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A Guide to Understand the Economic Impacts of Fisheries Management

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A GUIDE TO UNDERSTAND THE ECONOMIC IMPACTS OF FISHERIES MANAGEMENT

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A GUIDE TO UNDERSTAND THE ECONOMIC IMPACTS OF FISHERIES MANAGEMENT

1. INTRODUCTION

Fishery management agencies are faced with the difficult task of protecting a public resource while allowing users to harvest the resource for the economic advantage of society. As more and more fisheries reach or exceed their maximum sustainable yield, conflicts arise between different user groups for rights to harvest the available stocks. Since the allocation of these harvesting rights can change the economic returns to society from the resource, it is important that fishery managers understand how the economic effects of allocation decisions can be measured.

Economists typically employ two different techniques to evaluate the economic changes caused by management decisions: benefit-cost analysis and economic impact analysis. As the name implies, benefit-cost analysis is a means of measuring and comparing the economic benefits and costs of a decision. In the context of fishery allocation decisions, it can be used to measure the relative benefits and costs of one allocation to another and indicate which allocation provides more net benefits to society. Economic impact analysis, on the other hand, is designed to measure how economic activity within a region is affected by an allocation decision. These impacts are measured through changes in output (sales), income and employment. Impact analysis can be used to compare the effects on economic activity from one or more allocation alternatives but it does not indicate which alternative provides more economic benefits to society.

The purpose of this report is to explain how the economic impacts of allocation decisions can be measured and what this information means to fishery managers. This is accomplished by defining the key measures of economic activity used in impact analysis, describing the main analytical methods used to calculate economic impacts, and by illustrating these methods using hypothetical examples of allocation decisions affecting commercial and recreational users of a fishery stock.

While professional economists are probably the only people who get really excited about the technical concepts and terms discussed in this report, every effort has been made to present this information in everyday language with as little jargon as possible. To facilitate this general presentation, the primary focus is on the basic principles of impact analysis with examples to illustrate

these principles. Brief discussions and references are provided for more advanced techniques. A good understanding of the basic principles, however, should be sufficient to organize, conduct, and interpret an economic impact analysis of a fishery management decision.

This report is organized as follows. Section 2 presents an overview of the alternative types of impacts caused by fishery management decisions. Economic impacts are one type of impact measure that should be distinguished from the others. Section 3 describes the meaning and significance of the different "yardsticks" used to measure economic activity either within a nation or a region. The most important precursors to an actual impact analysis are discussed in Section 4. Economic base analysis is one of the principal methods used for economic impact analysis and this method is described in Section 5. In this section the reader is introduced to the concept of the "multiplier" and the critical role that the multiplier plays in impact analysis. Section 6 presents a more detailed alternative method, input-output analysis, that has been used in many economic impact studies. The material in this section describes the basic input-output approach and explains how multipliers are derived with this method. Also, different techniques for estimating multipliers from input-output models are discussed. The application of these methods is illustrated with a hypothetical fishery management decision to change the allocation of a stock between commercial and recreational users. Some of the limitations of the economic base and input-output methods of impact analysis are also discussed. Section 7 provides a summary of the report and some recommendations on how to avoid abuses of economic impact analysis in fishery management decisions.

2. THE MULTIPLE DIMENSIONS OF SOCIOECONOMIC IMPACT ANALYSIS AND THE SCOPE OF ECONOMIC IMPACT ANALYSIS

The term "impact" means that some change has or will occur as a result of a resource management decision (Leistritz and Murdoch 1981). Fishery managers may want to compare the potential impacts of alternative regulations before deciding on a course of action. Or, they may want to know how a specific regulation has impacted the region using the fishery. The information from an impact analysis can be used to understand how regional communities respond to changes in the use of a fishery resource.

There are many different ways that communities can be affected by fishery regulations. The possible impacts include changes in:

1) employment,
2) the level and structure of economic activity,
3) the provision of public sector services,
4) taxes collected for public services,
5) environmental quality,
6) social organization within the community, and
7) the racial, ethnic and age composition of the community.

Each of these possible impacts can change the social conditions within a region so it is important to understand these dimensions.

Employment refers to the number of workers in an industry or region and to the extent of unemployed workers in the available labor force. Fishery regulations can change the number of workers employed by increasing or decreasing the demand for workers. For example, a regulation to prohibit charter boats from catching a certain species would decrease the demand for captains and mates. If there were not sufficient charter boat customers willing to pursue other unrestricted species, the number of employed workers in the charter boat industry would decrease. Whether these workers would become unemployed depends on the demand for workers in other industries and the workers' skill levels. Alternatively, a regulation may increase the commercial catch of a species. If there are not a sufficient number of boats in the fishery to harvest the increase, the entry of new boats would increase the demand for captains and crew. The increased commercial catch may also increase the demand for processing plant workers to prepare the catch for the wholesale and retail markets. Thus, the number of workers in the commercial fishing and fish processing industries could increase because of the regulation. But, the increase in employment in these industries does not imply that the number of unemployed workers in the region would decrease since the new fishery workers may move from jobs in other industries or from other regions.

Regulations can also change the level of sales and income earned in fishing related industries and the way these industries relate to one another. For example, an increase in commercial catch could lead to an increase in the revenues from sales for the commercial fishing and processing industries. But, the revenues from sales could also decrease if the larger supply of fish depresses market price. Assuming that prices would not change, an increased

sales volume could lead to higher profits and wages for firms and workers in the impacted industries. The increased commercial harvest may also attract new firms into the regional fish processing industry thereby increasing the level of competition within the industry. With the increase in processing capacity, other fishery products that are exported for processing by firms in other regions may now be processed within the region. Thus, a regulation can have wide ranging impacts on the sales and income of businesses in the region. Similar types of sales and income impacts could be described for changes in recreational catch.

Changes in the demand for public sector services can also result from fishery regulations. Businesses engaged directly in commercial fishing and processing or in supplying goods and services to recreational anglers depend on public services such as utilities, fire and police protection, and education. A regulation to increase the allowed recreational catch of a species could, for example, increase the demand for motels, restaurants, and fishing supply stores in coastal towns visited by recreational anglers. As a result, the local municipalities would need to provide more services to these businesses.

Municipalities do not provide these services for free so the changes induced by fishery regulations can also change the amount of taxes and fees collected by governmental units within the region. However, since taxes are not always directly related to the services provided, the change in taxes may be larger or smaller than the costs of the services. And, these changes in taxes may impact other services provided in a community. For example, a regulation to prohibit commercial harvesting of a species may force a processing plant that depends on that species to close. The community where the plant was located would be impacted by the loss of property taxes paid by the plant. This may cause property owners in the community to pay higher taxes to compensate for the lost tax base. Thus, the economic effects of fishery regulations can extend to many individuals and businesses in the impacted communities and may not be limited solely to the recreational and commercials users.

As fishery regulations change the level and types of economic activity in impacted communities, they can also change the level of environmental quality. Higher levels of output by fish processing plants can lead to higher use of water and higher discharges of waste products. Similarly, increases in the number of tourist anglers in coastal communities can lead to increased demands on water supplies and higher waste discharges from motels and restaurants serving the

anglers. The many dimensions of environmental quality need to be considered in evaluating the impacts of fishery regulations.

Changes in the use of a fishery may also lead to changes in the social organization of communities dependent on the fishery. For example, patterns of social interaction, family linkages, and social class structure may be tied to the types of commercial or recreational fishing. Regulations that change established ways of fishing or the access rights of different groups can lead to changes in the prevailing way of life and cause new social arrangements to emerge.

Finally, fishery regulations can cause changes in the racial, ethnic and age characteristics of impacted areas. Regulations may lead to an influx of new residents or tourists that alter the prevailing demographic characteristics of the area. These changes may be tied to changes in the social organization of the communities and cause conflicts as new patterns of social interaction emerge.

While all of these dimensions of the social impact of fisheries regulations are important, economic impact analysis focuses primarily on the first four dimensions. Economic impact analysis seeks to anticipate or explain the changes in employment, economic activity, and the provision of government services that result from regulatory decisions. The analysis may also be extended to consider the impacts on environmental quality but this type of analysis has not been widely practiced. Although social organization and demographic impacts are important, they are usually not addressed in economic impact analysis. These dimensions of impact analysis are considered in social impact assessment (Vanderpool 1987).

Now that the scope of economic impact analysis has been defined, it is useful to clarify the specific meaning of the key measures used. The next section provides a brief introduction to national income and product accounting and explains how it relates to regions impacted by fishery regulations. These income and product accounts are very important because they provide the "yardsticks" by which economists measure changes in the economy.

3. YARDSTICKS TO MEASURE ECONOMIC ACTIVITY

3.1 Gross or Total Output

Economic activity involves a myriad of transactions between individual buyers and sellers in a country. Since it would be impossible to report each and every transaction, national governments have found it useful to construct aggregate measures of economic activity that account for these transactions. These agggregate accounts are useful for either national or regional analysis of economic activity.

The national account that is most often reported in the popular press is the gross or total national product. Total national product is the total value, at market prices, of final goods and services produced in the country during a specific period of time. These sales are "final" because they are made to the consumer of the product and they are not intended for further processing or resale. For some region of a country, it is also possible to define a total regional product that measures the market value of final sales within the region.

The total national or regional product can be measured by adding up all the consumption(C), government(G), and business investment(I) sales and net export(NE) sales (the sales value of exports minus imports) to create the simple equation:

$$\text{Total Product} = C + G + I + NE.$$

This equation depicts consumers, government, business and the "rest-of-the-world" as the demanders of the final products of the economy. These demands create economic activity and the incomes that provide the basis for these demands.

A related measure of economic activity is gross or total output. This measure is commonly used in economic impact studies to estimate the total value of all sales that occurred in a nation or region. It differs from total product in that sales of inputs as well as sales of final products are counted in total output. Since the final product prices reflect the input costs, the total output measure "double-counts" the value of sales. As a result, total output is considerably larger than total product and comparisons between the two should be made with the understanding that total product is part of total output.

Both total output and total product are indicators of economic activity but they do not tell very much about the economic well-being of the nation or region.

First, they only measure market transactions so events that occur outside markets are not counted. For example, increased production by a factory could lead to higher output but cause pollution of rivers and lakes. The effects of the pollution would not be counted unless someone incurred costs to clean it up. Since these costs would require market transactions, the cleanup costs would be counted as "output" and added to the total output!

A second shortcoming of these measures is that they reveal very little about the value of the stock of resources used to support future economic activity. For example, commercial fishing boats could overharvest the stock of a species during a given year. While the output for that year would be higher than normal, it would be very likely that output in future years would be reduced substantially. Thus, the notion that "the higher the total output, the better" is not necessarily a useful principle for fisheries managers.

3.2 Income and Value Added

In addition to total product and output, a second measure of national or regional economic activity is income. It represents the earnings of all primary factors of production which includes: the wages and salaries of laborers and managers, the profits of business owners, the rents earned by land and resource owners, and the interest income for lenders of capital. Income also includes other payments such as social or medical insurance costs that are part of the costs of employing an individual. The payments made to individuals by government in the form of welfare payments or unemployment compensation are also counted in the income measure.

Since income is a direct payment to primary factor owners, it is a part of the value of final output. For this reason, it is sometimes referred to as the "value added" in the production of goods and services. When the value added comprises a large part of the dollar value of output, this indicates that factor owners (laborers, businesses, lenders, etc.) are receiving a healthy share of the economic value created in producing the output.

The relationship between the different components of income or value added and total output is illustrated in Figure 1. All payments to workers, lenders, business owners, and to government in the form of taxes are included in value added. Material costs are not included in the value added because these costs

are only sales from one business to another and do not add new income to the economy. However, these material costs are part of the inputs required to produce goods and services and contribute to the total output. Therefore, total output is the sum of both material costs and value added.

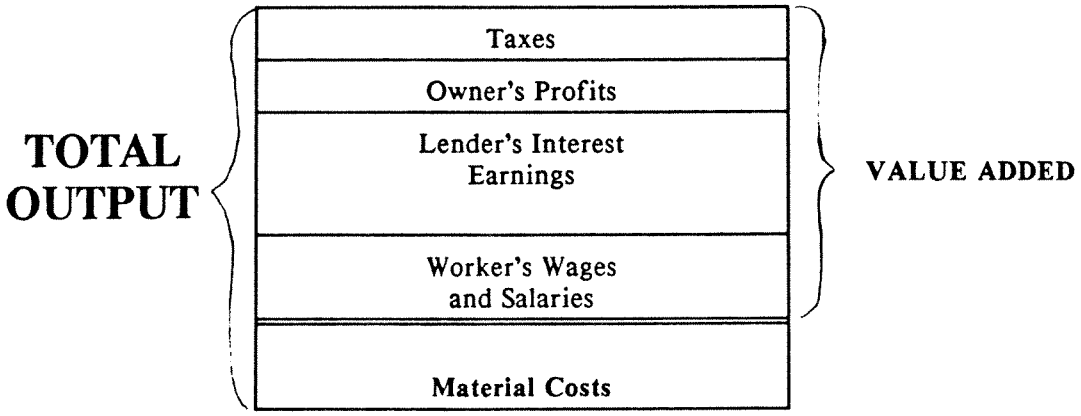

Figure 1. The composition of total output and value added.

Income is a valuable indicator of economic activity because it reflects people's command over goods and services. With higher incomes a national or regional population can buy more goods and services and/or invest in capital goods for future consumption. Income is not, however, a perfect measure of economic well-being within a nation or region. For example, income within a region could increase over time but the reason for the increase is an inmigration of unemployed workers from other regions who receive unemployment compensation from outside the region. Although regional income might increase causing regional output to increase also, the region would have more unemployed workers and possibly more social problems as a result.

Another limitation of the income measure is that it does not account for the size of the population in the region or nation. An increase in income may be accompanied by an increase in population so that the net effect on the average person depends on the relative size of the changes. One commonly used measure of average income is the per capita income which can show the significance of the relative change in income. Unfortunately, neither income nor per capita income provide any information about the distribution of income within the population.

Since the economic well-being of a nation or region may be influenced by the distribution of income, disaggregated studies of the incomes received by different groups must be conducted to identify the share of total income received.

3.3 Employment

The third aggregate indicator of economic activity is employment. The usual measure of employment is the number of people working for compensation at a particular point in time. These workers may be counted for a nation, for a region, or within a particular industry. Compensation can come from a private or governmental employer or the worker can be self-employed. People who work without monetary compensation (e.g. family members who provide full-time household services or part-time work for a family business or farm) are not counted as employed.

A worker who is in a job at a particular time of the year is counted as employed but the job may only be part-time or the job may be seasonal. This is common in fisheries related businesses that are influenced by the seasons of the year and fishes' biological cycles. To avoid confusion about the number of employees in an industry or region, it is common to express employment data as full-time equivalents (FTE) based on a full year of work. Thus, two part-time employees in 20 hour-per-week jobs would be classified as one FTE employee.

However, a person who is not employed is not necessarily unemployed. The unemployment rate measures the percent of the "labor force" that is not employed. A worker is unemployed if he/she is over a certain minimum age, is not employed but is actively seeking a job, or is not employed and is not seeking work because it is a temporary lay-off, he has a temporary illness, or he believes no job is available.

Because employment and the unemployment rate are not two sides of the same coin, it is important to recognize that a change in one does not necessarily translate into a change in the other. For example, an increase in employment within a region can occur with no change (or an increase) in the unemployment rate if new workers move into the region. Alternatively, the unemployment rate can decline while the number of workers employed also declines if unemployed workers decide to leave the labor force or if there is an out-migration of

laborers. Finally, it is important to note that a decline in the number of workers employed in a particular industry does not mean that overall employment will decrease or that total output within the industry will also decline. Since workers can change from industry to industry, a decrease in one industry may be accompanied by an increase in employment in another. In addition, total output can increase due to productivity improvements so changes in employment within an industry may not be directly related to changes in total output.

This brief discussion shows that the three most commonly used measures of economic activity: total output, income and employment, are not perfect or unambiguous. Each measure attempts to aggregate many diverse activities that occur within an economy and to provide a general indicator of the economy's performance. While these measures are useful for describing and analyzing changes caused by regulations or other events, it is important to remember the specific coverage of each measure and the limitations each has as an indicator of economic well-being.

4. PRECURSORS TO MEASURING ECONOMIC IMPACTS

4.1 Defining the Impacted Region

Economic impact analysis focuses on the changes in economic activity within a region of a national economy. Virtually any area within a nation can be defined as a region but most often political boundaries define the region. This is because most economic data are reported for county and state or provincial regions.

The impacted region may encompass one or several counties within a state or it may include several states. There are no hard and fast rules that can be applied to define the impacted region. But, a simple principle to use is that the region should be large enough to include most of the businesses that would gain or lose from a change in a fishery regulation and small enough to exclude areas where businesses experience little or no change from a regulation. The main concern is to balance the need for completeness with the recognition that, as the size of the region increases, the impacts of changes in fishery related sectors on the total economy decreases. These dimensions of the analysis may be influenced also by the particular objectives of the impact analysis.

For example, suppose a regulation would reduce the commercial harvest of a relatively minor commercial species by 50 percent. This particular species is only harvested from a small area in one of the Great Lakes and the commercial fishing boats and processors involved in the harvest are clustered around two ports in two adjacent counties. In this situation the impacted region should be defined as the two counties where the boats and processors are located since these communities are most likely to experience the most change in economic activity as a result of the regulation.

An alternative situation might occur for a popular species pursued by recreational anglers in three states adjacent to a body of water. If a regulation reduced the allowed recreational catch, the result might be a reduction in the number of recreational fishing trips in each of the three states. The impacted region then could be defined as the three states even though recreational fishing expenditures will be a relatively small share of the total economic activity in these states. The analysis could also be disaggregated so that the impact in each of the three states in the region can be identified. An alternative approach would be to limit the impacted region to those counties directly adjacent to the water body so that the businesses that depend on recreational fishing for the regulated species will constitute a large share of the economy in the impacted region. The region could then be aggregated across the three states or disaggregated for each state.

4.2 The Meaning of Internal, Export and Import Activities

The definition of the impacted region is so important because it helps to determine which economic activities are internal, export and import. Internal economic activity is defined as the sales by businesses within the impacted region to households within the region plus the sales between businesses within the impacted region. The sales to customers within the region is one part of the final demand for the final products of businesses within the region. The sales between businesses within the region are referred to as the intermediate product of business activity. These are "intermediate" sales because the products which are sold are combined with other products before the final products are sold to households. For example, the fish that are sold by a fishing boat to a processor within an impacted region would be one of the intermediate product sales that are

internal to the region. After processing and subsequent sale to a retail fish market within the region, the sale of the fish product by the retail market would be part of the final demand that is internal to the region.

When either intermediate or final products are sold to businesses or households outside the impacted region, these can be classified as export activity. Exports are commonly thought of as sales to other countries but this is not necessary in impact analysis. Any sales outside the impacted region are exports. These export sales are also part of the final demand for the products of businesses within the impacted region.

Import activity occurs when households within the impacted region purchase final products from businesses outside the region or when businesses within the region purchase intermediate products from other businesses outside the region. As in the case of exports, these imports do not have to come from other countries. The only criterion for consideration is whether the business making the sale is located outside the impacted region.

4.3 Defining Sectors Within the Regional Economy

One way to view economic activity within a region is as groups of businesses producing the same or closely related products. This grouping of businesses into sectors or industries represents the diversity of economic activity that occurs within the region. And, these sectors are a convenient way of classifying the products of perhaps thousands of businesses.

The problem with viewing the economy as a collection of sectors, however, is that there is no single way to group businesses into sectors. Few businesses produce just one product and even fewer produce exactly the same product. Therefore, the task of defining sectors within a regional economy is to select classifications for sectors that are specific enough to define a particular type of activity yet sufficiently broad to encompass the full variety of product forms. In some cases "special" sectors may be created to focus on a particular type of activity that will be impacted by a regulation.

One of the most commonly used classification systems for defining sectors within a region is the Standard Industrial Classification (SIC) structure used by the U.S. Bureau of the Census (Office of Management and Budget, 1972). The SIC structure consists of 4,000 sectors to describe activity within the economy

and to serve as the basis for analysis. There grouping of firms within sectors is usually referred to as two-digit, three-digit, or four-digit aggregation and the four-digit groups are the least aggregated. The problems with the SIC structure, however, are that it is usually too large to adapt to a small regional economy and it is not detailed enough to focus on specific groups of businesses that may be impacted by regulations.

To overcome these problems, analysts frequently define new sectors that are an aggregation of sectors as defined in the SIC codes or sectors that disaggregate businesses within an SIC code. For example, Table 1 shows some representative sectors for the commercial and recreational fishing sectors of an economy. The table also shows the primary products from these sectors and the four-digit SIC code(s) for these sectors.

The Fish Processing sector illustrates the way in which individual sectors can be aggregated. The two SIC sectors are closely related so they can be easily combined. The Fishing Vessels sector is also another natural combination. The Marine Hardware and Equipment sector shows a possible combination of businesses from different SIC codes to create a unique fishing related sector. In this case, the SIC codes actually define sectors that include many other types of business than the fishing related sectors. As a result, the aggregation of sectors used to create the Marine Hardware and Equipment sector in Table 1 is only combining businesses from these SIC sectors whose sales are primarily marine related in order to create a new sector that is exclusively related to fishing.

For some analyses it may be necessary to use more disaggregation than the representative sectors illustrated in Table 1. For example, King and Shellhammer (1981) used nineteen fish harvesting sectors and nine fish processing sectors to represent commercial fishing activity in California. In this analysis each fish harvesting sector was associated with a specific species and the processing sectors were combined only when the species processed were closely related (e.g. shellfish). Similarly, Prochaska and Morris (1978) developed seven fish harvesting sectors to represent the seven major species harvested in Florida and one "combined" harvesting sector for the seventy-eight other species caught in the state. In both cases the level of disaggregation was influenced by the relative importance of each species and the availability of data that would permit the analysts to disaggregate activity within the fish harvesting sector.

Table 1. Representative Commercial and Recreational Fishing Sectors Based on SIC System.

Sector	Primary Products	SIC Number and Description
	Commercial Sectors	
Fish and Seafood Harvesting	Raw fish and shellfish products	0912 - Finfish 0913 - Shellfish 0919 - Miscellaneous marine products
Fish Processing	Processed fish products	2077 - Fish oil and meal 2091 - Canned and cured seafoods 2092 - Fresh and frozen packaged fish
Wholesale and Retail Seafood	Seafood final products	5146 - Fish and seafood distributors 5423 - Meat and seafood markets 5812 - Eating places
	Recreational Sectors	
Marinas and Boatyards	Storage, repairs and supplies	4469 - Miscellaneous water transportation
Marine Trade	Retail sales of boats and supplies	5551 - Boat dealers 5311 - Department stores
Charter Fishing	Charter/party boats and guides	7999 - Amusement and recreation services
Hotels and Restaurants	Lodging and food	7000 - Hotels and lodging places 5812 - Eating and drinking places
	Other Related Sectors	
Fishing Equipment	Tackle, nets, etc.	3949 - Sporting and athletic goods 2298 - Cordage and twine
Fishing Vessels	Ships, boats and repairs	3731 - Ship building and repairing 3732 - Boat building and repairing
Marine Hardware and Equipment	Boat accessories, navigation, etc.	3429 - Miscellaneous hardware 3079 - Miscellaneous plastic products 3662 - Transmitting and detection equipment
Marine Services	Marine construction, finance, insurance, etc.	1629 - Miscellaneous heavy construction 6000 - Banking 6300 - Insurance

4.4 Data Sources on Economic Activity for Sectors

One of the dilemmas of regional economic impact analysis is the lack of data on economic activity for sectors within the region. This can be an especially troublesome problem for fishing related sectors because of the problems due to sector definitions discussed above. The most available and reliable data are employment and income (payroll) data collected by state level employment offices. These data on the number of workers and payrolls are usually reported by four-digit SIC code although the level of reporting may vary across states. Output data can also be collected from state level agencies in states where excise (sales) taxes are levied on products sold. This can be a problem, however, because excise tax coverage varies by state and certain types of sales are exempt. There is also less uniformity across states in the reporting of excise taxes by sector. In cases where an analyst wants to construct more detailed sectors than those available in the four-digit SIC codes, it is necessary to obtain individual firm level employment, payroll and sales data. However, regulations protecting firms confidentiality may limit access to individual firm data.

In some cases partial data on economic activity within a sector can be used to estimate activity that is not reported. For example, a commonly used technique in regional analysis is use employment data to estimate sales for a sector. This is done by comparing employment in the sector within the region to national employment in the sector. This approach, referred to as a location quotient, can be used when reliable data are available for both regional and national level employment for a sector. However, this can be a problem for fishing related sectors because of the level of aggregation at the national discussed earlier. More detail about the location quotient approach is provided in the following sections.

In most cases the secondary data on employment and sales will have to be supplemented by primary data collected from fishing related firms in the region. These surveys can be designed to collect basic data on employment, income and sales or they can collect detailed information on the amount and source of inputs, the level and destination of sales, and the level of activity accounted for by specific products. The level of detail used in the survey will depend on the purpose of the impact analysis and the type of analytical technique used for the analysis.

Another source of primary data for impact analysis is a recreational angler survey. This type of survey can provide data on angler expenditures that may not be reported as sales by fishing related firms (e.g. fuel sold by gasoline stations to boat fishermen). The primary problem with this type of data is that it only applies to one measure of economic activity, sales, so some other approach must be used to estimate other measures.

Since there is no single "best" way to conduct a primary data survey, a review of other studies to determine how the survey was conducted can be useful. Good examples of previous fishing related studies that discuss the survey methods are: Hushak et al. (1984), Milon et al. (1983), Talhelm (1988), and Usher (1987).

5. THE ECONOMIC-BASE THEORY APPROACH TO IMPACT ANALYSIS

5.1 Defining Basic and Nonbasic Sectors and the Multiplier Effect

Economic-base theory is the core of many economic impact evaluation methods. The fundamental premise of economic-base theory is that economic growth in the region is determined by the growth of exports from the region. These exports can be in the form of goods such as fresh or processed fish products sold to businesses or consumers outside the region. Or, the exports can be in the form of expenditures by tourists visiting to use the resources in the region. Charter boat services or bait and tackle sold to tourist anglers are examples of the latter type of export.

The export sectors constitute the basic sector of the regional economy and therefore sales, employment and income in the basic sector are determined by final demand outside the region. But, the basic sector is supported by output from the nonbasic sector in the form of intermediate products sold to firms in the basic sector or in the form of goods and services sold to workers in the basic sector. As the exports from the basic sector expand and contract, the demand for goods and services from the nonbasic sector also expands and contracts. Thus, changes in economic activity in both the basic and nonbasic sectors are tied to changes in exports.

A slightly different way to view economic changes with economic-base theory is through import substitution. Since exports represent an injection of money

into the region, imports are a leakage of money out of the region. These leakages reduce the level of economic activity in the region since goods and services are not produced by regional firms and workers. Products made in the region that substitute for imports reduce these leakages and contribute to the growth of economic activity. Thus, the use of a regionally produced fish product by consumers in the region in lieu of a fish product imported from outside the region will contribute to regional economic activity. Or, a change in regional activity can result from a change in expenditures by anglers for trips to fishing sites in the region instead of to sites outside the region.

The effects of changes in exports or import substitution are measured with a regional multiplier. The multiplier summarizes the total economic impact that occurs in the region for each unit of change in economic activity that caused the effect. The total economic impact is composed of three impacts: the direct impact is the initial change in final demand for exports (imports) in the region; the indirect impact is the change in output and employment to produce the goods and services required from firms in the region to support the output associated with the direct impact; and, the induced impact is the change in the demand for goods and services within the region caused by the change in income and employment from the direct and indirect impacts. The indirect and direct impacts together are commonly called the secondary impacts because they cannot occur without the direct or primary impact.

Multipliers are a very easy way to summarize a great number of economic relationships in a few numbers. This simplicity is a virtue if used properly but multipliers have often been abused in debates about fisheries regulations because the derivation and interpretation of multipliers is not well understood. Therefore it is important to take a detailed look at multiplier estimation techniques.

5.2 Different Multipliers to Measure Different Types of Total Impacts

Economic-base theory multipliers can be developed to measure different types of total impacts on economic activity within a region. One type of multiplier is computed as the ratio of total output in the region to output in the basic sectors, or

Output Multiplier = Total Output / Basic Output.

For example, if total output in the regional economy is $10 million and basic sector output is $5 million, the multiplier is 2 ($10/$5 = 2). A direct or initial impact on basic output of $1 million would lead to a total impact on output of $2 million in the regional economy ($1 x 2 = $2). The output multiplier is a convenient tool to estimate the total impact of an initial change in basic sector output on the regional economy.

The output multiplier describes the expected change in total regional output but this is only one measure of the change in economic activity. As total output changes it would be expected that employment, income and value added would also change. Since the output multiplier is only a ratio of one measure of economic activity to another, it might be tempting to think that all other measures of economic activity would have the same multiplier effect. Unfortunately there is no reason to expect one measure of economic activity to behave exactly as another and it would be quite unusual if they did. Therefore, it is necessary to develop multipliers for each measure of economic activity to fully account for all the impacts of a change in the basic sector on the regional economy.

Other multipliers that can be used to measure total economic impacts include:

- the employment multiplier to measure the expected change in total employment due to an initial change in basic sector employment which is computed as the ratio of total regional employment to basic sector employment; and,
- the income or value added multiplier to measure the expected change in total wages, salaries, profits and rents due to an initial change in basic sector income which is computed as the ratio of total regional income to basic sector income.

While all these different multipliers can be used for impact analysis, some multipliers may be more useful than others. For example, the output multiplier can be very misleading because of all the input purchases, many of which may be imports, that get counted in the output measure. The income or value added multiplier will usually give a more useful indication of the change in economic activity because it measures the change in income for workers in the region and doesn't count purchases made outside the region.

To illustrate the difference in the information provided by these multipliers, consider as an example the hypothetical regional economy of Codland. The region of Codland exports many products but it is also very dependent on imports from other regions for intermediate goods used in the production of final goods. The economic-base multipliers for Codland are the following:

Output multiplier = 2.2
Employment multiplier = 1.3
Value added multiplier = 1.1

A proposed fishery regulation would allow firms in the fish harvesting and processing sector to harvest more fish from within the region leading to an expected increase in direct output of $1 million. This increase in output would add 10 new FTE employees to the payroll in the fish sector and the value added (wages plus profits) would be $150,000. These are the initial, direct impacts of the regulation. All of the sectors output is sold as exports but, like other industries in Codland, the fishing sector relies heavily on imported intermediate goods that are combined with the raw fish products to produce final fish products for export. Based on the economic-base multipliers for Codland, the expected total economic impacts from the initial increase in exports are:

Total output = $2.2 million
Total employment = 13 workers
Total value added = $165,000

These multiplier effects illustrate the point that the measure of economic activity used to indicate the expected impact of a fishery regulation can make a big difference in the perceived effects on the region. Based on the total output measure, the total impacts of the regulation would be 120 percent greater than the direct impact of $1 million. However, the total employment impact would be only 30 percent greater and the total value added impact would be only 10 percent greater. This latter change is a measure of how workers and owners in the region benefit from the regulation and doesn't count the cost of imported intermediate goods used to produce the final products. Thus, if a fishery managers looked only at the output impact of the regulation they might conclude that the total impact would be relatively large. But, if they looked at the employment and value added impacts, the total impacts are much smaller. Therefore it is very important for fishery managers to understand that the multiplier effects of fishery regulations are not the same for all measures of

economic activity and the employment and value added multipliers provide a more useful measure of economic changes within the region.

5.3 Determining Basic and Nonbasic Sectors and the Size of Multiplier Effects

The concepts of export or basic sectors and multiplier effects are relatively clear-cut and are an easy way for fishery managers to understand how regulations can have impacts on economic activity within a region. But, it is important to also understand that dividing sectors into basic and nonbasic is not always straightforward. In addition, there are many factors that will determine the size of the multiplier effects for fishery related sectors.

The simplest way to categorize sectors as basic or nonbasic is to assume that certain types of products are inherently exports. For example, mining, agriculture, fishing, forestry, and manufacturing sectors are typically considered basic sectors because firms in these sectors usually export a major portion of their output to other regions. In most cases the region is defined as a subnational area comprised of one or a few counties or states. Other sectors such as public utilities, financial and government services, and retail trade are considered nonbasic because these sectors primarily serve local markets. The definitional problem is that most firms sell some part of their output to local purchasers and, as the size of the region expands, the share of output sold locally usually increases. In addition, there is no particular reason why all of the output from agricultural or fishery sectors could not be sold within the region. This problem can be overcome if an analyst knows the amount of exports by different sectors within a region. This type of information may be difficult to obtain but it may be available for some industries from various national surveys or from direct surveys of firms within a region.

The alternative ways of categorizing basic and nonbasic sectors are based on comparisons of economic activity in the region under study with other economies. One technique is the location quotient(LQ). The LQ is defined as:

$$LQ = (E_{ir} / E_{in}) / (E_r / E_n),$$

where E is a measure of economic activity such as output, employment, etc., the subscript i indicates a specific sector within the region under study, r, or in the national economy, n. If this ratio is larger than one, the sector is classified as basic because the share of total regional economic activity

accounted for by that sector exceeds the share of total national activity for that sector. The sum of all sectors with LQs larger than one is defined as the basic component of the regional economy. The justification for this approach is that, when the share of regional economic activity accounted for by a sector exceeds the national average, the sector must be producing for export markets. While there are many assumptions required to use this technique and many variations (see Richardson 1985), it is one of the most commonly used techniques in regional economic analysis.

Another popular alternative to identify basic sectors is the minimum requirements technique. This technique is also based on a comparison. But, the comparison is between the region under study and a group of similar sized regions instead of the national economy. For each sector, the share of economic activity for that sector in the study region is compared to that sector's share of economic activity in the region with the minimum share of activity in that sector. The amount of activity in a sector that exceeds the sector's activity in the minimum share region is a measure of the sector's exports. Thus, in theory, any sector could export and be a part of the region's basic sector.

These three techniques to identify the basic sectors of the regional economy can lead to very different results. There is no reason why each of the three techniques should give the same classification of basic and nonbasic sectors. And, the economic-base multipliers that emerge from the classification can also be very different. The fishery manager should be aware that the classification process can be a major source of differences in estimates of economic-base multipliers.

There are other factors, however, that influence the size of economic-base multipliers. The most important factors are the level of interdependence between sectors in the region and the geographic scale of the region. Economic interdependence refers to the linkages that export sectors have to other sectors within the region. As a general rule, the greater the linkages between sectors, the larger the multiplier. For example, in the earlier example of how multipliers are used, the fish harvesting and processing sectors were described as highly dependent on imported intermediate goods. This meant that other businesses from within the region could not provide the intermediate goods needed to produce finished fishery products. Therefore, even though money flowed into the region from the export of fishery products, part of the money "leaked" back

out to buy inputs and was unavailable for spending within the region. If the fish sector had been able to buy more intermediate goods from businesses in the region, less money would flow out of the region and the multiplier effect of a change in export demand would be larger.

The linkages between sectors also depend on the geographic scale of the region. Businesses in a small region such as a few counties are usually more dependent on suppliers from outside the region than businesses in large regions where a broad array of products are produced. Therefore, the induced effects of a change in exports will be limited by the size of the region, and the multipliers will generally be lower for small regions.

Interdependence also occurs through the income generated by exports since this income is the source of the induced impacts of a regulation. Income that is received by workers and owners within the region is available for local consumption. However, if this income is not retained in the region, and the money is used to buy goods outside the region, the induced effects will be reduced. And, as the induced effects decrease, the size of the multiplier will also decrease. The most extreme example of this would be an "island region" where all wages and profits are paid to workers and owners who live outside the region and only come to the island to work. In this case the induced effects would be zero. This is a potentially important issue for fisheries managers because many fishery related sectors are dependent on seasonal labor. This seasonal labor may be for crew work on fishing boats, as line workers in processing houses, or as service workers in marine recreation businesses. To the extent that these seasonal workers do not spend their income in the region, the total impacts of a fishery regulation that changes the level of business activity in the fishery sectors will be reduced.

One final consideration about multiplier effects is the correspondence between the size of the region and the initiation of secondary impacts. As discussed above, multiplier effects generally increase as the size of the region increases. But, as the size of region expands, the likelihood that regulations change exports from the region decreases. This is because "exports" from one region to another would no longer be exports if the two regions were combined together. At the extreme, if the "region" were defined as the national economy and all products were sold within the national economy, there would be no secondary impacts because there would be no exports. Therefore, there would be

no need to estimate multipliers since the direct impact of a fishery regulation would measure all the relevant changes in economic activity. This is why the choice of boundaries for the study region is such an important part of economic impact analysis.

5.4 Limitations of the Economic-Base Theory Approach

While economic-base theory is a useful and relatively simple way to understand how economic impacts occur and can be measured, it also has some serious limitations. The most important limitation is the assumption that all economic impacts are generated by changes in basic sector output. This assumption limits the consideration of economic impacts to changes in exports so that changes in nonbasic sector economic activity are essentially irrelevant. This limitation is compounded by the lack of a single technique to define basic and nonbasic sectors. Since one technique could lead to the classification of fishery related sectors as basic and another technique might classify these same sectors as nonbasic, the results of an economic impact analysis of fishery regulations could vary considerably. Fishery managers should be aware of the potential differences in estimated economic impacts when economic-base analysis is used.

A second limitation is that economic-base multipliers are aggregate multipliers that do not distinguish between different sectors. It is assumed that all sectors within the basic sector have the same multiplier effects on the regional economy regardless of how varied the linkages between one basic sector and the nonbasic sectors may be compared to another basic sector. Thus, the economic-base multipliers that would be used for an impact study of fishery regulations in a region would also be used for an impact study of the effect of air emission regulations on auto manufacturing plants. Clearly the fishery and auto manufacturing sectors will have different linkages within the regional economy but these differences could not be considered with economic-base multipliers.

These limitations are serious but they can be overcome with another economic impact analysis approach called input-output analysis. Unfortunately, these gains are accompanied by a significant increase in both the complexity and cost of impact analysis.

6. THE INPUT-OUTPUT APPROACH TO IMPACT ANALYSIS

6.1 Economic Linkages and the Transactions Table

The linkages between sectors in a regional economy can be described with input-output(I/O) analysis. Instead of dividing the regional economy into basic and nonbasic sectors, I/O analysis begins with the economy divided into suppliers and purchasers. These two groups are further divided into primary and intermediate subgroups defined as follows:

Primary suppliers provide labor, capital and land resources that do not require other inputs; they receive final payments in the form of wages, salaries, profits, and rents. As defined earlier, these final payments are also the region's value added.

Intermediate suppliers provide intermediate products to other intermediate suppliers or to final demand.

Intermediate purchasers buy the output from primary and intermediate suppliers to use as inputs in production.

Final purchasers buy the output from suppliers as final products; this final demand is the reason for the intermediate purchases from suppliers.
While this taxonomy of groups within the regional economy may be confusing, it is important to keep in mind that intermediate suppliers and intermediate purchasers are essentially one and the same. They buy and sell products to each other and provide the linkage between primary suppliers and final purchasers.

The basic framework of I/O analysis can be understood from the transactions table shown in Table 2. This transactions table for the hypothetical region of Codland represents the buying and selling of goods and services by three sectors: commercial fishing, recreational fishing, and all other sectors. These are obviously very aggregate sectors and a real input-output table would be much more detailed. But, the simple economic structure can be revealing. First, note that the suppliers of goods and services are arrayed on the left hand side of the table and include both intermediate and primary suppliers. Along the top of the table are the intermediate and final purchasers. Reading along the rows from left to right, the table shows that the commercial fishing sector supplied $1 million in output to itself (sales by businesses within the sector such as from fish harvesters to processors), $2 million to all other sectors, $2 million to

households within the region, and $1 million of output was exported to businesses and households outside the region. Total output from the sector was $6 million but note that final sales were only $3 million ($2 million to households and $1 million in exports). This illustrates the point made earlier in Section 3 that total output and total product (final sales) are not the same. The second and third rows show the intermediate and final sales for the recreational and all other sectors which had total output of $6 million and $100 million, respectively. Since these three sectors comprise the entire economy of Codland, the total output for the region was $112 million.

The bottom rows of the table show the value added (wages, salaries, profits, etc.) from the output produced and the imports. Note that the total value added ($70 million) is considerably less than the total output. Also, in this example, value added in the recreational fishing sector is lower than the value added in the commercial fishing sector even though the two sectors have the same amount of total output.

The columns of Table 2 show the purchases by intermediate and final purchasers. Reading down the first column, the commercial fishing sector purchased $1 million of inputs internally, $1 million of inputs from other industries, $3 million from households, and $1 million in imports. The total input purchases of $6 million equal the $6 million of total output. This is one convention of I/O analysis to account for all transactions in the region. The second and third columns show the input purchases by the recreational fishing and all other sectors. The sum of these input purchases by each sector also equal the total output by that sector so that the total input purchases by all sectors of $112 million equals total output in the region.

The transactions between intermediate suppliers and purchasers described in the upper left hand part of Table 2 show the importance of linkages between sectors in the regional economy. In order for the recreational fishing sector to sell its output of $6 million, it must buy $2 million of inputs from the all other sector. This means that every $1 of output from the recreational fishing sector requires $.34 of inputs from the all other sector. Similarly, for every $1 of output from the all other sector it must but $.02 of inputs from both the commercial and recreational sectors and $.27 from itself. This interdependence is very important because it means that a change in output in one sector influences output in every other sector. Thus a fishery regulation that changed

Table 2. Input-Output Transactions Table for a Hypothetical Regional Economy.

		INTERMEDIATE PURCHASES			FINAL PURCHASES		TOTAL OUTPUT
		Commerical Fishing	Recreational Fishing	All Others	Households	Export	
INTERMEDIATE SUPPLIERS	Commercial Fishing	1,000,000	0	2,000,000	2,000,000	1,000,000	$6,000,000
	Recreational Fishing	0	1,000,000	2,000,000	2,000,000	1,000,000	$6,000,000
	All Others	1,000,000	2,000,000	27,000,000	60,000,000	10,000,000	$100,000,000
PRIMARY SUPPLIERS	Households (Value Added)	3,000,000	2,000,000	65,000,000	-	-	
	Imports	1,000,000	1,000,000	4,000,000	6,000,000	-	
	TOTAL INPUT	$6,000,000	$6,000,000	$100,000,000			$112,000,000

the output level in the recreational fishing sector would also change output levels in the other sectors. These linkages between sectors are the source of multiplier effects in I/O analysis and will be discussed in more detail below.

Other useful information from Table 2 is the purchases and sales by households in the region. When households sell their labor or capital services they become primary suppliers. The income or value added they earn is used to purchase the goods produced by the businesses they work for. In the region of Codland, households earn income from all three sectors but the majority is from the all other sector. This income is used for final purchases by the household sector which is part of the final demand for output in Codland. Notice that households do not make intermediate purchases because all of the products they buy are for final consumption. The sum of all final purchases by households (excluding imports) is the total product of Codland which is $64 million. Notice that this total product is also considerably smaller than the total output of $112 million. Total product would equal total value added of $70 million but $6 million "leaks" out of the regional economy through imports of final products.

The introduction of information about employment in the fictional economy of Codland can provide other insights about the use of I/O analysis. The number of FTE employees in these sectors is as follows: commercial fishing sector - 120 employees, recreational fishing sector - 300 employees, and all other sector - 3,000 employees. Combining this information with the data in Table 2 for output and value added by sector it is possible to calculate the ratio of output and value added per employee:

	Commercial Fishing	Recreational Fishing	All Other
Output per Employee	$50,000	$20,000	$33,334
Value Added per Employee	$25,000	$6,667	$21,667

These numbers show that output per employee is highest in the commercial fishing sector and lowest in the recreational fishing sector. Similarly, value added is highest in commercial fishing. This is useful information but it should be interpreted with care. The higher output and value added per employee does not mean that the commercial fishing sector is "more valuable" because the final demand for both sectors' output is the same, $2 million. In addition, more workers are employed in the recreational sector.

What this information conveys is one of the ways that I/O analysis can be used to estimate economic impacts. Consider a hypothetical initial, direct

impact of $1 million in the final demand for each of the three sectors. To be consistent with the economic-base multiplier analysis presented earlier, assume that the initial change in final demand comes from outside the region and all three sectors are considered "export" sectors. Using the output and value added per employee it is possible to determine the number of new employees that will be needed in each sector and the new value added that will result. For example, in the commercial sector the $1 million increase in total output would require 20 new employees ($1 million divided by $50,000 per employee) which would generate $500,000 in value added (20 employees times $25,000 per employee). The results for all sectors would be:

	Commercial Fishing	Recreational Fishing	All Other
New Employees	20	50	30
New Value Added	$500,000	$340,000	$650,000

These direct impacts of a $1 million increase in each sectors output partially show how the regional economy would change. The number of new employees would be largest in the recreational fishing sector but the value added would be largest in the all other sector. Thus, the same initial direct output impact of $1 million would have quite different employment and income impacts across the three sectors. This is one of the significant differences between I/O analysis and economic-base analysis since the latter did not provide a means to evaluate the difference in economic impacts across sectors. To understand further how I/O analysis can be used to estimate economic impacts it is necessary to consider multiplier effects.

6.2 Multiplier Effects in Input-Output Analysis

Multiplier effects in I/O analysis are similar in concept to the multipliers developed in economic-base analysis. The multipliers provide a measure of the total impacts on regional economic activity due to a direct impact. The main differences between the two methods to estimate multipliers are: a) I/O analysis provides different types of multipliers to estimate the indirect and induced impacts, not just the total impacts, b) I/O analysis provides output, value added and employment multipliers for each sector in the region rather than for the region as a whole, and c) I/O analysis does not divide the economy into basic and nonbasic sectors so any change in final purchases can generate multiplier effects, not just a change in basic sector output.

I/O analysis provides two types of output, value added and employment multipliers. A Type 1 multiplier identifies the direct and indirect impacts of a change in final purchases. These direct and indirect impacts are the result of the buying and selling by intermediate suppliers and purchasers in response to increases or decreases in output. This means that an initial change in final output of $1 million in the recreational fishing sector will impact more than this sector alone. Using the economy of Codland described earlier in Table 2, an initial $1 million increase in output would require the recreational sector to buy $166,667 worth of inputs from firms within the sector and $333,334 worth of inputs from the all others sector. These are input requirements determined by the existing linkages between the suppliers and purchasers. But, notice that the purchase of $333,334 of inputs from the all other sector would result in an increase in that sector's output of the same dollar amount. And, in order to meet this increase in output, the all other sector would have to purchase additional inputs from the commercial and recreational fishing sectors. Thus, the direct impact of $1 million occurs in the recreational fishing sector but it indirectly causes further impacts in every other sector in the economy. The Type 1 multiplier expresses these impacts as the ratio of the sum of the direct and indirect impacts to the direct impacts.

A Type 2 multiplier extends this process one step further to include the fact that the recreational sector would also create new value added of $333,334 in response to the initial direct impact of $1 million. This new value added would be in the form of wages, profits, etc. that would accrue to workers and owners in the recreational sector. But since this new value added would also make more money available for final purchases by households, the new spending would induce additional output, value added and employment impacts in every other sector. Because these induced impacts occur in addition to the indirect impacts, Type 2 multipliers are generally larger than Type 1 multipliers. Type 2 multipliers are expressed as the ratio of the sum of the direct, indirect and induced impacts to the direct impacts. For this reason Type 1 and 2 multipliers are sometimes called ratio multipliers.

Type 1 and Type 2 multipliers can be computed for each sector in the regional economy using a well-known procedure that is described in many books on I/O analysis (e.g. Hewings 1985, Miller and Blair 1985). The details of this procedure are beyond the scope of this guide but they are not needed to

understand how to interpret I/O multipliers. This can be done by evaluating the multipliers for the economy of Codland described in Table 2. The Type 1 multipliers are listed below along with the calculated direct and indirect impacts of an initial direct $1 million increase in final demand in each sector. Once again it is assumed that the change in final demand comes from outside the region.

Type 1 Multiplier	Commercial Fishing	Recreational Fishing	All Other
Output	1.49	1.79	1.46
Value Added	1.57	2.30	1.44
Employment	1.62	1.55	1.47
Direct and Indirect Impacts			
Output	$1,490,000	$1,790,000	$1,460,000
Value Added	$785,000	$782,000	$936,000
Employment	32	77	44

The Type 1 multipliers show how the linkages within the economy of Codland determine the direct and indirect impacts. As a general rule, I/O multipliers will increase in size as a sector's level of interdependence with other sectors increases. The output and value added multipliers for the recreational fishing sector are larger than for the other two sectors because the recreational sector is more dependent on inputs from other sectors (see Table 2). The all other sector has the smallest multipliers because it is the least dependent of the three sectors. The employment multipliers for the three sectors are roughly the same because the indirect effects for the recreational sector are relatively small compared to the direct effects.

The direct and indirect impacts for an initial $1 million increase in each sector's output show how impacts vary across the sectors. The recreational fishing sector has the largest output impact due the size of the output multiplier. But, the value added in the commercial sector is larger than in the recreational sector even though the value added multiplier is larger for the recreational sector. This occurs because the initial value added per $1 of output is larger in the commercial sector (see the discussion in Section 6.1). The all other sector has the largest impact on value added even though the sector had the smallest multipliers. This occurs because this sector had the largest direct impact on value added. Similarly, the number of new employees added is larger in the recreational sector because the direct employment impact in this

sector is larger than in either of the other sectors. These results illustrate the important point that the size of the multiplier is determined by the linkages between sectors but the size of the multiplier alone is not an indicator of a sector's importance in generating income and employment.

Type 2 multipliers account for the additional regional economic activity that is induced by household spending from the new value added created by the direct impact. As with the Type 1 multipliers, the Type 2 multipliers express the expected increase in each type of economic activity due to a direct impact on the regional economy. The major difference between the Type 1 and Type 2 multipliers is that the Type 2 multipliers measure the total impact (direct, indirect and induced) whereas the Type 1 multipliers only measure the direct and indirect impacts. The Type 2 multipliers for the region of Codland are listed below along with the calculated total impacts of an initial direct impact of $1 million in output in each sector.

Type 2 Multipliers	Commercial Fishing	Recreational Fishing	All Other
Output	12.63	12.74	14.68
Value Added	9.61	13.83	8.74
Employment	11.37	13.39	9.15
Total Impacts			
Output	$12,630,000	$12,740,000	$14,680,000
Value Added	$4,805,000	$4,702,200	$5,681,000
Employment	227	670	275

The addition of induced impacts with the Type 2 multiplier shows some significant differences from the Type 1 multiplier impacts. As expected, the Type 2 multipliers are larger than the Type 1 due to the addition of induced impacts. However, the addition of induced impacts also changed the relative size of the multipliers as compared to the Type 1 multipliers. For example, the recreational sector multipliers are still generally larger than for the other sectors but the all other sector now has the largest output multiplier. This is the result of the large share of final demand accounted for by the all other sector so that a large share of induced demand occurs in this sector.

The estimated total impacts with the Type 2 multipliers are dramatically different from the Type 1 impacts. These total impacts show the total increase in the output, value added and employment in Codland. Output, value added and employment are all considerably larger due to the large induced impacts

associated with the addition of household spending. The all other sector has the largest output and value added impact. This occurs because of the structure of the Codland economy. The region is very self-sufficient with a very low level of imports overall and the all other sector has the lowest share of imports in the sector's input requirements (see Table 2). This means that new spending in the region cannot "leak away" to other regions so most of the impact occurs within Codland. As with the economic-base multipliers discussed earlier, Type 1 and 2 multipliers will generally be smaller if a region is small and not self-sufficient or larger if the region is larger and more interdependent.

Unfortunately, very few regions are as self-sufficient as this hypothetical example and multipliers are usually much smaller than in this example. Type 2 output multipliers estimated with I/O analysis for recreational and commercial fishery sectors have ranged from as low as 1.3 to as high as 8.60 but the average has been in the range of 1.75 to 3.00 (e.g. Grigalunas and Ascari 1982, Hushak 1987, Milon et al. 1982). Because these studies used different definitions of fishery related sectors and the regional economies studied were different in scale and structure, it is not possible to directly compare these studies or to use the results to predict the multipliers for other regions.

Another way that I/O analysis can be used for impact assessment is to disaggregate the changes in value added across the different sectors in Codland. This type of disaggregation is based on the information used to calculate the value added multipliers (Miller and Blair 1985, pp.106-10). Using the same example of a hypothetical $1 million increase in final demand for each of the three sectors in Codland, the distribution of increases in value added for the total impacts in the economy of Codland would be as follows:

	Increase in Value Added by Sector		
Final Demand by Sector	Commercial	Recreational	AllOther
Commercial	$744,000	$103,700	$3,957,300
Recreational	$146,500	$514,000	$4,041,700
All Other	$201,000	$137,000	$5,343,000

This analysis of the distribution of income changes shows that the all other sector is the principal beneficiary of all changes in final demand. This is due to the difference in the relative size of this sector and the other two sectors and because this sector is very self-sufficient. The analysis also shows that every sector gains from an increase in final demand even though the change may

occur in another sector. For example, the $1 million increase in final demand in the commercial fishery sector increased value added in that sector by $744,000 and it also increased value added in the recreational sector by $103,700. Similarly, the $1 million increase in recreational sector final demand increased value added in that sector and in the commercial sector. These results illustrate that the economic impacts of changes in final demand are not limited to the sector where the initial change occurs. I/O analysis is a useful tool to identify these economic impacts across sectors.

6.3 Multiplier Effects for Internal Changes in Final Demand

While the preceding analysis was based on a hypothetical increase in each sector's final demand due to a change in exports, it is possible to change the example and show another use of I/O analysis. Fishery managers in Codland are considering a change in the allocation of fish caught by recreational and commercial fishermen. The reallocation would increase the amount of fish caught by recreational anglers and decrease the commercial catch. These changes would not change commercial fishery exports or tourism in the recreational sector so only internal commercial and recreational fishery economic activity would be effected. As a result of the increased recreational catch, recreational anglers would take more fishing trips and spend more money on recreational sector products so that final demand in the recreation sector would increase by $1 million. With fewer fish to catch and sell to households in Codland, the final demand for commercial sector output would decrease. For this example assume that the decrease in final demand is $1 million so that there is no direct change in the output level of the region.

Using the results from the previous example, the direct and total impacts of the reallocation can be shown for the region. The direct impacts of the change in the source of final demand would be as follows:

	Source of Final Demand		Net
Direct Regional Impacts	Commercial	Recreational	Direct Impact
Output	-$1,000,000	+$1,000,000	$0
Value Added	-$500,000	+$340,000	-$160,000
Employment	-20	+50	+30

The analysis shows that the reallocation would have no net direct impact on final demand in the region but the loss in value added in the commercial sector is larger than in the recreational sector so the net regional value added would fall

by $160,000. But, since more employees are needed per unit of output in the recreational sector, net employment would increase by 30 employees.

Using the Type 2 multipliers for Codland discussed in the previous example, the total impacts on the region from the change in the source of final demand are as follows:

	Source of Final Demand		Net
Total Regional Impacts	Commercial	Recreational	Regional Impact
Output	-$12,630,000	+$12,740,000	+$110,000
Value Added	-$4,805,000	-$4,702,200	-$102,800
Employment	-227	+670	+443

The total impact analysis shows how the reallocation would change total economic activity due to the change in final demand across sectors. Total regional output would increase by $110,000 even though there was no net change in final demand. This increase is due to changes in intermediate purchases caused by the reallocation of final demand. The net total change in value added for the region is less than the net direct impact because a portion of the change in intermediate purchases offset the decrease in commercial sector output. Hence, some value added was gained in the recreational and all other sectors through the indirect and induced spending. Total employment increases by 443 employees because of the higher employee per unit of output requirements and the larger Type 2 employment multiplier in the recreational sector. Thus, the overall impact on the region from the reallocation was a gain in total output and employment but with a loss in total value added.

It is also useful to compare these net impacts from internal changes in final demand to the impacts presented earlier for external changes in final demand. In the earlier example the Type 2 multiplier effects showed that total output would increase anywhere from $12.63 million to $14.68 million depending on which sector received the $1 million increase in final demand. The value added and employment changes are also large. However, in the present example the Type 2 multiplier effects show that the net increase in total output would be $110,000 and the value added and employment impacts are much smaller. The dramatic difference between the two economic impacts is due to the different source of change in final demand. When the change in final demand comes from outside the region (exports) this adds new money to the regional economy and makes possible a sizable expansion in economic activity. But, when the change

in final demand is due to a reallocation of spending within the region, there is no new money added to the region. The economic impacts are readjustments in the composition of spending and large changes in total economic activity are not likely to occur unless there are large differences in the multiplier effects in the impacted sectors.

The same example of a reallocation of spending can be further extended to identify the specific changes in value added across sectors using the information from the Type 2 multipliers discussed earlier. The changes in total value added by sector due to the change in the source of final demand are as follows:

	Source of Final Demand		
Change in Value Added by Sector	Commercial	Recreational	Net Impact
Commercial	-$744,000	+$146,500	-$597,500
Recreational	-$103,700	+$514,000	+$410,300
All Other	-$3,957,300	+$4,041,700	+$84,400
Total Region	-$4,805,000	+$4,702,200	-$102,800

This analysis confirms that the reallocation causing a change in the source of final demand has a relatively large negative impact on value added in the commercial sector that is only partially offset by gains in value added in the other two sectors in the region. A similar type of analysis could be used for specific regions to inform fishery managers how reallocation decisions would change value added in different sectors. The reader should keep in mind that this example is based on a hypothetical regional economy so the results and implications would not be applicable to any other regions.

6.4 Further Extensions of Input-Output Analysis

The preceding discussion has focused on the basic methods and applications of I/O analysis for fishery management and used a simplified description of a regional economy to illustrate the basic issues. In practice an analysis would involve much more detail and it would be possible to examine other types of economic impacts than those considered thus far. For example, the value added measure of economic activity is an aggregation of wages and salaries, profits, interest, and government tax payments. An I/O analysis can decompose these elements so that the economic impact of a fishery regulation can be evaluated in more detail. Policy issues such as the impact of a regulatory decision on government tax collections or the distribution of gains and losses between owners

and employees can be addressed with a more detailed analysis. However, none of the basic concepts or applications would differ from those discussed above.

Another extension of I/O analysis is the inclusion of government services in the impact evaluation. For example, the quantities of water and electric services used in seafood processing plants can be related to output produced. These measures of infrastructure needs to support the processing plants can then be added to the I/O analysis. With this additional information, and information on services needs in other sectors, an impact evaluation could estimate how the demand for these government services would change with changes in the output level of the fisheries sector. This type of analysis is most appropriate for a small region because it may be difficult to relate infrastructure needs to specific governmental units if a large region is considered.

Finally, one additional extension of the basic framework should be considered because it leads to a direct consideration of one of the limitations of I/O analysis for economic impact studies. In both the economic-base and I/O approaches to economic impact analysis, the region is usually considered a distinct unit separate from the "rest of the economy." This is helpful because it makes it easier to define the linkages within the region and to measure exports and imports. But, with this distinction it is easy to neglect the consequences of change in other regions that may influence overall economic activity. For example, suppose a region is defined as state X and fishery managers in state X decide to prohibit recreational fishing for species Q in state waters. This decision only effects anglers from the adjoining state Y because, for the sake of this example, no anglers from X fish for species Q. And, anglers from state Y only go to state X to fish for species Q so the regulation would eliminate some final demand (export) in the recreational fishing sector in state X. An economic impact analysis of the regulation for the region of state X would show the negative economic impacts of the decrease in recreational sector final demand on the regional economy. But, this analysis would neglect to consider how final demand in the recreational sector in state Y would change now that anglers are no longer fishing in state X. If these anglers now take the same number of trips and spend the same amount of money for fishing in their home state, the net impact of the regulation across the two states would be considerably smaller and might even be positive. Thus, the

choice of boundaries for the impacted region can have a significant impact on the outcome of an impact analysis.

One extension of I/O analysis to consider these impacts in different regions is an interregional I/O analysis (see Miller and Blair 1985, pp.53-85). With this type of analysis it is possible to estimate economic impacts within several adjoining regions and account for the reallocation of fishing effort across regions that may occur with fishery regulations. Unfortunately this type of analysis is very cumbersome and requires very good data. An alternative is to expand the scope of "the region" to include two or more adjoining regions in a single I/O analysis. But, this "aggregation" approach cannot be used to analysis the economic impacts within one of the "subregions."

6.5 Limitations of the Input/Output Approach

I/O analysis is a more sophisticated and informative approach to economic impact analysis than economic-base theory analysis. There is no need to classify sectors as basic and nonbasic so changes in economic activity can occur through any change in internal or export final demand. In addition, I/O analysis provides multipliers for each sector within a region rather than a single aggregate multiplier for an entire region. Assuming that the increased data requirements of I/O analysis are not prohibitive, this approach is a superior method of evaluating the economic impacts of fishery regulations.

While the I/O approach provides clear advantages, there are still many limitations that influence the interpretation of impact studies. These limitations can be classified under two broad headings: 1) assumptions about the current economic structure of the regional economy, and 2) assumptions about the timing and extent of economic impacts. The first group of limitations involve basic assumptions used in I/O analysis that can be evaluated and modified if necessary. The limitations in the second group are more closely tied to the structure of the regional economy and are more difficult to overcome. Most of these are also problems in the economic-base approach but will be discussed here only in the context of I/O analysis.

The basic premise of I/O analysis is that output can expand and contract without changing the existing structure of the regional economy or the prices of inputs and outputs. This means that changes in the level of output do not

influence the cost of production so commonly accepted principles such as economies of scale in production (lower costs with higher output levels) are not considered. What this means is that there is no way to determine how a change in output will change the number of firms or the degree of competition in a sector. A doubling of output in a sector could lead to a doubling of output for each of the firms already in the sector or it could lead to a doubling of the number of firms all producing the same average level of output. Alternatively, a decrease in output could lead to monopoly power for one or a few firms. This limitation can be a problem in estimating impacts for sectors like commercial fisheries where output levels are influenced by the size or harvesting technology of vessels and regulations may be designed to limit the number of vessels in the fishery. More detailed analytical methods may be necessary for this type of problem.

The assumption that the prices of inputs and outputs do not change with changes in the level of outputs is also problematic. Changes in output levels and in the corresponding demand for inputs may cause input prices to change so that expected output levels are unrealisitic. For example, an increase in recreational fishery harvests may lead to an expected increase in total output for the sector. But, in order for the sector to expand, firms must hire new employees. If new workers are not available at the existing wage, the firms will be forced to pay higher wages. If these new costs cannot be passed on to recreational customers, other input purchases will not expand as much as anticipated. As a result, the total impacts will be different than expected because the secondary impacts are changed by the reduced level of intermediate purchases.

This example of changing wage rates highlights a serious problem in I/O analysis of employment in a region. It is assumed that employment expands and contracts with changes in output levels but there is no consideration of actual labor market conditions. If a region is already at full employment, additional employees may not be available to facilitate an increase in output in a sector. Firms may be able to attract new workers from other regions but this depends on the availability of workers in these other regions. Even if the region is not at full employment, there may still be problems. Unemployed workers in a region may not have adequate skills or be willing to work at the prevailing wage in the sector. Firms may then hire new workers from outside the region. Therefore a

projected increase in employment may have little or no effect on the unemployment rate in a region. Similarly, expected decreases in employment in a sector do not necessarily mean that unemployment will increase in a region. Workers may move from one sector to another in the region or they may decide to move to other regions. In either case there would be no change in the unemployment rate in the region. For these reasons, I/O analysis is not very useful for evaluating regional labor market conditions. Fishery managers should avoid using the results of economic impact studies to draw conclusions about the effects of regulations on unemployment rates in a region.

It is also very difficult to anticipate the timing and extent of economic impacts. Multiplier effects appear to be a matter of simple arithmetic and many non-economists expect the impacts to occur instantaneously. In fact, there is considerable disagreement among professional economists about the amount of time required for multiplier effects to work through a regional economy (Richardson 1985, pp. 635-36). Most economists agree that the direct impacts occur within a relatively short period of time, usually one to two years, after the initial regulation or other change occurs. The timing of secondary impacts will depend on many factors. If the impacts involve changes in intermediate suppliers' production capacity or extensive movement of employees into or out of the region, the secondary impacts may be delayed for several years. Also, the competitiveness of industries in the region and governmental responses to changing economic conditions will influence the timing of secondary changes in regional economic activity.

It is also possible that the actual multiplier impacts will be larger or smaller than expected. Changes in the structure of the regional economy will influence the actual size of the secondary impacts. For example, if the regional economy becomes more self-sufficient due to new intermediate suppliers so that less money leaks out of the region, the secondary impacts will be larger than would have been expected. Such a change to more interdependence within the region may occur as a result of the initial impact (such as a change in fishery regulations) or it may occur for unrelated reasons. On the other hand, the region could also become less self-sufficient due to the loss of intermediate suppliers. With fewer opportunities for the secondary impacts to ripple through the economy, the actual impacts would be reduced. As a general rule, changes in the linkages between intermediate suppliers that are closely tied to fishery

related sectors will have more influence on secondary impacts from fishery regulations than changes in the linkages to unrelated sectors. Thus, a structural change in regional transportation equipment suppliers who provide inputs to boat builders would have more influence on these secondary impacts than a structural change in coal mining suppliers who are unrelated to the fishery sectors.

7. ECONOMIC IMPACT ANALYSIS IN PERSPECTIVE

7.1 A Brief Recap

Economic impact analysis is a set of tools for understanding the role of fishery related sectors in the structure of regional economies and for evaluating the effects of fishery regulations on economic activity in those economies. The key indicators of regional impacts are total output, value added and employment. These measures are similar to several indicators of national economic performance reported in the popular press but the measures should not be confused in impact studies. An economic impact analysis can also focus on governmental services/taxes or environmental quality. Perhaps the most critical aspect of impact analysis is deciding on the boundaries for the "impacted region" because this choice will influence the structure of the region, the level of self-sufficiency within the region, and the magnitude of economic impacts within the region.

While there are many different analytical methods that can be used for impact analysis (see Propst and Gavrilis 1987), the two most commonly used are the economic-base and input-output approaches. The economic-base approach divides the regional economy into basic (export) and nonbasic sectors and identifies the basic sector as the source of all change in regional economic activity. Output, value added and employment multipliers can be developed to evaluate the total economic impact of initial changes in economic activity caused by fishery regulations. But, these economic-base multipliers are aggregate values for all basic sectors within the region so they are relatively crude measures to apply to specific sectors such as commercial and recreational fisheries.

The input-output approach is a more sophisticated tool that can be used to disaggregate the regional economy into almost as many sectors as data will permit. This disaggregation is represented through the transactions table which shows the linkages between suppliers and purchasers within the region and the extent of each sector's dependence on exports and imports. This is particularly useful information because it can be used to show how fisheries sectors relate to other sectors in the regional economy and the sources of final demand for the products of fisheries sectors. This approach also provides output, value added and employment multipliers for each sector within the region so that both external and internal changes in final demand due to fisheries regulations can be evaluated. It is also possible to decompose the economic impacts to examine the distribution of value added, income or employment impacts in each sector. This type of distributional analysis can show which sectors gain or lose from fisheries regulations.

Although the input-output approach is a powerful tool for evaluating economic impacts, it also has limitations. The transactions table and the multipliers derived from it are based on a static view of a region's economic structure at a point in time. Economic impacts do not change the prices of goods sold within this structure or the basic production relationships. Therefore this approach can not be used to evaluate the effects of regulations on competition within the region. Also, there is no direct consideration of supply and demand in labor markets so the approach can not be used to anticipate regulatory impacts on unemployment in a region. Since the structure of regional economies does change over time, many intervening factors can change the actual impacts from what might be predicted from an impact analysis.

Finally, regional impact studies tend to focus on a specific region and neglect to consider how economic activity in other regions change in response to changes in the study region. While multiregional analysis is possible, it is often too cumbersome and costly for most impact studies. Therefore it is important for fisheries managers to know the specific sources of economic impacts in a region and consider how these sources of change might cause offsetting impacts in other regions.

7.2 Avoiding Abuses of Impact Analysis

Fishery managers are frequently reminded by different user groups of the economic importance of their group and warn of dire consequences for the regional economy if catch restrictions are imposed on their group. Other groups promise that allocations favorable to their group will bring happy days to the region. These positions are sometimes supported by multiplier values and total impact estimates. While there is nothing inherently wrong with the use of economic impact analysis for this purpose, more often than not the impacts are misrepresented and can be easily misinterpreted. This abuse of economic impact analysis can be avoided if fisheries managers understand the appropriate tools for analysis and are certain these tools are applied in the proper context.

One common use of impact analysis is to estimate the sectors' total output in the regional economy and then use this information to develop multipliers for one or more fishery sectors. This is useful information to understand the nature and structure of the regional economy but it has virtually nothing to do with allocation decisions. The total output of a sector is an historical measure that can only reflect economic activity at a particular point in time. Allocation decisions may, or may not, change final demand for fisheries related sectors. These initial changes in final demand cause the direct economic impacts that are the proper source of changes in total output. And, these initial changes should be evaluated to determine the regional economic impact of an allocation decision.

To further illustrate this point, consider again Table 2 in Section 6 that showed the regional economic activity in Codland. Both the commercial and recreational fishery sectors had the same total output of $6 million with final demand (households and exports) of $3 million. This was useful information because it established these sectors' share of the total regional output and provided part of the information needed to construct the transactions table for the region. However, once the multipliers were estimated from the transactions table, the total output for each sector was irrelevant. In each of the examples of allocation problems considered in Section 6, the initial change in final demand in each sector was the relevant focus of analysis. Multipliers were used to estimate the total changes in economic activity from these direct impacts. In each example it was shown that the total impact of the allocation decision would be different in each sector even though both sectors had the same initial

total output of $6 million. Thus, fishery managers should not give much consideration to historical total output estimates for a sector but should focus on the relevant changes in final demand caused by allocation decisions.

A related abuse of impact analysis is the argument that the elimination of a specific sector's use of a fishery would reduce regional economic activity by the amount of the sector's output. For example, in the case of the hypothetical Codland economy, this argument suggests that elimination of the recreational sector would reduce total regional output by $6 million. Unfortunately, this argument overlooks the different ways that recreational anglers could reallocate their final demand and the impact of the reallocation. These anglers might now buy more commercial fishery products thereby increasing total output in that sector. Or, they might purchase other types of recreational goods and services that might have an offsetting or positive net impact on the economy. A case on point is the study by Harris and Norton (1978) who found that the (hypothetical) elimination of the commercial fishery sector in the U.S. might increase total value added in the economy! Thus, predictions of dire consequences should be accompanied by an assessment of the possible impacts of spending reallocation.

7.3 The Contribution of Impact Analysis to Fisheries Management

Economic impact analysis can provide useful information to fishery managers if it is used properly and the limitations are well understood. Impact analysis provides a way to anticipate how management decisions could change regional economic activity. It should be viewed as a complement to other types of socioeconomic evaluation procedures such as benefit-cost analysis. However, each provides different types of information so fishery managers should clearly identify their information needs and not substitute one type of analysis for another. In addition, with this Guide fishery managers should have a better understanding of the data needs for different types of impact analysis so they can assist in matching the analytical tool to their information needs.

The most direct contribution of economic impact analysis is to provide estimates of the changes in total output, value added and employment in a region impacted by management decisions. Perhaps the most important of these changes is the value added component because it provides a direct indication of how people's ability to buy goods and services will change. It is also possible to

evaluate how the distribution of value added will change across sectors so that managers can assess the "fairness" of allocation decisions. Employment impacts can also be evaluated across different sectors so that labor requirements can be determined. The knowledge gained by analysts in developing impact estimates from detailed methods such as input-output is also a potentially valuable asset for fishery managers to use.

In summary, there is no reason for fishery managers to fear or be confused by economic impact studies. The results from these studies are relatively straightforward if the user understands what information these tools provide and they are aware of erroneous uses of impact estimates. The ultimate value of these studies will be determined by fishery managers willingness to use these results for more effective public sector decision making.

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