 1984 dollars. A record crop of 8,070,320 lbs was harvested in 1908. At current prices this would be worth over $49 million. A combination of overfishing and lack of cultivation-management techniques partially explain the subsequent decline in oyster production. In 1903, the Bureau of Fisheries Commissioner stated: "There is very little doubt, however, that in the years to come private oyster culture will have to be resorted to on a large scale in this state if the oyster supply is to be maintained." (U.S. Comm. Fish & Fisheries, 1905: 387).

Economic information on the shellfishery to date has been limited to the value of commercial landings. Little information concerning biological evaluations of the shellfish resource (stock assessments) has been available. As a result, state officials have had very limited information on which to base policy decisions and decide among trade-offs involving economic alternatives that sometimes compete for resource space (e.g., shoreline residential development in the Savannah area has closed down some shellfish beds, due to potential water quality degradation caused by waste sewage). Because of a lack of information, state and local policymakers have assumed that the shellfish industry is of little or no economic importance. The result is that economic alternatives have been favored over state and local investments in the shellfish industry, and, in turn, this preference has contributed to a declining shellfish industry.

To help reverse this trend, the Coastal Resources Division of Georgia Department of Natural Resources (GA DNR) funded an economic assessment project in 1985 to examine the state's shellfish industry. This report is the result of that effort. The objectives of this report are threefold: 1) to inform the general public on the importance of shellfish in the coastal and state economy of Georgia; 2) to provide information to policymakers, inside and outside of government, on the role of shellfish in the economy; and 3) to enable oyster and clam harvesters, processors, wholesalers and retailers to compare their operations with those of other operators. Included in the study are the harvesting, processing, and wholesale and retail trade sectors.[1] Emphasis of the study is on the contributions of these sectors to local, coastal and state economies. Contributions include economic impacts of sales, income, and employment effects resulting from shellfish. Comparisons of individual operations with an "average operation" can stimulate changes in management strategies which may increase the profitability of shellfish harvesting and processing in the state.

The first section of the report provides information about harvest, processing, and wholesale and retail trade characteristics, specifically costs and returns. The second section provides estimates of the assessed commercial value of the shellfish resource in presently approved waters. Projected economic impacts of shellfish-related sectors comprise the final section. The report is based on survey data for the 1984-85 oyster and 1985-86 clam seasons collected during field work

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[1]A sector can consist of one or more industries or operators. In this report it represents a number of operators or businesses.

in September 1985, along with secondary data from a variety of sources through 1984. Highlights include the following:

- For oyster harvesters variable costs averaged $1537/boat ($1.91/bu), fixed costs were $699/boat ($.87/bu), with total costs of $2236/boat ($2.78/bu) for the 1984-85 season. Gross returns averaged $4211/boat ($5.23/bu) and net returns were $1975/boat ($2.45/bu) over the same time period.

- For clam harvesters, variable costs averaged $4.24/bag, fixed costs $3.76/bag, with total costs of $8.00/bag for the 1985-86 season. [A bag roughly equals .5145 bushels. These figures ($/bag) are multiplied by .5145 to obtain $/bu measures.] Gross returns were $19.61/bag with net returns of $11.62 per bag harvested for 1985-86.

- Along the Georgia coast, oyster-shucking was once a thriving, traditional business, but now is almost nonexistent. Some reasons include lack of a willing labor force, lack of a local supply of oysters, and the availability of low-cost shucked oysters from the Appalachicola Bay region (the major competitive region). Sketchy accounts of the oyster-shucking industry from oystermen suggest that up to 14 large shucking operations employing 50 to 75 people each were in operation during the early 1900s. Presently there are limited oyster-shucking operations. Only three operated in 1985 with a combined labor force of 36 people. For these operations, returns averaged $18.71/bu of inputs ($25/gal of output) during the 1984-85 season. Costs for the same time period were $10.91/bu ($14.67/gal); variable costs represented 84% of this and fixed costs 16%. Net returns averaged $7.81/bu ($10.43/gal) for 1984-85.

- In approved Georgia waters, the shellfish resource, both oysters and clams, was assessed a commercial value. This assessment represents a value that would occur annually under conditions of full exploitation by commercial harvesters. In present markets and product forms, the commercial value of the resource is projected at $1.2 million annually with net returns of $553,503/year.

- During the 1984-85 season shellfish harvesters, middlemen, shuckers and other processors spent $2.3 million to operate and received $2.1 million in sales. They created over $4 million in outside economic activities (output leakages) and generated over $8 million in total economic activities with total income impacts of over $9 million. The employment of 12 seasonal harvesters and 36 people in oyster shucking operations generated total projected impacts of 21 and 166 jobs, respectively, in all sectors within the state economy.

- The economic impact analysis found that for every $1 spent by businessmen in the shellfish industry about $4.25 was generated in outside economic activities, and roughly $4.72 was generated in income effects. Similarly, for every job in the shellfish industry roughly 3.8 jobs were generated in other economic sectors of the state.

Previous research examining economic aspects of oysters in Georgia has consisted of descriptive, summary accounts of harvesters and value of landings (Carley and Frisbie, 1968). Cato and Prochaska (1979) examine production and marketing practices and potential expansion possibilities of the oyster industry. Both of the above studies examined impediments to the industry, including: 1) conflicts and controversy about ownership and harvest rights to intertidal oyster beds resulting in areas not harvested, and 2) pollution from both domestic and industrial sources which has caused bacterial contamination and closed oyster beds. Cato and Prochaska (1979) stress the need for adoption of cultivation techniques and allowance of mechanical harvesting techniques. In a study of the U.S. oyster industry, Dressel and Whitaker (1983), summarize processing technology and current structure of processors and seafood market channels for the United States. They conclude that widespread adoption of cultivation techniques, from simply breaking up cluster oysters to more long-term mariculture techniques, appear to hold great promise in potential oyster production.

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COMMERCIAL SHELLFISH HARVESTING AND PROCESSING SECTORS

Historical Background

At the turn of the century, annual oyster production in Georgia reached an all-time high with over one million lbs of oyster meats harvested in the years 1890, 1897, 1902, 1908, 1910 and 1923 (Table 1). Production reached a record high of 8,070,320 lbs of meats in 1908. This represented 41% of the South Atlantic oyster harvest and 5% of the United States harvest (Lyles, 1967). Historical data of hard clam production indicated a record harvest of 43,000 lbs of meats in 1908 (Table 1).

Only in recent years has the state's annual oyster production fallen below 100,000 lbs of oyster meats. The only economic data available about today's state shellfish resource concerns the quantity and value of commercial landings. In 1984, harvesters landed 5916 lbs of oyster meats worth $36,040 and 3474 lbs of clam meats valued at $11,866 (Table 1). During the most recent 5-year period, 1980-84 (4-year period for clams), the average value of oyster landings was $40,939 and clam landings $20,836. However, the contribution of shellfish to local and state economies extends well beyond the value of commercial landings.

Historical data on the processing and wholesale industries in the state yields limited information. In the 1923-25 era, the number of oyster canneries increased to 7, and declined to 2 in 1931. Only one remained in operation after 1931 (Table 2). In 1902, the capital value of 6 canneries was assessed at $44,800 with cash reserves of $89,000 (U.S. Comm. of Fish & Fisheries, 1905). These 6 canneries employed some 522 individuals and processed a record 2,594,004 cases of oyster meats worth $202,049 in 1902. The number of wholesale fishery operations has continually increased in Georgia from 7 in 1897 to 32 in 1929 (Table 2).

Methodology

Shellfish harvesters and processors were surveyed by personal interview during early September 1985. Detailed landings (production) and financial information for the 1984-85 oyster and 1985-86 clam seasons came from each harvester's records and memories. Similarly, volume and financial information for retail, wholesale, and processing operations over the 1984-85 oyster season were obtained from operators' records and memories. Time required for each interview ranged from 45 minutes for small operators to almost 8 hours for large operations. During the 1984-85 oyster and 1985-86 clam seasons, 7 individuals held commercial permits and reported harvested shellfish to GA DNR. This defined the population. The individuals who held permits are referred to as harvest operations in this report. In some cases, these harvest operations employed 2 to 4 people to harvest the shellfish. The five harvest operations surveyed employed a total of 12 individual harvesters. In addition, oyster processing operations were surveyed, one a canning operation, the other a large shucking operation. Because of the small number of oyster processors and confidentiality of the data, these results are not presented.

Table 1. Historical Oyster and Clam Harvest, Pounds and Value of Meats Harvested, Georgia, 1880-1984.

Year	Oysters lbs.	Oysters Value	Clams lbs.	Clams Value	Year	Oysters lbs.	Oysters Value	Clams lbs.	Clams Value
1880	393,400	35,000	NA	NA	1956	120,200	35,716	NA	NA
1887[a]	618,678	26,950	NA	NA	1957	112,300	27,401	NA	NA
1888[a]	677,772	29,370	NA	NA	1958	142,600	35,002	NA	NA
1889	917,184	26,356	NA	NA	1959	248,000	60,937	NA	NA
1890	1,260,875	40,520	NA	NA	1960	231,400	58,831	NA	NA
1897[a]	2,734,883	86,709	2,640	165	1961	158,500	47,650	NA	NA
1902[a]	6,878,880	220,467	10,000	825	1962	146,900	51,415	NA	NA
1908[a]	8,070,320	334,000	43,000	9,400	1963	235,500	82,425	NA	NA
1910	2,839,084	170,812	NA	NA	1964	195,800	68,536	NA	NA
1918[b]	891,028	73,913	120	75	1965	247,700	86,696	NA	NA
1923	1,381,182	86,771	NA	NA	1966	181,900	63,563	NA	NA
1927	608,033	43,602	NA	NA	1967	203,100	113,860	NA	NA
1928	841,736	54,670	800	125	1968	190,600	106,619	NA	NA
1929	442,266	19,970	1,800	280	1969	255,000	144,196	NA	NA
1930	159,385	10,608	2,240	350	1970	178,700	100,347	NA	NA
1931	307,766	9,251	1,200	150	1971	138,500	72,870	NA	NA
1932	588,408	15,670	600	75	1972	152,100	86,812	NA	NA
1934	568,700	31,361	NA	NA	1973	105,900	65,122	NA	NA
1936	330,100	21,066	NA	NA	1974	64,664	9,028	0	0
1937	239,000	12,576	NA	NA	1975	44,062	6,014	0	0
1938	154,000	8,038	NA	NA	1976	71,839	24,016	10,885	16,397
1939	234,400	12,353	NA	NA	1977	87,221	35,716	0	0
1940	264,800	15,178	NA	NA	1978	20,938	42,113	0	0
1945	255,100	50,026	NA	NA	1979	11,375	11,459	0	0
1950	307,900	76,740	NA	NA	1980	33,117	18,792	0	0
1951	292,700	72,155	NA	NA	1981	24,898	75,009	5,855	21,014
1952	221,200	55,300	NA	NA	1982	18,292	49,240	9,725	36,498
1953	222,800	58,400	NA	NA	1983	4,427	25,613	3,482	13,964
1954	217,200	65,160	NA	NA	1984	5,916	36,040	3,474	11,866
1955	173,300	51,990							
1980-84 Avg.	-	-	-	-		17,330	40,939	5,634	20,836

Note: NA refers to not available.

a. Refers to years in which oyster production was the leading seafood product, in which data were available.

b. Including 1918 and in subsequent years, oyster production no longer ranked 1. In both 1918 and 1923, oyster production ranked 3, shrimp production ranked 1, followed by menhaden.

Source: 1974-84: Georgia Dept. of Natural Resources. Georgia Shellfish, Annual Landings and Value. Coastal Resources Division. New Brunswick, GA.

Oysters, 1880-1965: Lyles, C.H. 1967. Fishery Statistics of the United States, 1965. Bureau of Commercial Fisheries, U.S. Department of Interior, Washington, DC.

Oysters, 1965-1973: Fishery Statistics of the United States. Bureau of Commercial Fisheries, U.S. Dept. of Interior, Washington, DC, Various years.

Clams, 1897-1932: "Statistics of the Fisheries of the South Atlantic." (In) Report of the Commissioner. U.S. Commission of Fish and Fisheries, Washington, DC, Various Years, and

Fishery Industries of the United States, Report of the Division of Statistics and Methods of the Fisheries. Bureau of Fisheries, U.S. Department of Commerce, Washington, DC, Various Years.

Table 2. Historical Information on Canneries, Wholesalers, and Processors of Oyster and Fishery Products, Georgia, 1897-1934.

	Oyster Canneries					Wholesalers			Fishery Processors				
Year	Firms	Labor		Oyster Sales		Firms	Labor		Firms	Labor		Oyster Sales	
	No.	No.	$	Cases	$	No.	No.	$	No.	No.	$	$	%
1897[a]	3	383	NA	1,617,843	127,148	7	57	41,015	NA	NA	NA	NA	NA
1902	6	522	45,625	2,594,004	202,049	6	90	19,020	NA	NA	NA	NA	NA
1905	NA	NA	NA	NA	257,000	NA	NA	NA	NA	NA	NA	NA	NA
1908	NA	NA	NA	NA	374,000	NA	NA	NA	NA	NA	NA	NA	NA
1918	NA	NA	NA	NA	NA	18	223	66,900	10	634	129,075	94,832	17
1921	NA	NA	NA	12,674	68,020	NA	NA	NA	NA	NA	NA	NA	NA
1922	NA	NA	NA	18,812	85,371	NA	NA	NA	NA	NA	NA	NA	NA
1923	7	NA	NA	16,373	77,022	13	179	85,462	13	1,050	150,859	126,877	19
1924	6	NA	NA	12,226	65,621	NA	NA	NA	NA	NA	NA	NA	NA
1925	7	NA	NA	16,963	92,744	NA	NA	NA	NA	NA	NA	NA	NA
1926[b]	5	NA	NA	11,105	56,362	NA	NA	NA	NA	NA	NA	NA	NA
1927	3	NA	NA	9,339	46,755	14	210	104,299	12	768	161,535	46,755	5
1928	6	NA	NA	22,100	119,730	24	395	148,858	13	497	172,338	119,730	14
1929	5	NA	NA	18,258	92,540	32	285	157,029	11	408	164,789	92,540	10
1930	3	NA	NA	4,293	19,747	NA	NA	NA	29	459	253,445	19,747	3
1931[c]	2	NA	NA	3,526	12,562	NA	NA	NA	35	329	201,545	38,459	8
1934[d]	NA	NA	NA	NA	NA	NA	NA	NA	29	287	158,356	32,742	5

Note: NA refers to not available. Canneries in 1897 were located in Chatham Co. (2) and in Glynn Co. (1).

a. Value of oysters wholesaled is $41,015 (439,250 lb meats) which represented 20% of all wholesaled fishery products.

b. Cannery data based on 5 plants, 4 in Georgia and 1 in Florida.

c. Cannery data represents canned oysters, clams and terrapin meats. It could not be disaggregated.

d. Value of oysters processed represents shucked oysters only (32,297 gallons). Value of canned oysters is unknown.

Source: 1897-1902: Report of the Commissioner. U.S. Commission of Fish and Fisheries, Washington, DC, Various Years.

1905-1908: Fisheries of the United States, 1908. Department of Commerce and Labor, Bureau of the Census, Washington, DC.

1918-1934: Fishing Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries. Bureau of Fisheries, Department of Commerce, Washington, DC, Various Years.

The distribution of the harvest operations holding permits by county were: Chatham – 3; McIntosh – 2; and Camden – 2. One harvest operation which employed 4 individuals harvested 75% of their output from Chatham Co., the rest from McIntosh Co.

Costs and Returns

Production costs can differ due to variations in input prices and quantities such as labor, size of vessel, equipment, and entrepreneurial ability. Costs may also vary according to location variables, such as water salinity, and volume of tidal flow. Weather conditions can also affect costs.

Because of the nature of output (product) and input markets, an individual operator has no control over prices. However, one can improve the operating efficiency by minimizing operating costs and by establishing effective marketing practices. Efficient management requires allocating available resources to achieve the best combination of labor and capital while maintaining long-term resource management objectives. Factors affecting the risks in shellfish production are weather, tides, shellfish predators and diseases, bacterial contamination, and the price of shellfish.

A wide range of operators with many different backgrounds participated in the survey. Varying degrees of business and resource management skills were exhibited. Survey results show that many operators maintain financial records mainly for income tax purposes rather than for their own management purposes. Although not formally tested, it is readily hypothesized that the more financially successful operators keep better records. Operators can use good financial records in making sound financial decisions and in identifying the strengths and weaknesses of their operations.

Average Costs and Earnings – Oyster Harvesters

A major item of capital equipment of harvesters is a boat in the 17- to 25-foot class (average of 20.4ft) with 25 to 150hp engines (average of 115hp). Additional capital items consist of a boat trailer and a pickup truck for harvesters who do not dock their boats. Average costs and earnings of harvesters with boats in the 17- to 25-foot size class were calculated on a per bushel of oyster harvested and per vessel basis.

During the 1984-85 season, average earnings from select and cluster oysters per boat were $4211 or $5.23/bu (Table 3). Costs of operation were separated into variable and fixed costs, where the latter are costs that harvesters must pay if they remain idle (i.e., do not harvest). Variable costs comprise the remainder and can be thought of as costs that change as the level of harvest activity changes. As one would expect, fuel is an important cost and ranked as the highest single cost component with an average of $811/boat or $1.08/bu of oysters harvested. The second largest cost item represented depreciation allowances (a fixed cost) with $542/boat ($.67/bu). Expenses for sacks and bags ranked third ($387/boat, $.48/bu), followed by hipboots and boots ($126/boat, $.16/bu). This last item may be surprising to individuals not familiar with the rather unique harvesting technique in Georgia. Because of the location of oysters

Table 3. Average Costs and Earnings, Oyster Harvesters, Georgia, 1984-85.

Category:	$/boat	$/bu
Returns:		
Oysters	4,211.31	5.23
Variable Costs:		
Gas	811.36	1.08
Oil	70.13	0.09
Hipboots/Boots	126.10	0.16
Gloves	58.75	0.07
Rakes - Small	6.00	0.01
Hand Tongs	35.00	0.04
Grabs	14.00	0.02
Culling Hammer	2.00	0.002
Sacks	386.50	0.48
Files	0.80	0.00
Transport Expense	26.80	0.03
Total Variable Costs	1,537.44	1.91
Returns above Variable Costs	2,673.87	3.32
Fixed Costs:		
Oars	21.57	0.03
Lifejackets	9.10	0.01
Oil Drum Containers	20.00	0.02
Depreciation-Vessel, Engine, Trailer, Truck	541.59	0.67
Misc. Busi. Exp.	106.50	0.13
Total Fixed Costs	698.76	0.87
Total Costs	2,236.20	2.78
Returns to Risk, Management	1,975.11	2.45

Note: The column associated with the $/bu average will not sum due to rounding.

along steep banks of tidal marshes and creeks, and 6- to 8-foot tides that occur with strong currents, shellfish harvesters must stand on the tidal beds at low tide to harvest shellfish rather than work from boats as in other oyster production areas (e.g., Chesapeake Bay, Appalachicola Bay).

Overall, variable costs averaged $1537/boat ($1.91/bu), fixed costs $699/boat ($.87/bu), and total costs $2236/boat ($2.78/bu). The difference between earnings and total costs (net returns) averaged $1975/boat ($2.45/bu).

Labor Use — Oyster Harvesters. Reliable information about labor use was obtained from oyster harvesters only. Survey results indicated that labor used in harvest operations represented 76% of total labor averaging 334.8hr/boat (.416hr/bu). The remainder, an average of 103.3hr/boat (.128hr/bu), was used for transportation to the oyster beds and for bringing in oysters to wholesale or retail operators (shipping).

Average Costs and Earnings — Clam Harvesters

Average harvest costs and returns are from vessels in the 18- to 20-foot class (average of 19.3ft) with engines ranging from 35 to 100hp (average of 78.3hp). Due to a small number of clam harvesters, costs and returns are only reported on the basis of a 250-count bag. This also prevents a detailed breakdown of expense items; only averages of major cost categories (variable, fixed and total) are reported.

Over the 1985-86 clam season, gross returns from sales of topnecks, littlenecks, cherrystone, and chowder clams averaged $19.61/bag. Total expenses averaged $8.00/bag with variable costs of $4.24/bag and fixed costs of $3.76/bag. Net earnings returned a profit of $11.62/bag on average. Overall, costs represented 41% of gross returns.

Although there seems to be a relatively higher profit margin with clam harvesting, clam harvesters claimed that market channels for clams are not as well developed in Georgia as are oyster markets. Clams must be shipped out of state to be sold. With improved marketing and promotional techniques, introduction of clams into the raw bar trade (half-shell market) and restaurant trade could create a promising local wholesale market. Combined with educational promotion techniques (recipe suggestions, cooking contests, promotional samples), a retail market could evolve.

Average Costs and Earnings — Oyster-Shucking Operations

Financial and production data were obtained from 3 shucking operations, 2 small and 1 large operation, for the 1984-85 oyster season. Because of the small number of business enterprises, only major cost and returns categories appear below on the basis of bushels of oysters shucked or gallons of oysters produced.

Gross earnings from shucked oyster sales averaged $18.71/bu of oyster input or $25/gallon of oyster output. Costs were $10.91/bu ($14.67/gal) with variable costs of \$9.21/bu (\$12.31/gal) and fixed costs of \$1.69/bu (\$2.26/gal). Net returns resulted in average profits of \$7.81/bu (\$10.43/gal).

Average Costs and Earnings – Wholesale and Retail Bag Trade

Costs and earnings for wholesale and retail oyster trade are given for small operators that marketed local Georgia oysters in-state during the 1984-85 oyster season. Gross earnings averaged \$10.58/bu and total costs \$8.20/bu (variable costs \$7.21/bu, fixed costs \$.99/bu), thus yielding net returns of \$2.39/bu. It should be noted that quite a few large seafood wholesalers and retailers located primarily in Savannah and Brunswick did not participate in this study. These operators are the primary source of supply to the restaurant and raw bar trade, and they deal in large volumes (in some cases a trailer truck per week is shipped in). These large operators have a different operating and cost structure from the small operators reported above.

ASSESSED VALUE OF COMMERCIALLY HARVESTABLE SHELLFISH IN GEORGIA

The purpose of this section is to determine an economic value of the market potential of harvestable shellfish in approved waters of Georgia. An assessment of the commercial value was derived on the basis of estimated acreage in which shellfish occur in approved waters, estimates of average oyster and clam yields, as well as average cost and return estimates calculated from surveyed harvesters. It must be emphasized that the projected values are based on present harvest technology, financial cost and returns structure, current prices, and the assumption that currently approved waters are not closed down from pollution. The assessed estimates represent an annual value that would occur assuming the above conditions do not change.

Projected annual commercial gross returns to local harvesters were estimated at \$220,019 for oysters and \$720,158 for clams (Table 4). Harvest costs based on present harvest techniques were estimated at \$411,806 for oysters and clams combined, yielding net returns of \$530,738.

An assessed value of commercial gross returns was estimated at \$487,099 for oysters sold as fresh and shucked product through current wholesale and retail trade channels.

The total commercial value (gross) of shellfish sold in all current markets and product forms was projected at \$1,207,257 per year with a net value of \$553,503/year.

Table 4. Assessed Economic Value of Commercially Harvestable Shellfish, Georgia, 1985.

<u>Potential Harvestable Resource</u>:

Oysters: 6,054 (acres) * 7.012 (bu/acre) = 42,451 bu/year
Clams: 6,054 (acres) * 6.066 (bag/acre) = 36,724 bags/year

<u>Value of Landings</u>:

Oysters: 42,451 (bu) * 7.407 (1984-85 $/bu) = $314,435/year
Clams: 36,724 (bg) * 19.866 (1985-86 $/bg) = $729,559/year

Category[a]	Gross Rtns	Total Costs	Net Rtns
Harvest-Oysters (100%)	220,019	118,014	104,005
Retail-Oysters (89%)[b]	399,723	309,804	90,297
Shucked-Oysters (11%)[b]	87,376	50,950	36,473
Total Market Value	487,099	360,754	126,770
Harvest/Retail-Clams	720,158	293,792	426,733
Shellfish-Harvest/ Dockside Value	940,177	411,806	530,738
Shellfish-Retail	1,207,257	654,546	553,503

Note: Dollar values are in 1984-85 dollars for oysters, 1985-86 dollars for clams. 1 bag of clams = 250 count bag.

a. Gross returns, total costs, and net returns derived from product of potential resource harvested and the respective average returns and cost data (Table 3).

b. Assumes the present mix of oysters sold retail and shucked, 89% and 11%, respectively.

MARKET POTENTIAL OF GEORGIA OYSTERS

Along the coast of Georgia an active oyster market has been in existence for some time with the greatest concentration located in Savannah. Practically all of the wholesale and retail bag trade business involves washing, repacking and reselling imported oysters that originate from Appalachicola Bay and Texas or Louisiana waters. According to these operators, present and potential oyster harvests from Georgia waters alone would not be able to satisfy the Savannah market demands, but Georgia harvests could make important contributions, since all operators expressed a preference and willingness to market local oysters. However, these operators did stress that locally caught oysters may not be cost competitive due to the inherent labor-intensive harvest process, which may explain why few people are interested in oyster harvesting.

To overcome the labor-intensive characteristics of traditional harvest techniques, technological developments and improvements might assist in the establishment of mariculture techniques to cultivate oysters. The substitution of technology and labor used in developing cultivation practices for technology and labor used in search and harvest practices may assist in developing a more competitive oyster product and improving harvested oyster yields and quality. Cato and Prochaska (1979) suggest the use of mechanical harvesting techniques to produce more cost competitive oysters. This would involve a change in current laws, however, and indications are that the GA Department of Natural Resources would not support a law change. Mechanical harvesting, therefore, is not a viable option.

ECONOMIC IMPACT ANALYSIS[2]

One approach in determining the economic value or importance of an industry to a local and state economy is to estimate the economic impact of the industry on that economy. Economic impacts may be thought of as the effect of a general change in local industries (e.g., investment, sales) on a given economy.

Each dollar of investment in an industry or sector has an effect on regional and state output (sales), income, and employment. Therefore, a change in investment or sales will change these factors in a multiplier fashion throughout the study economy. The magnitude of impacts within an economy resulting from a change in part of the economy is influenced by the degree of interdependency that exists among the various sectors within that economy. Economic impacts reflect the effect that changes in output, investment, or employment of a particular sector (e.g., shellfish harvesting) have on the output (investment, etc.) of the other sectors within the economic region. This effect consists of several rounds of impacts, described as a **multiplier** effect. The first round of impacts involves only the sector of interest (i.e., primary sector) and sectors that directly interact with the primary sector (i.e., secondary sectors). Subsequent

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[2]The following general description draws heavily from Prochaska and Morris's (1978) excellent description of economic impacts.

rounds involve impacts based on the interaction of these secondary sectors with other sectors, and the interaction of these other sectors with still other sectors, until the effect originating in the designated primary industry is measured throughout the economy.

It must be stressed that economic impact assessment measures differ from those of gross regional product. The latter measures net changes in value without double counting. Economic impact measures do contain some double counting in the summation of the effects throughout the economy which are precipitated by an initial change.

Methodology

Primary Economic Impact

Following Prochaska and Morris (1978), this report uses primary economic impact to measure the direct economic effect resulting from an economic activity in a designated sector or industry. It must not be confused with the **direct effect** commonly used in input-output analysis discussed below. **Primary economic impacts** are calculated as the sum of sales of outputs and expenses for inputs for a given industry or sector. This technique assumes that economic activity generated in the primary sector is reflected in sales, while expenditures measure the economic value of all goods and services purchased from other sectors in the economy (i.e., economic activity generated by the primary study sector). Hence, the primary economic impact captures the degree of interdependence among the study sector and other sectors within the economy. Furthermore, the primary economic impact estimate is a measure of **partial** economic activity generated by the study sector rather than one of **total** economic activity. This is because it considers only the direct economic activity generated from the effect of the primary sector on secondary sectors, and not the effects of interactions among the secondary sectors with still other sectors in the economy.

Input-Output Analysis

In economic applications, input-output (I-O) models are among the more widely accepted methodologies for assessing local impact analysis. The attractiveness of I-O analysis is that it identifies the linkages and interdependencies that characterize economic activity in a given local or state economy (Miernyk, 1965). The disadvantages of I-O analysis are the data requirements. A considerable level of detail is needed to identify the inherent linkages and interdependencies that exist within a given economy. Thus, data from each economic sector and activity including household consumption is required to characterize economic activity.

Based on an I-O model solved for sector outputs, the economic impacts corresponding to the level of activity in a final demand sector on the level of outputs of other sectors and on the economy as a whole can be estimated. The resulting economic impacts are characterized as either direct, indirect, or induced effects. **Direct effects** represent the change in demand of industries or sectors directly affected from a change in the final demand of a given primary sector. Suppose an increase in demand for fresh oysters occurs in a local economy. This will result in increased oyster harvesting activity to supply the demand represented by increased sales. This, in turn, increases fishermen's purchases for fishing inputs and supplies (e.g., fuel, ice, fishing gear, repair services) provided by marine and fishing support businesses (secondary sectors). Thus, an increase in fresh oyster demand has a direct impact on the goods and services sector (secondary sector) used in the harvest activity.

Indirect effects measure the effect of marine and fishing support businesses' (secondary sectors) increased purchases of the inputs necessary to meet the increased demand for their products. The effect of income generated from this increased activity that is re-spent in the given economy is defined as an **induced effect.**

Aggregate economic impacts on a given economy are referred to as multiplier effects that can measure output, income, and employment effects. **Output multipliers** measure the total change in the economic activity associated with output (sales) of all sectors of the economy (primary, secondary sectors and beyond) that is generated from an additional dollar of final demand (goods and services of the primary sector, e.g., sales of commercial oyster harvesters). The total change in income that occurs in a given economy due to a dollar change in final demand is reflected by the **income multiplier. Employment multipliers,** however, have a slightly different interpretation. They show the change in a given economy's employment generated by a change in output that causes an employment change of one unit.

Two types of multipliers are estimated in I-O studies to project the total economic impacts created from a change in final demand (sales) per dollar of direct change in the primary sector within the economy (i.e., endogenous primary sector). **Type I multipliers** are defined as (D+I)/D where D=direct and I=indirect effects, and represent the combined direct and indirect effects of economic activity within a given economy per dollar of direct change in the designated primary sector. **Type II multipliers,** (D+I+IN)/D where D=direct, I=indirect and IN=induced effects, measure the combined direct, indirect and induced effects of economic activity throughout the economy per dollar change in the primary sector within the economy. It is the product of these multipliers with sales (for output and income effects), and employment in the primary sector (for employment effects) that results in projections of economic impacts.

Previous Marine Input-Output Studies

Due to funding limitations, an I-O study specifically for the coastal region in Georgia was not feasible. Projected impacts were based on previous studies that examined marine economies and included sectors for oysters, shellfish, and seafood products.

In all, 13 studies examined specific marine economies. Two studies conducted for the California marine and commercial fishing economy (King and Flagg, 1982; King and Shellhammer, 1982) did not include any shellfish breakdowns, and so were not considered in the analysis. Tables 5, 6, and 7 summarize the direct, indirect and induced effects along with Type I and Type II multipliers corresponding to output, income, and employment effects, respectively. For some studies, estimated impact multipliers were fairly close to one another, for example, Type II output multipliers of the Florida studies — 1.41 with 1.4017, 1.57 with 1.5236 for oyster harvesters (Table 5). This illustrates, in part, the similarity of the structure of the commercial harvesting sector over time.

Across areas and time, differences among multipliers show inherent differences corresponding to the structure for a given sector, technological differences (labor versus capital intensiveness), and differences in the definition of particular sectors (shellfish versus all fishery products). For example, the differences in the Florida and Connecticut studies could be explained by the different harvest techniques — hand labor in Florida versus dragging in Connecticut for shellfish harvesting. The Alabama-Mississippi studies could represent predominantly shrimp vessels, including all types of commercial harvest activities.

For illustrative purposes, the interpretation of the multipliers and the associated effects for each of the output, income, and employment impacts are outlined below for the Connecticut study (Crawford, 1984). For every dollar of final demand for processed shellfish associated with commercial processors, total output of all sectors within the economy changed by $1.27 (Type I) and $2.82 (Type II) (Table 5). A change in final demand for processed shellfish of $1 generates $.686 in direct personal income to households employed in the processing sector, $.748 in personal income to all sectors that supply the primary shellfish processing sector ($.062 is the indirect effect), and $.944 in personal income to households in the overall regional economy ($.196 is the induced effect reflecting the amount of income re-spent within the regional economy) (Table 6).

Considering employment effects, a change in output in shellfish processing (in response to increased shellfish demand) that causes a per unit change in employment generates a change in total regional employment of 1.4 man-years (Type I) and 2.1 man-years (Type II) when induced effects are included, thus measuring all employment effects in the economy (Table 7). Another way of interpreting employment multipliers is that for every 10 people employed in shellfish processing, 14 full-time jobs in the regional economy are generated (See Rossi et al., 1985; Andrews and Rossi, 1986, for this interpretation.).

Of all the I-O studies reviewed in Tables 5, 6 and 7, only the Prochaska and Mulkey (1983) study estimated Type II output (sales) multipliers for the oyster harvest sector in the Appalachicola Bay, Florida region. The Centaur (1984) study derived output, income, and employment Type I multipliers for the processing, wholesale, and retail trade sectors, specifically for oyster products within the Gulf of Mexico and Southeast Atlantic region.

The present study relied heavily upon both of these studies in developing shellfish (oysters and clams) economic impact projections for county and state economies of Georgia. The rationale was that the harvesting sectors of Florida and Georgia are very similar to one another in harvesting and processing technology, and at the same time are quite distinct from other regions of the country. Regarding seafood wholesale and retail trade sectors, oysters harvested and processed in Georgia are sold locally and exported to large seafood markets out-of-state. Because of the established structure of seafood market channels, seafood originating from most regions goes through the same channels as that sold in local markets. Thus, it is not surprising that little difference occurred in

Table 5. Output Effects and Multipliers Associated with Oyster Harvesting, Processing, Wholesale and Retail Operations.

Category: Study - State		Effects D	Effects D+I	Effects D+I+IN	Multipliers Type I	Multipliers Type II
		--per $1 sales-				
<u>Oyster Harvest</u>:						
Prochaska & Mulkey	FL	1.0		1.41		1.41
		1.0		1.57		1.57
		1.0		1.92		1.92
Prochaska & Morris[a]	FL			1.4017		1.4017
Morris & Prochaska[a]	FL			1.5236		1.5236
Nissan et al.[a]	AL/MS				1.70	3.434
Nelson & Hardy[a]	AL				2.01	5.41
Crawford	CT				1.4747	2.8274
Rossi et al.	NJ				1.200	2.021
<u>Shellfish Process</u>:						
Nelson & Hardy[a]	AL				2.47	5.74
Crawford	CT				1.2662	2.8167
Centaur[d]	SE[b]				2.17	
<u>Shellfish Whsl/Ret</u>:						
Crawford	CT-W[c]				1.2984	1.6807
Rossi et al.[a]	NJ-W[c]				1.502	2.136
Centaur[d]	SE[b]-W[c]				1.52	
Centaur[d]	SE[b]-R[c]				1.43	
Avg. Centaur[d]	SE[b]				1.475	

Note: D - direct effect, D+I - direct + indirect effect, D+I+IN - direct + indirect + induced effect, Type I - (D+I)/D, Type II - (D+I+IN)/D.

a. All fisheries and/or fishery products, not just shellfish.

b. SE refers to Gulf of Mexico and Southeast Atlantic Regions.

c. W refers to wholesale, R refers to retail.

d. Oysters only.

Source: See Appendix Table A-2.

Table 6. Income Effects and Multipliers Associated with Shellfish Harvesting, Processing, Wholesale and Retail Operations.

Category: Study	State	Effects D	Effects D+I	Effects D+I+IN	Multipliers Type I	Multipliers Type II
		----per $1 sales----				
Shellfish Harvest:						
Nissan et al[a]	AL/MS				1.56	2.37
Nelson et al[a]	AL				1.80	1.54
Grigalunas	SNE[b]	.6687	.8125	1.1441	1.22	1.71
Callaghan	RI					1.32
King & Storey	MA					1.31
Crawford	CT	.5354	.6578	.8241	1.2286	1.5392
Rossi et al	NJ	.456	.499	.536	1.094	1.177
Shellfish Process:						
Nelson et al[a]	AL				3.51	6.87
Grigalunas[a]	SNE[b]	.1302	.4986	.7027	3.83	5.40
Rorholm[a]	SNE[b]-Fresh					4.15
	SNE[b]-Frozen					9.84
Callaghan[a]	RI					3.87
Crawford	CT	.6857	.7482	.9442	1.0911	1.3771
Centaur[c]	SE[b]				3.48	
Shellfish Whsl/Ret:						
Grigalunas[a]	SNE[b]	.0905	.5520	.7781	6.10	8.60
Crawford[a]	CT	.1346	.1822	.2299	1.3536	1.7079
Rossi et al[a]	NJ-W	.249	.385	.414	1.549	1.666
Centaur[c]	SE[b]-Whsl				1.37	
Centaur[c]	SE[b]-Ret				1.33	
Avg. Centaur	SE[b]				1.35	

Note: D = direct effect, D+I = direct + indirect effect, D+I+IN = direct + indirect + induced effect, Type I = (D+I)/D, Type II = (D+I+IN)/D, W refers to wholesale, Ret refers to retail.

a. All fisheries and/or fishery products, not just shellfish.

b. SNE refers to Southern New England, SE refers to Gulf of Mexico and Southeast Atlantic Regions.

c. Oysters only.

Source: See Appendix Table A-3.

Table 7. Employment Effects and Multipliers Associated with Shellfish Harvesting, Processing, Wholesale and Retail Operations.

Category: Study - State		Effects D	Effects D+I	Effects D+I+IN	Multipliers Type I	Multipliers Type II
		---per $1,000 sales--				
Shellfish Harvest:						
Nissan et al[a]	AL/MS				1.55	2.44
Nelson et al[a]	AL				1.37	2.23
Grigalunas	SNE[b]	.011	.020	.057	1.82	5.18
Crawford	CT	.0982	.1120	.1210	1.4106	1.2324
Rossi et al	NJ	.0185	.0247	.0405	1.339	2.195
Shellfish Process:						
Nelson et al[a]	AL				3.25	5.41
Grigalunas[a]	SNE[b]	.087	.025	.045	3.92	6.43
Crawford	CT	.0189	.0262	.0398	1.3818	2.0957
Centaur[c]	SE[b]				2.83	
Shellfish Whsl/Ret:						
Grigalunas[a]	SNE[b]	.005	.024	.049	4.80	9.80
Crawford[a]	CT	.0101	.0213	.0239	1.9337	2.1795
Rossi et al[a]	NJ-W	.0174	.0307	.0429	1.762	2.461
Centaur[c]	SE[b]-Whsl				1.37	
Centaur[c]	SE[b]-Ret				1.13	
Avg. Centaur	SE[b]				1.25	

Note: D - direct effect, D+I - direct + indirect effect, D+I+IN - direct + indirect + induced effect, Type I - (D+I)/D, Type II - (D+I+IN)/D, W refers to wholesale, Ret refers to retail.

a. All fisheries and/or fishery products, not just shellfish.

b. SNE refers to Southern New England, SE refers to Gulf of Mexico and Southeast Atlantic Regions.

c. Oysters only.

Source: See Appendix Table A-4.

Type I multipliers across areas (studies) for seafood wholesale and retail sectors with the exception of the Grigalunas and Ascari (1982) study (see shellfish wholesale/retail sections of Tables 5-7). This also held for Type II multipliers.

Projected Economic Impacts of the Georgia Shellfish Sector

As mentioned earlier, the value of shellfish landings does not measure the economic activity associated with shellfish on local and state economies. This must be determined from a multiplier effect. For output and income impacts the procedure involves the product of sales of a given sector with a respective multiplier.

Economic output impacts of the shellfish harvest sector were projected at $105,465 (direct and indirect) per dollar change in harvesting (Table 8). This reflects the change in economic activity between the primary harvest sector and secondary sectors that supply inputs to oyster harvesters (measured by input expenses) generated from a change in oyster harvest sales. Thus, it is not too surprising that the projected primary economic impact estimate of $112,414 that measures a similar type of activity is reasonably close in magnitude to the above output impacts. Projected income impacts were estimated at $105,555 (Type II) and represent all the economic activity within the coastal region associated with impacts to household income. The impacts of 12 full-time but seasonal shellfish harvesters in the region resulted in projected employment impacts of 17 full-time seasonal jobs created in primary and secondary sectors of the economy (Type I) and 21 full-time seasonal jobs in all sectors of the economy (Type II).

Projected output effects due to the shucked oyster processing sector were estimated at $953,650 (Type I) and $2,184,078 (Type II) (Table 8). Although primary economic impacts were more variable in this case it can serve as an upper limit (in comparison with Type I impacts). The estimated effects on personal income from economic activity due to oyster-shucking operations was projected at $2,475,491 (Type II). For all oyster processing operations, shucking and canning processors, these activities generated estimated impacts of $8,136,984 in output (Type II), $9,222,668 in income (Type II), reflecting all economic activities generated solely from the oyster processing sector. The direct employment of 36 full-time people in oyster-shucking operations results in projected employment impacts of 166 full-time jobs (Type II) in all sectors within the economy.

Projected economic impacts resulting from surveyed industries that wholesale and retail oysters (bag trade only) were estimated at $771,993 – output (Type II) and $689,545 – income (Type II).

Table 8. Projected State Economic Impacts Generated By Shellfish Harvesting, Processing, and Wholesale/Retail Sectors, Georgia, 1985.

Category:	State Projected Impacts						Primary Economic Impacts[b]
	Output/Sales		Income		Employment[a]		
	Type I	Type II	Type I	Type II	T-I	T-II	
	$				No.		$
Shellfish Harvest	105,465	NA	88,329	105,555	17.0	20.6	112,414
Processing-Shucked	953,650	2,184,078	1,529,356	2,475,491	101.9	166.0	1,046,114
Processing-All	3,552,911	8,136,984	5,697,755	9,222,668	NA	NA	3,442,261
Wholesale/Retail Trade	566,428	771,993	518,424	689,545	8.8	11.0	864,690

Note: NA refers to not available.

a. T-I = Type I, T-II = Type II impacts.

b. Sum of sales and expenses.

Source: See Appendix B, for derivation of impacts.

FUTURE DIRECTIONS

Knowledge of the economic importance of the shellfishery in Georgia, as well as information on the coastal economy's dependency on the shellfishery, can aid state policymakers and fishery managers in determining policies regarding the future of the state's shellfish resource, and in decisions of resource allocation, where multiple uses of the coastal zone conflict with the shellfishery.

The success of the shellfish resources in Georgia will depend partially upon the efforts of the state acting through the Department of Natural Resources. State legislation designed to supersede earlier legislation defining harvest rights seems the only means to overcome one of the greatest impediments to the shellfish industry and to the state's shellfish program. State legislation limiting real estate development in the coastal zone will help prevent competition for the resource space and water quality degradation from septic runoff. Legislation that requires the return of oyster shellstock (cultch planting) on a routine basis will enable the maximum biomass of the resource to be achieved and will help to ensure resource availability for future generations. State investment in Research and Development can help to develop mariculture techniques that will work in Georgia's intertidal zone (so as to maximize the yield per unit of area and reduce the costly labor required in the search and harvest effort). Similar investment in promotional programs of Georgia shellfish products will help to maximize earnings of shellfish harvesters and processors. Some of these efforts are currently ongoing.

The state DNR is drafting stringent rules concerning real estate development and marina use in the coastal zone restricting development and use that would degrade water quality and create a detrimental impact on shellfish populations. Present guidelines exist that limit certain development and use adjacent to "approved" shellfish areas in the coastal zone. The state presently requires that each permitted commercial harvester return 1/3 bushel of shellstock for every bushel of oysters harvested. Future research will determine whether this ratio of shellstock to harvest return promotes optimal production. GA DNR researchers are presently conducting experiments to evaluate the production contributions of cultch planting. Research of this nature will help to determine the state's future role in cultch planting.

Presently, the state allows shellfish stock to be harvested and transported from areas restricted to commercial harvest to areas that are approved. This prevents any commercial losses from occurring, while achieving the full commercial productive potential of the resource at the same time. At this time, the operation of depuration plants has not proved to be as cost-effective nor as profitable as the transportation of oyster shellfish stock in Georgia.

Development and adoption of mariculture techniques offer much promise to the state shellfishery. Such techniques have the potential to reduce the amount of labor-intensive effort that characterizes present harvest techniques, and to realize optimum yields per unit of breeding area. On the basis of fairly recent state and federal R & D (Sea Grant) expenditures, mariculture techniques for clam shellfish have been refined to suit Georgia conditions. The techniques are proven to be effective and profitable, as some commercial clam harvesters have adopted the techniques on a routine basis. University of Georgia Marine

Extension Service agents have the capability to assist shellfish harvesters interested in the techniques.

Another incentive that some states (e.g., South Carolina) have used to enable investment in shellfish resource management and experimentation involves the creation of an operating fund earmarked specifically for shellfish, such as a fisheries development fund. Typical sources of revenues come from the sale of commercial permits, service fees, and taxes and royalties on both harvested and commercially sold shellfish. This type of fund is illegal in Georgia according to state law, except in certain situations (e.g., the state Trout Stream Fishery Program in North Georgia). Commercial harvesters and processors have, however, expressed an interest in this type of fund.

The final area of state involvement that could benefit the state shellfishery involves the promotion, marketing and advertising of Georgia shellfish products. Many state agricultural products in the Northeast, Florida, and California have benefitted from state involvement in promotional programs (e.g., citrus produce in Florida, walnuts in California, farm grown produce in Massachusetts, Connecticut and New Jersey). Producers that develop individual marketing channels have found it sometimes very costly in both time and money. Some agricultural research has found that many marginal producers do not have the time or lack the skills to develop marketing channels. State involvement in shellfish promotional programs would give Georgia harvesters an advantage in the marketplace and assist them in realizing a maximum level of revenues.

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APPENDIX A

Assumptions and Input-Output Analysis Literature Review

Appendix Table A-1. Assumptions Used in Assessing a Potential Commercial Economic Value of Shellfish in Georgia.

1) Harvestable Acreage = .10(60,546) = 6,045 acres
Present ('84-85) Acreage = .10(37,500) = 3,750 acres.

2) Yields-Oysters: 7.012bu/acre or 31.018lb/acre
Yields-Clams: 6.066bags/acre or 31.079lb/acre.

3) Value-Oysters: $7.407/bu or $1.675/lb
Value-Clams: $19.866/bag or $3.877/lb

4) Average Returns, Costs & Net Returns:

	Avg. Rtn.	Avg. Cost	Avg. Net
Oysters:			
Harvest	$ 5.23/bu	$ 2.78/bu	$ 2.45/bu
Retail	10.58/bu	8.20/bu	2.39/bu
Shucked	18.71/bu	10.91/bu	7.81/bu
Clams:			
Harvest/ Retail	$19.61/bag	$ 8.00/bag	$11.62/bag

Note: Dollar values are in 1984-85 dollars for oysters, 1985-86 dollars for clams. 1 bag of clams = 250 count bag.

Appendix Table A-2. Output Effects and Multipliers Associated with Oyster and Shellfish Harvesting, Processing, Wholesale and Retail.

Category: Study - State	Effects D	Effects D+I	Effects D+I+IN	Multipliers Type I	Multipliers Type II
	--per $1 sales-				
Oyster Harvest:					
Prochaska & Mulkey(1983)-FL					
Franklin Co.	1.0		1.41		1.41
Franklin & Gulf Co.	1.0		1.57		1.57
Appalachicola Bay	1.0		1.92		1.92
Prochaska & Morris(1978)[a]					
Florida			1.4017		1.4017
Morris & Prochaska(1979)[a]					
Florida			1.5236		1.5236
Nissan et al.(1978)[a]					
Alabama/Mississippi				1.70	3.434
Nelson & Hardy(1980)[a]					
Alabama				2.01	5.41
Crawford(1984)					
New London Co., CT				1.4747	2.8274
Rossi et al.(1985)					
Ocean Co., NJ				1.200	2.021
Shellfish Process:					
Nelson & Hardy(1980)[a]					
Alabama				2.47	5.74
Crawford(1984)					
New London Co., CT				1.2662	2.8167
Centaur(1984)[b]					
Gulf & So. East Atlantic				2.17	
King & Flagg(1982)-CA[a]					
Whsl/Proc/Dist-sm	1.0	2.3073	4.1706	2.3073	4.1706
Whsl/Proc/Dist-med	1.0	2.3661	4.0210	2.3661	4.0210
Whsl/Proc/Dist-lg	1.0	2.2680	4.1472	2.2680	4.1472
King & Shellhammer(1982)-CA[a]					
Whsl/proc/Dist-sm	1.0	2.2649	4.1326	2.2649	4.1326
Whsl/proc/dist-med	1.0	2.3364	3.9876	2.3364	3.9876
Whsl/proc/dist-lg	1.0	2.2316	4.1081	2.2316	4.1081
Shellfish Whsl/Ret:					
Crawford(1984)					
New London Co.,CT-Whsl				1.2984	1.6807
Rossi et al.(1985)a					
Ocean Co., NJ-Whsl				1.502	2.136
Centaur(1984)[b]					
Gulf & So. East Whsl				1.52	
Gulf & So. East Retail				1.43	

Note: D - direct effect, D+I - direct + indirect effect, D+I+IN - direct + indirect + induced effect, Type I - (D+I)/D, Type II - (D+I+IN)/D.

a. All fisheries and/or fishery products, not just shellfish.

b. Oysters only.

Appendix Table A-3. Income Effects and Multipliers Associated with Shellfish Harvesting, Processing, Wholesale and Retail Operations.

Category: Study - State	Effects D	Effects D+I	Effects D+I+IN	Multipliers Type I	Multipliers Type II
	----per $1 sales----				
Shellfish Harvest:					
Nissan et al.(1978)[a]					
Alabama/Mississippi				1.56	2.37
Nelson et al.(1980)[a]					
Alabama				1.80	1.54
Grigalunas et al.(1982)					
So. New England	.6687	.8125	1.1441	1.22	1.71
Callaghan et al.(1978)					
Rhode Island					1.32
King & Storey(1974)					
Massachusetts					1.31
Crawford(1984)					
New London Co.,CT	.5354	.6578	.8241	1.2286	1.5392
Rossi et al.(1985)					
Ocean Co. NJ	.456	.499	.536	1.094	1.177
Shellfish Process:					
Nelson et al.(1980)[a]					
Alabama				3.51	6.87
Grigalunas et al.(1982)[a]					
So. New England	.1302	.4986	.7027	3.83	5.40
Rorholm et al.(1967)[a]					
So. New England-Fresh					4.15
So. New England-Frozen					9.84
Callaghan et al.(1978)[a]					
Rhode Island					3.87
Crawford (1984)[a]					
New London Co.,CT	.6857	.7482	.9442	1.0911	1.3771
Centaur (1984)[b]					
Gulf & So. East Atlantic				3.48	
Shellfish Whsl/Ret:					
Grigalunas et al. (1982)[a]					
So. New England	.0905	.5520	.7781	6.10	8.60
Crawford (1984)[a]					
New London Co.,CT	.1346	.1822	.2299	1.3536	1.7079
Rossi et al.(1985)[a]					
Ocean Co., NJ-Whsl	.249	.385	.414	1.549	1.666
Centaur (1984)[b]					
Gulf & So.East-Whsl				1.37	
Gulf & So. East-Ret				1.33	
Avg. Whsl/Ret				1.35	

Appendix Table A-3 cont.

Category: Study - State	Effects D	Effects D+I	Effects D+I+IN	Multipliers Type I	Multipliers Type II
	----per $1 sales----				
King & Flagg (1982)-CA[a]					
Whsl/Proc/Dist-sm	.1587	.6497	.9052	4.0934	5.7028
Whsl/Proc/Dist-med	.0963	.5771	.8040	5.9903	8.3456
Whsl/Proc/Dist-lg	.2088	.6553	.9129	3.1381	4.3720
King & Shellhammer (1982)[a]					
Whsl/Proc/Dist-sm	.1662	.6260	.9059	3.9256	5.4492
Whsl/Proc/Dist-med	.0992	.5769	.8008	5.8145	8.0711
Whsl/Proc/Dist-lg	.2158	.6557	.9101	3.0384	4.2176

Note: D = direct effect, D+I = direct + indirect effect, D+I+IN = direct + indirect + induced effect, Type I = (D+I)/D, Type II = (D+I+IN)/D, W refers to wholesale, Ret refers to retail.

a. All fisheries and/or fishery products, not just shellfish.

b. Oysters only.

Appendix Table A-4. Employment Effects and Multipliers Associated with Shellfish Harvesting, Processing, Wholesale and Retail Operations.

Category: Study - State	Effects D	Effects D+I	Effects D+I+IN	Multipliers Type I	Multipliers Type II
	---per $1,000 sales--				
Shellfish Harvest:					
Nissan et al.(1978)[a]					
Alabama/Mississippi				1.55	2.44
Nelson et al.(1980)[a]					
Alabama				1.37	2.23
Grigalunas et al.(1982)					
So. New England	.011	.020	.057	1.82	5.18
Crawford(1984)					
New London Co.,CT	.0982	.1120	.1210	1.4106	1.2324
Rossi et al.(1985)					
Ocean Co.,NJ	.0185	.0247	.0405	1.339	2.195
Shellfish Process:					
Nelson et al.(1980)[a]					
Alabama				3.25	5.41
Grigalunas et al.(1982)[a]					
So. New England	.087	.025	.045	3.92	6.43
Crawford (1984)[a]					
New London Co.,CT	.0189	.0262	.0398	1.3818	2.0957
Centaur (1984)[b]					
Gulf & So. East				2.83	
Shellfish Whsl/Ret:					
Grigalunas et al.(1979)[a]					
So. New England	.015	.024	.049	4.80	9.80
Crawford (1984)[a]					
New London Co.,CT	.0101	.0213	.0239	1.9337	2.1795
Rossi et al.(1985)[a]					
Ocean Co., NJ-Whsl	.0174	.0307	.0429	1.762	2.461
Centaur (1984)[b]					
Gulf & So. East-Whsl				1.37	
Gulf & So. East-Ret				1.13	
Avg. Whsl/Ret				1.25	
King & Flagg (1982)-CA[a]					
Whsl/Proc/Dist-sm	.0165	.0724	.0863	4.3889	5.2305
Whsl/Proc/Dist-med	.0073	.0595	.0719	8.1552	9.8446
Whsl/Proc/Dist-lg	.0121	.0688	.0828	5.6822	6.8396
King & Flagg (1982)-CA[a]					
Whsl/Proc/Dist-sm	.0165	.0602	.0743	3.6507	4.5014
Whsl/Proc/Dist-med	.0073	.0482	.0606	6.6008	8.3008
Whsl/Proc/Dist-lg	.0121	.0554	.0695	4.5801	5.7457

Note: D = direct effect, D+I = direct + indirect effect, D+I+IN = direct + indirect + induced effect, Type I = (D+I)/D, Type II = (D+I+IN)/D, W refers to wholesale, Ret refers to retail.

a. All fisheries and/or fishery products, not just shellfish.

b. Oysters only.

APPENDIX B

Derivation of Economic Impacts

Derivation of Output Multipliers:
Output multipliers used are Type II – 1.41 (Prochaska and Mulkey, 1983) for oyster/clam harvesting; Type I – 2.17 (Centaur, 1984) and Type II – 4.9698 [weighted ratio of Type II to Type I times Type I multiplier used (8.5567/3.7362)*2.17] (Nelson & Hardy, 1980; Crawford, 1984) for oyster processing; and Type I – 1.475 (average of Centaur, 1984, wholesale and retail multipliers) and Type II – 2.0103 [weighted ratio of Type II to Type I times Type I multiplier used (3.8167/2.8004)*1.475] (Crawford, 1984; Rossi et al., 1985) for oyster wholesale/retail operations.

Derivation of Income Multipliers:
Income multipliers used are Type I – 1.1809 (average of commercial shellfish multipliers, Grigalunas et al., 1982; Crawford, 1984; Rossi et al., 1985) and Type II – 1.4112 (average of commercial shellfish multipliers, Grigalunas et al., 1982; Callaghan et al., 1978; King & Storey, 1974; Crawford, 1984; Rossi et al., 1985) for oyster/clam harvesting; Type I – 3.48 (Centaur, 1984) and Type II – 5.6329 [weighted ratio of Type II to Type I times Type I multiplier used (13.6471/8.4311)*3.48] (Nelson & Hardy, 1980; Grigalunas et al., 1982; Crawford, 1984) for oyster processing; and Type I – 1.35 (average of Centaur, 1984, wholesale and retail multipliers) and Type II – 1.7956 [weighted ratio of Type II to Type I times Type I multiplier used (11.9739/9.0026)*1.35] (Grigalunas et al., 1982; Crawford, 1984; Rossi et al., 1985) for oyster wholesale/retail trade sector.

Derivation of Employment Multipliers:
Employment multipliers used are Type I – 1.4174 (average of commercial shellfish multipliers, Crawford, 1984; Rossi et al., 1985; the Grigalunas study was deemed to overstate these impacts) and Type II – 1.7137 (average of commercial shellfish multipliers, Crawford, 1984; Rossi et al., 1985) for oyster/clam harvesting; Type I – 2.83 (Centaur, 1984) and Type II – 4.6117 [weighted ratio of Type II to Type I times Type I multiplier used (13.9357/8.5518)*2.83] (Nelson & Hardy, 1980; Grigalunas et al., 1982; Crawford, 1984) for oyster processing; and Type I – 1.25 (average of Centaur, 1984, wholesale and retail multipliers) and Type II – 1.5696 [weighted ratio of Type II to Type I times Type I used (4.6405/3.6957)*1.25] (Crawford, 1984; Rossi et al., 1985; the Grigalunas study was deemed to overstate the impacts) for oyster wholesale/retail trade operations.

Source: See Appendix A, Appendix Tables A-2, 3, 4.