

**THE ECONOMIC VALUE OF  
MARINE-RELATED RESOURCES  
IN NEW BRUNSWICK**

**Prepared for the  
New Brunswick Department of Fisheries and Aquaculture  
and the  
Department of Fisheries and Oceans**

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## Executive Summary

### The Economic Value of Marine-Related Resources in New Brunswick

The principal aims of this project were to estimate how important the marine sector is in the economy of New Brunswick, and to refine a methodology by which this could be done more easily in future.

The marine sector is made up of those private industries and government departments that either depend on the ocean as a resource, or use it as a medium of movement, operation, or innovation.

The economic importance of the marine sector can be shown in several ways. These include its direct and indirect contribution to Gross Domestic Product (GDP); how many people it employs; and how much these people take home in wages and salaries. In calculating the net impact of these contributions in this sector, an average of the three years 1995, 1996 and 1997 was used. The net impact is summarized in Table ES.1 and Chart ES.1:

<b>Table ES.1: The Marine Sector in New Brunswick: Summary of Economic Impact</b>				
	<b>Direct Impact</b>		<b>Total Impact</b>	
	<b>Impact</b>	<b>% of Total NB</b>	<b>Impact</b>	<b>% of Total NB</b>
<b>GDP</b>	\$609.6 million	4.3	\$1,032.2 million	7.2
<b>Household Income</b>	\$369.2 million	4.1	\$821.2 million	9.2
<b>Employment</b>	15,090 jobs	4.8	26,553 jobs	8.5

**Chart ES.1: The Marine Sector in New Brunswick: Summary of Economic Impact**

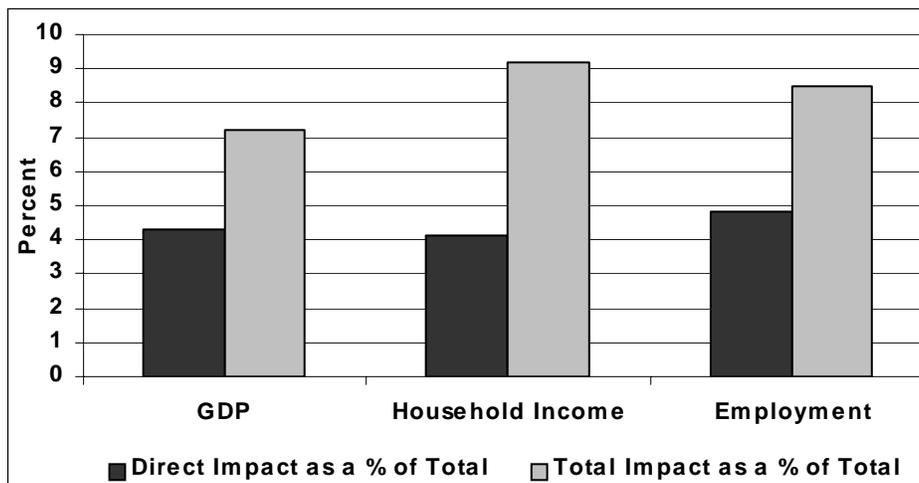


Table ES.1 and Chart ES.1 provide the net direct and total (direct + indirect + induced) impacts of the marine sector, and are calculated using Canmac's New

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Brunswick Input-Output tables. These include a series of economic activities that are, to a greater or lesser extent, related to marine resources. The list does not include all marine-related activities, only those for which data could be readily obtained or estimated. It is concluded that these data cover a large majority of relevant activities. The research team has estimated impacts conservatively, so the calculated results are considered to be low.

The total direct impact of the marine sector in New Brunswick amounts to almost \$610 million, or 4.3% of GDP. This compares favourably with the important forest products industries (lumber, pulp and paper), which directly contribute 4.5% to the provincial economy. Once indirect and induced effects associated with the marine sector are also incorporated, its share of GDP rises to 7.2%, or more than \$1 billion.

The marine sector also accounts for 4.1% of direct household income in New Brunswick (almost \$370 million), and 9.2% of total household income (more than \$820 million). This makes it an important contributor to family spending and retail sales, especially in many smaller coastal communities.

The employment impacts of the marine sector are 4.8% of all jobs directly (almost 15,000 jobs), and 8.5% of all jobs in total (more than 26,550 jobs). This means that about one in twelve jobs in New Brunswick can trace its existence to economic activities involving the ocean. This proportion rises to a much higher value in coastal communities. Table ES.2 (page III) gives details of the contributions of private industries and government departments to the marine sector in New Brunswick, ranked in descending order of size.

For the three indicators (GDP, household income, and employment) most of the economic impact (88-89% of the total marine sector) is in private industries. The proportion accounted for by government departments, although small, is important because of the critical management and regulatory role it encompasses.

For the purpose of this study, ten private industries have been identified as marine-related. In terms of impact, fish processing, traditional fishing, and aquaculture, which rank first, fourth and fifth respectively, account for over half the total impact of the marine sector. These three, along with shipbuilding and boatbuilding, and ports (ranked second and third overall) constitute the top five industries in terms of economic activity. These five account for 94% of the private industry total, and 89% of the grand total of all private industries and government departments; 95% and 88% respectively of household incomes; and 94% and 88% respectively of employment.

<b>Table ES.2: The Marine Sector in New Brunswick</b>				
<b>Summary of Total Economic Impact (Average 1995-1997)</b>				
	<b>Total GDP</b>	<b>Total Household Income</b>	<b>Total Employment</b>	<b>Overall rank (a)</b>
	<b>- \$ million -</b>			
<b>Fish processing</b>	<b>359.9</b>	<b>272.4</b>	<b>7,031</b>	<b>1</b>
<b>Ports</b>	<b>140.9</b>	<b>174.7</b>	<b>6,115</b>	<b>2</b>

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<b>Ship- Boatbuilding</b>	<b>232.1</b>	<b>158.1</b>	<b>4,690</b>	<b>3</b>
<b>Traditional fishing</b>	<b>98.2</b>	<b>63.0</b>	<b>3,492</b>	<b>4</b>
<b>Aquaculture</b>	<b>88.0</b>	<b>54.7</b>	<b>2,048</b>	<b>5</b>
<b>Dept. of Fisheries and Oceans (b)</b>	<b>30.5</b>	<b>38.0</b>	<b>1,168</b>	<b>6</b>
<b>Ferries</b>	<b>22.4</b>	<b>14.4</b>	<b>585</b>	<b>7</b>
<b>Ecotourism</b>	<b>17.1</b>	<b>13.4</b>	<b>498</b>	<b>8</b>
<b>Marine construction</b>	<b>12.0</b>	<b>10.5</b>	<b>350</b>	<b>9</b>
<b>NB Fisheries and Aquaculture (b)</b>	<b>11.6</b>	<b>10.3</b>	<b>232</b>	<b>10</b>
<b>Environment Canada (b)</b>	<b>6.6</b>	<b>7.5</b>	<b>198</b>	<b>11</b>
<b>Research etc.</b>	<b>3.2</b>	<b>2.3</b>	<b>88</b>	<b>12</b>
<b>Marine tech.</b>	<b>8.4</b>	<b>1.4</b>	<b>43</b>	<b>13</b>
<b>NB Environment (b)</b>	<b>0.3</b>	<b>0.5</b>	<b>15</b>	<b>14</b>
<b>PRIVATE INDUSTRY TOTAL</b>	<b>982.2</b>	<b>764.9</b>	<b>24,940</b>	
<b>GOVERNMENT DEPT TOTAL</b>	<b>49.0</b>	<b>56.3</b>	<b>1,613</b>	
<b>GRAND TOTAL</b>	<b>1,031.2</b>	<b>821.2</b>	<b>26,553</b>	
<b>Total NB Economy</b>	<b>14,295.3</b>	<b>8,945.0</b>	<b>314,000</b>	
<b>Marine Sector as % of NB</b>	<b>7.2</b>	<b>9.2</b>	<b>8.5</b>	
Note (a) The overall ranking is simply a total of the rankings for the individual indicators.				
(b) Public sector.				

The other significant private industries are (in descending order) ferries, ecotourism, marine construction, research and other services, and marine technology manufacturing. Although their relative share of the total impact is small (about 6% of total GDP attributable to marine-related resources) they are important as they have considerable potential. This is certainly the case for ecotourism, research services, and marine technologies.

The biggest marine-related public sector presence is the Department of Fisheries and Oceans (DFO), which has a wide-ranging mandate under the Oceans Act to manage and regulate marine-related activities. DFO's role is complemented by the New Brunswick Department of Fisheries and Aquaculture. Environment Canada and the New Brunswick Department of the Environment also have marine-related activities under their mandate, so contribute to the marine sector economy.

All parts of the marine sector are cyclical. For example, although the shipbuilding industry was strong in the years up to and including the mid-1990s, it is now (in early 2000) languishing due to lack of orders at the big shipyard in Saint John. What was previously the busiest ferry service in Atlantic Canada, between New Brunswick and Prince Edward Island, has been replaced by the Confederation Bridge since mid-1997. Aquaculture has expanded to approximate a contracting traditional fishery in terms of value of output since the late 1970s. Government departments have had their budgets constrained in the 1990s.

New Brunswick fronts on two different and quite distinct parts of the northwest Atlantic Ocean, the southern Gulf of St Lawrence to the north and east, and the Bay of Fundy to the south. In aggregate, 57% of marine-related private industry GDP is in the southern Gulf, and 43% in the Bay of Fundy. The split between the different industries is often wider than this. There is more fish processing and traditional fishing in the southern

Gulf, for example, whereas the Bay of Fundy claims larger shares of shipbuilding, ports and aquaculture. The other sectors are more evenly split between the two regions.

The marine sector can also be broken down into those activities that depend on the ocean as a resource, and those that use the ocean as a medium of operation or movement. The quality of the marine environment is much more important to resource users, which include fish processing, traditional fishing, aquaculture, and ecotourism. When these four private industries are combined, they account for over half of the total impact of the marine sector in terms of GDP (\$563.2 million); household incomes (\$403.5 million); and employment (13,069 jobs). This emphasizes the importance of proper management of marine resources, to sustain both their natural integrity and the jobs and incomes that depend on the oceans.

As much as this has been a project to gauge how important the marine sector is to New Brunswick, it has also evaluated methods and estimation procedures to measure the impact of these industries as accurately as possible. The methods outlined are only as good as the data that underpin them. Further refinement of the methodology will improve the validity of the results, and will cover parts of the marine sector that are currently omitted because of inaccessible data.

A precise measurement of the marine sector will help policy formulation related to economic development and marine management. At some stage, consideration of the marine sector should move beyond an economic accounting exercise, to begin investigating policy-related issues such as a potential industrial cluster centered on the sector. This would not only involve private industry, but would also engage universities, governments, and research institutions.

Any future work should also adequately account for the costs of economic growth, namely depleted resources, pollution, and environmental degradation. Ultimately, marine resource management should involve both environmental and market-oriented uses. Reconciling environment and economy effectively will require special skills to ensure that industries depending on the oceans continue to contribute to New Brunswick's economic progress.

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## Glossary of Terms

### Gross Domestic Product (GDP)

The measure of economic activity in an economy, in this case the New Brunswick economy. GDP measured on an expenditure basis is expressed as:

$$\text{GDP} = C + G + I - X - M$$

*where:*

- C = Personal consumption (expenditure) of goods and services.
- G = Government expenditures on goods and services.
- I = Investment in capital, machinery equipment and inventories.
- X = Exports of goods and services.
- M = Imports of goods and services.

*GDP is also measured on an income basis and consists of :*

- labour income
- corporate profits before taxes
- interest and investment income
- net farm income
- unincorporated business income
- inventory valuation adjustment
- indirect taxes less subsidies
- capital consumption allowance

Gross domestic product of an industry is the value added by labour and capital in transforming inputs purchased from other producers into outputs.

### Direct Contribution

All '*first round*' economic activities which contribute to GDP. These can vary from investment in a new or expanded fish processing facility to wages paid to employees directly involved in marine-related activities.

### Indirect Contributions

All '*subsequent rounds*' of economic activities which contribute to GDP. These activities are not directly associated with the marine activity but are a result of direct marine-related activities. A good example of this is the inputs needed to build a fishing boat. The investment in the fishing boat is a direct marine-related activity contributing to GDP (investment). The subsequent increase in demand for sawn timber (sawmills) and the increased demand for timber (logging) are indirect contributors to GDP. These indirect contributions also include '*induced contributions*' which measure the economic activity associated with the respending of wages paid in the direct, indirect, and to a lesser extent earlier rounds of induced activity.

**Input-Output (I-O)**

The input-output model measures the wide economic impact of a direct economic event by the known inter-industry dependency in the given economy. Different sectors of an economy depend on other sectors of the economy to supply its inputs or purchase its output to varying degrees. The imbalance in this supply/demand relationship is made up by imports (*supply*) and exports (*demand*).

The input-output model measures total economic activity defined as direct + indirect + induced activities. For an explanation on direct, indirect and induced activity see preceding GDP definition.

**Input-Output Tables**

These tables list the supply (make) of commodities by industry, demand (use) of commodities by industry and final demand (personal expenditure, government expenditure, investment, exports and imports). In an input-output model which is closed with respect to households (includes induced impacts) households are treated as an industry.

These tables along with employment and GDP by Industry in the input-output system are used to produce impact multipliers for output, employment, household income and GDP.

**Input-Output Multipliers**

Relate the indirect and induced impact by industry to the direct increase or reduction of the output of a given industry. The sum of all industries indirect and induced impacts plus the direct industry impact equals the total impact.

Multipliers are produced for output, income, GDP, and employment.

'*Output Multipliers*' relate the indirect and induced output impact to the change in direct output.

'*Income-generated Multipliers*' relate the change in household income to the change in output.

'*Income-based Multipliers*' relate the indirect and induced household income to the direct income associated with the change in output.

'*Employment Multipliers (output basis)*' relate the additional employment per output change.

'*Employment-based Multipliers*' relate the indirect and induced employment to the direct employment associated with the change in output.

'*Value added/GDP Multipliers*'. These multipliers (coefficients) relate the additional GDP per output change.

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With the data presented in Tables 3.1, 3.2 and 3.3 all of the above multipliers can be calculated.

## Chapter One Introduction

This report presents estimates of the importance of the marine sector in the New Brunswick economy. The impact of this sector is measured relative to the total provincial economy. It comprises both private industry and government department activities (for example, regulating and managing the uses of marine resources) involving the waters that border New Brunswick on three sides.

Estimating the value of the marine sector in New Brunswick will help policy development and the management of the uses of the marine environment. This is the first study in New Brunswick to attempt this estimation. It employs a methodology that was first developed and used in Nova Scotia, and which continues to be tested and refined<sup>1</sup>.

This report is in four chapters. This first chapter provides background on the project. Chapter Two describes the assembly of basic data for the project, profiles the marine sector in more detail (by industry and by department), and provides the direct value of the sector for New Brunswick. Chapter Three estimates indirect and induced economic impacts of the marine sector, based on the data reported in Chapter Two. Chapter Four summarizes findings and points to further work.

Appendix A provides a brief analysis of data quality, and describes sources or origins of the data. Appendix B contains a brief description of the Input-Output model that is used to estimate total impacts.

### 1.1 Background

New Brunswick has 2,065 kilometers of coastline. The sea has historically influenced economic development in the province. Much settlement followed the coastline, and 60% of the province's population still live within 50 kilometers of salt water. Fishing has been an important economic activity since the first European settlement. Land-based resource and manufacturing industries, such as forestry and mining, must consider their proximity to the sea in terms of transportation of goods to markets. Tourism has developed into a major industry, focusing significantly on coastal attractions and experiences. Important manufacturing sectors like shipbuilding and boatbuilding depend on the sea as a medium of operation. Transportation and ports are also important marine resource "users".

There are two principal watersheds in New Brunswick (Map 1), one that flows to the Gulf of St Lawrence in the north and east, and one that flows to the Bay of Fundy to

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<sup>1</sup> Mandale Consulting, Canmac Economics, and the North American Policy Group, Estimating the Economic Value of Coastal and Ocean Resources: The Case of Nova Scotia, prepared for the Oceans Institute of Canada and the Atlantic Coastal Zone Information Steering Committee, February 1998.

the south. As well as reporting on the province overall, this research attempts to assign its marine sector statistics to these two areas, to see where the activities concentrate. The provincial analysis follows a template devised for a similar project in Nova Scotia, which was reported in February, 1998<sup>2</sup>. The extension of the analysis to sub-regions within the province is new to New Brunswick and to the methodology.

## 1.2 Defining the Marine Sector

A broad definition of the marine sector is adopted for this project, that not only includes activities associated with inshore and nearshore waters (including bays and estuaries) but also seawards to include Canada's Exclusive Economic Zone.

As well as being an economic resource, marine regions are also ecological and social systems. They involve special management challenges, as the values of marine environments go far beyond what is measured in economic or market terms. Distinguishing between "*market*" or "*economic*" and other values can be complex, but for the purpose of this project it essentially encompasses those products from, or uses of, marine or ocean environments that enter the world of commerce; that is, they can be exchanged for money.

Many definitions go much further than this to account for the "*non-market*" values of natural functions of marine resources, such as being an integral part of the hydrological cycle, or the aesthetics of coastal scenery. These are usually those attributes of natural systems that we commonly regard as being "*free*", in so far as no commercial market has yet developed for them. The value of natural systems extends beyond the ability of even very sophisticated market mechanisms. It should be noted, however, that commercial markets are constantly evolving for previously unpriced products and services; the development of "*tradable permits*" for polluters is an example.

For the purposes of this project, defining the marine sector involves a broad twofold split, between those activities that use the ocean as a resource, and those that use it as a medium of movement, operation, or innovation. The first of these includes the commercial fishery, aquaculture, and recreation and tourism. One distinguishing characteristic that sets resource-dependent industries apart is that they are sensitive to a deterioration in marine environmental quality whereas other industries operating in the marine milieu are essentially insensitive to this issue.

The marine sector includes activities that have become important components of the New Brunswick economy, for example the regulation and management of fisheries and the environment. This means that activities can reside in private industry or government departments, and can encompass goods production and services. Even when an activity occurs in a private industry, it can still involve a hefty measure of government spending. Much of the Canadian shipbuilding industry in the 1990s, for example, relied on government work for orders, whether for naval ships, Coast Guard vessels, or ferries. "Private industry" is defined in terms of commercial operations which are carried out to make a profit, or at least to cover costs of operation.

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2 *Ibid.*

Although the spirit of this research project has been to include as many activities as possible, lack of data means that some are not included in the analysis. For this reason, the estimates of the economic impact should be considered to be conservative. Further, the research team purposely chose to err on the side of caution in estimating the results, to avoid overstating the impact of the marine sector in New Brunswick. Consequently, final figures are easier to defend; this was the approach adopted in the study for Nova Scotia<sup>3</sup>. Where there is error and omission in this work, its correction would usually increase the relative importance of the marine sector in the provincial economy.

### 1.3 Methodology Overview

The two basic steps that form the heart of the project are data collection and impact analysis.

***Data Collection:*** This critical step assembles data for each industry and department. The data include economic output (sales), employment, and payroll (household income). Sources for this data were occasionally straightforward, but more often required considerable search. In some cases, published sources are easily accessible for most of the variables listed. In other cases, special studies have been completed recently that give an adequate set of data. Some require estimation from other data. In yet other cases data reside in internal files and need special requests, and usually some time, to unearth.

Our approach is to collect data for three recent years (1995, 1996, and 1997) and then use the average of these years for analysis. This avoids problems with a single year being abnormal in any way, and improves the quality of the final estimates. Data for all three of these years were not always available for some of the private industries; the exceptions are noted in the discussion below. This step of the methodology will result in a set of gross data for each of industry and department identified at the beginning of Chapter Two.

***Impact Analysis:*** Gross data as assembled can be corrected to give the first important set of measurements - the direct impact. The correction involves netting out any double counting in the gross data. This recognizes the fact that impact estimation is an economic accounting exercise. The value of fish bought from fishermen for processing in a fish plant, for example, cannot appear more than once in the exercise; it is always lumped into the higher value-added activity, in this case, the output of the fish plant. However, if fishermen sold their fish to a plant outside their jurisdiction (outside New Brunswick), or sold their fish directly to the final consumer, the fish become an export from the province, and the value-added is “captured” by the fishermen rather than the local plant.

Input-Output (I/O) analysis extends the direct impact to capture so-called indirect and induced effects. Indirect effects are those involving the purchase of inputs by an industry or department to assist it in its own operations. Induced effects are those that accumulate as incomes earned in an industry or department are spent and respent throughout an

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3 *Ibid.*

economy. I/O models have been used to calculate these wider economic impacts since the 1930s. It is based on the presumption of interdependence in an economic system - each activity in the system depends to varying degrees on every other activity, either to supply its inputs or to purchase its output. Adding direct, indirect, and induced impacts together gives the total impact of an activity or collection of activities.

The impact analysis will give three key pieces of data - output (or Gross Domestic Product), household income (based on data collected for payroll by industry), and employment.

## 1.4 Basic Structure of the New Brunswick Economy

The most commonly used measure of an economy in Canada is Gross Domestic Product (GDP). This is the sum of the market values of the economy's goods and services in their final use. New Brunswick's GDP in the mid-1990s was \$14.3 billion (the average of the years 1995, 1996, and 1997). Table 1.1 compares New Brunswick' GDP with the other Atlantic provinces and Canada.

	<b>\$ billion</b>	<b>% of Canada</b>
<b>New Brunswick</b>	<b>\$14.3</b>	<b>2.0</b>
<b>Nova Scotia</b>	<b>\$16.9</b>	<b>2.3</b>
<b>Newfoundland</b>	<b>\$9.0</b>	<b>1.2</b>
<b>Prince Edward Island</b>	<b>\$2.4</b>	<b>0.3</b>
<b>Canada</b>	<b>\$726.8</b>	<b>100</b>
Source: Statistics Canada, Catalogue 15-203		

The province's economy is the second largest in Atlantic Canada, and accounts for 2% of Canada's GDP. There is an approximate 70:30 split between services and goods in the province. Services encompass a huge array of enterprises, ranging from retail stores through haircuts, lawyers, transportation, and health care and education. Marine-related services include shipping, ports, ferries, large parts of tourism, and professional consulting. Goods have physical substance, such as fish products, ships and boats, or navigation instruments.

Although goods production is less than one-third of New Brunswick's economy, the importance of this share should not be underestimated; it provides the lion's share of the province's exports. New Brunswick is Atlantic Canada's biggest exporting province. Exports are vital to the province, as they represent much larger markets than those contained within New Brunswick, which has a population of only about 750,000 people. To generate reasonable advances in standards of living, therefore, the province must sell outside its borders. To date, these exports have mostly been goods.

The goods sectors are important in the context of the present project. The biggest private industries defined are goods-producers. They are, or have the potential to be, export industries in the traditional goods-based sense. This is not to say that the province does not export services; professional service exports are increasing in importance, as is tourism which is an "export" in the sense that non-residents including many Americans, come to New Brunswick to spend money they earned elsewhere.

To put New Brunswick's economy in a little more context, Table 1.2 lists some other sectors and their contribution to provincial GDP.

<b>Sector</b>	<b>Proportion of GDP (%)</b>
<b>Agriculture</b>	<b>1.1%</b>
<b>Mining</b>	<b>2.4%</b>
<b>Manufacturing</b>	<b>12.5%</b>
<b>Food Processing</b>	<b>3.1%</b>
<b>Forest Products</b>	<b>4.5%</b>
<b>Services</b>	<b>71.6%</b>
<b>Wholesale/Retail Trade</b>	<b>11.9%</b>
Finance, Insurance, & Real Estate	<b>15.9%</b>
<b>Professional Services</b>	<b>3.5%</b>
<b>Communications &amp; Utilities</b>	<b>8.2%</b>
<b>Public Administration</b>	<b>9.7%</b>
<b>Source: Statistics Canada, Catalogue 15-203 (1997)</b>	

The provincial economy still depends quite heavily on resource-based production, particularly forest- and mining-based. Forest products (lumber, pulp and paper) alone account for 4.5% of GDP directly. This report will show that the marine sector almost matches the size of this traditional mainstay of the provincial economy. There have been some changes to the overall structure of the economy in the 1990s, when more information technology enterprise, particularly telecommunications-based, has emerged as a source of new jobs and incomes.

## **1.5 Assessing the Importance of the Marine Sector: The Experience of Canada and Other Countries**

Five estimates of the importance of the marine sector to national and provincial economies are of comparative interest. One is older, the others are quite recent (see Table 1.3).

The U.S. estimate is different from the others not only because of its age, but also because of its method of calculation. It employed a national accounts approach to divide the economy into an oceans sector and a non-oceans sector, broadly based along geographic rather than industry lines. The 2.6% of the U.S. economy represented by ocean industries (about US\$30.6 billion in 1972, roughly equivalent to US\$112 billion at 1996 prices, or C\$154 billion) matched the size of agriculture, mining, transportation, and communications in 1972.

<b>Jurisdiction</b>	<b>Benchmark Year</b>	<b>Estimate (% of Economy)</b>
<b>United States (1)</b>	<b>1972</b>	<b>2.6% (GNP)</b>
<b>United Kingdom (2)</b>	<b>1994-95 (mostly)</b>	<b>4.8% (GDP)</b>
<b>Australia (3)</b>	<b>1994 (mostly)</b>	<b>8.0% (GDP)</b>
<b>Canada (4)</b>	<b>1988</b>	<b>1.6% (GDP)</b>
	<b>1996</b>	<b>1.4% (GDP)</b>

## Value of Marine-Related Resources

Nova Scotia (5)	1994	9.6% (direct GDP) 17.5% (total GDP)
Sources: See footnote (4) below		

The British, Australian and Canadian estimates have been calculated using methods that broadly correspond to those employed in the current study, but are confined to *direct* impacts only, and cover a rather different array of activities than the current study. Measuring direct impacts is an important first step in any assessment of the marine sector, but fails to capture the indirect and induced (“spin-off”) impacts that come with the spending and re-spending of marine sector incomes and profits throughout the larger economy.

The British marine sector had a net direct impact of 4.8% of the national economy in 1994-95, or £28.7 billion (C\$58.2 billion). The 17 activities considered include familiar ones, like the fishery, tourism, shipbuilding, ports, and marine crossings (ferries and toll bridges), plus others such as oil and gas, defence, telecommunications (underwater cables), and aggregates (seabed mining) that are less familiar in the context of New Brunswick.

In 1994, the marine sector accounted for 8% of the Australian economy, amounting to A\$30 billion (about the same in Canadian dollars). The activities conform quite closely to the private industries identified for New Brunswick. The Australian study also noted that the marine sector grew by about 8% a year in real terms (inflation-adjusted) between 1987 and 1994, well over the rate for the total economy, and accounted for 7.7% of total exports from Australia in 1994.

The Canadian study estimated the direct impact of the marine sector as 1.6% of GDP in 1988 and falling to 1.4% in 1996. The study also provided some regional data. In Atlantic Canada, the contribution was 10.2% of GDP in 1996. In the Pacific region, the contribution was 3.9% of GDP.

Alone among these estimates, the Nova Scotia study estimated both direct and total impacts, and also included estimates for employment and household income. In terms of GDP, the marine sector was about 10% of direct GDP, and 17.5% of total GDP. Employment and household income estimates were roughly the same in direct terms, but rise to almost one-quarter of all jobs and incomes in terms of total impact. The

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4 (1) Giulio Pontecorvo et al., *Contribution of the Ocean Sector to the United States Economy*, *Science*, 208 pp 1000-1006, May, 1980. (2) David Pugh and Leonard Skinner, *An Analysis of Marine-Related Activities in the UK Economy and Supporting Science and Technology*, Inter-Agency Committee on Marine Science and Technology, Information Document No. 5, December, 1996. (3) Australian Marine Industries and Science Council, *Marine Industry Development Strategy*, Australian Development of Industry, Science and Tourism, January, 1997. (4) Dept. of Fisheries & Oceans, *Canada’s Ocean Industries: Contribution to the Economy, 1988-1996*, 1998. (5) Mandale Consulting et al, *Estimating the Economic Value of Coastal and Ocean Resources: The Case of Nova Scotia*, prepared for the Oceans Institute of Canada and the Atlantic Coastal Zone Information Steering Committee, February 1998.

## **Value of Marine-Related Resources**

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methodology used for the Nova Scotia study is applied and improved upon in this study for New Brunswick.

## Chapter Two

### The New Brunswick Marine Sector: Private Industries and Government Departments

This chapter sets out the direct economic value of the marine sector in New Brunswick. It first identifies those private industries and government departments that relate more or less directly to the ocean. For each activity, three sets of data are presented - direct output (sales), employment, and payroll. The data have been compiled wherever possible for three consecutive years (1995, 1996, and 1997) and an average of these years is used both in this chapter and the next for the impact estimates. Where data are available, value of exports has been added to the summary tables in this chapter to supplement the brief descriptions of recent trends, and to demonstrate the importance of the marine sector as an export earner.

In Chapter One we broadly defined New Brunswick's marine-related private industries as those that either use the ocean as a resource, or as a medium of operation. Government is also actively involved; it can pursue a developmental role in promoting output and jobs from private industries such as aquaculture and traditional fishing, but there are important regulatory, management, safety (rescue), and infrastructure functions as well. These roles are summarized in this chapter.

There are 14 relevant marine-related industries or departments, ten of which fall more or less into the private sector and four of which are government departments:

#### **Private Industries:**

- Traditional fishing
- Aquaculture
- Fish processing
- Shipbuilding and boatbuilding
- Marine technology manufacturing
- Ferry services
- Marine-related ecotourism
- Marine construction
- Ports
- Research and other services

**Government Departments:**

New Brunswick Department of Fisheries and Aquaculture  
New Brunswick Department of the Environment  
Department of Fisheries and Oceans  
Environment Canada

**2.1 Private Industries**

There are ten private industries engaged in the marine sector in New Brunswick. These are evenly split between goods-production and services. Goods-producing industries in general are bigger and therefore more important in terms of economic impact.

**2.1.1 Traditional Fishing and Aquaculture**

Primary fishing (actually taking fish from the water) is one of the most important marine-related activities in New Brunswick. In 1997, its two principal components, traditional fishing and aquaculture, had a combined output of \$287.8 million dollars, split about 50:50.

The traditional fishery has been a mainstay of the marine sector for many years. It is based principally on shellfish (mainly lobster and crabs) but with a significant element of pelagic species (mainly herring). The breakdown of landed values in 1997 was 86.5% shellfish, 10.9% pelagic species, and 2.6% other species including groundfish<sup>5</sup>. New Brunswick's fishery suffered less from the collapse of the groundfishery in the early 1990s than Newfoundland and Nova Scotia, as it depends less on species such as cod and haddock. At the end of 1994 there were 971 New Brunswickers eligible for federal assistance under The Atlantic Groundfish Strategy (TAGS) compared to 35,529 in the other Atlantic provinces<sup>6</sup>.

Fishing is an important source of economic activity for many of New Brunswick's smaller coastal communities. There are two main fisheries. One is in the Gulf of St Lawrence, which borders New Brunswick's northern and eastern shores. The other is in the Bay of Fundy, along New Brunswick's southern shore. The Gulf fishery in New Brunswick is larger than the Bay of Fundy fishery, accounting for 82% of its landed values, and 71% of landed weight in 1997.

The overall performance of the traditional fishery in New Brunswick is modest (Charts 2.1, 2.2, and 2.3). Landings have dropped since the last peak of 99,433 tonnes in 1989. Stronger prices, which reached \$6,100/tonne in 1995, have meant landed values kept going up in the early 1990s, but have dropped since 1995. Employment and aggregate incomes from the fishery have dropped at the same time (see Table 2.1 and

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<sup>5</sup> Department of Fisheries and Oceans, *Statistical Review 1995, 1996, 1997*. December, 1998.

<sup>6</sup> Mount Allison University, Geography Department, *Coastal Communities in Crisis: Issues and Impacts*, November, 1996.

Chart 2.4 on page 12). Not only are markets a factor in this volatility, but also the health and availability of stocks of fish.

New species have entered the commercial fishery in recent years, including sea urchins and rock crab.<sup>7</sup> The value of traditional products such as lobster, snow crab, and herring continues to increase as marketing, value-added (such as smoking and entrees), and packaging have improved.

New markets have also been penetrated. New Brunswick lobster has made significant inroads in Europe. But the United States and Japan continue to be the province's two main markets for fish and seafood, accounting for 58% and 32% of total exports respectively.

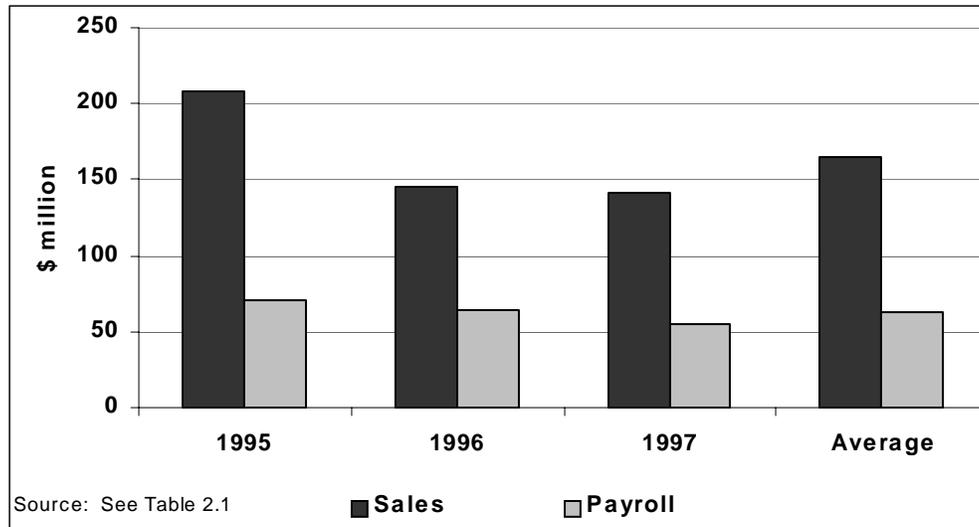
Table 2.1 and Chart 2.4 present basic data for traditional fishing. The industry had average sales from 1995 through 1997 of \$165 million a year, employed 3,492 people on a full-time basis, who earned an aggregate income of \$63 million. The employment numbers need qualifying. They include both those fishermen classified as full-time, or whose principal income (75% of the total) is fishing; and part-time fishermen converted to a full-time equivalent at a ratio of four to one (four part-timers make one full-timer). Many part-timers (about 6,000 in total on average) fish only a few weeks a year, and have incomes from other sources at various times of the year. A part-time to full-time ratio of four to one implies the average part-timer gets between 40 and 50 fishing days a year.

<b>Table 2.1: New Brunswick Traditional Fishing: Key Economic Indicators</b>				
	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>AVG.</b>
<b>Sales (\$ million)</b>	<b>208.2</b>	<b>145.4</b>	<b>141.4</b>	<b>165.0</b>
<b>Employment</b>	<b>4024</b>	<b>3322</b>	<b>3131</b>	<b>3492</b>
<b>Payroll (\$ million)</b>	<b>70.8</b>	<b>63.6</b>	<b>54.5</b>	<b>63.0</b>
Sources: Fisheries and Oceans Canada Statistical Review, various years. Revenue Canada Taxation Statistics, various years. N.B. Fisheries and Aquaculture Summary Review, various years. Commercial Fisheries in New Brunswick, June, 1999.				

**Chart 2.4: New Brunswick Traditional Fishing  
Key Economic Indicators**

7 N.B. Government Web Site

## Value of Marine-Related Resources



If the traditional fishery represents the “old” way of doing things, aquaculture is the “new”, at least in Canada. It is a recent arrival in New Brunswick, virtually being non-existent before 1979. By 1997, it rivaled the traditional fishery, having output worth over \$146 million and employing 1,362 people. It was dominated by Atlantic salmon which is 95% of production, with the balance being trout, oysters,

and mussels. It is heavily concentrated in the Bay of Fundy, and in particular in Charlotte County where most salmon sites are located.

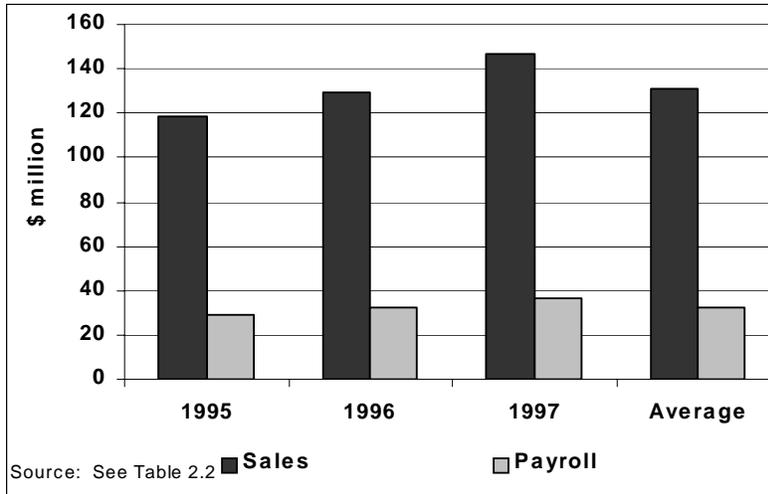
Salmon farming is a good example of how a lucrative industry can spring from research carried out by governments. Much of the early experimentation and experience in breeding and growing salmon from egg to mature fish was done in government laboratories, such as the St. Andrews Biological Station, beginning in the 1930s. This was aimed primarily at restocking prime salmon rivers. This work is a slow process (as current trials with other species such as cod, haddock, halibut and plaice demonstrate) which fish farmers themselves do not have the resources to undertake. All of the experiments with the species noted show promise for New Brunswick.

The performance of New Brunswick's aquaculture sector was very strong from 1979 to 1997 (Chart 2.5 and 2.6). But as with any commodity-based activity, there is volatility in production and prices; prices have ranged from \$6,200/tonne to \$14,000/tonne over the period (Chart 2.7). There are challenges posed by the risk of disease, and also from fierce competition (from places like Norway, Chile, and Scotland) on international markets. Expansion is also limited by the number of suitable sites available, and conflict with the traditional fishery. Aquaculture still holds potential for significant growth, showing that even in established sectors like the fishery there are always new ways of doing things.

Table 2.2 and Chart 2.8 present basic data for aquaculture. Using averages for 1995 through 1997, the industry had an average output of \$131.3 million a year, employed an estimated 1,222 people, who earned an aggregate income of \$32.6 million. Almost all of the output (97%) was exported from the province. In contrast to the traditional fishery, main indicators for aquaculture have been trending upwards quite strongly. By rivaling primary fishing in terms of output but with a workforce only about 60% of its size, economic productivity (output per worker) in aquaculture is significantly higher and demonstrates the dynamism and the potential of the industry.

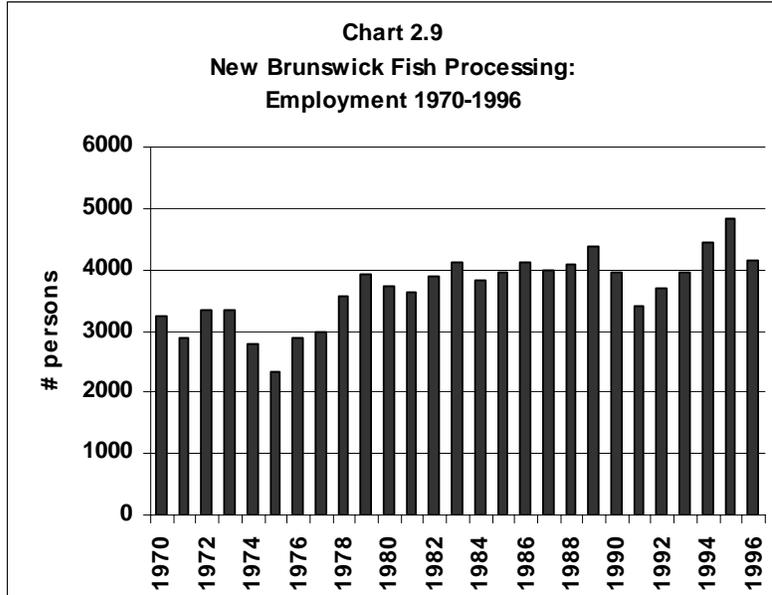
<b>Table 2.2: New Brunswick Aquaculture: Key Economic Indicators</b>				
	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>Avg.</b>
<b>Sales (\$ million)</b>	<b>118.4</b>	<b>129.2</b>	<b>146.4</b>	<b>131.3</b>
<b>Exports (\$ million)</b>	<b>114.8</b>	<b>125.3</b>	<b>142.0</b>	<b>127.4</b>
<b>Employment</b>	<b>1101</b>	<b>1202</b>	<b>1362</b>	<b>1222</b>
<b>Payroll (\$ million)</b>	<b>29.4</b>	<b>32.0</b>	<b>36.3</b>	<b>32.6</b>
Sources: New Brunswick Fisheries and Aquaculture Summary Review Commercial Fisheries in New Brunswick, June, 1999. Canadian Aquaculture Industry Alliance, Canadian Aquaculture Industry Profile and Labour Market Analysis				

**Chart 2.8: New Brunswick Aquaculture  
Key Economic Indicators**



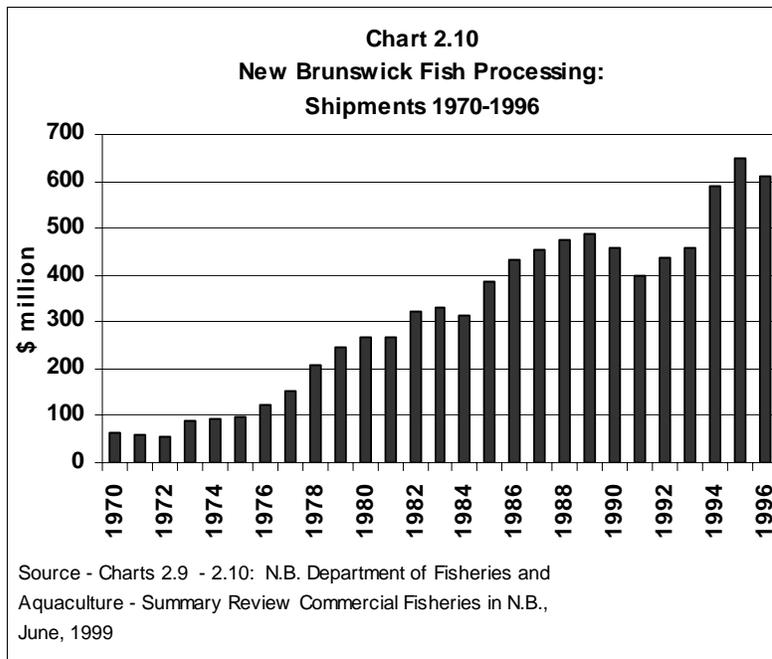
## 2.1.2 Marine-related Manufacturing

Marine-related manufacturing has three main parts - fish processing, shipbuilding and boatbuilding, and, marine-related technology. The first two are substantial, long-established industries. The third is still small in New Brunswick, and data are not easily obtained, but it holds considerable potential so is presented here as a separate sector.



### Fish Processing

Fish products are about 7% of New Brunswick's total manufacturing shipments. The processing that occurs echoes the traditional fishery with shellfish being the dominant species, although there is important (and high value-added) sardine canning, and increasing salmon-based processing, in the Bay of Fundy. A fish plant survey by DFO reported for 1995 that about 80% of fish plant employment was in shellfish plants with the remaining 20% in other types of plant<sup>8</sup>. Fish processing is dominated by the Gulf Region with about 82% of total production.



Charts 2.9 and 2.10 show that the sector has been a significant and growing contributor to the New Brunswick economy for many years. Shipments went up from less than \$100

million in 1970 to more than \$600 million in 1996, an annual average rate of growth of about 15%. Some of this growth in value would be offset by inflation over the same

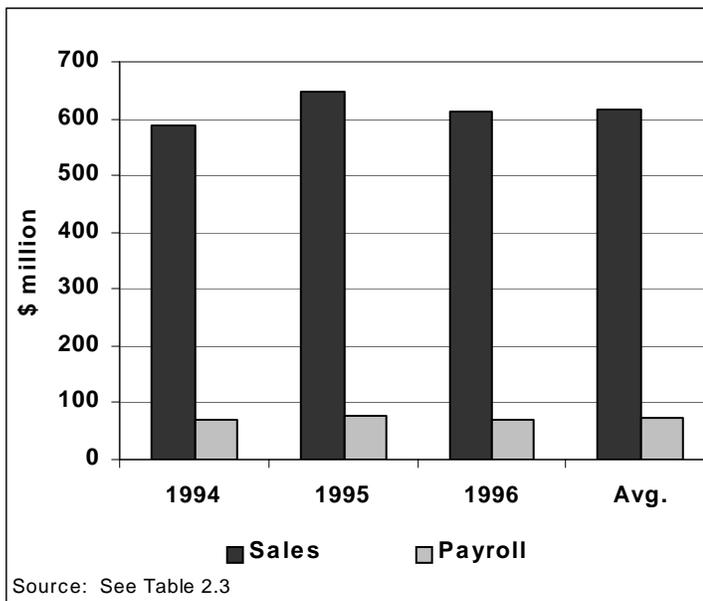
<sup>8</sup> Department of Fisheries and Oceans, *Statistical Review 1995, 1996, 1997*, December 1998.

period. Employment has been more variable, but has still tended to increase to reach about 4,000 in 1996.

Table 2.3 and Chart 2.11 provide the basic data for 1994 through 1996 for fish processing. Average sales were \$616 million a year, average employment was 4475 persons, who earned an aggregate income of \$72.1 million. The industry is a significant exporter, with two-thirds of its output, worth \$407 million, being sold outside the province.

<b>Table 2.3: New Brunswick Fish Processing: Key Economic Indicators</b>				
	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>Avg.</b>
<b>Sales (\$ million)</b>	<b>589.4</b>	<b>648.5</b>	<b>611.4</b>	<b>616.4</b>
<b>Exports (\$ million)</b>	<b>384.6</b>	<b>460.3</b>	<b>376.3</b>	<b>407.1</b>
<b>Employment</b>	<b>4442</b>	<b>4827</b>	<b>4155</b>	<b>4475</b>
<b>Payroll (\$ million)</b>	<b>68.3</b>	<b>78.6</b>	<b>69.3</b>	<b>72.1</b>
Source: Statistics Canada 31-203, Industry Canada Web Site: <a href="http://www-ic.gc.ca">http://www-ic.gc.ca</a>				

**Chart 2.11: New Brunswick Fish Processing:  
Key Economic Indicators**



## Shipbuilding and Boatbuilding<sup>9</sup>

Boatbuilding and shipbuilding is highly concentrated in New Brunswick, dominated by Saint John Shipbuilding Ltd. Output figures for this industry are heavily weighted by the multi-year \$6.2 billion Canadian Frigate Program at this shipyard, which was completed in 1996. Work in Canada at big shipyards is inconsistent in nature, with big contracts, that occupy a skilled labour force and demand specialized inputs from many other industries over a period of years, alternating with no work. This promotes a “feast or famine” pattern. In general, shipyards all across Canada face grim times in the late 1990s and early 2000s, with few contracts and intense competition from Asian and European builders. Two container ships are almost complete at the Saint John yard with nothing on the order books. Whereas employment (mostly skilled) at the yard reached between 3,000 and 4,000 while the frigate program was at its peak, it is now just a few hundred and will get lower unless new orders are received.

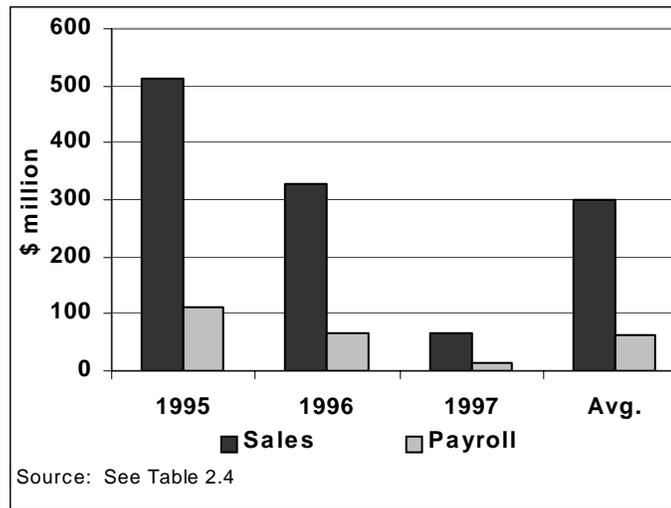
Boatbuilding is a much smaller industry. There are ten establishments, but with a value of output in aggregate much smaller than Saint John Shipyard Ltd. Work at boatyards tends to be more evenly spread than shipyards. Even here, though, there is variability depending on conditions in the fishery which has traditionally been the industry’s biggest source of work. A few boatbuilders are successfully diversifying into the much more lucrative market for recreational boats.

Table 2.4 and Chart 2.12 provide the three-year basic data and averages for shipbuilding and boatbuilding. From 1995 to 1997, the industry had shipments of \$301.7 million on average, employed 1369 people, who earned an aggregate income of \$63.5 million. All of these main indicators declined sharply over the period, and will get lower in the absence of big orders at Saint John.

	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>Avg.</b>
<b>Sales (\$ million)</b>	<b>512.1</b>	<b>326.7</b>	<b>66.3</b>	<b>301.7</b>
<b>Exports (\$ million)</b>	<b>0.2</b>	<b>0.4</b>	<b>0.6</b>	<b>0.4</b>
<b>Employment</b>	<b>2383</b>	<b>1420</b>	<b>303</b>	<b>1369</b>
<b>Payroll (\$ million)</b>	<b>110.9</b>	<b>65.6</b>	<b>14.1</b>	<b>63.5</b>
Source: Statistics Canada 31-203, Industry Canada Web Site: <a href="http://www.ic.gc.ca">http://www.ic.gc.ca</a>				

<sup>9</sup> In general, the distinction between a boat and a ship is weight - up to five tonnes it is a boat, above five tonnes it is a ship.

**Chart 2.12: New Brunswick Shipbuilding and Boatbuilding:  
Key Economic Indicators**



### Marine Technology Manufacturing

Marine technology manufacturing is small in New Brunswick. There are several manufacturers of navigation equipment and marine-related control and monitoring equipment, mostly centred on the main shipbuilding centre in Saint John. Data are difficult to obtain, and only a single year (1997) is presented in an effort to gauge the industry's relative importance. They show output of \$8 million, associated direct employment of 30 jobs, and aggregate income of \$1 million.

These figures are probably low. Many machine manufacturing firms could very well sell to marine-related enterprises, so would have marine-related output. Identifying which firms these are would require a special survey. It is important, however, to note these modest data; these technology manufacturing companies offer considerable potential in New Brunswick. They are knowledge-based, pay very good wages, are often export-oriented, and make high value-added products.

### 2.1.3 Marine-based Services

#### Ferry services

Ferry services are dominated by Marine Atlantic, a federal Crown corporation. Although ferry services are included in this analysis as an important component of marine-related industries, they would not figure as prominently in future analyses, as the mid-1990s were a time of great change. Primarily, the service to Prince Edward Island (Marine Atlantic's biggest and busiest) was replaced by the Confederation Bridge in mid-1997.

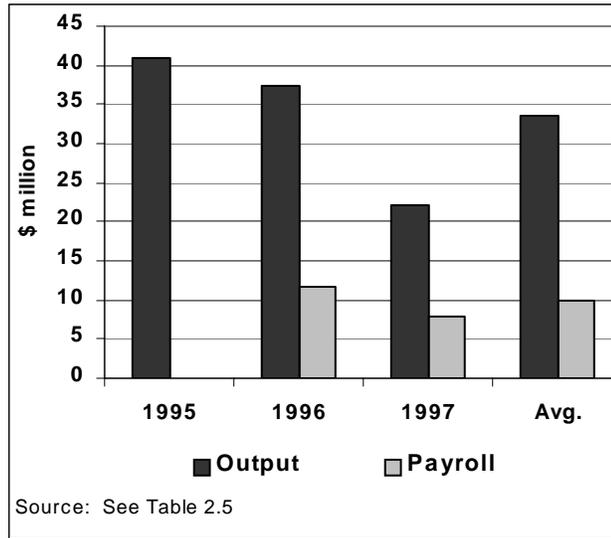
Marine Atlantic's other main service, linking Saint John and Digby, Nova Scotia, is still operating but is now privately-owned. Most of the personnel who run this service are based in New Brunswick. Marine Atlantic has for long had its head office in Moncton, but it has already moved many of its functions and personnel to locations near its remaining principal run, between Nova Scotia and Newfoundland. Other ferry services

link the mainland with islands in the Bay of Fundy, notably Grand Manan and Deer Island. There is a small ferry between Dalhousie and the Gaspé in the north. Data for all these services are included in this analysis.

Table 2.5 and Chart 2.13 present basic economic data for ferry services. From 1995 to 1997 the industry had an average output of \$33.5 million, employed 424 people, who earned an aggregate income of \$9.8 million. Note that employment and payroll data are for two years only, 1996 and 1997.

<b>Table 2.5: New Brunswick Ferry Transportation: Key Economic Indicators</b>				
	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>Avg.</b>
<b>Output (\$ million)</b>	<b>41.0</b>	<b>37.5</b>	<b>22.0</b>	<b>33.5</b>
<b>Employment</b>	<b>na</b>	<b>423</b>	<b>426</b>	<b>424</b>
<b>Payroll (\$ million)</b>	<b>na</b>	<b>11.7</b>	<b>7.8</b>	<b>9.8</b>
Source: Marine Atlantic, Canmac Economics Ltd., N.B. Department of Transportation				

**Chart 2.13: New Brunswick Ferry Transportation:  
Key Economic Indicators**



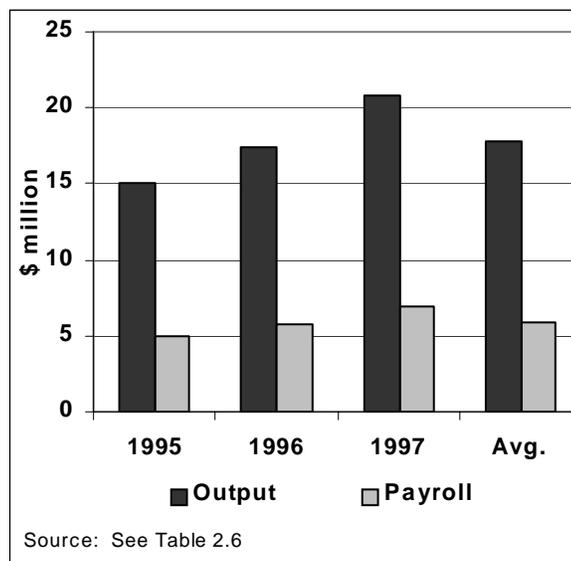
### Marine Construction Services

Marine construction is the building, maintenance and repair of docks, wharves, breakwaters and other marine infrastructure necessary for any boat-based enterprise or activity to proceed. It is mainly paid for by governments, but the work is generally undertaken by private companies under contract. It can be highly variable from year to year, in part because of fiscal considerations. Key data are provided in Table 2.6 and Chart 2.14 for 1995 to 1997. The averages for these three years are \$17.8 million in output, 189 jobs, and an aggregate income of \$5.9 million.

	1995	1996	1997	Avg.
<b>Output (\$ million)</b>	15.1	17.4	20.8	17.8
<b>Employment</b>	161	18.5	221	189
<b>Payroll (\$ million)</b>	5.0	5.7	6.9	5.9

Source: Statistics Canada 61-223, Canmac Economics Ltd.

**Chart 2.14: New Brunswick Marine Construction: Key Economic Indicators**



### Ports

New Brunswick’s coastline is dotted with ports and harbours, but in terms of economic activity the Port of Saint John is dominant. This ice-free port is Canada’s fourth largest, and it handles a wide range of bulk, break-bulk and containerized cargo. It is an integral part of many of the province’s important trading sectors, being the point of export of forest products, refined petroleum products, potash, and salt and the point of import of crude oil for the big refinery in Saint John. There are other locally-important cargo-handling ports at Miramichi, Belledune, and Dalhousie.

Table 2.7 and Chart 2.15 show total cargo handled in New Brunswick and specifically Saint John between 1986 and 1997. In 1997, Saint John handled 85% of total

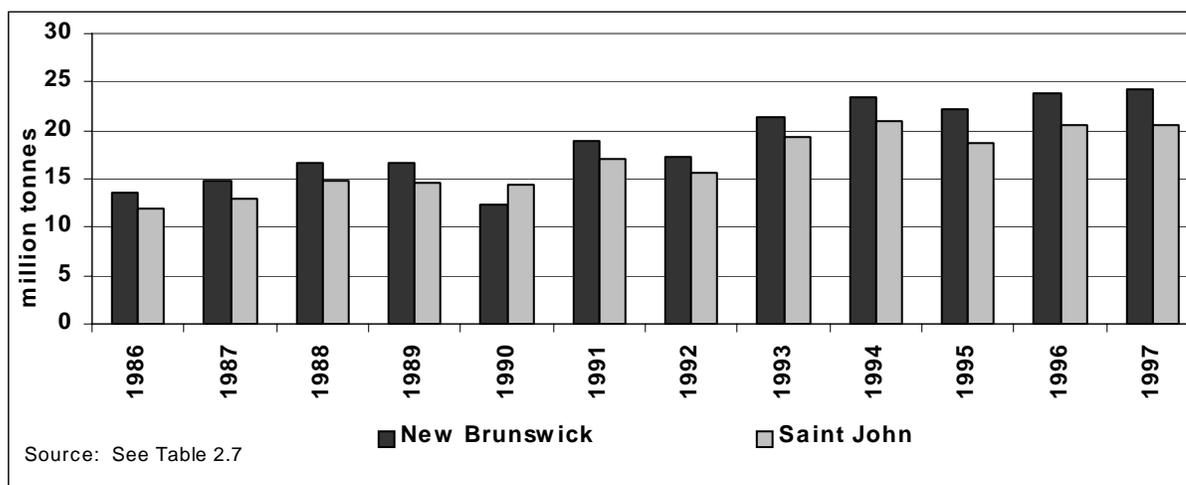
cargo movement through the province's ports. Between 1986 and 1997, New Brunswick's average annual growth in total cargo handled was 5.5%, and that for Saint John was a little lower at 5.1%.

**Table 2.7: Total Cargo Handled - Domestic And International  
Saint John and Total New Brunswick  
(million tonnes)**

Year	New Brunswick	Saint John
1986	13.5	11.9
1987	14.8	13.0
1988	16.7	14.7
1989	16.6	14.6
1990	12.3	14.4
1991	18.9	17.1
1992	17.2	15.6
1993	21.3	19.3
1994	23.5	20.9
1995	22.1	18.7
1996	23.8	20.6
1997	24.3	20.6

Source: Statistics Canada 54-205-XPB

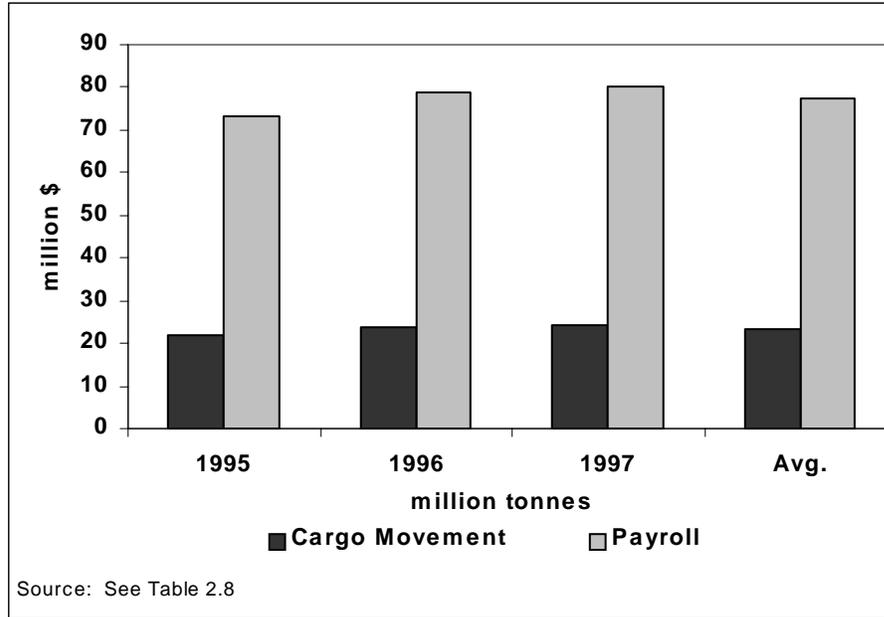
**Chart 2.15: Total Cargo Handled - Domestic and International  
Saint John and Total New Brunswick**



The basic data for New Brunswick ports are in Table 2.8 and Chart 2.16 for 1995 to 1997. Average movement of cargo (used here as a proxy for value of output, which is not available) through the ports was 23.4 million tonnes, generating almost 2,700 jobs and an aggregate income of \$77.3 million.

<b>Table 2.8: New Brunswick Ports: Key Economic Indicators</b>				
	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>Avg.</b>
<b>Cargo Movement (million tonnes)</b>	<b>22.1</b>	<b>23.8</b>	<b>24.3</b>	<b>23.4</b>
<b>Employment</b>	<b>2547</b>	<b>2742</b>	<b>2799</b>	<b>2696</b>
<b>Payroll (\$ millions)</b>	<b>73.0</b>	<b>78.6</b>	<b>80.2</b>	<b>77.3</b>
Source: Port of Saint John, Canmac Economics Ltd.				

**Chart 2.16: New Brunswick Ports:  
Key Economic Indicators**



There are many other ports and harbours dotted along New Brunswick's coasts. DFO has records of 131 small-craft harbours, some 50 of which are expected to be turned over to locally-based management. Although not big in terms of direct economic impact, they are important as a place for fishing and recreational boats to tie up. Precise numbers are difficult to obtain, although departmental spending, which is covered in Section 2.3 below, is almost \$7 million a year.

### Marine-related Ecotourism

Tourism is one of the world's fastest growing industries. The figures for international tourism (people moving outside their own national boundaries) are impressive. Between 1989 and 1999 the number of international arrivals around the world increased from 426 million to 668 million, or by an annual average rate of 4.6% a year. The amount of money they spent is even more impressive. Total tourist receipts from international arrivals went up from \$262 billion in 1989 to \$651 billion in 1998, or by an annual average rate of 10.6% a year<sup>10</sup>. Not only are there more people traveling internationally, but they are spending much more.

Ecotourism is a part of overall tourism, but no-one knows for sure how big a part, because there is no commonly-accepted definition. The definitions that do exist emphasize the enjoyment of some aspect of the natural environment, either actively or passively. The World Tourism Organization has estimated global ecotourism receipts at 7% of all tourism spending. This means it accounted for spending of \$45.6 billion by international tourists in 1998. It has been growing even faster than tourism in general. Typically, ecotourists are older than the average tourist, are better educated, travel further to get to a destination, stay longer, and spend more when they get there.

Marine-related ecotourism is a niche of ecotourism, but how big a niche can only be estimated very roughly, for several reasons. Firstly, tourism as an industry generally does not have sharply-defined edges, but cuts across other industries. Secondly, the economic value of ecotourism is elusive in so far as the things "consumed" (such as beaches, sand dunes, birdwatching, whale-watching, clean air and clean water) do not often have economic values; markets have not yet been developed for them, or are imperfect. In common with other environmentally-sensitive assets, society tends to under-price their value to the point of often regarding them as being "free".

This is not to say that there are no market valuations at all for these services. People often travel considerable distances to enjoy a particular attraction, so the cost of their travel is a proxy "value" for that attraction. While in the vicinity of the attraction, they buy food and accommodation. Much of this spending, however, goes into the pockets of the people providing such services, and it is difficult to separate the part of such spending that properly "belongs" to the attraction that drew them there in the first place. Most of the revenue from whale-watching, for example, is collected by the owners of the boats that take tourists out to the whales. Some attractions like national or provincial parks do manage to capture part of direct consumer spending by charging entry fees, and the size of these fees is in part determined by demand for the attraction in much the same way as the prices of other products and services are determined.

A very conservative approach to ecotourism valuation is adopted for this study. It understates the true economic impact of marine-related ecotourism in New Brunswick considerably, because it only covers two specific "suppliers". These are the two National

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<sup>10</sup> The rate of increase in U.S. dollars, from which these figures were converted to Canadian dollars, was 7.9% a year. The difference is explained by a declining value of the Canadian dollar over the period, from 84.46 cents (American) in 1989 to 68.5 cents (American) in 1998.

Parks, one on the Bay of Fundy, the other on the southern Gulf of St. Lawrence. These are the only places where we could obtain good data on the number of visitors and how much they spend. Most visitors come to the parks at least in part to enjoy the associated marine experience. What they spend is our estimate of the direct impact of the ecotourism market, and will allow calculation of the wider impacts.

Fundy National Park has rocky beaches, and steep cliffs backed by deep wooded valleys, and the famous Bay of Fundy tides. Established in 1948, the park covers 206 square kilometers in southern New Brunswick. Further north in Kent County, Kouchibouguac National Park covers 238 square kilometers. The park is a mix of marine and inland habitats, including beaches, sand dunes, lagoons, salt marshes bogs, rivers, forests and fields. Both parks have abundant birdlife, marine animals, and forest animals of all sizes.

The National Parks’ contribution to the New Brunswick economy has a direct spending component and an economic impact component. The direct component is money spent on operations and maintenance (O&M) by Parks Canada. The economic impact component is defined as the estimated total visitor spending that results in income and employment for the people who live around the parks, in addition to the economic activity generated by O&M spending.

An indication of the demand for marine-related ecotourism is the number of person-visits. Table 2.9 and Chart 2.17 show the growth in person-visits for Fundy and Kouchibouguac from 1994/1995 to 1998/1999. These are fiscal years running from April 1 to March 31, so the main visitation in 1998/1999, for example, would be in the summer of 1998. Fundy has been slightly more popular with 51% of combined visitation in 1994/1995, and 53% in 1998/1999. Visitation has been variable to the two parks, with stable or declining numbers from 1994/1995 to 1997/1998, but there was a sharp increase in 1998/1999.

	<b>1994/95</b>	<b>1995/96</b>	<b>1996/97</b>	<b>1997/98</b>	<b>Avg.</b>
<b>Fundy</b>	<b>241,076</b>	<b>233,474</b>	<b>220,714</b>	<b>236,147</b>	<b>232,853</b>
<b>Kouchibouguac</b>	<b>230,089</b>	<b>226,631</b>	<b>229,562</b>	<b>229,572</b>	<b>228,963</b>

Source: Parks Canada Web Site <http://www.parks.canada.gc.ca>

**Chart 2.17: Person-Visits, Fundy and Kouchibouguac National Parks**

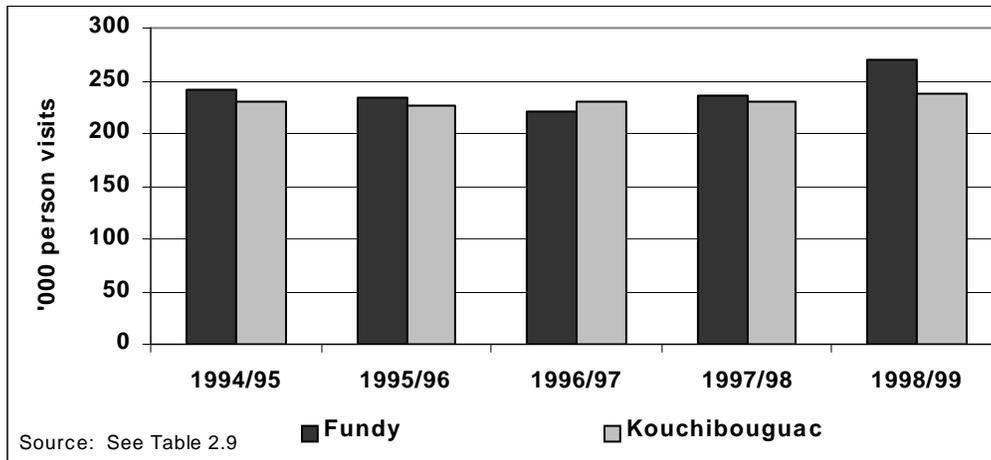


Table 2.10 and Chart 2.18 present basic data for the two national parks for 1995, 1996 and 1997. The average value of output over the three years was \$25.9 million, some 290 jobs were generated, and aggregate income was \$8.1 million.

	1995	1996	1997	Avg.
<b>Output (\$ millions)</b>	25.6	25.4	26.7	25.9
<b>Employment</b>	289	287	296	290
<b>Payroll (\$ millions)</b>	7.8	7.4	9.0	8.1

Source: Parks Canada, Gardner Pinfold Economic Impacts of National Parks & Historic Sites, Canmac Economics Ltd.

**Chart 2.18: New Brunswick Marine-related Ecotourism:  
Key Economic Indicators  
Fundy and Kouchibouguac National Parks**

These are only two of the many marine tourist attractions in New Brunswick. Other notables are the Hopewell Rocks and the Reversing Falls on the Bay of Fundy, and Parlee Beach and the newly-opened Irving Ecocentre at the Bouctouche Dune (which cost \$2.8 million to build from 1996-1998) on the southern Gulf. If comprehensive data were available for these attractions then the economic importance for marine ecotourism tourism would increase. It would also allow consideration of other marine-related activities such as beach recreation, which is not usually included as an ecotourist feature.

Provincial promotion efforts in recent years have emphasized the natural attractions of the Bay of Fundy in particular. The important linkage between the ocean and expanding tourism in New Brunswick cannot be ignored; total gross revenues from all kinds of tourism in 1999 have been estimated at \$920 million. The part that ecotourism plays in this total is getting bigger, and is especially important in that New Brunswick is adjacent to the affluent American tourist market.

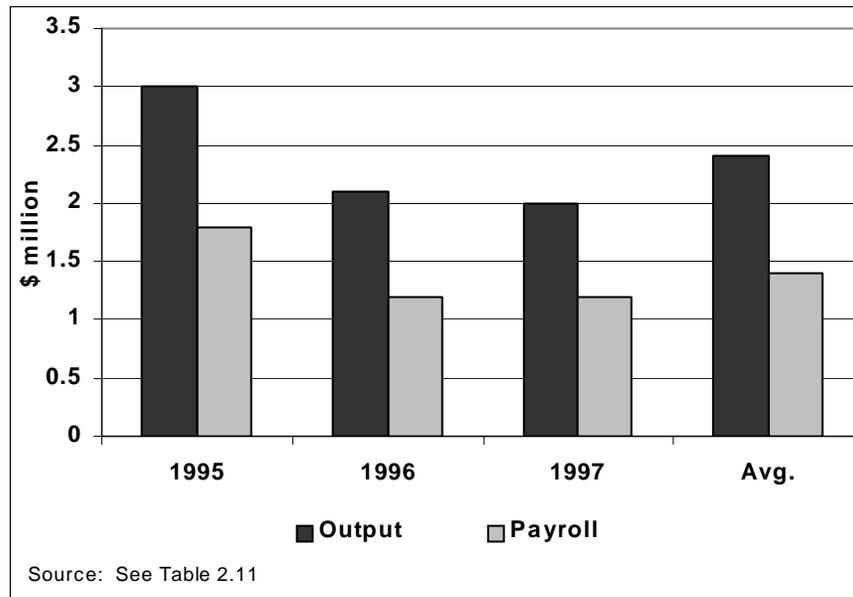
### **Marine-related research and other services**

Research and other marine-related services are an important source of innovation for New Brunswick. The Huntsman Marine Science Centre in St. Andrews, for example, is both a teaching and research centre funded jointly by a consortium of eastern Canadian universities, and by federal and provincial governments. It conducts basic and applied research in marine-related activities, and is also home to an aquarium and museum. Other parts of this sector are at the provincial Research and Productivity Council (RPC), the University of Moncton, the Fisheries School in Caraquet, and the New Brunswick Community College campus in St. Andrews.

Table 2.11 and Chart 2.19 present basic data for research and related services from 1995 to 1997. On average for this period, total output was \$2.4 million, there were 56 jobs, with an aggregate income of \$1.4 million.

<b>Table 2.11: New Brunswick Marine-Related Research and Other Services: Key Economic Indicators</b>				
	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>Avg.</b>
<b>Output (\$ millions)</b>	<b>3.0</b>	<b>2.1</b>	<b>2.0</b>	<b>2.4</b>
<b>Employment</b>	<b>72</b>	<b>48</b>	<b>48</b>	<b>56</b>
<b>Payroll (\$ millions)</b>	<b>1.8</b>	<b>1.2</b>	<b>1.2</b>	<b>1.4</b>
Source: Huntsman Marine Science Centre Annual Reports, N.B. Research and Productivity Council, University of Moncton, School of Fisheries, N.B. Community College Campus St. Andrews				

**Chart 2.19: Ocean-Related Research and Other Services:  
Key Economic Indicators**



## 2.2 Government Departments

In New Brunswick there are four government departments which have mandates and responsibilities wholly or partly for activities associated with marine resources. Federal departments are the Department of Fisheries and Oceans (DFO), which devotes most of its resources to marine-related activities, and Environment Canada with part of its spending being marine-related. The New Brunswick Departments of Fisheries and Aquaculture, and the Environment are also more or less involved in marine-related activities. Other provincial departments have concerns and activities that touch on marine matters, including Natural Resources and Energy; Economic Development, Tourism and Culture; and Transportation, but the impacts of these are very small.

### **New Brunswick Department of Fisheries and Aquaculture (NB DFA)<sup>11</sup>**

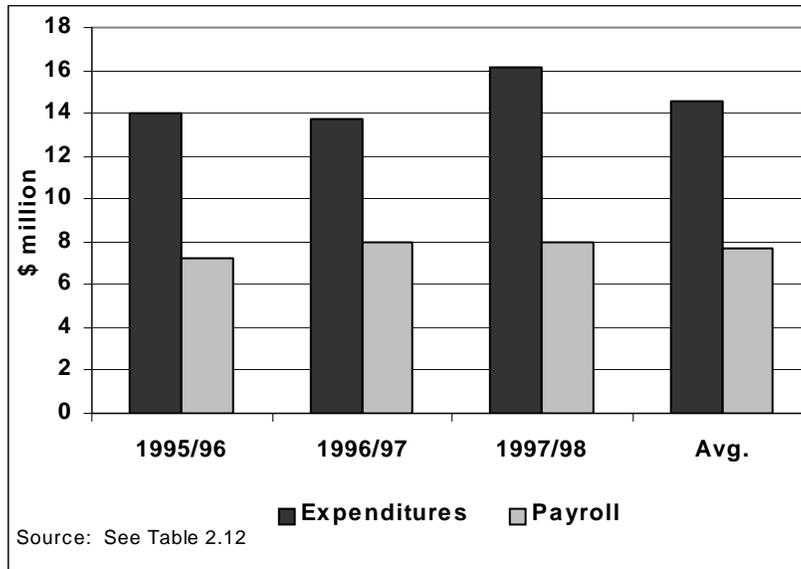
This is the most important of the provincial departments having an interest in marine resources. Its principal mission is the development of a market-driven fishery and aquaculture industry, founded on sound commercial, public health and environmental principles. The department's activities are directed at maximizing long-term economic benefits. Clients include inshore, midshore and offshore fishermen, aquaculturists, fish processing plants, and seafood wholesalers and retailers.

After forestry, agriculture, and mining, the fisheries and aquaculture sector is the fourth largest industry in New Brunswick. Table 2.12 and Chart 2.20 present NB DFA's basic data. Direct departmental spending averaged \$14.6 million a year from 1995 to 1997, actually rising from 1995/96 to 1997/98 by almost 16%. Average annual direct employment in the department was 141, with an aggregate income of \$7.7 million.

	<b>1995/96</b>	<b>1996/97</b>	<b>1997/98</b>	<b>Avg.</b>
<b>Expenditures (\$ million)</b>	<b>14.0</b>	<b>13.7</b>	<b>16.1</b>	<b>14.6</b>
<b>Employment</b>	<b>142</b>	<b>140</b>	<b>140</b>	<b>141</b>
<b>Payroll (\$ million)</b>	<b>7.2</b>	<b>8.0</b>	<b>8.0</b>	<b>7.7</b>
Source: N.B. Department of Fisheries and Aquaculture				

<sup>11</sup> As this report was being finalized, NB DFA was disbanded and its components incorporated into other departments.

**Chart 2.20: New Brunswick Department of Fisheries and Aquaculture:  
Key Economic Indicators**



**New Brunswick Department of the Environment<sup>12</sup>**

The New Brunswick Department of the Environment also has an interest in the marine resources, but this is small relative to NBDFA. The department’s mission is "to provide leadership in protecting and enhancing the environment thereby contributing to the environmental, social and economic sustainability of New Brunswick, for present and future generations". This mission is applied to marine regions and environments. The department also participates in organizations such as the Gulf of Maine Council on the Marine Environment.

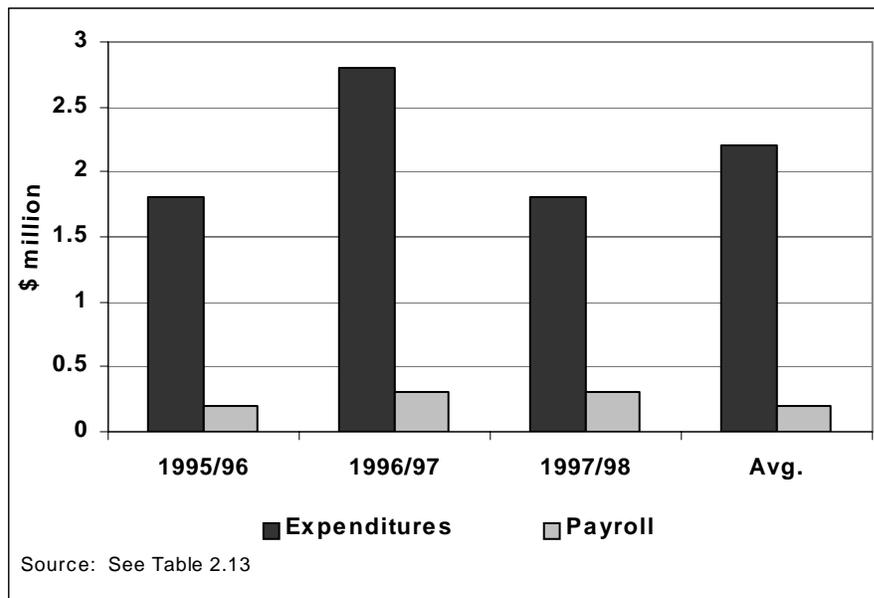
The department is also concerned with municipal waste treatment studies in coastal areas, indeed all land-based sources of pollution, both residential and industrial, have an obvious impact on marine resources. The department may also require environmental assessments in marine areas.

Key data for the department are in Table 2.13 and Chart 2.21. Estimates show average annual spending of \$2.2 million allotted to marine-related activity, or 6.3% of the departmental budget in 1997/98. There are four jobs on average a year associated with marine-related activities, with an aggregate income of \$230,000.

<sup>12</sup> As this report was being finalized, NB Environment became part of the new Department of the Environment and Local Government. This new department also absorbed part of the old NBDFA (see footnote 7).

<b>Table 2.13: New Brunswick Department of the Environment: Key Economic Indicators</b>				
	1995/96	1996/97	1997/98	Avg.
<b>Expenditures (\$ million)</b>	1.8	2.8	1.8	2.2
<b>Employment</b>	3.6	4.5	4.5	4.2
<b>Payroll (\$ million)</b>	0.2	0.3	0.3	0.2
Source: N.B. Department of the Environment				

**Chart 2.21: New Brunswick Department of the Environment: Key Economic Indicators**



**Department of Fisheries and Oceans (DFO)**

DFO's mission is "to manage Canada's oceans and major waterways so that they are clean, safe, productive and accessible, to ensure sustainable use of fisheries resources and to facilitate marine trade and commerce." The department has prime responsibility for marine fisheries management and regulation in Canada. This includes scientific research, stock assessment, commercial fishing licensing, enforcement, oceanographic research, hydrographic charting, rescue, buoys, and many small craft harbours.

In addition, since April 1, 1995, the Canadian Coast Guard (CCG) has become part of DFO, providing services such as search operations and icebreaking. This merger combined the government's two main civilian marine programs within one department. DFO is now one of the larger federal departments, with a budget for 1997-98 of \$1.1 billion and 9,200 personnel. It is the only federal department with an "oceans" mandate, that is responsible for managing aquatic resources, the marine environment, and maritime safety services.

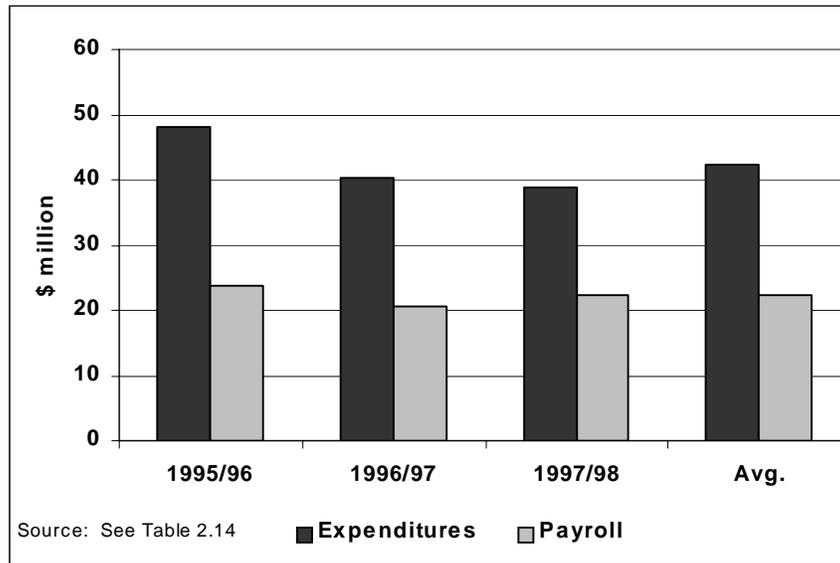
DFO manages New Brunswick fisheries from two regions. The Gulf fishery is part of the Gulf Region, with its head office in Moncton, and staff that includes fisheries managers, scientists, hydrographers, and technicians. There is also a field office in Tracadie-Sheila. The Bay of Fundy fishery is managed as part of the Scotia-Fundy Region, with its head office in Dartmouth, Nova Scotia. A field office is also located on New Brunswick's southwestern shore at the St. Andrews Biological Station.

CCG has an operations base in Saint John, which covers the Bay of Fundy and adjacent waters to Cape Sable Island on the southern tip of Nova Scotia. This base is equipped with the ships and equipment required for pollution response, buoy maintenance, search and rescue and other tasks.

Table 2.14 and Chart 2.22 present basic data for the department. Average spending by DFO in New Brunswick for 1995/96 to 1997/98 was \$42.4 million, but has gone down year by year for a total drop of 20% over the period. There are over 600 jobs associated with the department, and an aggregate income of over \$20 million.

<b>Table 2.14: Department of Fisheries and Oceans: Key Economic Indicators</b>				
	<b>1995/96</b>	<b>1996/97</b>	<b>1997/98</b>	<b>Avg.</b>
<b>Expenditures (\$ million)</b>	<b>48.1</b>	<b>40.4</b>	<b>38.7</b>	<b>42.4</b>
<b>Employment</b>	<b>596</b>	<b>576</b>	<b>666</b>	<b>613</b>
<b>Payroll (\$ million)</b>	<b>23.9</b>	<b>20.5</b>	<b>22.2</b>	<b>22.2</b>
Source: Department of Fisheries and Oceans				

**Chart 2.22 Department of Fisheries and Oceans:  
Key Economic Indicators**



**Environment Canada**

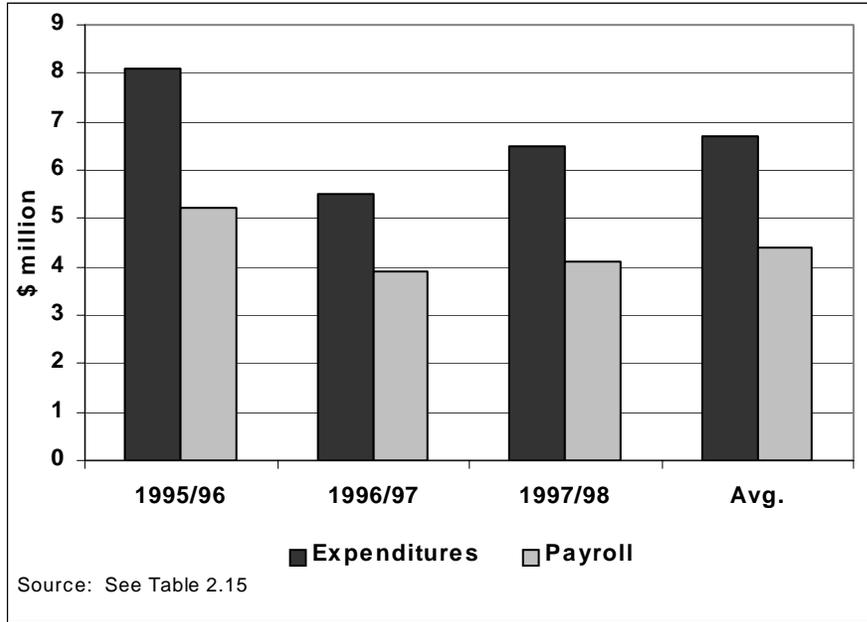
Environment Canada is a science-based department with a mandate that includes preservation and enhancement of the quality of the natural environment, renewable resources (including migratory birds and other non-domestic flora and fauna), meteorology, and coordination of federal environmental policies and programs. Environment Canada is organized into five integrated regions across Canada, including an Atlantic Region based in Dartmouth, Nova Scotia. Environment Canada has approximately 4,900 employees, and a current budget of \$546 million. There are meteorological and other offices in New Brunswick, including the Atlantic regional headquarters of the Canadian Wildlife Service in Sackville.

Key data for Environment Canada operations are in Table 2.15 and Chart 2.23. The department has had budget cuts similar to other federal departments. Over the three years 1995/96 to 1997/98 department spending in New Brunswick averaged \$6.7 million a year. Annual direct employment was 89 jobs, with associated aggregate income of \$4.4 million.

	1995/96	1996/97	1997/98	Avg.
<b>Expenditures (\$ million)</b>	8.1	5.5	6.5	6.7
<b>Employment</b>	106	78	84	89
<b>Payroll (\$ million)</b>	5.2	3.9	4.1	4.4

Source: Environment Canada

**Chart 2.23: Environment Canada: Key Economic Indicators**



### 2.3 Gulf-Fundy Division of Economic Activity

The New Brunswick marine sector divides into two main natural sub-regions – the Bay of Fundy and the southern Gulf of St. Lawrence (as shown in Map 1, page 2). Each has a different mix of marine-related activities. Table 2.16 and Chart 2.24 provide estimates of the direct total output of marine sector private industries in each of these two regions. The southern Gulf dominates in the traditional fishery and fish processing, with aquaculture much more of a factor in the Bay of Fundy, along with shipbuilding and boatbuilding, ports and research activities. Ferry services and ecotourism are more evenly split between the two regions. In terms of total activity, there is a 57:43 split in favour of the southern Gulf.

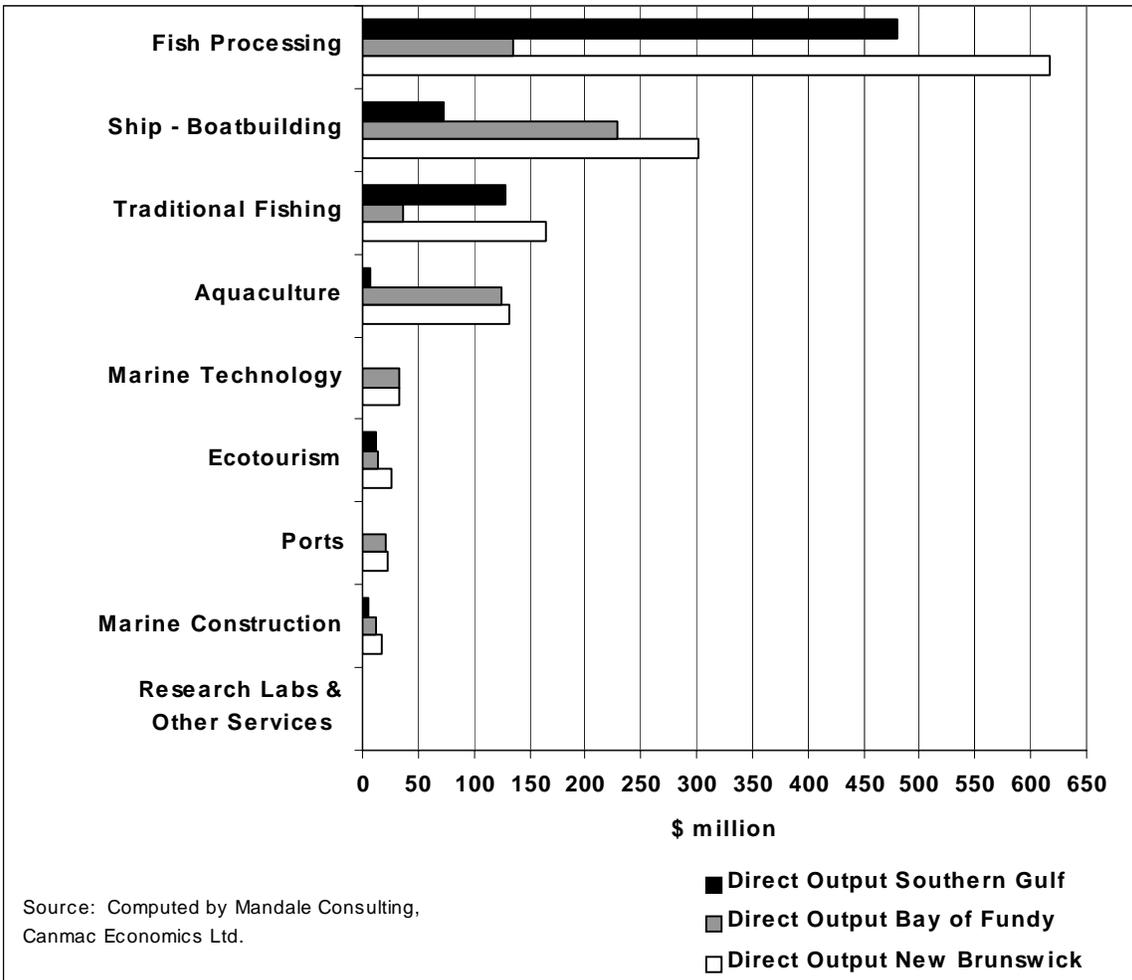
**Table 2.16: Private Industry Output, New Brunswick and Gulf and Fundy Watersheds (Average of 1995, 1996 and 1997, \$ million)**

	New Brunswick	Fundy	Gulf
Fish processing	616.4	135.6	480.8
Ship - and boatbuilding	301.7	229.3	72.4
Traditional fishing	165.0	36.3	128.7
Ports	(a)	(a)	(a)
Aquaculture	131.3	124.7	6.6
Ferries	33.5	20.1	13.4
Ecotourism	25.9	13.9	11.9
Marine Construction	17.8	5.3	12.5
Marine Tech	8.3	4.6	3.7
Research etc.	2.4	2.1	0.3
<b>Total (b)</b>	<b>1,302.3</b>	<b>571.9</b>	<b>730.3</b>
<b>% of total</b>	<b>100.0</b>	<b>43.2</b>	<b>56.8</b>

Notes (a) Output data for ports not available. Sector is inserted here based on direct GDP ranking as determined below. (b) Excluding ports.

Source: Computed by Mandale Consulting, Canmac Economics Ltd.

**Chart 2.24: Estimates of the Direct Total Output of Private Industry Marine Sector Activities, New Brunswick, and Gulf and Fundy Watersheds**



## **2.4 Summary: Private Industry and Government Departments Combined**

Table 2.17 provides summary information on the overall direct economic contribution of the marine sector to the New Brunswick economy. It is a significant contributor by the gross measures outlined in this chapter, directly accounting for 4.8% of total employment in the province, 4.3% of GDP, and 4.1% of household income. The derivation of the GDP number, and others, is the subject of the next chapter of this report

In contrast to Nova Scotia, the private sector dominates. It accounts for 95% of total marine sector output, 96% of employment, and 91% of incomes. In some cases, of course, the activity underpinning these numbers is generated from government contracts, in marine construction and service sectors especially. But the actual work is still mostly done by private industries. This highlights the important role that both governments and private industries have to play in New Brunswick's marine sector, where diverse economic and environmental factors are often inseparable.

<b>Table 2.17: Marine Sector Summary, Basic Data (Average 1995, 1996 and 1997) (Ranked by Output within Private Industry and Government Departments)</b>				
	<b>Direct Output (\$ million)</b>	<b>Direct GDP (\$ million) (a)</b>	<b>Direct Employment</b>	<b>Direct Income (\$ million)</b>
<b>PRIVATE INDUSTRY:</b>				
Fish processing	616.4	147.4	4,475	72.1
Ship-and boatbuilding	301.7	159.9	1,369	63.5
Traditional fishing	165.0	98.2	3,492	63.0
Ports	(b)	77.3 (c)	2,696	77.3
Aquaculture	131.3	57.4	1,222	32.6
Ferries	33.5	9.8(c)	424	9.8
Ecotourism	25.9	10.7	290	8.1
Marine construction	17.8	9.4	189	5.9
Marine tech.	8.3	3.6	30	1.0
Research etc.	2.4	1.4(c)	56	1.4
<b>TOTAL PRIVATE INDUSTRY</b>	<b>1,302.3(d)</b>	<b>575.1</b>	<b>14,243</b>	<b>334.7</b>
<b>GOVERNMENT DEPARTMENTS</b>				
Department of Fisheries and Oceans	42.4	22.2(c)	613	22.2
NB Fisheries and Aquaculture	14.6	7.7(c)	141	7.7
Environment Canada	6.7	4.4(c)	89	4.4
NB Environment	2.2	0.2(c)	4.0	0.2
<b>TOTAL GOVERNMENT DEPARTMENTS</b>	<b>65.9</b>	<b>34.5(c)</b>	<b>847</b>	<b>34.5</b>
<b>GRAND TOTAL (RATIO PRIVATE: GOVERNMENT)</b>	<b>1,368.2</b>	<b>609.6</b>	<b>15,090</b>	<b>369.2</b>
	<b>(95:5)</b>	<b>(94:6)</b>	<b>(94:6)</b>	<b>(91:9)</b>
<b>TOTALS FOR NEW BRUNSWICK</b>		<b>14,295</b>	<b>314,000</b>	<b>8,945</b>
<b>Marine sector as direct % of NB</b>		<b>4.3</b>	<b>4.8</b>	<b>4.1</b>
Notes (a) This will be discussed in the next chapter. (b) Data not available. (c) Where ratios to estimate GDP from output either do not exist or are too difficult to derive it is common practice to use payroll figures as GDP. This is especially the practice in estimating GDP figures for government departments and other quasi-public agencies or activities. (d) Excluding ports.				
Source: Computed by Mandale Consulting, Canmac Economics Ltd.				

## Chapter Three

### Exploring the Wider Impacts of the Marine Sector: Direct, Indirect, and Induced Effects

The data used to describe the marine sector so far in this report give a first impression of its importance in New Brunswick's economy, but they can also be used to show much more. To do this we use the Input-Output (I/O) model of the provincial economy. This section begins with a brief description of the I/O model and how it works. There is a longer explanation in Appendix B.

An I/O model attempts to relate demand for a sector's output, and its own demand for inputs, to the performance of every other sector in an economy. By including a "household" sector as well, consumers are built into the model, and how their purchases reverberate through the total economy as the money they earn by working is spent and respent on goods and services. The three basic impacts to be modelled in this chapter are direct, indirect, and induced. The **direct impact** of the marine sector is defined as its total value of output, or the values explained in Chapter Two of this report less any double-counting (see below). The **indirect impact** is the total value of output from other sectors as they supply the marine sector. This includes the "suppliers of suppliers" to the marine sector. The **induced impact** refers to the additional industry output that arises as households spend the incomes they earn in the marine sector or in the suppliers to that sector. By adding these three impacts up we arrive at a total impact.

#### 3.1 Economic Impact Results

The impact modelling exercise involves taking the direct marine sector output values derived in the preceding chapter and estimating their wider impacts. This involves tracing the local spending of each private industry and government department as they purchase goods and services from suppliers. The first step in this process is to eliminate double-counting between each industry and department specified. For example, fish processing plants purchase fish from the traditional fishery. If we measured the economic impact of the traditional fishery and the economic impact of the fish processing industry in the gross terms explained in Chapter 2 we would be counting the fish twice, since each sector counts this as part of its output. To avoid this, we must first eliminate inter-industry sales between marine-related activities. It should be noted that this in no way detracts from the value or importance of the industry that "loses" the double-counted share, which is usually awarded to the higher value-added activity, for example, in the case of fishing and fish processing, to the latter.

Data are lacking on the size of industry sales within the marine sector. It is probable that a large proportion of the output of traditional fishing is, in fact, bought by fish plants within New Brunswick, and this represents the biggest amount of double counting. Other inter-industry sales are probably very small, although they can be imputed - traditional fishing, for example, buys most of the output of boatbuilding, but as this is lumped with shipbuilding, this double-counting would be very small and would not show up in the modelling. To accommodate double-counting within the fish-related industries (not aquaculture), we report traditional fishing as its direct impact, and

combine it with fish processing for indirect and induced impacts. Although this will understate the wider impacts of traditional fishing, because some fish are sold directly into export markets or to final consumers, lack of data makes it difficult to make any more precise calculation.

### 3.2 GDP Impact

Overall direct GDP of the marine sector private industries in New Brunswick amounts to \$575 million dollars (Table 3.1 and Chart 3.1). Estimating the indirect and induced impacts (accomplished by means of “multipliers” built into I/O models), the *total* GDP accounted for by these industries comes to more than \$1 billion (\$1,031 million) or 7.2% of provincial total GDP. Shares for the three main indicators are presented in Table 3.4. The largest contributor to total GDP is fish processing. When combined with traditional fishing, the total GDP impact is \$458 million, or 46.6% of the total of all private marine-related industries, or 3.2% of the provincial economy. Adding aquaculture GDP to these increases the total number to \$546 million, or 3.8% of New Brunswick’s GDP.

There are other important marine-related industry contributors to the provincial economy, notably shipbuilding and boatbuilding, and ports. The top five sectors (three fish-related plus the two just mentioned) together dominate the private industry component of the marine sector, with about 94% of total private industry GDP. The others are worth \$63 million in terms of GDP but are especially important for the potential they offer i.e. ecotourism, marine technology, and research services.

Government department activities in terms of GDP are dominated by DFO, although both NBDFA and Environment Canada are also significant. It is interesting that direct government activity is a small share (less than 5%) of all marine sector enterprise, a proportion that seems even smaller given that government departments have critical responsibilities in managing and regulating marine resource use and activities.

**Table 3.1: The Marine Sector in New Brunswick  
Gross Domestic Product Impacts, Average of 1995, 1996 and 1997  
(\$ million, ranked by total GDP within sub-groups)**

	Output	Direct GDP	Total GDP	% of sub-total	% of Grand Total
<b>PRIVATE INDUSTRY</b>					
Fish processing	616.4	147.4	359.9	36.6	34.9
Ship- and boatbuilding	301.7	159.9	232.1	23.6	22.5
Ports	(a)	77.3	140.9	14.3	13.7
Traditional fishing	165.0	98.2	98.2	10.0	9.5
Aquaculture	131.3	57.4	88.0	9.0	8.6
Ferries	33.5	9.8	22.4	2.3	2.2
Ecotourism	25.9	10.7	17.1	1.7	1.7
Marine construction	17.8	9.4	12.0	1.2	1.2
Marine tech.	8.3	3.6	8.4	0.8	0.8
Research etc.	2.4	1.4	3.2	0.3	0.3

**Value of Marine-Related Resources**

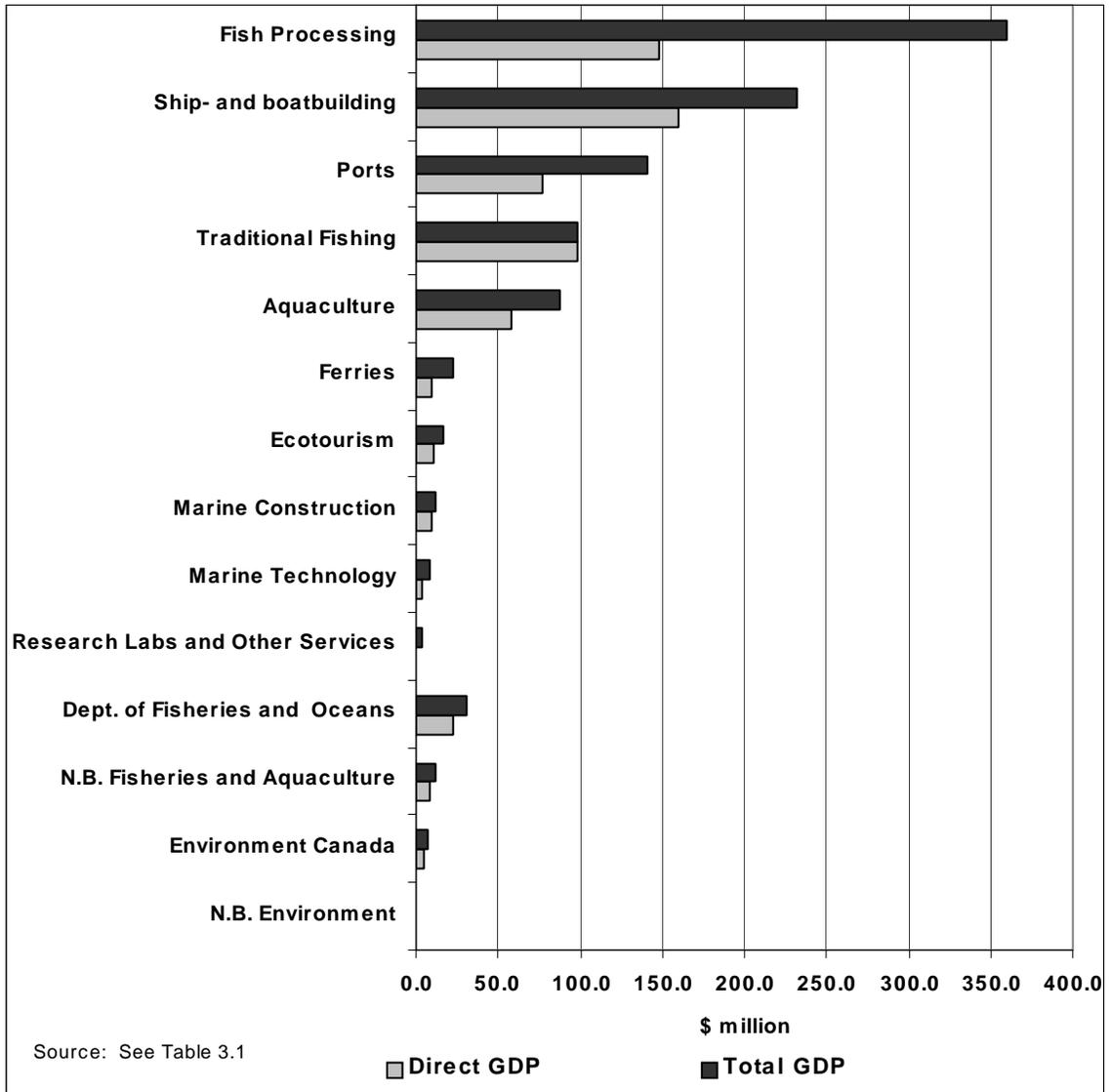
<b>Sub-total</b>	<b>1,302.3</b>	<b>575.1</b>	<b>982.2</b>	<b>100.0</b>	<b>95.2</b>
<b>GOVERNMENT DEPARTMENTS</b>					
<b>Dept. of Fisheries and Oceans</b>	<b>42.4</b>	<b>22.2</b>	<b>30.5</b>	<b>62.2</b>	<b>3.0</b>
<b>NB Fisheries and Aquaculture</b>	<b>14.6</b>	<b>7.7</b>	<b>11.6</b>	<b>23.7</b>	<b>1.1</b>
<b>Environment Canada</b>	<b>6.7</b>	<b>4.4</b>	<b>6.6</b>	<b>13.5</b>	<b>0.6</b>
<b>NB Environment</b>	<b>2.2</b>	<b>0.2</b>	<b>0.3</b>	<b>0.6</b>	<b>(b)</b>
<b>Sub-total</b>	<b>65.9</b>	<b>34.5</b>	<b>49.0</b>	<b>100.0</b>	<b>4.8</b>
<b>Grand total</b>	<b>1,368.2</b>	<b>609.6</b>	<b>1,031.2</b>		<b>100.0</b>

Note (a) Dollar output figure for ports was not available.

Note (b) Less than 0.05%. Totals may not add due to rounding.

Source: Computed by Mandale Consulting, Canmac Economics Ltd.

**Chart 3.1: The Marine Sector in New Brunswick  
Gross Domestic Product Impacts, Average of 1995, 1996 and 1997  
(ranked by total GDP within sub-groups)**



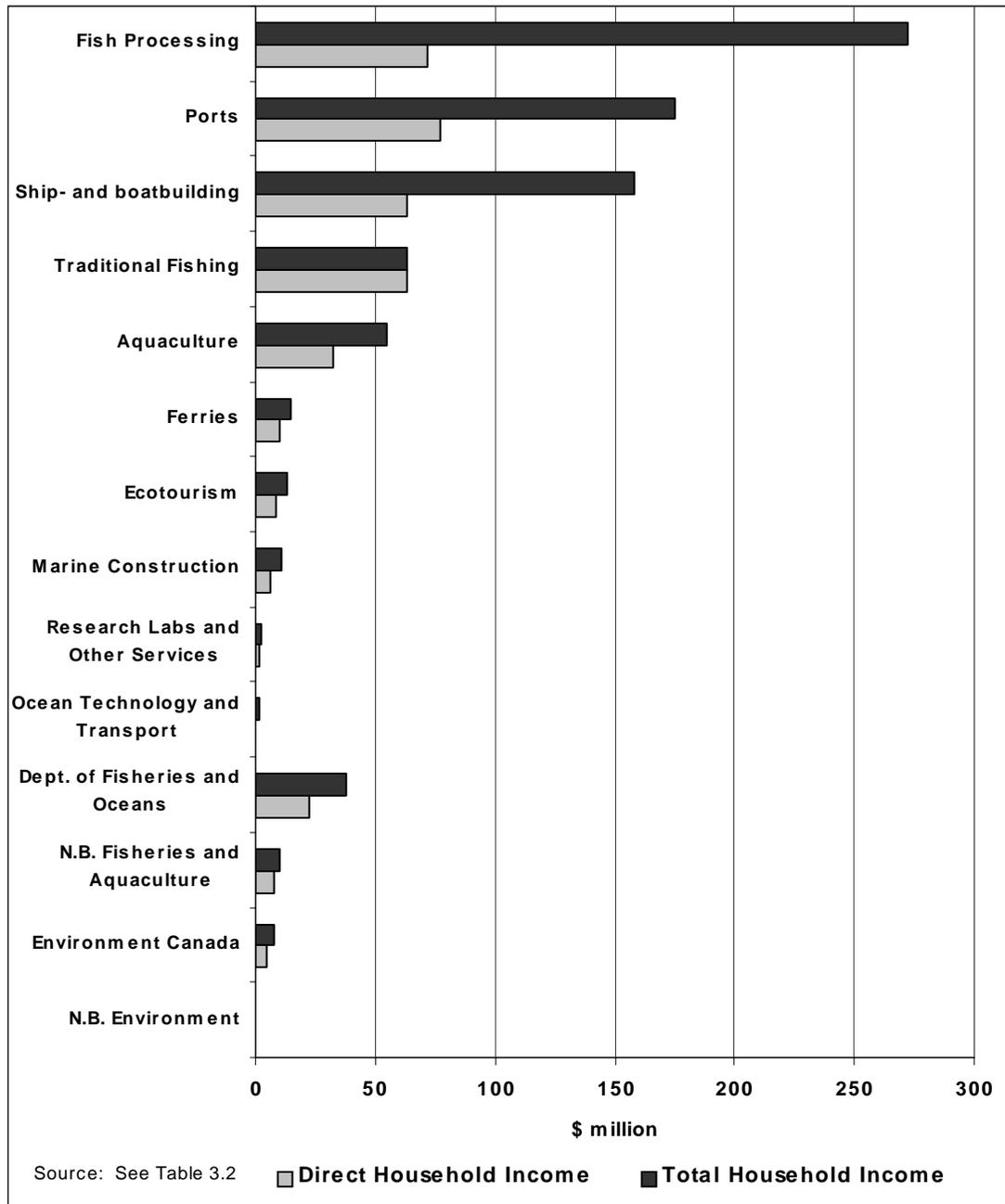
### 3.3 Household Income Impacts

People working in the marine sector in New Brunswick generate a total household income of \$821 million, or 9.2% of the New Brunswick total as measured by official data for total wages and salaries (Table 3.2 and Chart 3.2). Once again, fish processing leads, followed by ports and then shipbuilding and boatbuilding. The fact that ports come second in the ranking for household income, and shipbuilding third (a reversal of order from the GDP figures) can partly be explained by the fact that shipbuilding is more capital-intensive, and port services more labour intensive. This means that economic returns from shipbuilding are more likely to be captured by the owners of capital, and those from ports by the “owners” of labour (or workers). Combining the three fish-related sectors gives a total household income of \$390 million, or 4.4% of total household income in New Brunswick.

Within government departments, DFO and NBDFA once again dominate. The departments in total have a bigger share of total household income, about 7% of the total compared with less than 5% of GDP, due to generally higher wages paid by governments.

<b>Table 3.2: The Marine Sector in New Brunswick Household Income Impacts, Average of 1995, 1996 and 1997 (\$ million, ranked by total impact within sub-groups)</b>				
	<b>Direct Household Income</b>	<b>Total Household Income</b>	<b>% of Sub-total</b>	<b>% of Grand Total</b>
<b>PRIVATE INDUSTRIES</b>				
Fish processing	72.1	272.4	35.6	33.2
Ports	77.3	174.7	22.8	21.3
Ship- and boatbuilding	63.5	158.1	20.7	19.3
Traditional fishing	63.0	63.0	8.2	7.7
Aquaculture	32.6	54.7	7.2	6.7
Ferries	9.8	14.4	1.9	1.8
Ecotourism	8.1	13.4	1.7	1.6
Marine construction	5.9	10.5	1.4	1.3
Research etc.	1.4	2.3	0.3	0.3
Marine tech.	1.0	1.4	0.2	0.2
Sub-total	334.7	764.9	100.0	93.1
<b>GOVERNMENT DEPARTMENTS</b>				
Dept. of Fisheries and Oceans	22.2	38.0	67.5	4.6
NB Fisheries and Aquaculture	7.7	10.3	18.3	1.3
Environment Canada	4.4	7.5	13.3	0.9
NB Environment	0.2	0.5	0.9	(a)
Sub-total	34.5	56.3	100.0	6.9
<b>Grand total</b>	<b>369.2</b>	<b>821.2</b>		<b>100.0</b>
Notes (a) Less than 0.05%. Totals may not add to 100% due to rounding Source: Computed by Mandale Consulting, Canmac Economics Ltd.				

**Chart 3.2: The Marine Sector in New Brunswick  
Household Income Impacts, Average of 1995, 1996 and 1997  
(ranked by total impact within sub-groups)**



### 3.4 Employment Impacts

Total employment created by the marine sector in New Brunswick mirrors the household income impact (Table 3.3 and Chart 3.3). Total employment in both private industries and government departments was 26,553 jobs on average for 1995, 1996 and 1997. This represents 8.5% of all of the jobs in New Brunswick<sup>13</sup>. Almost one job in twelve in the province can trace its origin directly or indirectly to the marine sector.

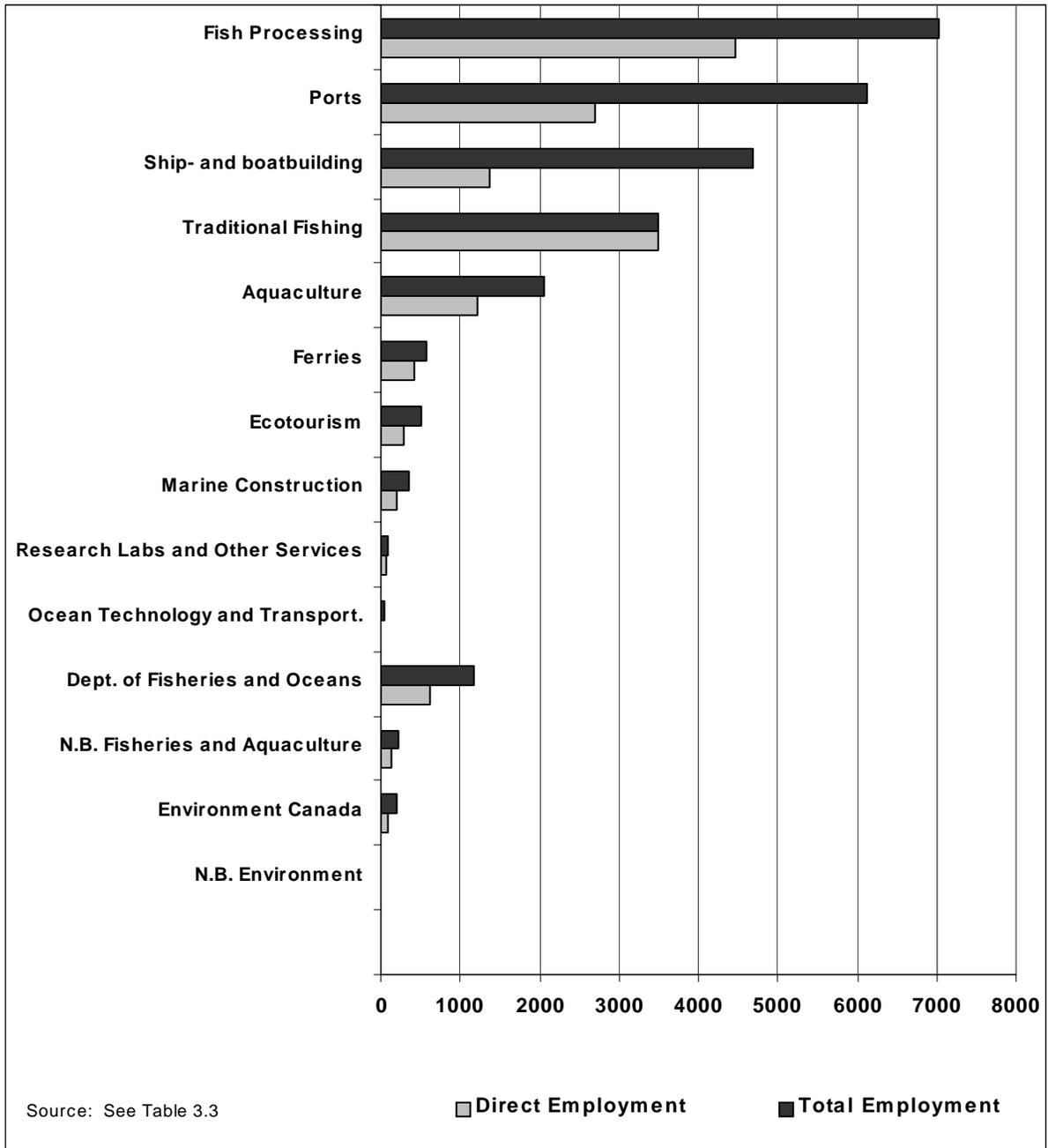
The order of private industries and government departments is the same as for household income. For private industries, fish processing is first, followed by ports, shipbuilding and boatbuilding, then traditional fishing and aquaculture. Fish-related sectors in total account for half of all private industry jobs, and ports and shipbuilding another 43%. There are particularly impressive indirect and induced impacts in terms of employment for several industries, like ports, shipbuilding and boatbuilding. For every direct job created in shipbuilding, for example, 2.4 others are created in other industries. The ratio (or multiplier) for ports is 1.3 jobs for every direct job. Aquaculture, and ecotourism also have significant multipliers.

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<sup>13</sup> This proportion is low, because total employment as reported by the Labour Force Survey does not distinguish between full-time and part-time jobs. The analysis in this report includes part-time work only as full-time equivalent.

<b>Table 3.3: The Marine Sector in New Brunswick Employment Impacts, Average of 1995, 1996 and 1997 (ranked by total impact within sub-groups)</b>				
	<b>Direct Employment</b>	<b>Total Employment</b>	<b>% of Sub-total</b>	<b>% of Grand total</b>
<b>PRIVATE INDUSTRIES</b>				
Fish processing	4,475	7,031	28.2	26.5
Ports	2,696	6,115	24.5	23.0
Ship- and boatbuilding	1,369	4,690	18.8	17.7
Traditional fishing	3,492	3,492	14.0	13.2
Aquaculture	1,222	2,048	8.2	7.7
Ferries	424	585	2.3	2.2
Ecotourism	290	498	2.0	1.9
Marine construction	189	350	1.4	1.3
Research etc.	56	88	0.4	0.3
Marine tech.	30	43	0.2	0.2
Sub-total	14,243	24,940	100.0	93.9
<b>GOVERNMENT DEPARTMENTS</b>				
Dept. of Fisheries and Oceans	613	1,168	72.4	4.4
NB Fisheries and Aquaculture	141	232	14.4	0.9
Environment Canada	89	198	12.3	0.7
NB Environment	4	15	0.9	(a)
Sub-total	847	1,613	100.0	6.1
<b>Grand Total</b>	<b>15,090</b>	<b>26,553</b>		<b>100.0</b>
Note (a) Less than 0.05%. Totals may not add to 100% due to rounding. Source: Computed by Mandale Consulting, Canmac Economics Ltd.				

**Chart 3.3: The Marine Sector in New Brunswick  
Employment Impacts, Average of 1995, 1996 and 1997  
(ranked by total impact within sub-groups)**



### 3.5 Summary of Total Impacts

The total economic impact of New Brunswick's marine sector is summarized in Table 3.4. All the industries and departments combined account for 7.2% of total GDP in New Brunswick, 9.2% of household income, and 8.5% of total employment. Almost all of this (95% of GDP, 93% of household income, and 94% of employment) resides in private industries. This is in sharp contrast to the situation in Nova Scotia, where a much larger proportion of the marine sector is in the public sector, weighted significantly by the fact that Halifax is the base for most of Canada's navy<sup>14</sup>.

Private industries break down quite sharply into a two groups. The five biggest industries are dominated by fish processing, ports, and shipbuilding and boatbuilding, but also with significant contributions from traditional fishing and aquaculture. The five smallest industries include some with good potential, including ecotourism, marine technologies, and research services.

Table 3.4 ranks all marine-related activities by size, and not by private industry and government department sub-groups as in Tables 3.1 through 3.3. This shows that DFO is the sixth biggest marine-related activity in New Brunswick, and NBDFA is tenth. Once again, the importance of these departments' management, regulatory, safety, and promotional functions is underlined.

The marine sector, it must be emphasized, is dynamic and shifting. Currently, for example, shipbuilding is in steep decline and if this exercise were to be done using data from later years than the ones shown it would figure less prominently. Similarly, the impact of ferry services has declined from the period analyzed in this project, and any updating of the data would reflect this. Aquaculture, on the other hand, still has potential to grow, as do some of the smaller industries mentioned above. Public sector activity is less variable, but even here there has been erosion of budgets during the 1990s, at a time when pressures on marine resources have been increasing.

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14 See Mandale Consulting *et al.*, *op cit.*

<b>Table 3.4: The Marine Sector in New Brunswick Summary of Total Economic Impact (Average of 1995, 1996 and-1997)</b>				
	<b>Total GDP</b>	<b>Total Household Income</b>	<b>Total Employment</b>	<b>Overall rank (a)</b>
	<b>- \$ million -</b>			
<b>Fish processing</b>	<b>359.9</b>	<b>272.4</b>	<b>7,031</b>	<b>1</b>
<b>Ports</b>	<b>140.9</b>	<b>174.7</b>	<b>6,115</b>	<b>2</b>
<b>Ship - and boatbuilding</b>	<b>232.1</b>	<b>158.1</b>	<b>4,690</b>	<b>3</b>
<b>Traditional fishing</b>	<b>98.2</b>	<b>63.0</b>	<b>3,492</b>	<b>4</b>
<b>Aquaculture</b>	<b>88.0</b>	<b>54.7</b>	<b>2,048</b>	<b>5</b>
<b>Dept. of Fisheries and Oceans(b)</b>	<b>30.5</b>	<b>38.0</b>	<b>1,168</b>	<b>6</b>
<b>Ferries</b>	<b>22.4</b>	<b>14.4</b>	<b>585</b>	<b>7</b>
<b>Ecotourism</b>	<b>17.1</b>	<b>13.4</b>	<b>498</b>	<b>8</b>
<b>Marine construction</b>	<b>12.0</b>	<b>10.5</b>	<b>350</b>	<b>9</b>
<b>NB Fisheries and Aquaculture (b)</b>	<b>11.6</b>	<b>10.3</b>	<b>232</b>	<b>10</b>
<b>Environment Canada (b)</b>	<b>6.6</b>	<b>7.5</b>	<b>198</b>	<b>11</b>
<b>Research etc.</b>	<b>3.2</b>	<b>2.3</b>	<b>88</b>	<b>12</b>
<b>Marine tech.</b>	<b>8.4</b>	<b>1.4</b>	<b>43</b>	<b>13</b>
<b>NB Environment (b)</b>	<b>0.3</b>	<b>0.5</b>	<b>15</b>	<b>14</b>
<b>PRIVATE INDUSTRY TOTAL</b>	<b>982.2</b>	<b>764.9</b>	<b>24,940</b>	
<b>GOVERNMENT DEPT TOTAL</b>	<b>49.0</b>	<b>56.3</b>	<b>1,613</b>	
<b>GRAND TOTAL</b>	<b>1,031.2</b>	<b>821.2</b>	<b>26,553</b>	
<b>Total NB Economy</b>	<b>14,295.3</b>	<b>8,945.0</b>	<b>314,000</b>	
<b>Marine Sector as % of NB</b>	<b>7.2</b>	<b>9.2</b>	<b>8.5</b>	

Note (a) The overall ranking is simply a total of the rankings for the individual indicators.  
(b) Public sector.  
Source: Computed by Mandale Consulting, Canmac Economics Ltd.

It is instructive to do another division of the impact data shown in Table 3.4, to show the relative importance within private industries of those that depend on oceans as a resource, and those that use oceans as a medium of operation or movement. This is shown in Table 3.5.

	Total GDP	Total Household Income	Total employment
	- \$ million - (% of total)		- number - (% of total)
<b>Resource-dependent industries(a)</b>	<b>563.2</b> <b>(57.3)</b>	<b>403.5</b> <b>(52.8)</b>	<b>13,069</b> <b>(52.4)</b>
<b>Non-resource dependent industries(b)</b>	<b>419.0</b> <b>(42.7)</b>	<b>361.4</b> <b>(47.2)</b>	<b>11,871</b> <b>(47.6)</b>

Notes (a) Fish processing, traditional fishing, aquaculture, and ecotourism. (b) Other private sectors.  
Source: Computed by Mandale Consulting, Canmac Economics Ltd.

By all the indicators in Table 3.5, resource-dependent private industries account for more than half of the activity, and given some decline in non-resource-dependent industries (shipbuilding and ferries, for example) these shares will have increased since the period under analysis. This share could also go higher if we consider the fact that some non-dependent industries, such as boatbuilding and marine construction, sell much of their output to resource-dependent industries

A final division of the impact data is between resource-dependent and non-resource-dependent private sectors by major watershed. This uses the proportional breakdown used for gross output figures in Table 2.16 on page 34 only applying these to total GDP impact as in Table 3.5 above. The results are shown in Table 3.6.

	Fundy	Gulf - \$ million - (% of total)	New Brunswick
<b>Resource-dependent industries (a)</b>	<b>186.4</b> <b>(33.1)</b>	<b>376.8</b> <b>(66.9)</b>	<b>563.2</b> <b>(100.0)</b>
<b>Non-resource-dependent industries (b)</b>	<b>301.3</b> <b>(71.9)</b>	<b>117.7</b> <b>(28.1)</b>	<b>419.0</b> <b>(100.0)</b>

Notes (a) and (b): See notes to Table 3.5 above.  
Source: Computed by Mandale Consulting, Canmac Economics Ltd.

Quality of the marine environment is important in both the Gulf and Fundy watersheds, but especially in the former. This is where two-thirds (66.9%) of the GDP is attributed to industries that would be adversely affected by any deterioration of the marine environment. It could also be true, however, that in the Bay of Fundy, resource-dependent industries are more at risk because there is a heavier preponderance of environmentally insensitive (non-resource-dependent) industries.

The quality of the marine environment is, therefore, critical to the majority of private industry activities that make up most of New Brunswick's marine sector, whether

## Value of Marine-Related Resources

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this share is measured in terms of gross domestic product, household income, or jobs. Decisions on managing the uses of the marine environment, and resources devoted to it, cannot ignore this generator of economic activity in New Brunswick.

## Chapter Four Conclusions

This has been a project that has used economic impact assessment techniques to estimate the importance of the marine sector in the New Brunswick economy. Ultimately, whether the project team has achieved its objectives depends on the reliability of data used. In their opinion, this has been accomplished, but this does not preclude the need for further work both to refine data collection and estimation techniques, and to include activities that are currently left out due to difficulties in obtaining even the roughest data.

The evident conclusion from this work is that the marine sector is an important contributor to New Brunswick's economy, whether measured in terms of GDP, household income, or employment. The total economic impact of all the private industries and government departments analyzed reveals that the marine sector accounts for 7.2% of GDP in New Brunswick, 9.2% of household income, and 8.5% of total employment. These percentages translate into more than \$1 billion of GDP, \$821 million of household income, and 26,553 jobs. The overwhelming majority of this activity (about 95%) occurs in private industries. Economic activities, indeed entire economies, are dynamic and subject to change, often in response to external shocks. The marine sector is particularly vulnerable in this respect, subject as it is to natural as well as market forces.

The private industries that either depend on the ocean as a resource or use it as a medium of movement or operation are quite diverse. Fish-related industries are the most important, whether traditional fishing, processing plants, or aquaculture. Shipbuilding and boatbuilding are also important, as are ports. A variety of smaller industries include ferry services, marine construction, ecotourism, marine research, and marine technology manufacturing. Although quite small, some of these offer great potential for growth.

New Brunswick's marine sector has two distinct parts, one that is based in the southern Gulf of St Lawrence, another that is based on the Bay of Fundy. Some industries are more important in one of these parts than the other. Traditional fishing and fish processing, for example, are bigger in the Gulf, aquaculture in Fundy. In aggregate, however, there is quite an even split between the two, with a slight advantage (about 57% of gross output) in favour of the Gulf. Those private industries that are resource-dependent (the fish-related industries and ecotourism) provide over half the impact in terms of GDP, incomes and jobs. This means over half of the marine sector requires a high level of marine environmental quality for its sustained contribution to the provincial economy.

The role of government in conserving, regulating and managing marine resources and the private industries that develop around them is critical. The most important government presence in New Brunswick's marine sector is Department of Fisheries and Oceans. This is not surprising given the depth and breadth of its mandate, its marine orientation (the department has the lead role in the Oceans Act), and the recent inclusion of Coast Guard responsibilities in the department. The involvement of this and other federal and provincial departments in marine resource management reinforces the fact

that commercial markets only account for part of the marine sector and that society's broader perspective needs to be taken into account when making decisions on the use of this vital resource.

Management of such an important resource demands government involvement, both to ensure that industries that depend on it can be sustained, and also that natural systems can be conserved. Federal and provincial departments all have roles to play, and should constantly examine those roles to make sure they are pertinent and relevant. Cooperation among departments should reduce or eliminate duplication of effort.

All of the industries and departments described and analyzed in this report have one thing in common - they are all marine-related. This brings an overall aspect of this research to the fore, the need to move beyond what this project has done (essentially an economic accounting exercise) to some form of new development paradigm. Economic systems are shifting to knowledge-based enterprise, where for example the source of competitive advantage is increasingly not seeking out fish endowed by nature, but innovation and knowledge-based ways of growing and harvesting fish by means of aquaculture. An increasingly popular way of doing this is to develop a cluster of industries and other institutions (universities, governments), with close and frequent linkages among every part of the cluster. In this way, an innovation-driven cluster of economic and industrial development begins, which once it reaches critical mass can be a potent tool for progress. This is not an easy process, but experience from other parts of the world suggests it can be done. An innovation cluster that is centred on the marine resource is an obvious development in New Brunswick, and deserves further investigation.

The fact that this has been an economic accounting exercise also deserves extra attention, more for what this does not do than for what it does. Economic growth is not costless, but in many cases these costs are not reflected (paid for) in markets; they are observed in terms of pollution, environmental degradation, and loss of habitat. There is frequently a social cost involved, as well, measured by loss of community, for instance, if a commercial fish stock collapses, and the jobs and incomes derived from catching or processing those fish disappear as a result. The kind of economics that takes account of these costs is beginning to be developed. Canada, and Atlantic Canada in particular could very usefully develop this kind of overall accounting, incorporating both economics, the environment, and society, to become a leader in innovative marine-related analysis.

For New Brunswick to maintain and sustain any economic progress based on the marine environment requires constant attention not only to developing new products and markets based on marine activities, but also to the resource and natural environment that makes this possible - the ocean.

# APPENDIX A

## **A Brief Analysis & Summary of Data Quality**

## APPENDIX A

### A BRIEF ANALYSIS AND SUMMARY OF DATA QUALITY

The research team has tried to be as transparent as possible in this project, with respect to data and methods of estimation in particular. Where data have been judged to be less reliable or difficult to obtain than is desired, this has been noted. The following table is a summary of some of these misgivings, and points both to the integrity of audit trails and to the desirability of further research to improve data quality.

Data for each sector are assigned a rating of "A", "B", or "C", which attempts to summarize the data's quality in terms of accuracy and accessibility or availability. Combinations of ratings ("A/B", "B/C") have been used where necessary. Allocation of a lower rating should not reflect negatively on either the sources of the material or the people who provided them to the project team. More, it shows how difficult it sometimes is to gain an accurate picture of coastal industries. Ratings have been assigned by the project team based on their familiarity with the data, and have occasionally been changed on the recommendation of reviewers. Considerations when assigning ratings include the following:

- A rating of "A" refers to data that are easily available, and of high quality, in published form. Regular series of data are generally assigned this rating, collected and published frequently.
- A rating of "B" indicates some misgivings both as to data quality and its availability. Availability, for example, might be from a single survey, conducted sporadically or irregularly, and from which extrapolations may have to be made to characterize the benchmark year.
- A rating of "C" indicates more serious misgivings, for example where data can only be obtained by special request, where extra effort is required within assembling agencies to assemble the necessary information, or where estimation techniques involve quite strong assumptions in the absence of better knowledge or intelligence.

Sector	Quality Rating
<b>Private Sector:</b>	
<b>Traditional Fishery</b>	A
<b>Aquaculture</b>	A
<b>Fish Processing</b>	A
<b>Shipbuilding &amp; Boatbuilding</b>	B/C
<b>Marine Technology Manufacturing</b>	C
<b>Ferry Services</b>	B/C
<b>Ecotourism</b>	C
<b>Marine Construction</b>	A
<b>Ports</b>	B/C
<b>Research and Other Services</b>	B/C
<b>Public Sector:</b>	
<b>N.B. Department of Fisheries &amp; Aquaculture</b>	B/C
<b>N.B. Department of Environment</b>	B/C
<b>Fisheries &amp; Oceans Canada</b>	B/C
<b>Environment Canada</b>	B/C

Ratings are assigned by sector and not by actual data series. A rating, therefore, refers to quality or availability for an entire sector, even though one or more of the four key series might be of better or worse quality or availability than the whole.

One of the intentions of doing these ratings is to begin to point out where efforts will be required in future projects of this nature.

**Data Sources**

**Traditional Fishery**

Value of landing data and direct employment are from the Department of Fisheries and Oceans. The Department reports fishers on a full-time and part-time basis. The reported results show full-time at 1,771 persons and part-time at 5,439 in 1997. Quality data on the conversion of part-timers to full-time equivalents is not available. We used a conservative 4 to 1 ratio in our reported results to estimate the number of full-time equivalents as 3,131.

Direct payroll is taken from Revenue Canada's Taxation Statistics for individuals - various years. The reported gross fishing income is \$125.8 million with which is the payroll figure reported. Gross payroll overstates the actual payroll since it includes allowances for expenses.

**Aquaculture**

Aquaculture sales data is taken directly from the New Brunswick Department of Fisheries and Aquaculture. The sales data is comprised primarily of salmon production

which has the best time series. We adjusted these up by 5% to account for trout, etc., as reported in the Canadian Aquaculture Industry Alliance *Study "Canadian Aquaculture Industry Profile and Labour Market Analysis"*.

The data on employment and payroll for the aquaculture sector is weak. We relied on the data provided in the Canadian Aquaculture Industry Alliance *Study "Canadian Aquaculture Industry Profile and Labour Market Analysis"*. We used the employment and payroll ratios and applied these to the sales data for 1995, 1996, 1997 to derive our estimates for those years.

### **Fish Processing**

Value of output for fish processing is taken from Statistics Canada's "Manufacturing Industries of Canada: National and Provincial Area" Catalogue No. 31-203. We use total activity shipments. The values reported here are considered the most reliable estimates of this sector's output. The values are 'at the factory gate', i.e. exclusive of transportation margins.

The payroll and employment data are the total employment and payroll as reported in Statistics Canada's 31-203.

### **Shipbuilding and Boatbuilding**

Sales data for shipbuilding and boatbuilding was developed from two sources. Boatbuilding shipment data was available for 1995 from Statistics Canada 31-203. Data for subsequent years were not published due to confidentiality requirements. Data for subsequent years was held constant at the 1995 level. Shipbuilding output was provided by Saint John Shipbuilding Limited for 1995-1997. The payroll and employment data also came from the same two sources.

### **Marine Technology Manufacturing**

Sales, employment and direct payroll data was difficult to acquire for the Ocean Technology Manufacturing sector. The small size of this sector precluded Statistics Canada as a data source. We were able to glean a list of Ocean Technology Manufacturing firms from a database prepared for the Federal Department of Fisheries and Oceans - Canada's Ocean Industries, December, 1998. We then developed employment estimates using the New Brunswick Manufacturing Directory (1998) as a guide. Finally, we applied the average New Brunswick manufacturing shipments to employment ratio and wagebill to employment ratio. The end result was estimates of sales, payroll and employment.

### **Ferry Services**

Output, employment and payroll data are not available in published form for ferry services. We relied on estimates derived from direct sources. Specifically, Marine Atlantic provided estimates of total operations costs - our output measure and payroll and employment activity for 1995 - 1997 period.

### **Marine Construction Services**

Output data are available in published form for Marine Construction activity in Statistics Canada Capital Expenditure by type of asset catalogue number 61-223. We estimated employment levels and payroll by applying the ratios of payroll to total construction available in the input-output model and applying the New Brunswick average construction wage to the payroll data to get employment.

### **Ports**

Our proxy measure for port output is cargo movement. Cargo movement data are available in published form from Statistics Canada 15-203. Employment data and payroll data for the Port of Saint John was obtained directly from the Port of Saint John. Data was available for 1995. We then estimated the 1996, 1997 data using the 1995 employment to cargo and payroll to cargo ratios.

### **Ecotourism**

As noted in the main report, data on ocean-related ecotourism are virtually non-existent hence we using indirect methods to estimate output, employment and payroll. We relied on published data and direct query from Parks Canada. Output data is derived from direct visitor expenditures and park operation expenditures. Direct visitor expenditure data was available on a per visitor basis from a National Parks Economic Impact Report prepared by Gardner Pinfold Consulting Economists. Total visitation for 1995, 1996, 1997 was provided by the Parks Canada web site. We obtained operational expenditures and wagebill data directly from the finance department, Park Canada Atlantic Region.

### **Research and Other Services**

Output, employment and payroll for the research and other services was provided by direct interview and annual reports for the various organizations engaged in research and other services. The major organizations included Huntsman Marine Science Centre, RPC , and Universite de Moncton.

**Department of Fisheries and Oceans**

The output, employment and payroll data are for DFO within New Brunswick and are based on direct interview estimates from Maritimes Region, Financial Planning and Analysis Division.

**Environment Canada**

Output, employment and payroll data have been estimated based on interviews with the Atlantic Office of Environment Canada.

**New Brunswick Department of Fisheries and Aquaculture**

Output, employment and payroll data are taken from the New Brunswick Public Accounts and New Brunswick Department of Fisheries and Aquaculture interviews.

**New Brunswick Department of the Environment**

Economic data are taken from the Public Accounts supplemented by direct interviews with the New Brunswick Department of Environment.

# APPENDIX B

## **The New Brunswick Input-Output (IO) Model**

## Appendix B The New Brunswick Input-Output (IO Model)

Our approach to measuring the total direct, indirect and induced effects associated with the New Brunswick coastal resource sector is to conduct simulations with the latest Canmac New Brunswick Input-Output (IO) model. IO or inter-industry analysis was developed by the economist Wassily Leontief during the 1930s. It is an empirical representation of a general theory of production based on the notion of economic interdependence. Leontief's original IO table showed how each sector of the economy depends upon every other sector (including households), either to supply its inputs or to purchase its outputs. This is still the basic characteristic of all IO models.

In an IO model each industry in the local economy depends, in principle, on every other industry for the supply of intermediate goods. The ultimate goal of the IO model is to trace the transmission of demand through the economy. The model's operations are somewhat restricted. Firstly, industry production functions are linear and inputs must be used in fixed proportions. In other words, economies and diseconomies of scale are not permitted, as they would require intricate calculation of non-linear functions representing complex and rapidly changing relationships between industries. Secondly, a generally strict assumption of IO models is that prices and wages are fixed and the supply of both intermediate goods and final goods is unlimited. Thirdly, IO models take a long time to construct, and may reflect economic relationships that are slightly out-of-date when they are applied.

Today, IO tables are available for about forty national economies and the number of regional and local IO tables is growing rapidly. The Regional Science Institute can provide IO tables for every American state and many smaller areas. The development of computers and efficient methods of calculation permits a great deal of industrial disaggregation, providing considerable details on the economic transactions within an economy, and offering some understanding of how demand moves throughout the economy. This is often simulated as a "shock", say a 10% or 20% increase or drop in demand.

The IO model describes impacts in terms of direct, indirect and induced effects. In this impact exercise, the direct effect is defined as the total value of output for the specified coastal sectors (based on the data explained in Chapter 2 of this report). The indirect effect is defined as the total value of output from other industries in New Brunswick that is supply ocean-based. This supply includes 'suppliers of suppliers', that is the demand for goods and services includes both direct suppliers to coastal sectors, and to their suppliers. The induced effect refers to the additional industry output that arises as households spend the incomes they earn by working in ocean-related sectors, or in supplying inputs to ocean-based sectors (that is, at the direct and indirect stages), on other goods and services in the New Brunswick economy. The total economic value of New Brunswick's coastal sectors is measured as the sum of the direct, indirect and induced sales.

Atlantic Canada, including New Brunswick, has an enviable record in the use and production of regional IO models. The pioneering work of Kari Levitt resulted in Atlantic Canada having some of the first region-specific and province-specific IO models in Canada, indeed in North America. New Brunswick's IO tables were updated in 1974, 1979 and again in 1989. (Updating such massive tables is a major undertaking.) The latest IO model is supported and actively used for policy analysis by the New Brunswick Department of Finance.