The Economic Impacts of the Maine Seafood Sector

Prepared for

Seafood Economic Accelerator for Maine

Prepared by

Middlebury Institute *of* International Studies at Monterey

Center for the Blue Economy

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1 Executive Summary

This analysis utilizes the best available data from the Maine Departments of Marine Resources and Labor together with the IMPLAN economic model to estimate the total (direct, indirect, and induced) economic impacts of the commercial seafood sector and core value chain components on the state of Maine and substate regions. The analysis is intended to serve as a baseline indicator from which to compare impacts in future years, as well as to evaluate the impact of specific investments or initiatives on the growth of the sector over time. The major findings of the analysis are summarized below.

- The seafood sector contributed **over $3.2 billion dollars in total economic output** to the Maine economy in 2019. Retail seafood ($692 million), lobster harvesting ($511 million), and seafood processing ($343 million) were the largest contributing industries to total economic output.

- The sector supported **over 33,300 jobs statewide** in 2019, 23,846 of which were employed directly in sector industries and another 7,300 additional jobs supported from other indirect and induced multiplier effects. **Harvesting including lobster, non-lobster species and aquaculture is the largest employing part of the seafood sector supporting over 12,700 jobs**, followed by retail seafood outlets, including restaurants (8,550).

- Total direct and multiplier effects jobs in seafood estimated here makes the seafood sector the **largest natural resource-based sector in the Maine economy**.

- Employment supported **$1.3 billion in total labor income**, $967 million of which were from direct employment in the value chain industries and another $336 million resulting from other indirect and induced multiplier effects. Contributions to labor income were led **by lobster harvesting ($393 million)**, retail ($285 million), and all other non-lobster species harvesting ($155 million).

- The seafood sector supported an estimated **$449 million in tax revenues** in 2019, including local, state, and federal. The sector supported nearly $91 million in local and $110 million in state tax revenues. A total of $248 million in federal tax revenues were also supported.

- Regionally, the seafood sector in the **Downeast region accounted for 45 percent of all direct jobs** (and 47.4% of total impact jobs) and supported $390 million in labor income (16 percent) in 2019. The seafood sector in Downeast supports slightly more jobs than Southern Maine despite having less than one-fifth of the population. Downeast seafood jobs were concentrated in the harvesting subsector — the region accounted for 65 percent of all harvesting jobs in seafood sector statewide in 2019. These estimates are likely conservative as a result of a significant amount of harvesting activity that did not have geographic identifying information attached — accounting for nearly 3,700 jobs.

- The seafood sector supported over 10,000 jobs and over $260 million in labor income in 2019 in the Midcoast region. The sources of economic impacts from the seafood sector are concentrated in lobster harvesting and retail for the region, with aquaculture comprising a smaller but growing sources of jobs and income in the region.

- In Southern Maine, the seafood sector supported over 7,600 jobs and $370 million in labor income — slightly less than Downeast. The bulk of direct jobs were supported by the retail industry sector (over 4,000), while harvesting (all species wild caught) supported roughly 1,240 jobs.
- The seafood sector's total economic impact is a much larger share of the Downeast region, accounting for almost 20% of employment than the sector comprises of Midcoast or Southern economies.

This study focused on 2019, prior to the Covid pandemic. The continuing updating and improvement of economic data for the seafood sector and the individual industries should be a high priority for the industry and policy makers.

2 Introduction

2.1 Background

Maine seafood is central to the state's economic identity both in Maine and beyond. The seafood sector value chain collectively supports thousands of jobs and billions of dollars in incomes and output each year in the state and supports the prosperity of numerous communities along Maine's coast.

The Seafood Economic Accelerator for Maine (SEAMaine) commissioned the Middlebury Institute for International Studies Center for the Blue Economy (CBE) and the University of Southern Maine Center for Business and Economic Research (CBER) to quantify the economic contribution of the seafood sector to the Maine economy. This analysis is intended to support a larger effort aimed at improving the marketing of Maine seafood and is complementary to the work of other SEAMaine subcommittee reports. The analysis focuses on the domestic commercial seafood sector in Maine and should serve as a baseline case from which to compare impacts in future years, as well as to evaluate the impact of specific investments or initiatives on the growth of the sector.

2.2 The Maine Seafood Sector

The seafood sector is a composition of several economic activities, or industries, and can be characterized as a value chain as suggested in Figure 1. This figure describes the wild capture fisheries including lobsters, finfish, and other shellfish. The economic process begins with the purchase of certain inputs to the catching and cultivation process and proceeds through landing the catch, transporting it to processors and/or on to wholesale distribution or retail markets, such as seafood markets, grocery stores, or restaurants. At each stage of the process value is added to the fish caught, generating economic impacts through each step.

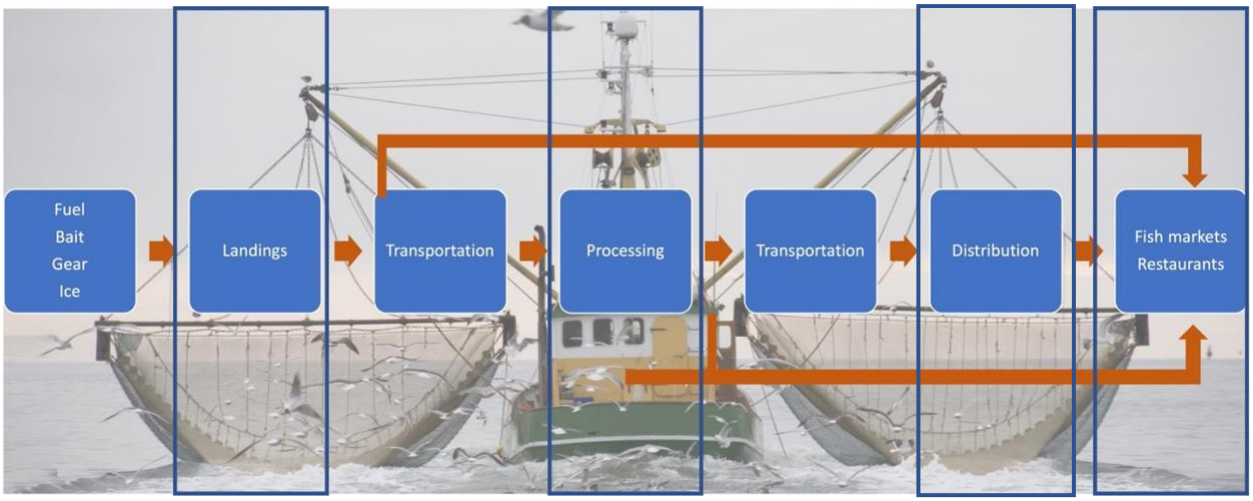

Figure 1: Wild Caught Fisheries Value Chain

The boxes in Figure 1 show the major points at which the economic contributions of the fisheries are measured: at the point of first sale (landings), at the point where the fish is processed into higher value products, at the points where the fish is distributed through wholesale markets, and at the final point of

sale through retail outlets. The value chain for aquaculture is very similar except that the inputs include food and in-water structures rather than bait, ice, and boats.

The economic characterization of the seafood sector tracks value creation through the four major industries — harvesting and production, processing, distribution, and retail since these are defined industries in standard economic data. The interrelationships among industries related to fishing are measured through economic impact (multiplier) analysis as described below. The total economic activity in Maine related to fishing is also affected by the purchases of goods and services within Maine not only by the fish harvesting stage. Data on inputs to harvesting and aquaculture such as bait, fuel, ice, dockage and mooring are not monitored and so are not included in this analysis directly. Approximations of the role of these inputs are provided in the IMPLAN model.

2.3 Methods Summary

This analysis is focused on quantifying the economic contribution (impacts) of the seafood sector on the Maine economy, inclusive of the direct economic impacts of the sector and its value chain components, as well as the other indirect or induced effects that result from recurring rounds of business to business and employee wages in the economy. For this purpose, a number of standard economic data sets and tools are used.

But it must be acknowledged at the outset that there are several significant weaknesses in the available data when it comes to fisheries. These include the fact that the vast majority of those employed in the harvesting sector are not counted in the most important regional economic data series because harvesters are not covered by unemployment insurance and are usually paid in shares of the catch value rather than wages. A similar problem exists with aquaculture producers, though to a somewhat lesser extent because some firms in the aquaculture industry do have significant portions of their employment in the Department of Labor data used for the study. The fishing industry's contribution shares to such industries as wholesale, retail, and transportation is also not measured in Maine and so national relationships must be used. This analysis, therefore, requires careful construction of data from multiple sources.

Employment is estimated as the number of jobs, both full-time and part-time, and includes wage and salaried employees, sole proprietors, and active partners. Employment is reported as inclusive of both the number of full-and part-time jobs. See the Appendix for a detailed description of job estimates in the harvesting industries.

Labor Income includes wages and salaries and any other compensation to labor such as benefits.

Value Added is the difference between gross output (sales) and the costs of inputs such as supplies, inventory, and capital goods. It primarily consists of payments to labor and to ownership (adjusted for taxes). Value added can be compared between industries without double counting.

Gross Output is equivalent to gross revenues or sales. Gross output cannot be easily compared between industries because the sales of one industry

The initial measures of the various sector industries are based upon data from the Maine Department of Labor, Maine Department of Marine Resources, and other supporting sources covering employment, wages, or ex-vessel landed value. Estimation of the direct and economic impacts are generated using the IMPLAN economic model and other available data. Employment in the harvesting and aquaculture industries are estimated using Department of Marine Resources licensing data. The Appendix provides a detailed explanation of how the licensing data was used to estimate employment. Economic impacts are reported across four core indicators—employment, labor income, value added, and gross output. For each

indicator the direct, indirect, and induced effects are reported. Details of data sources and limitations and estimation methods can be found in the Section 7.

The analysis focuses on the sector's economic impact in 2019. Some data is available for 2020 and 2021, however, the data series are not yet in place to accurately measure the many disruptions stemming from the COVID-19 pandemic. To be sure, the pandemic likely caused longer term implications within the sector, whether related to markets, inter-industry relationships, or firm/establishment-level operations, that will take time to emerge from several years of post-pandemic data. Despite 2019 being a more appropriate year for complete measurement, the analysis is not able to capture significant year-to-year changes that may not be related to the pandemic, such as the growth in aquaculture employment and wages.

3 Economic Impacts by Major Industry

3.1 Statewide Economic Impact Summary for 2019

The seafood sector contributed over $**3.2 billion dollars in total economic output** to the Maine economy in 2019 (Table 1). The sector supported over **33,000 jobs statewide**, 23,846 of which were employed directly in sector industries and another 9,400 additional jobs supported from other indirect and induced multiplier effects. **Harvesting (all species) accounts for over 12,700 direct jobs. Seafood retail and restaurant employment accounts for over 8,500 jobs.**

Employment supported **$1.3 billion in total labor income**, $967 million of which were from direct employment in the value chain industries and another $336 million resulting from other indirect and induced multiplier effects. Contributions to labor income were led by lobster harvesting ($393 million), retail ($285 million), and all other non-lobster species harvesting ($155 million), while retail ($692 million), lobster harvesting ($511 million), and processing ($343 million) were the largest contributing industries to total economic output.

In total, the seafood sector contributed over $3.2 billion in total economic output to the Maine economy in 2019, two-thirds ($2.15 billion) resulting from direct sales in sector industries. Of total economic output, roughly $1.97 billion is accounted for as value added.

Table 1: Maine Seafood Sector Economic Impact Summary

Industry	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Aquaculture	540	$28.9	$190.1	$198.4
Harvesting (Non-Lobster)	7,663	$154.7	$174.8	$196.2
Harvesting (Lobster)	5,037	$393.0	$446.9	$511.6
Processing	735	$36.5	$48.6	$343.1
Retail	8,558	$285.3	$425.9	$692.4
Wholesale & Logistics	1,313	$68.6	$91.0	$212.6
Total Direct	23,846	$966.9	$1,377.3	$2,154.3
Indirect (all other)	3,154	$106.4	$169.7	$353.8
Induced	6,319	$229.9	$419.4	$732.6
Total	33,319	$1,303.22	$1,966.35	$3,240.72

3.2 Industry Sector Economic Impacts

This section provides the economic impacts of each individual value chain component (industry), including indirect and induced impacts occurring in other subsector value chain components. As a result, the total of the estimates reported for each value chain component that follows will not sum to the statewide summary presented in Section 3.1., which adjusts the indirect and induced impacts to account for value chain overlaps in the individual value chain component subsectors. For example, indirect jobs estimated for the processing industry will include jobs in the harvesting industry. While those jobs are included in the estimates for the processing industry in this section, those jobs are adjusted in the statewide summary to eliminate double counting.

The industry-level impacts reported here are summarized by both statewide total and by region. The seafood sector in concentrated along coastal communities, however, its impact extends to all corners of the state. To provide a greater level of geographic detail of where sector impacts are concentrated, impacts are reported for 4 regions in the state based on county level aggregates (Figure 2).

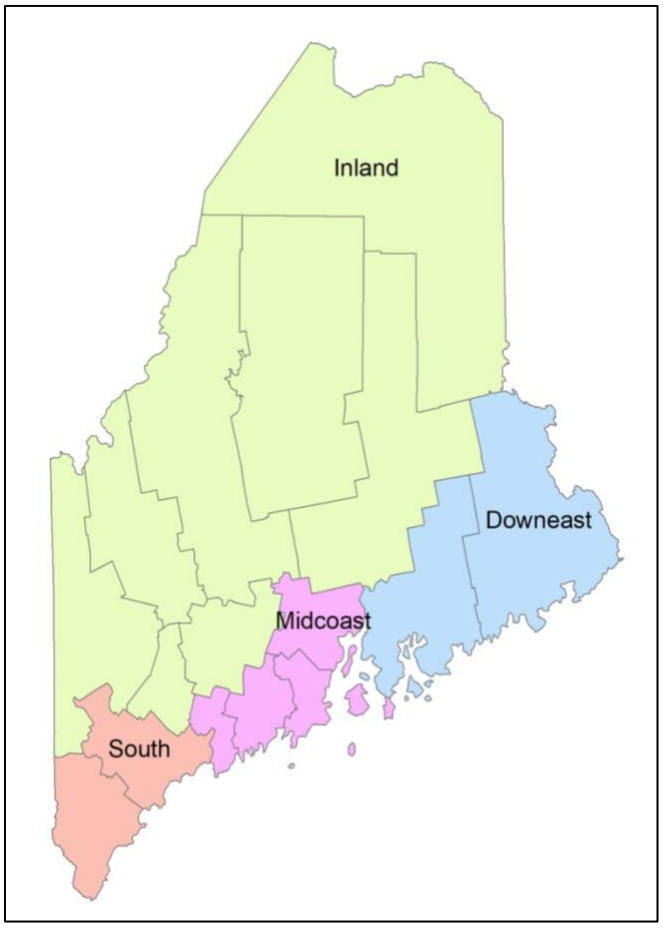

Figure 2: Regions Used in Seafood Economic Analysis

These regions are reported in place of county level estimates to protect confidentiality of industry participants and data management requirements for various data series. In some cases, data for certain industries lacked geographic identifying information and could not be assigned to a region within the state. These impacts are included in the state level reporting but are reported as an "unidentified" region. As a result, the regional specific impacts reported here for harvesting and to a lesser extent wholesale and logistics, can be considered conservative.

3.2.1 Aquaculture

Aquaculture involves the cultivation of fish, shellfish, and marine plants which may utilize ocean sites or be produced in land-based facilities using sea water[1]. Although considerably smaller than wild-caught harvesting, aquaculture is growing rapidly in operations in development or under consideration that would support hundreds of additional jobs and income in the coming years.

Measuring the economic scale of the industry is difficult, due in part to the infancy of the industry in Maine and the length of the business cycle from inception to realized revenues from production, which can take up to five years. Maine DMR data indicate approximately 156 aquaculture lease sites spanning over 1,400 acres as of 2019. However, not all lease sites actively realize revenue from production. Furthermore, the majority of these lease sites, if in operation, do not report employment data to the state but are overseen by owner-operators who are counted as self-employment. The Department of Labor data indicate there were approximately 36 aquaculture operations supporting 340 jobs in 2019 with labor income totaling roughly $29 million — direct effects of the industry. We estimate that 200 additional jobs are located in organizations operating

[1] In Maine, aquaculture is primarily of marine species. Freshwater hatcheries in Maine for trout and landlocked salmon are run by the U.S. Fish & Wildlife Service and Maine Department of Inland Fisheries & Wildlife but these are not included here because the relevant economic data for these facilities is reported as part of state government employment in general.

Limited Purpose Aquaculture sites of 400 square feet for commercial purposes (See Appendix for more details.)

In total, at least 540 jobs were supported in 2019 and over $36 million in labor income (Table 2). The industry supported total output of $223 million, accounting for approximately 7 percent of the entire seafood sectors impact in 2019. The bulk of impacts from aquaculture were located in Downeast followed by the Midcoast region accounting for nearly 90 percent of the industry's output and 75 percent of the industry's employment statewide (Table 3).

Table 2: Economic Impacts of Aquaculture

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Direct	540	$28.9	$190.1	$198.4
Indirect	78	$1.2	$2.8	$4.6
Induced	218	$6.3	$11.5	$19.9
Total	837	$36.4	$204.4	$222.9

Table 3: Total Economic Impacts of Aquaculture by Region

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Downeast	308	$16.3	$105.4	$114.7
Inland Maine	52	$6.7	$11.8	$14.2
Midcoast	219	$9.1	$74.2	$79.5
Southern Maine	162	$4.4	$13.0	$14.5
Total	740	$36.4	$204.4	$222.9

3.2.2 Harvesting - Lobsters

Lobster harvesting is perhaps the most emblematic part of the Maine seafood sector and is an icon of the Maine brand. Like other harvesting industries, employment in lobstering is difficult to quantify due to the seasonality of the industry and business structure and to the nature of the statistical systems. There was a total of 8,923 lobster licenses of all types in 2019 reported by DMR. These were converted to 8,200 individuals by counting unique name-date of birth identifiers and removing multiple licenses. From this total, noncommercial license holders were removed along with under 18, demonstration licenses, and non-resident licenses. The result is approximately 5,000 unique individuals holding commercial lobster licenses. Actual employment in lobster harvesting cannot be directly measured since some of these license holders may not engage in harvesting.

In 2019, the landed value of lobster totaled $485 million. Although the amount of landed weight was lower compared to previous years, the price of lobster remained high throughout the season. Of the total landed value, 41 percent was in Downeast, with another 32 percent in the Midcoast region and roughly 13

percent in Southern Maine. Approximately 13 percent of the landed value was not associated with a specific geography and is therefore attributed to the state as a whole (Table 5).

An estimated 5,000 jobs were supported directly from lobster harvesting, with $393 million in labor income in 2019 (Table 4). These jobs, which include full- and part-time jobs, are the typical level of employment associated with the total landed value (output), as calculated by the IMPLAN model. An additional 1,500 jobs and $106 million in labor income were supported from indirect and induced effects. A total of $852 million in economic output were supported statewide accounting for over one-quarter of the entire seafood sector output statewide in 2019.

Table 4: Economic Impacts of Lobster Harvesting Statewide

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Direct	5,037	$393.0	$446.9	$511.6
Indirect	127	$11.3	$20.8	$42.6
Induced	1,376	$95.0	$171.5	$298.3
Total	6,540	$499.3	$639.2	$852.5

Table 5: Total Economic Impacts of Lobster Harvesting by Region

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Downeast	2,951	$214.5	$273.2	$382.3
Inland Maine	243	$139.0	$184.3	$233.7
Midcoast	2,189	$73.6	$88.2	$111.2
Southern Maine	1,157	$72.2	$93.5	$125.3
Total	6,540	$499.3	$639.2	$852.5

Special Note: Boat building and Repair. Boatbuilding and repair is a significant supplier industry to the harvesting industries. The Maine boat building industry supplies the recreational, commercial, and fishing industries, but no data series provides separate estimates for these markets. Indirect jobs supported in boatbuilding and repair for fisheries are estimated separately. Existing data allowed estimates only for new boats purchased in 2019. These estimates were derived from boat registrations reported in various datasets (Maine Inland Fisheries and Wildlife, Department of Marine Resources, and US Coast Guard) and average cost by retail value of these vessels. In total, $8.1 million in new vessel sales for the harvesting industry were assumed which supported an estimated 30 jobs in boatbuilding and an addition 22 from multiplier effects. These jobs collectively supported a total of $2.7 million labor income across the Midcoast and Downeast regions, where most of the boat building industry is located.

3.2.3 Harvesting – Non-lobster

Although lobster accounts for the largest share of wild caught species, $183 million in landed value of other species were realized in 2019. The non-lobster species can be grouped as follows (with the number of individuals holding licenses):

Finfish	2,731
Eel/Elver	1,193
Shellfish	2,541
Echinoderms	260
Marine Worms	775
Seaweed	163
TOTAL	7,663

Like other harvesting industries such as lobster harvesting, counting employment in the industry is challenging because there are no official data on the number of people employed in the various fisheries. Based on data for the various species, just over 7,600 licenses were identified in 2019.

Harvesting of wild caught species excluding lobster supported over 10,300 jobs in 2019, of which 7,600 were directly involved with harvesting operations (Table 6).[2] A total of $201 million in labor income was supported by the industry, including $158 million from direct effects and another $46 million from indirect and induced effects. A total of $345 million in total economic output was supported by wild caught harvesting excluding lobster in 2019. This accounted for approximately 11 percent of the seafood sector's total output. Like lobster harvesting, impacts were largest in the Downeast region (Table 7). However, some caution should be taken in this interpretation given the significant number of impacts that were not able to be geographically identified.

[2] It should be noted that 7,663 direct jobs based on license data is an indication of people that work or derive some level of income from fishing. We have no basis to determine how many of these individuals derive substantial income from fishing or what the fishing income distribution of licenses holders is. The IMPlan model estimates 2,737 direct jobs based on the 2019 landed value (output), which is the number of jobs typically associated with the corresponding level of output for a national fishery that includes much larger fisheries and fishing enterprises than found in Maine.

Table 6: Economic Impacts of Harvesting (Non-lobster) Statewide

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Direct	7,663	$154.7	$174.8	$196.2
Indirect	194	$4.1	$7.6	$15.8
Induced	2,535	$42.4	$76.1	$133.1
Total	10,392	$201.2	$258.5	$345.0

Table 7: Total Economic Impacts of Non-Lobster Harvesting

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Downeast	5,401	$29.8	$37.9	$53.0
Inland Maine	705	$19.2	$25.4	$32.2
Midcoast	2,836	$20.5	$24.6	$31.0
Southern Maine	1,450	$131.8	$170.6	$228.7
Total	10,392	$201.2	$258.5	$345.0

3.2.4 Processing

Seafood processing includes the value-added production of harvested fisheries and aquaculture that turn raw living resources into seafood products, including frozen seafood and other specialty seafood products. Most processors in the state are larger operations and are included in the standard data series. Based on DOL data, a total of 735 jobs were supported in the seafood processing industry in 2019, which in turn supported another 1,142 indirect jobs and 395 induced jobs (Table 8). A total of $108 million in labor income was supported by the processing industry in 2019, or which $37 million were from direct payrolls of seafood processors. The industry supported $515 million in economic output which accounted for 16 percent of the seafood sector's total output.

The impacts of the processing industry are highest in Southern Maine which supported over 930 jobs (Table 9), followed by Downeast (725 jobs), and the Midcoast region (611 jobs). The concentration in Southern Maine is partly a legacy of a time when Portland was a major center of the fishing industry and where there was easy access to a labor force. The shift of landings eastward over the past two decades has supported growth in processing, which may continue in the future.

Table 8: Economic Impacts of Processing Statewide

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Direct	735	$36.5	$48.6	$343.1
Indirect	1,142	$54.1	$75.6	$117.2
Induced	395	$17.2	$31.7	$55.5
Total	2,271	$107.8	$156.0	$515.8

Table 9: Total Economic Impacts of Processing by Region

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Downeast	735	$34.1	$49.5	$145.6
Midcoast	611	$29.0	$43.5	$153.4
Southern Maine	936	$44.7	$63.0	$216.7
Total	2,282	$107.8	$156.0	$515.8

3.2.5 Wholesale and Logistics

Wholesale and logistics are focused on the distribution of raw and processed seafood products to domestic and international markets. The industry includes the storage, transportation, and logistics of moving seafood products to retail and consumer markets. Businesses engaged in the shipment and handling of seafood products are required to be licensed by DMR. Those records are matched with DOL data to then aggregate wholesale operations handling seafood. Over 1,300 jobs were supported by wholesale and logistics operations in 2019 across the state, which in turn supported another 990 jobs through indirect and induced effects (Table 10). Over $115 million in labor income was supported, of which $69 million was from direct payrolls of seafood wholesalers. In total wholesale and logistics supported over $350 million in output, accounting for 11 percent of the seafood sector's total output.

The economic impacts of the seafood wholesale and logistics industry was concentrated in Southern Maine (1,060 jobs), followed by 880 jobs in the Downeast region and 320 jobs in the Midcoast region (Table 11).

Table 10: Economic Impacts of Wholesale and Logistics Statewide

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Direct	1,313	$68.6	$91.0	$212.6
Indirect	572	$27.8	$40.4	$80.3
Induced	421	$18.8	$34.4	$59.9
Total	2,306	$115.2	$165.8	$352.8

Table 11: Total Economic Impacts of Wholesale/Logistics by Region

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Downeast	881	$44.6	$64.2	$121.7
Midcoast	319	$14.8	$21.3	$48.9
Southern Maine	1,068	$54.1	$78.0	$177.6
Unidentified	37	$1.6	$2.3	$4.6
Total	2,306	$115.2	$165.8	$352.8

3.2.6 Retail: Markets and Restaurants

The retail seafood industry includes seafood specialty food stores, supermarkets, and seafood restaurants. Fish and seafood specialty markets are identified in DOL economic data totaling 370 jobs across 37 establishments in the state. In addition, approximately 5 percent of supermarket employment is included to account for seafood department employment. Seafood is sold in many restaurants in Maine, but much of that seafood will have come from outside Maine. To focus on those restaurants that use Maine seafood as an input, DMR data is combined with DOL data. Restaurants engaged in the handling of raw seafood products are required to be licensed by DMR. Those records were matched with DOL records to then aggregate restaurant operations handling seafood and are assumed to be 7,830. In total, over 8,550 jobs were supported by retail operations in 2019 across the state (Table 12). An additional 2,400 jobs were supported though indirect and induced effects. A total of $389 million in labor income was supported by the retail seafood industry, of which $285 million was from direct payrolls of seafood retailers. In total, retail seafood supported over $1 billion in output, accounting for 32 percent of the seafood sector's total output.

Nearly half of the total impacts of retail seafood were located in the Southern Maine region totaling over 5,100 jobs (Table 13). Retail seafood is the key conduit between the coastal regions of Maine and the inland counties of the rest of the state. Retail seafood supported 2,175 jobs in the Inland Region of the state, extending from Aroostook County to Oxford County.

Table 12: Economic Impacts of Retail /Restaurant Statewide

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Direct	8,558	$285.3	$425.9	$692.4
Indirect	1,041	$46.0	$76.1	$164.4
Induced	1,374	$58.1	$108.5	$191.0
Total	10,974	$389.4	$610.5	$1,047.9

Table 13: Total Impacts of Retail/Restaurant by Region

	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Downeast	1,579	$62.0	$96.9	$163.6
Inland Maine	2,175	$64.9	$104.9	$189.3
Midcoast	2,082	$67.2	$107.2	$187.3
Southern Maine	5,138	$195.3	$301.4	$507.7
Total	10,974	$389.4	$610.5	$1,047.9

4 Regional Economic Impacts

4.1 Downeast Maine

The seafood industry plays an outsized role in the Downeast region contributing over $960 million in total economic output in 2019, which accounted for nearly 14 percent of the region's total output (Table 14). The sector supported over 10,900 jobs, of which approximately 8,200 jobs were directly employed in the sector with another 2,300 jobs supported from other indirect and induced multiplier effects. The seafood sector supported $390 million in labor income, or 12 percent of the Downeast regional total. Similar to employment, roughly two-thirds of total labor income was supported directly by sector industries.

Although well-known as the center of lobster harvesting in Maine (with about 3,000 jobs), the Downeast region is also the major center for non-lobster harvesting (about 5,400 jobs). Retail contributed another 1,400 jobs, while other non-lobster species harvesting and wholesale supported roughly 500 jobs in each of those industries. Processing played a much smaller role relative to the size of the harvesting industry in the region in 2019. The seafood sector in Downeast supports considerably more jobs than Southern Maine despite having less than one-fifth of the population. Downeast sector is much more comprised of the harvesting and production of seafood products, whereas in Southern Maine the sector is much more concentrated in the retail consumption of seafood products.

Table 14: Economic Impact Summary for the Downeast Region

Industry	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Aquaculture	308	$12.2	$97.9	$102.1
Harvest Non-lobster	5,401	$21.9	$24.1	$29.1
Harvest Lobster	2,951	$158.1	$173.8	$209.7
Processing	275	$11.1	$14.7	$88.5
Retail	1,144	$38.5	$57.7	$93.2
Wholesale Distribution & Logistics	881	$22.5	$29.7	$61.3
Total Direct	10,961	264	398	584
Indirect (all other)	1,639	$41.0	$64.0	$124.1
Induced	3,284	$86.3	$150.6	$255.6
Total	15,884	$391.70	$612.47	$963.68

4.2 Midcoast

Harvesting in the Midcoast region accounts for about 5,000 jobs, somewhat smaller than Downeast (Table 15). But at 2,000 jobs, the retail/restaurant industry has almost twice as many jobs as the Downeast region. Direct employment in the Midcoast seafood sector accounted for 8,200 jobs with a total economic impact from 10,800 jobs. These jobs generate over $260 million in labor income in the region. The sources of economic impacts from the seafood sector are concentrated in lobster harvesting and retail for the region, with aquaculture comprising a smaller but growing sources of jobs and income in the region.

Despite the smaller footprint of the seafood sector in the Midcoast region, over $710 million in total economic output is still supported in the region accounting for almost 6% of total regional economic output.

Table 15: Economic Impact Summary for the Midcoast Region

Industry	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Aquaculture	219	$7.6	$71.1	$74.1
Harvest Non-lobster	2,836	$16.4	$20.0	$22.3
Harvest Lobster	2,189	$118.6	$145.3	$161.7
Processing	611	$10.7	$14.3	$107.5
Retail	2,082	$50.9	$77.9	$128.1
Wholesale Distribution & Logistics	319	$9.1	$12.2	$30.8
Total Direct	8,255	$213.2	$340.8	$524.5
Indirect (all other)	860	$20.2	$31.5	$71.0
Induced	1,724	$34.0	$65.6	$118.3
Total	10,840	$267.4	$438.0	$713.9

4.3 Southern Maine

The Southern Maine seafood sector supported over $1 billion of Southern Maine's total economic output in 2019 (roughly 2% of total regional output) (Table 16). Over 7,600 jobs were supported by the sector and $370 million in labor income. Unlike the other two regions, the bulk of direct jobs were supported by the retail industry sector (over 4,000), while harvesting (all species wild caught) supported roughly 1,270 jobs in 2019. In total, just under 6,300 jobs were directly supported by the seafood sector in Southern Maine, while another 1,300 jobs were supported through other indirect and induced multiplier effects.

Table 16: Economic Impact Summary for the Southern Region

Industry	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Aquaculture	137	$3.7	$11.7	$12.2
Harvest Non-lobster	270	$17.3	$18.5	$20.0
Harvest Lobster	947	$62.1	$66.3	$71.9
Processing``	275	$14.7	$19.6	$147.2
Retail	4,041	$152.7	$223.1	$354.6
Wholesale Distribution & Logistics	611	$36.1	$48.1	$118.2
Total Direct	6,281	$286.5	$387.3	$724.2
Indirect (all other)	440	$31.7	$50.8	$113.9
Induced	882	$51.6	$98.8	$175.5
Total	7,603	$369.8	$536.9	$1,013.6

Inland Maine

The presence of the seafood sector in the Inland regions of Maine is primarily in the retail consumption supporting 1,700 jobs, while another 20 jobs are supported by inland fish hatcheries (Table 17). These jobs provided $49 million in labor income. In total, over $200 million in economic output was supported by the seafood sector in noncoastal counties in the state that make up the Inland region.

Table 17: Economic Impact Summary for the Inland Region

Industry	Employment	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Aquaculture	21	$5.4	$9.4	$9.8
Retail	1,704	$43.2	$67.2	$116.5
Total Direct	1,725	$48.6	$76.6	$126.4
Indirect (all other)	214	$10.6	$17.3	$36.9
Induced	429	$12.4	$22.8	$40.2
Total	2,368	$71.6	$116.8	$203.4

4.4 Unspecified Location Values

Approximately $120 million of landed value in non-lobster harvesting and $65 million in lobster harvesting landed value had an unidentified geographic location in the DMR data (Table 18). We have no basis for allocating these impacts to a specific region, and so we report the value of these outputs in a separate category. We do not report employment for these unidentified location values on the assumption that the harvesting employment is captured elsewhere in the data.

Table 18: Economic Impact Summary of Unidentified Regional Activity

Industry	Labor Income ($M)	Value Added ($M)	Gross Output ($M)
Harvest Non-lobster	$99.1	$112.2	$124.7
Harvest Lobster	$54.3	$61.4	$68.3
Wholesale Distribution & Logistics	$0.8	$1.0	$2.3
Total Direct	154	175	195
Indirect (all other)	$4.6	$8.3	$17.3
Induced	$46.8	$83.4	$146.0
Total	$205.5	$266.4	$358.6

4.5 The Seafood Sector in Regional Economic Context

The analysis of the seafood sector's size also raises a question of the role of the sector in each of the regions. As noted, the economic impacts are largest in the Downeast region, followed by the Midcoast and then the Southern region. It is also important to show the importance of the sector in the overall economy of each of these regions. For that purpose, the seafood sector was compared with total employment, value added, and output for each of the regions. The results are shown in Figure 3, which shows that almost 20% of employment in the Downeast region is directly or indirectly related to seafood. This compares to about 9% in the Midcoast and 2% in the Southern Region. Seafood accounts for almost 12% of labor income in Downeast and 7% of value added. This concentration of the seafood industry in the rural economies of Hancock and Washington counties is one of the key findings of this analysis.

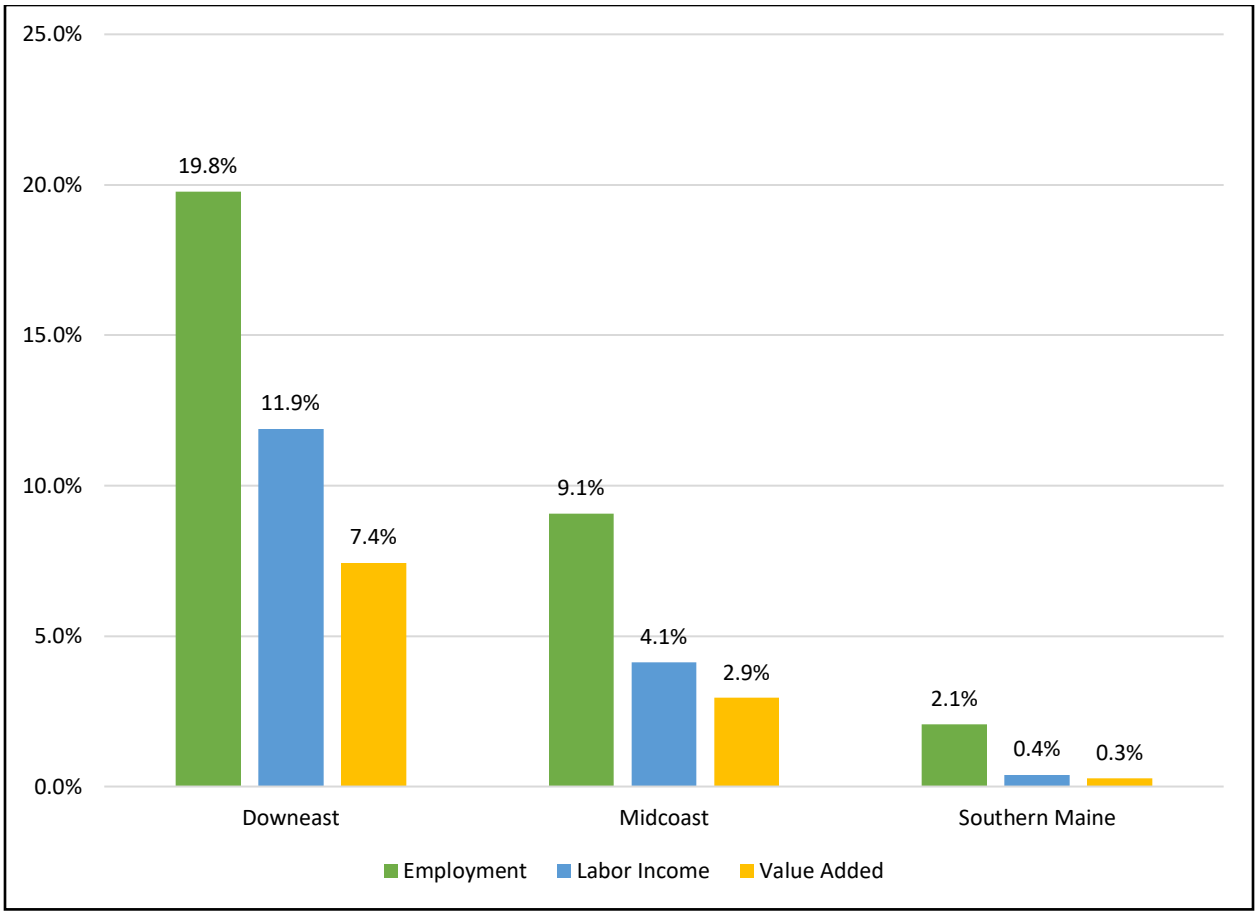

Figure 3: Relative Size of Seafood Sector in Maine Regions

5 Fiscal Impacts

The seafood sector supported an estimated $449 million in tax revenues in 2019, including local, state, and federal. The sector supported nearly $91 million in local (county aggregate) tax revenues and $110 million in state tax revenues. A total of $248 million in federal tax revenues were also supported.

Table 13 shows the break down across value chain industries. Of the total, $127 million in state and local tax revenues were supported from direct effects of the seafood sector value chain industries, with another $74 million in state and local tax revenues supported from indirect and induced effects. Retail had the largest contribution to state and local taxes totaling $66 million, followed by $43 million from harvesting (all species).

Table 19: Tax Revenue Impacts of the Seafood Sector in Maine

SeaMaine Industry Impact	Local	State	Federal	Total
Aquaculture	$3.22	$5.12	$9.52	$17.87
Harvesting (Non-lobster)	$4.00	$7.75	$22.36	$34.11
Harvesting (Lobster)	$11.26	$19.79	$56.34	$87.39
Processing	$1.38	$1.92	$7.53	$10.83
Retail	$33.08	$32.74	$58.73	$124.55
Wholesale & Logistics	$2.70	$3.72	$14.17	$20.59
Total Direct	$55.6	$71.1	$168.7	$295.3
Indirect (all other)	$10.43	$12.19	$28.34	$50.97
Induced	$24.89	$26.71	$51.29	$102.89
Total	**$90.96**	**$109.96**	**$248.29**	**$449.20**

6 Discussion and Conclusions

This study has estimated the economic dimensions of the seafood sector in Maine, including harvesting, processing, distribution, and retailing for capture fisheries and aquaculture. The best available data shows that in 2019:

- The sector directly employed 23,800 people, with a multiplier effect of an additional 9,400 jobs for a total impact of 33,300 jobs.
- These jobs accounted for $1.3 billion in labor income, of which $967 million was for direct jobs in the industries.
- On $2.2 billion in sales, the sector directly contributed $1.4 billion in valued added contribution to the Maine Gross State Product and contributed a total of $1.9 billion in value to multiplier effects.

Compared to other parts of the Maine economy, the seafood sector in 2019 was the largest natural resource-based industry:

- Total seafood direct employment would have been larger than forest products, as well as the combination of agriculture and other food products manufacturing.
- Total seafood value added is also larger than paper and wood manufacturing, and farming plus other food products.

It is also important to emphasize that the estimates in this report are likely to be *underestimates*. A large number of aquaculture operations are not incorporated in the data, only retail outlets (markets and restaurants) requiring a DMR license are included, and marine recreational fishing has been excluded entirely.

This study focused on a single year of data: 2019. This is because of the substantial amount of customized data construction that must be done to measure the economy of the food sector which had to be developed. The year 2019 was selected to avoid using data from a year affected by the Covid pandemic. But understanding the effects of the pandemic is still important. For that purpose, employment data from the Department of Labor for the major seafood industries as defined by the North American Industrial Classification System from 2018Q1 to 2022Q1 are shown in Figure 3. To smooth out the seasonal variations, a four-quarter moving average is used.

This analysis, which should be considered preliminary, shows that seafood markets have grown in employment since 2019, with little interruption from the pandemic. Processors and aquaculture in the Department of Labor data have declined slightly as measured by the Department of Labor data, but these trends were apparent before the pandemic. Seafood wholesalers and restaurants (on the right-hand vertical axis) did show significant drops from the pandemic, and neither industry has recovered to pre-pandemic levels. Note that these figures are for all restaurants; a future analysis needs to look at seafood restaurants in more detail.

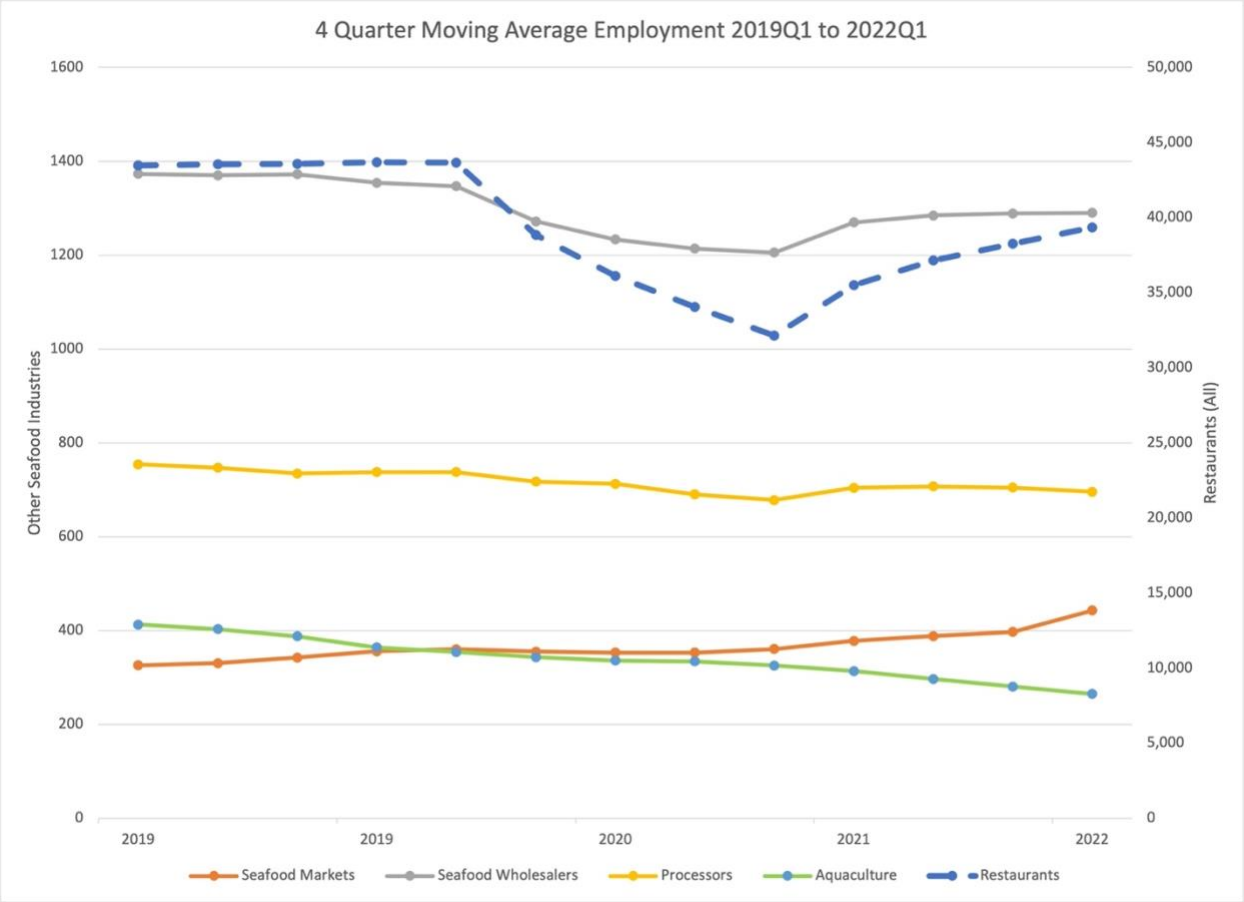

Figure 4: Trends in Employment in Major Seafood Industries

As this brief discussion of trends indicates, the snapshot of the industry presented in this study can only serve as a baseline against which to measure future changes. This report should be considered a supplement to the study conducted for SeaMaine by Gardner-Penfold. Key steps for continuing to understand the economic evolution of the seafood industries include:

1. Annual Updates
    - Employment data for the industries included in the Department of Labor industry data as in Figure 3.
    - Department of Marine Resources lobster and non-lobster licensing data to approximate employment in harvesting using the unique identifier method for non-lobster licenses.

- Landings and landed value data from the Department of Marine Resources

2. Improve measures

   As noted at several points in this study, the economic data for fisheries in the U.S. and in Maine is much weaker than for other industries, in large part because the economic structure of fisheries is different with a large proportion of proprietors, casual labor, seasonality and geographic flexibility. The inter-industry relationships are poorly measured in the Economic Census which is taken every five years and uses a national sample that often includes very few firms from a small state like Maine. Two projects could greatly improve the economic data for fisheries in Maine.

   The first would be to add a simple survey to the harvesting license renewal process asking for the number of days in the previous year that were actually spent fishing. The question could be set up as a single choice question from defined ranges to make answering quick. The answer to this question would convert license information into labor participation information providing a much more accurate measure of employment.

   The second would be to conduct a more detailed survey of fishing and aquaculture enterprises to measure total output (in the case of aquaculture) and in the case of inputs and costs for all harvesting enterprises. Such surveys are complex to administer because they are best done with online surveys or with survey diaries and with voluntary participation from a sample. A detailed study of the aquaculture industry is currently under development. The results of these studies would provide much more accurate measures of the economic impacts of the harvesting sector. For the processing, wholesale, transport, and retail sectors, standard impact models such as IMPLAN (used here) are adequate. These types of studies are complex and can be expensive and so should be done no more than every five years.

7 Data Sources

7.1 Quarterly Census of Employment and Wages

The primary data source for aquaculture, seafood processing, wholesale and logistics, and retail industries come from the Maine Department of Labor Center for Workforce Research and Information (CWRI) Quarterly Census of Employment and Wages (QCEW) establishment-level microdata. CBER was provided access to the establishment-level employment and wage data from which customized industry sectors and geographic regions were used to calculate direct employment and wage effects. Businesses are categorized in the QCEW by industry according to the North American Industry Classification System (NAICS) hierarchy. Included industries and concordance with the seafood sector are shown below.

Table 20: Seafood Sector Industry Data Map

Sector Industry	NAICS Industry	NAICS Code	Data Source	Model Inputs	IMPLAN Sector
Aquaculture	Finfish farming and fish hatcheries	112511	QCEW, DMR	Emp, wages	14
	Shellfish farming	112512	QCEW, DMR	Emp, wages	14
	Other aquaculture	112519	QCEW, DMR	Emp, wages	14
Harvesting - Lobster	Commercial Fishing	114111	DMR	Landed value (output)	17
Harvesting - All other species	Commercial Fishing	114111	DMR	Landed value (output)	17
Seafood Processing	Frozen specialty food manufacturing	311412	QCEW, DMR	Emp, wages	92
	Seafood product preparation and packaging	311710	QCEW, DMR	Emp, wages	92
Boatbuilding	Boat Building and Repairing	336612	DMR	Output	361
Wholesale & Logistics	Fish and Seafood Merchant Wholesalers	424460	QCEW, DMR	Emp, wages	398
	Specialized Trucking (Local)	484220	QCEW, DMR	Emp, wages	398
Retail	Supermarkets	445110	QCEW, DMR	10% of Emp, wages	406
	Fish and Seafood Markets	445220	QCEW, DMR	Emp, wages	406
	Full service restaurants	722511	QCEW, DMR	Emp, wages	509
	Limited service restaurants	722513	QCEW, DMR	Emp, wages	510

7.2 The IMPLAN Economic Model

The estimation of economic impacts utilizes IMPLAN — a commonly used proprietary input-output economic model that represents the sales and purchases of goods and services in the economy from raw inputs to end consumer. IMPLAN uses a variety of federal data sources to map the relationships between industries and consumers which allows a user to analyze the spending flows of an economic activity, whether individual firm, set of businesses, event, or policy, across a defined regional economy. The IMPLAN model used in for this analysis is based on county and state level data for Maine. Counties are further aggregated into regions to abide by confidentiality requirements for using QCEW data. More information on IMPLAN can be found at support.implan.com.

Definitions

Measuring Economic Impacts

Economic impact analysis attempts to quantify the net change to an economy that is a result of a business(es), policy, event, or in this case of an industry sector. From another perspective, economic impact analysis attempts to capture the hole left in the state and regional economies if the seafood sector did not exist. Economic impacts are generally characterized as the primary economic effects stemming from the object being analyzed and the secondary or multiplier effects from recurring rounds of spending in the defined economy.

Direct effects include the primary effects from employment and operations of seafood sector businesses across the value chain.

Indirect effects are secondary effects that result from the operational spending of seafood sector businesses on suppliers and vendors and the recurring rounds of spending that accrues. Indirect effects are also referred to as intermediate effects.

Induced effects are secondary effects from spending of employee wages from both seafood sector businesses as well as from wages of employees of suppliers and vendors spent in the local economy. Induced effects are also referred to as local consumption effects.

Economic Impact Indicators

Economic impacts are reported across several common indicators that include employment (jobs), labor income, value added, and output.

Employment is estimated as the number of jobs, both full-time and part-time, and includes wage and salaried employees, sole proprietors, and active partners. Employment is reported as inclusive of both the number of full-time (FT) and part-time (PT) jobs. Both FT and PT jobs are counted with equal weight and are not distinguished by the model, which is commonly reported in government-reported employment data as well as other economic models.

Labor Income measures the value of all employment derived income in the region. It is inclusive of wages and benefits of employees (employee compensation) or total payroll cost to an employer, as well as proprietor income, or income derived from self-employed workers, sole proprietors, partnerships, and tax-exempt cooperatives.

Value Added is a measure of economic value and is equivalent to the industry's contribution to gross domestic product (GDP). Value added includes all labor income, as well as taxes on production and imports and other property income. Conversely, it is total output less intermediate inputs to production.

Economic Output is a measure of the total value of all goods and services produced. Output includes all labor income, value added, as well as intermediate inputs to production. Total output can also be interpreted as total industry sales.

7.3 Online Data Sources

Department of Marine Resources

Data Access Portal with Mapping

https://dmr-maine.opendata.arcgis.com/

Data Sets in Open Data Portal

https://maine.maps.arcgis.com/home/group.html?id=b451a68027b542958df0d6634f73af4f#overview

Aquaculture Leasing Data

https://maine.maps.arcgis.com/apps/webappviewer/index.html?id=b846cf37b1d64c988f89eafa085c8b7a

Department of Labor

https://www.maine.gov/labor/cwri/qcew.html

8 Appendix: Using License Data for Estimated Harvesting and Aquaculture Employment

A major challenge facing all studies of the seafood sector, particularly the industries involving harvesting seafood through fishing as well as the more recent activities of aquaculture is that the standard government data series do not cover most people employed in the fishing industry in Maine. This industry is generally exempt from the unemployment insurance laws, which are the basis for the most detailed employment data available. Other methods must be used, the most important of which is the licensing data from the Department of Marine Resources.

This data is available from DMR for each individual license. The challenge is to convert licenses to individuals, assign the individuals to the relevant fishery and determine the location of activity. Adjustments must be made for people holding multiple licenses. It is also necessary to exclude licenses held by those who do not reside in Maine or who have licenses for non-commercial uses such as recreation or education. In 2019 there were 17,766 licenses for fishing, of which 8,923 were for lobstering; 2,791 for groundfish, pelagics, and anadromous; and 6,048 all other species. The employment total reported here of 12,700 was the difference between the total number of licenses and the total number of individuals.

Individuals were identified by dividing harvesting into three major groups: lobstering; commercial fishing for groundfish, pelagic, and anadromous species; and all other species. In each of these groups a unique identifier was calculated. The first name, last name, and date of birth (in Julian format, or the day number since 1/1/1900) was created. For example, John Doe, born on July 4, 1980, would have an identifier of doejohn29406. These unique identifiers were then examined for duplicate licenses held within each group and duplicate licenses counted as 1. The result of unique identifier and a single license then comprised the employment count.

This analysis has two potential limitations. One is the possibility of an individual holding licenses in more than one group. However, the groups are organized by major gear type so multiple licenses are not expected to be large. The other problem is that having a license does not guarantee actual participation in fishing activity. It is likely, in fact, that part time employment is more common than full time employment. All this indicates that any serious investigation of employment in Maine fisheries should be grounded in a more thorough investigation of multiple job holding as well as part- and full-time participation.

A somewhat similar problem exists with aquaculture. Some aquaculture firms, particularly the larger ones, are covered by unemployment insurance and their employees are counted in the aquaculture industry data reported by the Department of Labor. But many other aquaculture operations are quite small or are operated by larger organizations and included in their overall employment data. To estimate the employment in aquaculture not covered by DOL, we used data from the limited purpose aquaculture (LPA) licenses. These are licenses for small scale (up to 400 square feet) operations which may be for research, education, or commercial purposes. For this analysis, licenses for research and education were excluded[3] and the remaining licenses were reorganized to estimate the number of individuals rather than the number of licenses. Because of the size of these sites, it is possible for one person or organization to hold more than one LPA license. The resulting count of individuals with commercial LMA licenses was

[3] Aquaculture conducted for research or education should be reported as part of those industries, not aquaculture.

200 statewide. These were added to the DOL counted employment. However, we kept the wages at the same level because many of these LPA pay little compensation or pay it as contract or self-employment.