

METHODOLOGY
North Carolina’s Wild Caught Fishing Industry
Economic Impact Assessment

Authors:

Dr. Eric Edwards, NC State University
Dr. Sara Sutherland, Duke University
Dr. Chris Dumas, UNC-Wilmington
Andrew Hutchens, Graduate Researcher, NC State University
Yetunde Oshagbemi, Undergraduate Researcher, University of Maryland Baltimore County

1. Introduction

North Carolina’s commercial seafood sector provides important economic benefits by generating income and jobs in coastal counties and across the state through the sale and consumption of seafood products. Commercial fisheries support fishing jobs and income in coastal areas of the state, including rural coastal areas with few alternative employment opportunities. Commercial fishing activity also sustains jobs and income for the businesses that support fishing activity, such as marinas, boatyards, boat builders, fishing gear suppliers and fuel suppliers. Seafood landings support seafood processing, packing, warehousing and transportation jobs and income. Both along the coast and inland, the commercial seafood supply chain results in jobs and income for wholesalers, distributors, retail seafood markets, farmers markets, grocery chains, and restaurants.

This document discusses how we quantify the statewide economic impacts of North Carolina’s wild-capture seafood industry. Economic impact analyses (EIAs) quantify the effects of an economic change in one or more sectors of a region’s economy on the entire region’s economy as the change propagates through all sectors. EIAs work by categorizing all of a region’s economic sectors and then modeling the region’s economy as an input-output (I/O) model: a matrix of transactions between and within every sector. An EIA typically looks at supply chain “backward linkages,” that is, the economic activity of the workers and suppliers who support the industry in question. However, the commercial fishing industry also has “forward linkages,” sectors dependent on receiving N.C. seafood as an input. We combine these backward and forward linkages into an overall impact estimate.

We analyze economic impact via a two-step process. In the first step, we estimate the sales of N.C. fish and derived fish products for four key industries whose business models involve wild-caught N.C. seafood:

- Commercial fishing
- Dealers and processors
- Fish retailers
- Seafood restaurants

Our team estimated sales using both primary data, collected via surveys of harvesters, restaurants, and retailers, as well as secondary data from the N.C. Division of Marine Fisheries (DMF) and Data Axle Reference Solutions, a business database with information on 59 million U.S. businesses, searchable by company name, location, and detailed industry category

In the second step, estimated sales are input into an I/O model to determine multiplier effects. The sales estimates are known as direct effects—changes that are a consequence of direct spending associated with an industry. These industries purchase inputs from other industries, known as indirect effects—changes in inter-sector and intra-sector transactions that result from direct output or activity changes. In addition, these direct and indirect effects provide employment income, creating induced effects—changes in the

use of goods and services by households employed in the sectors affected by the direct and indirect effects. The I/O model calculates, given a set of production assumptions, the relationship between direct, indirect, and induced effects. The simplest representation of the model is known as a multiplier, which is the extent to which one dollar of direct effect leads to indirect, induced, or other effects like tax income or number of jobs.

We modify an off-the-shelf commercial I/O model known as IMPLAN to determine these multipliers. IMPLAN is an industry-leading model that can be modified based on industry-specific knowledge. Based on primary data collection, we modify the model to better match its assumptions with observed production decisions in the commercial harvesting sector.

We examine four geographical regions and four types of fish, providing the economic impact of eight distinct region/fish pairs:

- **All/All:** All fish types, all N.C. counties
- **All/North Coast:** Currituck, Camden, Pasquotank, Perquimans, Chowan, Hertford, Bertie, Washington, Tyrrell, Hyde, and Dare Counties.
- **All/Central Coast:** Beaufort, Pamlico, Craven, and Carteret Counties.
- **All/South Coast:** Onslow, Pender, New Hanover, and Brunswick Counties.
- **Finfish/All:** Amberjack, Bluefish, Catfishes, Atlantic Croaker, Dolphinfinh, Red Drum, American Eel, Southern Flounder, Summer Flounder, Groupers, River Herring, Thread Herring, Hog Snapper, Kingfishes, King Mackerel, Spanish Mackerel, Atlantic Menhaden, Stripped Mullet, White Perch, Yellow Perch, Porgies, Scup, Sea Basses, Spotted Seatrout, American Shad, Gizzard Shad, Hickory Shad, Sharks, Dogfishes, Snappers, Spadefish, Spot, Striped Bass, Swordfish, Tilefishes, Triggerfishes, Tunas, Wahoo, Weakfish, and Miscellaneous Finfish.
- **Oysters/All:** Hard Clams, Oysters, Bay Scallop, and Other Shellfish.
- **Crab/All:** Hard Blue Crabs, Peeler Blue Crabs, and Soft Blue Crabs.
- **Shrimp/All:** Brown Shrimp, Pink Shrimp, Unclassified Shrimp, and White Shrimp.

The remainder of the report is structured as follows: In section 2 we discuss our methodology for choosing industries and estimating sales. Section 3 discusses the modeling approach and the I/O model in more detail. Section 4 provides the results from all eight scenarios. A full report and methodology of the survey of restaurants and retailers and the commercial harvester survey, which were used as a primary data sources in this analysis, are available as stand-alone documents from NC Sea Grant.

2. Sales Estimation

Commercial Fishing Sales

For the commercial fishing industry, we estimate total sales using data from the North Carolina Division of Marine Fisheries (NCDMF).¹ The NCDMF creates an annual license and statistics report of commercial and recreational fishing in N.C. Using monthly reports/surveys of harvest, landings, and effort data from fishermen and dealers, they produce an annual report of catch and effort estimates of the fishing industry in the state. The NCDMF sends mail surveys to fishing license holders with questions about their fishing activity. These answers are used to compile total value estimates in aggregate. Using NCDMF 2019 harvest data, we calculated landing values for each geographic region and type of fish as shown in Table 1.

¹ Commercial fishing sales data from DMF 2020 LICENSE AND STATISTICS ANNUAL REPORT (page II-7) http://portal.N.C.denr.org/c/document_library/get_file?uuid=c217c085-1d04-4cbe-afd5-b3fb1ce57a1d&groupId=38337

Table 1: 2019 Commercial N.C. Commercial Fisheries Sales Estimates

Area	Landing Value
All N.C.	\$86,632,835
North Coast	\$40,841,505
Central Coast	\$30,621,284
South Coast	\$13,245,148
Finfish	\$29,298,017
Oysters	\$ 7,722,245
Crab	\$24,630,972
Shrimp	\$21,237,292

Restaurant and Retailer Sales

Because there are many N.C. fish harvesters, ways North Carolinians consume N.C. seafood, and pathways for the food to move from harvester to consumer, there is no single existing data source on demand and supply. To fill this data gap and provide insight into the businesses that serve N.C. seafood to N.C. consumers, we conducted a combined phone and mail survey of retail seafood establishments and restaurants in North Carolina. Fish retailer and restaurant sale numbers are estimated using these survey results.

We were generally interested in finding the total amount of seafood sold; its wholesale cost (providing estimates of margins and “value-added” by these establishments); and in gauging the variety, popularity, and barriers to selling N.C. seafood as perceived by restaurants and retailers. N.C. seafood is a specialty product sold by a small portion of the over 20,000 restaurants in the state and a select group of seafood retailers. However, N.C. seafood is critically important to the businesses that sell it. The average restaurant that sells N.C. seafood has 62% of seafood sales are from N.C. For retailers that sell N.C. seafood, 75% of seafood sales are N.C. products.

The seafood restaurant and retail samples were identified from a U.S. Businesses Database maintained by Data Axle.² Our total list consisted of 374 North Carolina restaurants.

From the base list of restaurants, we contacted restaurants in 5 key markets: North Coast (Dare County), Central Coast (Carteret County), South Coast (New Hanover and Brunswick Counties), the Triangle (Wake and Durham Counties), and the Triad (Guilford and Forsyth Counties). The research team had limited success in receiving survey responses from the Charlotte Metro Area and western North Carolina, although businesses in these areas were contacted. Overall, the research team contacted 207 restaurants.

For seafood markets, we created a base list of 194 markets. Our survey team contacted 113 fish markets in the five key regions, again having difficulty receiving responses from Charlotte and western North Carolina. In aggregate, we received responses from 18 (of 113) seafood markets, and 14 (of 207) restaurants. Each of the establishments was contacted via phone (at least once and as many as six times) and email. They were also contacted via Facebook, or Instagram, if available. After initial contact, each business that had not yet filled out a survey was mailed a paper survey to fill out. Contacts and responses are shown in table 2 by market area.

² <https://www.data-axle.com/>

Table 2: Retail/Restaurant Contacts and Responses

	Contacts		Responses	
	Markets	Restaurants	Markets	Restaurants
North Coast	19	17	5	3
Central Coast	18	26	5	3
South Coast	20	43	3	2
Triangle	20	67	4	4
Triad	5	30	1	2
Charlotte Metro	27	19	0	0
West	4	5	0	0
Total	113	207	18	14

Additional details on survey methods and results are included in a separate methods write-up. Here, we describe the technical details on how survey data were used to estimate sales of N.C. seafood by restaurants, retailers, and dealers.

Methods: Seafood Restaurant Sales

Table 3 shows our estimates of seafood restaurant sales. Based on survey responses, these N.C. seafood sales represent around 15% of the total seafood sales by the restaurants in our sample. A detailed description of our methods follows the table.

Table 3: Estimated Seafood Restaurant Sales and Purchases of N.C. Seafood by Region

Region (number)	N.C. Seafood Sales	N.C. Seafood Purchases
North Coast (26)	\$1,431,717	\$566,869
Central Coast (30)	\$8,857,303	\$2,491,650
South Coast (42)	\$16,210,336	\$4,039,734
Inland (276)	\$101,206,678	\$11,192,098
Total	\$127,706,034	\$18,290,351

An estimate of each restaurant’s N.C. seafood sales was obtained by multiplying their survey answer to estimated sales from seafood by estimated percentage of total seafood sales that came from N.C. harvested seafood. Each restaurant’s N.C. seafood purchases were estimated via a two-step process. First, each respondent’s purchases of N.C. finfish, shrimp, crab, and shellfish were obtained by, respectively: multiplying total wholesale cost for finfish (shrimp, crab, shellfish) by percentage of wholesale cost that is from N.C. finfish (shrimp, crab, shellfish). Then each respondent’s N.C. seafood purchases were estimated by summing their purchases of N.C. finfish, shrimp, crab, and shellfish.

To estimate N.C. seafood sales and purchases for all the other N.C. seafood restaurants for which we did not have survey responses, we used a linear regression of N.C. seafood sales/purchases on two variables: overall sales volume and a categorical variable representing a restaurant’s region (north coast, central coast, south coast, or inland) based on the county that they are located. The overall sales volume data was obtained from Data Axle for 374 N.C. seafood restaurants (including the 12 respondents used in the analysis).³

³ One restaurant survey respondent was dropped from the set of respondents because it was reclassified as a retailer.

Methods: Seafood Retailer Sales

Table 4 shows our estimates of seafood retail sales. Based on survey responses, these N.C. seafood sales represent around 83% of the total seafood sales by the retailers in our sample. A detailed description of our methods follows the table.

Table 4 Estimated Seafood Retailer Sales and Purchases of N.C. Seafood by Region

Region (number)	N.C. Seafood Sales	N.C. Seafood Purchases
North Coast (26)	\$19,474,785	\$6,188,643
Central Coast (16)	\$11,930,360	\$710,286
South Coast (43)	\$16,913,741	\$1,128,095
Inland (109)	\$30,270,469	\$19,297,016
Total	\$78,589,355	\$27,324,040

An estimate of each respondent’s N.C. seafood sales was obtained by multiplying their answer to total retail sales from all seafood sold in 2019 by their answer to percentage of retail sales that was harvested from N.C. waters.⁴ Since the retailer survey did not ask similar questions about seafood purchases, each respondent’s N.C. seafood purchases by type were estimated via the same two-step process used for restaurant survey respondents. Then each respondent’s N.C. seafood purchases were estimated by summing their purchases of N.C. finfish, shrimp, crab, and shellfish.

To estimate N.C. seafood sales and purchases for all other N.C. seafood retailers, we used a linear regression of N.C. seafood sales/purchases on two variables: overall sales volume and a categorical variable representing a retailer’s region (north coast, central coast, south coast, or inland) based on the county that they are located in. The overall sales volume data was obtained from Data Axle for 194 N.C. seafood retailers (including the 8 respondents⁵ used in the analysis⁶).

NC Seafood Dealers

To estimate dealer sales, we utilize restaurant and retailer survey responses, with results shown in Table 5. For the four all-species scenarios, we sum the extrapolated restaurant and retail purchases of N.C. seafood. For the seafood-type models, we multiply the estimated amount of restaurant purchased seafood by the percentage of each type purchased by restaurants on average, and equivalently for the retailers. For the geography-specific models, we assign purchases from all restaurants and retailers in those regions to dealers in those regions. We assign inland retail and restaurant purchases by proportion of harvested landings in each region.

⁴ One respondent’s N.C. seafood sales were estimated differently because it did not provide an answer to Q4.

⁵ Two responses were received from a business with multiple locations. These responses were combined into one representative entry by summing their answers to the relevant questions, so 7 data points were actually used in the regression model.

⁶ There were 18 retail survey respondents but only 8 had matching entries in our Data Axle retailer sample. Without a matching Data Axle entry, we could not apply our linear model to the respondent’s data.

Table 5: Estimated Dealer Sales

	Percentage Sales		Estimated Dealer Sales		
	Retail	Restaurants	To Retailers	To Restaurants	Total
Finfish	41%	58%	11,185,103	8,967,250	20,152,353
Shrimp	45%	12%	12,381,019	1,833,650	14,214,669
Crab	10%	6%	2,639,656	952,097	3,591,752
Shellfish	4%	24%	1,118,262	3,798,821	4,917,083

The most relevant data source on N.C. fish dealers comes from a survey sent by NCDMF to 727 licensed dealers who had purchased a dealer’s license for either the 2019 or 2020 license year. In total, 199 dealers responded to the survey for a final response rate of approximately 27%. Unfortunately, unlike the restaurant and retail surveys, we were unable to match respondent names from the survey to any overall population of dealers.

Because we cannot utilize the relevant primary data, our dealer sales estimates are based entirely on the retail and restaurant data responses. The pathways by which fish move from dockside to N.C. restaurants and retailers are also not well-defined by the IMPLAN I/O model. Based on the harvester survey, harvesters sell 22% of their product directly to seafood markets and 16% direct retail. For impact analysis, sales are estimated as if run through an intermediate dealer. This estimation approach is justifiable for estimating economic impact because even if harvesters are not utilizing dealers or wholesalers, markups and incurred costs may be similar, resulting in similar impact estimates. However, these sales estimates may not match directly with the activities by businesses that identify as dealers, wholesalers, or processors.

3. IMPLAN Analysis

To perform the economic impact analysis, we use the sales estimates described in the prior section to estimate impacts via the IMPLAN I/O model. These sales estimates are reported as sales in the subsequent tables. Once an I-O model is built and analyzed, we are interested in the multiplier results. These multipliers help pin down the magnitude of each sector’s impact on a region’s entire economy.

Output: Total gross sales of goods and services in an industry and their indirect and induced effects. Excludes indirect and induced effects from upstream firms that are also included in the model.

Employment Income: Personal income, from wages and salaries, and proprietors’ income. This income is a subcomponent of Output.

Value-Added: The measure of regional output, i.e. the total dollar amount of additional value per dollar in a given sector. This is a subcomponent of output and for downstream sectors provides an estimate of impact that does not include purchases from an industry whose sales are already included in the model.

State/Local Taxes: State and local tax revenue from estimated direct, indirect, and induced effects. This is a subcomponent of output.

Federal Taxes: Federal tax revenue from estimated direct, indirect, and induced effects. This is a subcomponent of output.

Jobs: Total full-time employment as a result of the estimated sales.

Economic Impact: Estimate of total effect of estimated sales on the economic region of interest.

For this study we take a standard definition of economic impact as total consumer plus producer surplus from direct, indirect, and induced activities within North Carolina (or sub-region). For the harvesting sector, this is output. For the downstream sectors, this is value-added. We note, however, that output numbers for all sectors are often reported as economic impact. Technically speaking, this measure counts

both a sale and a purchase, meaning if two businesses just sold a product back and forth with no markup, impacts would continually increase. A more serious interpretation mistake that is often made is adding output and employment income. Employment income is already included in the output measure.

It is important to note some key limitations of using an I/O model to estimate impacts. The most important assumption is that of constant returns to scale, which says that the required amount of inputs per unit of output remains the same regardless of the scale of output production. A second assumption is that government policy, input and output prices, production technology, and consumer preferences remain constant during the time period being analyzed (usually a year). EIAs based on I-O models justify this assumption by assuming a focus on short-run effects where such constancy is plausible.

The constant returns to scale assumption tells us that a Leontief production function is being assumed for all outputs across all sectors, which leads us to the assumption that each sector utilizes the same productive process or “technology” to produce each of its products/commodities. Moreover, it is assumed that every sector will always produce the same set of products/commodities no matter what the total level of production is. That is, every sector proportionately changes the output of all products in response to a change in one or more product’s output. It is also assumed that each product/commodity is produced using a unique set of inputs regardless of which sector is producing it. Supply constraints are assumed away when considering changes to final demand and/or the productive process, i.e. it is assumed that there are always enough materials and labor to produce the necessary amounts of input and output predicted by the model. Finally, changes in output do not cause changes in required input composition, i.e. no input substitution occurs because of output changes.

Backward Linkages

We estimate commercial fishing production functions based on responses to primary data collection from a survey of N.C. commercial harvesters, additional details of which can be found in a separate methods write-up. We condition on species type harvested and geographic location to produce eight production functions for the eight scenarios we analyze. Production inputs from out-of-state sellers were excluded from indirect and induced impact numbers.

Each production function is expressed on a "per dollar of harvester sales" basis; each production function gives, on average, the proportion of harvester sales that is spent by the harvester on each category of intermediate purchases and value-added components. Intermediate purchases are the goods and services purchased by the harvester in order to support their commercial fishing business (not including the value-added components). Value-added components include money spent by the harvester on the crew and hired captain (if any), taxes paid, and any profits retained by the harvester. The value of any non-paid harvesting labor supplied by the harvester's family is valued at \$12/hour (the typical pay rate for harvester labor reported by survey respondents) and is included as part of the value-added profits retained by the harvester. The analysis identifies any expenditures on goods and services purchased from sellers located outside NC; these expenditures are allocated to "imports," which are economic "leakages" from the state that do not result in multiplier effects within the state.

Post-stratification by vessel length category was used to correct/weight the survey expenditure mean proportions in order to adjust for differences in the distributions of vessels lengths between the survey sample and the full population of active NC commercial harvesters. Post-stratification by vessel length was used because vessel length data are available for all vessels in the population, as vessel length is collected by NCDMF at the time of vessel registration, and key cost components, such as crew expenses and fuel expenses, tend to scale with vessel length. Four vessel length categories were used, based on the four vessel length categories used by NCDMF in assessing commercial fishing vessel registration fees: small vessel: 0-18 ft., medium vessel: 19-38 ft., large vessel: 39-50 ft., and very large vessel: greater than 50ft. Post-stratification was done for the state as a whole, by geographic region, and by fish species

category. The need for post-stratification was indicated by the differences in vessel length distributions between the full population of harvesters and the harvesters in the survey sample (Table 6). Generally, the survey under-sampled smaller vessels; the purpose of post-stratification is to correct for such under-sampling.

Table 6: Differences in Vessel Length Distributions between Full Population of Harvesters and Survey Sample of Harvesters

Vessel Length Category	Statewide		North Coast		Central Coast		South Coast	
	Population	Survey Sample	Population	Survey Sample	Population	Survey Sample	Population	Survey Sample
Small Vessels	45.82	25.63	35.63	12.50	37.60	20.15	64.13	43.59
Medium Vessels	47.97	60.56	56.08	65.38	55.35	65.67	31.87	50.43
Large Vessels	2.96	7.89	4.94	16.35	2.20	2.99	2.05	5.98
V.Large Vessels	3.25	5.92	3.35	5.77	4.85	11.19	1.95	0.00

Note: The Small Vessel category includes harvesters who fish by hand without using a vessel.

For each geographic region r , where the regions are Statewide, North Coast, Central Coast, and South Coast, N_r is the total number of active commercial vessels in the vessel population in region r , and N_{rc} is the number of population vessels in vessel length category c in region r . Similarly, n_r is the total number of active commercial vessels in the survey sample in region r , and n_{rc} is the number of sample vessels in vessel length category c in region r . The sum of annual sales of all sample vessels in region r in length category c is given by s_{rc} . The post-stratified mean annual sales per vessel in region r , S_r^* , is given by:

$$S_r^* = \sum_c \left(\frac{N_{rc}}{N_r} \right) \cdot \left(\frac{s_{rc}}{n_{rc}} \right)$$

The sum of annual expenditures of all sample vessels in region r in length category c in expenditure category e is E_{rce} . The post-stratified mean annual expenditure per vessel in expenditure category e in region r , E_{re}^* is given by:

$$E_{re}^* = \sum_c \left(\frac{N_{rc}}{N_r} \right) \cdot \left(\frac{E_{rce}}{n_{rc}} \right)$$

The post-stratified mean proportion of harvester expenditures in expenditure category e in region r , p_{re}^* is given by:

$$p_{re}^* = \frac{E_{re}^*}{S_r^*} \quad \text{where} \quad \sum_e p_{re}^* \equiv 1$$

A similar post-stratification procedure was used to correct the mean expenditure proportions for each target species category, where the definition of r in the formulas above is changed to indicate various target species categories instead of geographic regions. In this case, the target species categories r are Finfish, Shellfish, Bluecrab, Shrimp.

An example production function for the Statewide region and All Target Species Combined is presented in Table 1 of the Appendix.

Forward Linkages

We estimate how N.C. seafood is distributed and sold to consumers throughout the state. Downstream industries purchase N.C. seafood or N.C. seafood products and then resell these products to other businesses or consumers. Within each sector, the products and services purchased in North Carolina are included in the indirect impacts, while the value of labor income associated with these purchases are included under induced impacts. After estimating total sales of N.C. seafood products for each industry

we make two adjustments to avoid double-counting. First, we set purchases from downstream sectors we are modeling separately, fish from harvesters and fish and seafood products from dealers, to have no indirect or induced impact. These indirect and induced impacts are already counted in upstream sectors output, so are not included in the output measures of the downstream sectors. Second, for economic impact estimates of downstream sectors, we focus on value-added impact measures. This avoids the problem of counting the impact of the sale of a fish or fish product as both a sale, by the upstream firm, and a purchase, by the downstream firm.

4. Result Tables

Using IMPLAN multipliers for the regions of study and modified production functions for our eight scenarios, we estimate economic impact measures as shown in Tables 7-13. Estimated sales, the basis for each model, are shown in column 1 and are equivalent to the total direct impact of an industry. Output, shown in column 2, represents the total sales due to direct, indirect, and induced impacts. Columns 3-6 break out potentially relevant components of total output number: employment income, value-added, state taxes, and federal taxes. The total jobs resulting from all direct, indirect, and induced expenditures are shown in column 7. Our estimate of total economic impact is shown in column 8. Economic impact for commercial fishing is equal to the output figure highlighted in grey in column 2, whereas total economic impact for dealers, retailers, and restaurants is equal to the value-added figure highlighted in grey in column 4.

Table 7: Economic Impacts for All of North Carolina

	Sales Estimate	Output	Employment Income	Value- Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$86,632,835	\$155,358,403	\$44,856,403	\$74,990,855	\$18,613,238	\$10,771,234	2,660	\$155,358,403
Dealers	\$42,875,858	\$59,367,413	\$9,686,557	\$14,361,011	\$1,274,485	\$1,942,877	210	\$14,361,011
Retailers	\$82,438,583	\$146,637,547	\$52,233,581	\$80,308,370	\$8,512,691	\$11,114,864	1,616	\$80,308,370
Restaurants	\$53,478,014	\$89,216,997	\$30,439,579	\$47,293,015	\$4,049,462	\$6,332,813	1,043	\$47,293,015
Total							5,528	\$297,320,799

Table 8: Economic Impacts for the North Coast Region

	Estimated Sales	Output	Employment Income	Value- Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$40,841,505	\$65,845,164	\$10,446,318	\$23,017,129	\$8,970,551	\$2,876,018	850	\$65,845,164
Dealers	\$20,979,830	\$26,417,676	\$3,434,335	\$5,376,207	\$545,706	\$740,987	92	\$5,376,207
Retailers	\$18,671,578	\$9,521,459	\$3,461,767	\$5,291,917	\$610,747	\$770,669	114	\$5,291,917
Restaurants	\$2,596,281	\$3,728,460	\$1,342,345	\$2,061,074	\$178,876	\$290,436	45	\$2,061,074
Total							1,101	\$78,574,363

Table 9: Economic Impacts for the Central Coast Region

	Estimated Sales	Output	Employment Income	Value- Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$30,621,284	\$48,640,991	\$15,634,462	\$25,001,084	\$6,628,712	\$3,495,450	906	\$48,640,991
Dealers	\$13,241,811	\$16,387,231	\$1,971,189	\$3,233,822	\$312,811	\$413,793	57	\$3,233,822
Retailers	\$2,142,984	\$1,090,215	\$371,606	\$567,867	\$71,224	\$79,303	14	\$567,867
Restaurants	\$6,904,157	\$9,828,075	\$3,273,544	\$5,008,759	\$479,321	\$673,148	133	\$5,008,759
Total							1,110	\$57,451,440

Table 10: Economic Impacts for the South Coast Region

	Estimated Sales	Output	Employment Income	Value-Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$13,245,148	\$21,567,220	\$6,446,877	\$10,690,490	\$2,882,687	\$1,413,655	593	\$21,567,220
Dealers	\$7,992,678	\$9,972,609	\$1,380,080	\$1,766,190	\$201,288	\$245,319	35	\$1,766,190
Retailers	\$3,403,542	\$1,798,003	\$619,697	\$959,789	\$115,506	\$127,898	22	\$959,789
Restaurants	\$7,952,228	\$11,634,117	\$3,835,495	\$6,016,822	\$567,757	\$780,726	153	\$6,016,822
Total							803	\$30,310,021

Table 11: Economic Impacts for North Carolina Finfish

FINFISH	Estimated Sales	Output	Employment Income	Value-Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$29,298,017	\$54,026,832	\$12,766,523	\$23,229,988	\$6,328,870	\$3,275,958	914	\$54,026,832
Dealers	\$20,152,353	\$27,903,714	\$4,552,860	\$6,749,930	\$599,029	\$913,184	99	\$6,749,930
Retailers	\$33,746,256	\$20,297,496	\$7,230,135	\$11,116,219	\$1,178,352	\$1,538,526	223	\$11,116,219
Restaurants	\$30,835,670	\$51,443,118	\$17,551,602	\$27,269,432	\$2,334,969	\$3,651,560	601	\$27,269,432
Total							1,837	\$99,162,414

Table 12: Economic Impacts for North Carolina Oysters

	Estimated Sales	Output	Employment Income	Value-Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$7,722,245	\$13,281,258	\$5,190,159	\$7,887,238	\$1,647,827	\$1,130,537	231	\$13,281,258
Dealers	\$4,917,083	\$6,808,346	\$1,110,872	\$1,646,943	\$146,155	\$222,808	24	\$1,646,943
Retailers	\$3,373,878	\$2,029,286	\$722,850	\$1,111,369	\$117,806	\$153,812	22	\$1,111,369
Restaurants	\$13,062,999	\$21,792,832	\$7,435,420	\$11,552,172	\$989,156	\$1,546,868	255	\$11,552,172
Total							532	\$27,591,741

Table 12: Economic Impacts for North Carolina Crab

	Estimated Sales	Output	Employment Income	Value-Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$24,630,972	\$39,097,776	\$6,008,332	\$13,509,177	\$4,988,388	\$1,852,495	736	\$39,097,776
Dealers	\$3,591,752	\$4,973,324	\$811,459	\$1,203,054	\$106,772	\$162,760	18	\$1,203,054
Retailers	\$7,964,030	\$7,149,118	\$1,999,601	\$3,325,038	\$454,690	\$445,898	69	\$3,325,038
Restaurants	\$3,273,974	\$5,462,047	\$1,863,549	\$2,895,352	\$247,925	\$387,714	64	\$2,895,352
Total							887	\$46,521,221

Table 13: Economic Impacts for North Carolina Shrimp

	Estimated Sales	Output	Employment Income	Value-Added	State/Local Taxes	Federal Taxes	Jobs	Economic Impact
Commercial Fishing	\$21,237,292	\$39,623,456	\$11,287,238	\$19,042,482	\$4,688,175	\$2,741,756	663	\$39,623,456
Dealers	\$14,214,669	\$19,682,128	\$3,211,392	\$4,761,118	\$422,531	\$644,124	70	\$4,761,118
Retailers	\$37,354,419	\$22,467,637	\$8,003,184	\$12,304,770	\$1,304,304	\$1,703,025	247	\$12,304,770
Restaurants	\$6,305,370	\$10,519,218	\$3,589,004	\$5,576,129	\$477,455	\$746,669	123	\$5,576,129
Total							1,102	\$62,265,473

Appendix. Example Production Function -- Statewide, All Target Species Groups Combined

Expense Category	IMPLAN Commodity Sector	IMPLAN Sector Description	Proportion of Total Expenditures
Fuel	3408	Retail services - Gasoline stores	0.148783013
Bait	3017	Fish	0.053986671
Ice	3105	Manufactured ice	0.018720589
Groceries	3406	Retail services - Food and beverage stores	0.025167281
Expendable Gear	3395	Wholesale services - Machinery, equipment, and supplies	0.029393466
AnnualVesselTripCostsNonLabor	(Subtotal)		0.276051049
Crew/Hired Captain	ValueAdded--LaborIncome	(this is compensation for crew members any hired captain)	0.341599109
AnnualVesselTripCosts	(Subtotal)		0.617650163
NC Fishing Licenses	3531	Other products and services of State Govt enterprises	0.006789675
Out-of-State Fishing Licenses	Expenditure outside NC	(a leakage that goes to imports)	0.001038404
Federal Fishing Licenses	Expenditure outside NC	(a leakage that goes to imports)	0.000979425
NC Accounting	3456	Accounting, tax preparation, bookkeeping, and payroll services	0.00335466
NC Telephone	3434	Wireless telecommunications (except satellite)	0.005452928
NC Internet	3433	Wired telecommunications	0.002398101
NC Office Equipment	3403	Retail services - Furniture and home furnishings stores	0.000809481
NC Office Rent	3448	Tenant-occupied real estate services	0.001635983
NC Association Dues	3523	Business and professional services	0.000958562
NC Truck Payment	3439	Nondepository credit intermediation and related activities	0.011464397
NC Health Insurance	3445	Insurance agencies, brokerages, and related services	0.000871783
NC Retirement Plans	3439	Nondepository credit intermediation and related activities	0.00011968
NC Property Taxes	3534	Other products and services of Local Govt enterprises	0.00194275
NC Other	3405	Retail services - Building material and garden equipment stores	0.001675533
NC Other	3405	Retail services - Building material and garden equipment stores	0.000468638
NC Other	3405	Retail services - Building material and garden equipment stores	0.0003218
Out-of-State Accounting	Expenditure outside NC	(a leakage that goes to imports)	1.95273E-05
Out-of-State Telephone	Expenditure outside NC	(a leakage that goes to imports)	0.00059094
Out-of-State Internet	Expenditure outside NC	(a leakage that goes to imports)	2.83098E-05
Out-of-State Office Equipment	Expenditure outside NC	(a leakage that goes to imports)	1.0445E-05
Out-of-State Office Rent	Expenditure outside NC	(a leakage that goes to imports)	0
Out-of-State Association Dues	Expenditure outside NC	(a leakage that goes to imports)	1.20312E-05
Out-of-State Truck Payment	Expenditure outside NC	(a leakage that goes to imports)	0.000713397
Out-of-State Health Insurance	Expenditure outside NC	(a leakage that goes to imports)	6.79654E-05

Out-of-State Retirement Plans	Expenditure outside NC	(a leakage that goes to imports)	0.00010947
Out-of-State Property Taxes	Expenditure outside NC	(a leakage that goes to imports)	0
Out-of-State Other	Expenditure outside NC	(a leakage that goes to imports)	0
Out-of-State Other	Expenditure outside NC	(a leakage that goes to imports)	0
Out-of-State Other	Expenditure outside NC	(a leakage that goes to imports)	0
NC Vessel Registration Fees	3531	Other products and services of State Govt enterprises	0.000914284
Other State Vessel Registration Fees	Expenditure outside NC	(a leakage that goes to imports)	0.000640669
Federal Vessel Registration Fees	Expenditure outside NC	(a leakage that goes to imports)	0.00041695
NC Vessel Loan Payment	3439	Nondepository credit intermediation and related activities	0.047242389
NC New Engine	3402	Retail services - Motor vehicle and parts dealers	0.031778862
NC Engine Repair	3512	Automotive repair and maintenance, except car washes	0.027422338
NC New Net Gear	3121	Other textile products	0.022378562
NC New Pot Gear	3259	Other fabricated metals	0.014113478
NC New Line Gear	3410	Retail services - Sporting goods, hobby, music and book stores	0.006845078
NC Gear Repair	3515	Commercial and industrial machinery and equipment repair and maint.	0.009465375
NC New Electronics	3404	Retail services - Electronics and appliance stores	0.008820814
NC Electronics Repair	3514	Electronic and precision equipment repair and maintenance	0.003599492
NC Other Maintenance	3515	Commercial and industrial machinery and equipment repair and maint.	0.019036225
NC Boat Slip Rent	3504	Other amusement and recreation (incl. marinas)	0.012374504
NC Boat Yard	3515	Commercial and industrial machinery and equipment repair and maint.	0.01067541
NC Vessel Cleaning	3515	Commercial and industrial machinery and equipment repair and maint.	0.001330195
NC Hull Insurance	3445	Insurance agencies, brokerages, and related services	0.009684109
NC P&I Insurance	3445	Insurance agencies, brokerages, and related services	0.011697834
NC Property Tax on Vessel	3534	Other products and services of Local Govt enterprises	0.007372254
Out-of-StateVessel Loan Payment	Expenditure outside NC	(a leakage that goes to imports)	0.000868468
Out-of-StateNew Engine	Expenditure outside NC	(a leakage that goes to imports)	0.000518504
Out-of-StateEngine Repair	Expenditure outside NC	(a leakage that goes to imports)	3.13359E-05
Out-of-StateNew Net Gear	Expenditure outside NC	(a leakage that goes to imports)	0.001398908
Out-of-StateNew Pot Gear	Expenditure outside NC	(a leakage that goes to imports)	0.001397289
Out-of-StateNew Line Gear	Expenditure outside NC	(a leakage that goes to imports)	1.30246E-06
Out-of-StateGear Repair	Expenditure outside NC	(a leakage that goes to imports)	7.73282E-05
Out-of-StateNew Electronics	Expenditure outside NC	(a leakage that goes to imports)	0.001017849
Out-of-StateElectronics Repair	Expenditure outside NC	(a leakage that goes to imports)	3.65552E-05
Out-of-StateOther Maintenance	Expenditure outside NC	(a leakage that goes to imports)	6.19944E-05
Out-of-StateBoat Slip Rent	Expenditure outside NC	(a leakage that goes to imports)	1.27873E-05
Out-of-StateBoat Yard	Expenditure outside NC	(a leakage that goes to imports)	0
Out-of-StateVessel Cleaning	Expenditure outside NC	(a leakage that goes to imports)	0

Out-of-StateHull Insurance	Expenditure outside NC	(a leakage that goes to imports)	0.000672744
Out-of-StateP&I Insurance	Expenditure outside NC	(a leakage that goes to imports)	0.000343359
Out-of-StateProperty Tax on Vessel	Expenditure outside NC	(a leakage that goes to imports)	1.19239E-05
AnnualVesselFixedCosts	(Subtotal)		0.252259106
AnnualShoreOtherFixedCosts	(Subtotal)		0.041833885
Paid Labor On Shore	ValueAdded--LaborIncome		0.003982175
AnnualFixedCosts	(Subtotal)		0.298075235
AnnualCosts	(Subtotal)		0.915725314
Returns to Owner (incl. family labor)	ValueAdded--LaborIncome		0.084274694
AnnualShoreFamilyLabor_perVessel	(Subcomponent of AnnualReturnsToOwner)		0.011524333

Notes for table:

VFC = "Vessel Fixed Cost" -- a fixed cost associated with a vessel

BFC = "Business Fixed Cost" -- a fixed cost associated with a fishing business, which could be spread over multiple vessels owned by the business (the business fixed costs were adjusted to a "per-vessel" basis based on the number of vessels owned by the business)

$AnnualVesselTripCostsNonLabor = AnnualVesselCost1Fuel + AnnualVesselCost1Bait + AnnualVesselCost1Ice + AnnualVesselCost1Groc + AnnualVesselCost1ExpGear$

$AnnualVesselTripCosts = AnnualVesselTripCostsLabor + AnnualVesselTripCostsNonLabor$

Annual Vessel Fixed Costs = sum of the VFC components (including the Non-NC)

Annual ShoreOther Fixed Costs = sum of the BFC components (including the Non-NC)

$AnnualFixedCosts = AnnualVesselFixedCosts + AnnualShorePdLaborFC_perVessel + AnnualShoreOtherFixedCosts;$

$AnnualCosts = AnnualVesselTripCosts + AnnualFixedCosts;$

$AnnualReturnsToOwner = AnnualSales - AnnualCosts;$

AnnualShoreFamilyLabor_perVessel is the value of paid and unpaid family labor. This is included as a subcomponent of AnnualReturnsToOwner.