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Assessing the Economic Importance of Commercial Fisheries in the Mid-Atlantic Region: A User's Guide to the Mid-Atlantic Input/Output Model

Photo Courtesy of John Walden, Northeast Fisheries Science Center

Project Funded by Cooperative Marine Education and Research (CMER) Award, NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole, Ma. Principal investigator is James E. Kirkley, Professor, Department of Coastal and Ocean Policy, College of William and Mary, School of Marine Science, Virginia Institute of Marine Science, Gloucester Point, VA. 23062. Contributing authors: Winnie Ryan and John Duberg

A User's Guide to the Mid-Atlantic I/O Model

Prepared for the Northeast Fisheries Science Center,
NOAA Fisheries, National Marine Fisheries Service,
Woods Hole, Ma.

Project Funded by Cooperative Marine Education and Research (CMER) Award, NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole, Ma. Principal investigator is James E. Kirkley, Professor, Department of Coastal and Ocean Policy, College of William and Mary, School of Marine Science, Virginia Institute of Marine Science, Gloucester Point, VA. 23062. Contributing authors: Winnie Ryan and John Duberg

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A User's Guide to the Mid-Atlantic I/O Model

Introduction

The Mid-Atlantic input/output (I/O) model is designed to estimate the economic impacts associated with the harvesting of fish[1] by commercial fishermen whose landings occur in a six-state region stretching from New York to North Carolina. These impacts are expressed in terms of employment (annual average jobs—both full and part-time jobs), labor income, and output (sales by U.S. businesses).

In addition to generating estimates of economic impacts for the Mid-Atlantic region, the model estimates these impacts for 12 subregions within this region. The subregions are defined by counties within the six-state Mid-Atlantic region. Individual states have from one to three subregions. All subregions are contained within individual states; no subregion crosses state boundaries.

Economic impacts are also estimated for 14 gear types. These gear-types account for all commercially landed fish in the Mid-Atlantic region.

The scope of the model is defined by the harvesting of fish in U.S. waters and includes the activities of commercial fishermen (reflected in commercial landings of fish), dealers/processors, and wholesalers/distributors. For dealers/processors and wholesalers/distributors, the model addresses only activities associated with fish harvested in the Mid-Atlantic region. The model also separately addresses the activities associated with Fulton Market, the seafood wholesale and distribution center in New York City. Fulton Market is unique, influential, and handles a substantial volume of fish and seafood.[2]

Given these different perspectives on commercial fishing and related seafood industry activities, the model generates a substantial number of individual estimates. At its greatest level of detail, the model generates over 150,000 estimates of impacts. Another measure of the volume of information generated by the model is that tables presenting all these impacts occupy over 500 pages.

Excluded from the model's estimates are activities at the retail level—either food markets or restaurants. Dependent in part on U.S. harvested fish, these activities have a substantial impact on the Mid-Atlantic economy through the value they add to their fish and seafood inputs.

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[1] As used here, the term fish refers to the entire range of finfish, shellfish, and other life (i.e., sea urchins, seaweed, kelp, and worms) from marine and freshwaters that are included in the landings data maintained by the National Marine Fisheries Service.

[2] In 1999, Fulton Market establishments bought an estimated $400 million of fish and seafood products from harvesters, importers, and other sources. Sales for Fulton Market for that year were estimated at over $650 million. "The Economic Contribution of the Sport Fishing, Commercial Fishing, and Seafood Industries to New York State," TechLaw, Inc. in cooperation with Thomas J. Murray and Associates, Inc., January 2001.

With its focus on the impacts of commercially harvested fish, the model does not address activities associated with fish produced by aquaculture operations or with imported fish and seafood products. Aquaculture operations have tended to grow over time (e.g., from 691 million pounds produced in the U.S. in 1992 to 823 million pounds in 2000), but produce less than 10 percent of the volume of U.S. commercially harvested fish.[3] The U.S. is also a net importer of fish and seafood products, which account for a significant component of all fish and seafood consumed in this country.

Any model represents an approximation of true conditions and is limited by various uncertainties. The most important uncertainty in the present model is likely that associated with the costs and earnings of commercial fish harvesters. Costs and earnings data are typically collected for specific gear types such as trawls or pots in a particular area of the U.S. One goal of this model is to synthesize these particular data into averages that reflect conditions across the Mid-Atlantic region.

Given that cost and earnings data for some important gear types are unavailable altogether and other data are specific to subregions within the larger Mid-Atlantic region or to areas outside the Mid-Atlantic region, there are unavoidable uncertainties built into this Mid-Atlantic model. Despite these limitations, the model produces estimates of the economic impacts of the Mid-Atlantic's fisheries that are logical and reasonable.

Furthermore, the model is structured so that improved data can be incorporated in an incremental manner, reducing uncertainties and increasing the utility of the model's estimates. Finally, the model is also structured to make its operations and assumptions reasonably transparent. The interested (and patient) user can reveal all links and calculations made by the model.

This user's guide comprises an overview of the model's operations, a brief discussion of modifying the model, and background information. The guide's purposes are

- to orient the user to the basic ways of using the model,
- to provide information on how the model can be updated or used to estimate special cases,
- to disclose the basic sources of information used to create the model, and
- to identify major opportunities to improve the model.

[3] U.S. Department of Commerce, National Marine Fisheries Service, *Fisheries of the United States, 2001*, September 2002, pp. 4, 23, available at www.st.nmfs.gov/st1/fus/; U.S. Department of Commerce, National Marine Fisheries Service, *Fisheries of the United States, 1998*, July 1999, pp. 4, 23.

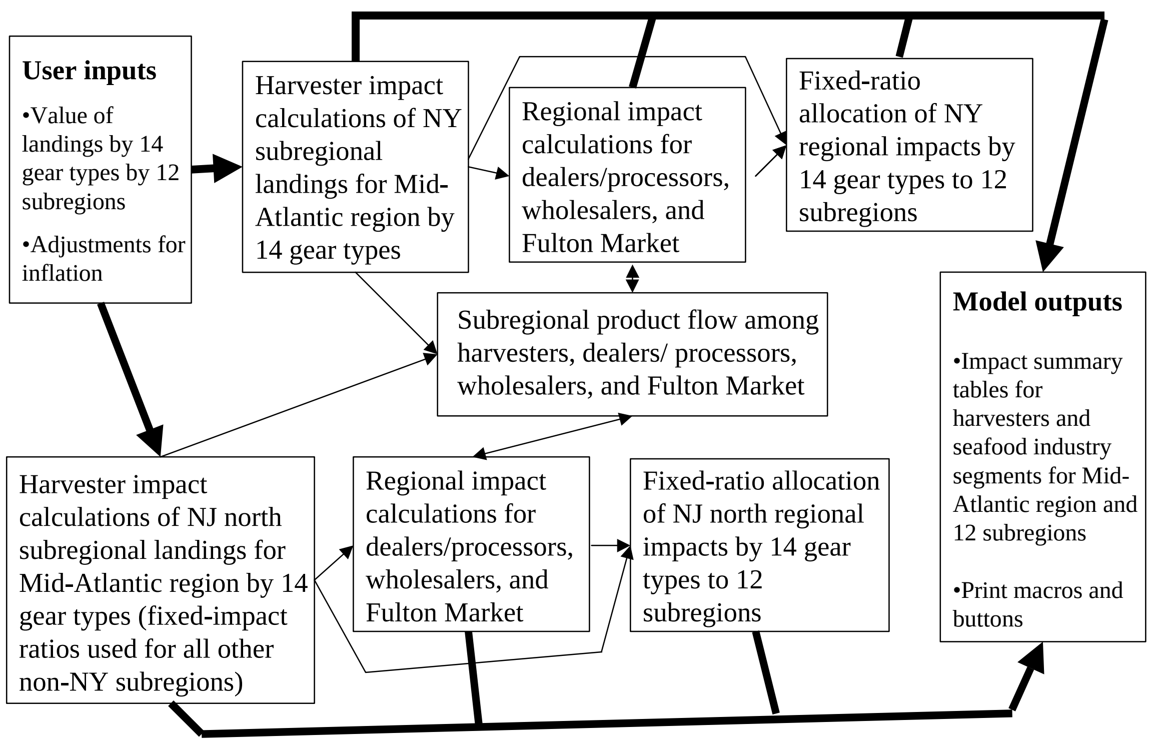
Overview of Model Operations

The Mid-Atlantic I/O model can be used with a minimum of effort on the part of the user to generate an estimate of regional and sub-regional economic impacts of commercial fish landings. The following introduces the major operations of the model. More detailed information on these operations is provided in subsequent sections.

Basic model structure

Created in Microsoft Excel, the model comprises a linked set of five worksheets. The general operation of the model is shown in Figure 1.

Figure 1. Overview of Mid-Atlantic I/O Model



The user is responsible for two types of inputs: landings and relevant dates. The value of landings is entered for 14 gear types for the Mid-Atlantic's 12 subregions; that is, the user enters up to 156 separate values for landings in the 12 Mid-Atlantic subregions. The user also enters the year the landings occurred and the applicable year for output values.

With these inputs, the Mid-Atlantic impacts of each subregion's landings are calculated by gear type. Product flow to that subregion's dealers and wholesalers and their respective values added are estimated. Product flow to Fulton Market and the value added by Fulton Market establishments are similarly estimated. The estimated Mid-Atlantic impacts of this value-added activity are calculated and aggregated for dealers, wholesalers, and Fulton Market. Aggregated impacts are summarized and expressed in 2003 dollars (or whatever year the user enters for output values).

These calculations produce a set of Mid-Atlantic (i.e., regional) impacts for harvesters, dealers, wholesalers, and Fulton Market. These impacts are then allocated to the 12 subregions based on the ratio of each subregion's employment, income, or output to the Mid-Atlantic region's employment, income, or output.

Major components of the model

Each of the five worksheets in the model addresses a distinct set of estimating issues as noted in Table 1. Some of these worksheets rely on data developed in additional files that support the development of the model. These data are described later in the user's guide (see Background Information).

Table 1: Worksheets within the Mid-Atlantic I/O Model

Model worksheets	***Description***
1. User Inputs-Landings, Dates	• A user only needs to enter data in this worksheet to estimate the economic impacts of Mid-Atlantic commercial fish landings. • Value of landings data are entered here. The user must manually allocate the value of landings to 14 gear-types and to the subregions within the larger Mid-Atlantic region. • The user must also enter dates (1) for the year of landings and (2) for the year of output values. The default settings are for 2001 landings and for output values to be expressed in 2003 dollars.
2. Print Tables and Macros	• Tables summarizing estimated employment, income, and output impacts are displayed here. Estimates are provided for each of the 12 subregions and for the Mid-Atlantic region. For each geographic area, impacts are provided for 14 gear types. • This worksheet provides all inflation adjustments for input data and output estimates. • Print macros and the buttons that activate them are located and described here.
3. Product Flow	• Data on the distribution of the value of fish and seafood products among harvesters and segments of the seafood industry are maintained here. • Data on relevant product flow for the Mid-Atlantic region

<table>
<tr><th>Model worksheets</th><th>Description</th></tr>
<tr><td></td><td>are synthesized. These data are used to allocate value in calculation worksheets.</td></tr>
<tr><td>4. Calculations-Subreg. 1, NY</td><td>This sheet creates the estimation of all Mid-Atlantic regional economic impacts related to commercial fish landings in the New York subregion, including
Harvesters’ impacts
Dealers/processors’ impacts
Wholesalers/distributors’ impacts
Fulton Market impacts
This worksheet converts these Mid-Atlantic regional impacts to subregional impacts using a fixed allocation process.
The value of landings is converted to costs and earnings for each gear type. Cost categories (e.g., fuel purchases by harvesters) are then used to estimate impacts. Wages and profits are treated as income, creating induced effects.
The value added by seafood industry segments is also disaggregated into expenditures, including income, which are used to estimate impacts.
For the New York subregion, product flow to Fulton Market is estimated, based on secondary data.</td></tr>
<tr><td>5. Calculations-Subreg 2, NJ north</td><td>This worksheet is similar to the New York subregion worksheet except that no product flow to Fulton Market is estimated because of a lack of data on this flow.
The New Jersey north subregion is the model for all other non-New York subregions. For these other subregions, the impacts of each gear type and each segment of the seafood industry are estimated by prorating the value of landings by gear type or value added by each seafood industry segment in those subregions relative to the New Jersey north subregion.</td></tr>
</table>

User inputs

The model is designed to generate estimates from a single set of inputs—the value of landings of Mid-Atlantic fisheries. This set of inputs must be disaggregated by gear type and by subregion. All subsequent calculations are based on this set of inputs.

To account for the effects of inflation, the user must also enter the dates for the landings and for the output values. Landings data are converted to 1998 dollars to match the I/O data used by the model. The estimated income and output impacts are initially expressed in 1998 dollars and then converted to dollars for the year specified by the user.

The model provides a substantial degree of flexibility to the user. It can create estimates of economic impacts for one or more subregions and for one or more gear types. The user can also enter a real or hypothetical value for any of the subregions or gear types defined by the model.

Gear Types

The NMFS landings data report gear used to harvest fish. The NMFS database includes scores of gear types. The model reduces this multitude of gear types into a more manageable number. The selected gear types are the same as those used in a similar model developed for New England.[4] The categories used by the model are listed in Table 2.

Table 2: Gear Type Categories

1. Inshore lobster
2. Offshore lobster
3. Large bottom trawl
4. Medium bottom trawl
5. Small bottom trawl
6. Large scallop dredge
7. Medium scallop dredge
8. Small scallop dredge
9. Surf clam/ocean quahog
10. Midwater trawl
11. Bottom longline
12. Other gear
13. Pots & traps
14. Gill nets

Two gear types—bottom trawlers and scallop dredges—are disaggregated by size. For bottom trawlers, large refers to vessels 65 feet or more in length; small refers to vessels under 65 feet in length (Lallemand et al 1998, Lallemand et al 1999). Medium bottom trawlers are an average, weighted by landings, of large and small bottom trawlers. Large scallop dredges are defined as vessels over 70 feet in length; medium vessels are 50 feet to 70 feet in length; small vessels are less than 50 feet in length (Georgianna et al 1999). The cost-earnings data for these vessels did not permit separate calculations by size. As a result, all scallop dredge vessel impact estimates are based on a weighted average of all scallop dredges.

The "other gear" category includes a broad range of gear excluded from other categories. This category also includes any landings for which no gear type was indicated or available.

[4] Scott Steinback and Eric Thunberg, " An Approach for Using IMPLAN and its Associated Data Package to Estimate the Economic Activity ("impact") Resulting from Fishery Management Actions," Northeast Fisheries Science Center, NMFS National Social Scientists Workshop, La Jolla, California, February 22-25, 2000.

Collectively, the 14 listed gear types encompass all Mid-Atlantic landings. The model thus estimates impacts for all Mid-Atlantic regional landings.

Seafood Industry

In this model the seafood industry is defined as those businesses that process and distribute on a wholesale basis fish and seafood products. Most of these businesses are broadly grouped into two segments: dealers/processors and wholesalers/distributors. Processing can be as little as sizing and packing shrimp or as elaborate as preparing cooked products.

Fulton Market, the wholesale market recently moved to the Bronx, represents a special case within the larger seafood industry. Given the large volume of fish and seafood that passes through this market and its influential status as a barometer of prices, Fulton Market is analyzed separately by this model. The availability of specific data on the flow of commercially landed fish and seafood to and from Fulton Market, however, is limited to the New York subregion. The model is constructed so that future information on product flow from other subregions can be added easily.

Cost and earnings data for these seafood industry segments are restricted to the value they add to the fish and seafood products that are inputs to their production activities. This avoids double counting the impacts of the value added by those inputs.

The seafood industry can also be extended to the retail level which comprises two major segments—retail markets such as groceries or fish markets and restaurants or other establishments preparing food for consumption away from home. The model currently does not incorporate these segments of the seafood industry. The value added and the resulting economic impacts from these segments, particularly from restaurants, can be substantial.

Product Flow

For the purposes of this model's efforts to estimate economic impacts, product flow refers to the sale of fish and seafood products by harvesters, dealers/processors, wholesalers/distributors, and Fulton Market. By understanding where these businesses sell their products, the full potential for economic impacts can be better understood. If fish or seafood products are sold to final consumers in the U.S. or exported, the opportunity for adding value and thereby creating new economic impacts ends. Alternatively, when fish or seafood products are sold to businesses that then add value, economic impacts are created.

The model estimates the product flow for fish and subsequent seafood products beginning with harvesting activities and ending with sales to final consumers or export markets. This effort to estimate flow includes retail businesses (i.e., grocers and other markets, restaurants and other food service establishments). As noted earlier, the impacts estimated by the model, however, exclude the retail level.

Model outputs

The model generates estimates for three types of impacts—employment, income, and output. Each of these impacts is expressed as direct, indirect, and induced effects as well as the total of these effects. Income and output impacts are expressed in dollars for the year specified by the user. Employment impacts are expressed in terms of annual average jobs (total number of full and part-time workers).

Estimates are also disaggregated for harvesting and seafood industry activities. For harvesting and each seafood industry segment, impacts are provided for each of the 14 gear types defined by the model. For the seafood industry, estimated impacts associated with dealers/processors, wholesalers/distributors, and Fulton Market are provided.

Finally, impacts are presented by geographic area. For each subregion, the impact of commercial fish landings and the seafood industry are presented for the Mid-Atlantic region as a whole and for each of the 12 subregions. These subregional impacts are totaled to presented the impacts of regional landings at the regional and subregional level.

Total impacts are also estimated. Total impacts are the sum of impacts for harvesting and all seafood industry segments. These total impacts for each subregion's landings are presented by gear type, by subregion, and for the Mid-Atlantic region as a whole. Total impacts for all Mid-Atlantic regional landings are also presented.

Print macros

Print macros allow the user to generate a paper copy of model outputs. There are 38 macros, which generate tables of impacts related to landings for the Mid-Atlantic region and to landings for each of the 12 subregions.

For landings in each of these geographic areas, there are three print macros. One macro generates tables for the Mid-Atlantic regional impacts of landings. The second macro generates the tables for the impacts related to the same landings for all of the 12 subregions defined by the model. For example, one macro prints the Mid-Atlantic impacts of landings in the Delaware subregion; another macro prints the impacts in each of the 12 subregions of those same Delaware subregional landings.

The third macro prints the tables presenting the impacts of the subregional landings in the subregion where the landings occur. Thus, one macro generates a hard copy showing the impacts of Delaware subregional landings in the Delaware subregion.

To facilitate the use of these macros, a set of buttons has been created. For each macro, there is a separate button, labeled with the landings used to generate the impacts and the relevant geographic area of impacts. For the example cited above, the button labeled "DE/Mid-Atl" prints the Mid-Atlantic impacts of landings in the Delaware subregion while the "DE/Subreg's" button prints the impacts in each of the 12 subregions of those same Delaware subregional landings. Finally, the "DE/DE" button prints tables showing the Delaware subregional impacts of Delaware subregional landings.

It is worth noting that printing model outputs can readily consume paper. A full set of impacts for each geographic area requires three pages. The set of Mid-Atlantic (i.e., regional) impacts of the Delaware subregion's landings thus requires three pages. Similarly, the set of Delaware (i.e., subregional) impacts of the Delaware subregion's landings also requires three pages. Printing out the 12 subregional sets of impacts of those Delaware landings requires 36 pages. Printing all impacts created by the model (i.e., for landings in all 12 subregions and for the region as a whole) requires over 500 pages.

Adjustments for inflation

Because the estimates are based on IMPLAN's model of the Mid-Atlantic economy in 1998, two adjustments for inflation have been incorporated. The value of landings in 2001 (or any other year from the period 1998 through 2002) is converted to year 1998 dollars before impacts are estimated. After estimates of labor income and output are created, they are converted to year 2003 dollars, the default year for the model's outputs.

The principal reason for converting input dollars to 1998 dollars is to avoid distorting estimates of employment impacts. Employment impacts are estimated on the basis of jobs per million dollars of expenditures. As a result, the effects of inflation overstate employment impacts. Expressed as the total number of both full-time and part-time jobs, these employment impacts, generated on the basis of 1998 dollars, are not subsequently adjusted.

Limitations and uncertainties

The model was developed using IMPLAN data for 1998. Consequently, there is a disconnect between input data for more recent years and the approximation of Mid-Atlantic economic relationships embodied in IMPLAN. Because these relationships tend to change relatively slowly, this mismatch between the date of landings and the date of the IMPLAN data should not be a significant problem.

Although cost-earnings data exist for most of the gear types used by the model, no such data were available for midwater trawl or for other gear. In both cases, cost-earnings data for medium bottom trawl is used as a proxy. To the extent that these proxy data are inaccurate, an element of uncertainty is entered into the model's estimates.

Product flow estimates are another source of uncertainty. These data are based on state-level studies of New York and Virginia and a study of the shrimp industry. Mid-Atlantic regional flow data might show different patterns of sales between and among harvesters and seafood establishments. In particular, the flow of fish and seafood to and from Fulton Market from locations outside New York would be defined. Based on product flow data for New York State (TechLaw 2001), it is also likely that more comprehensive data would demonstrate a pattern of product flow more complex than the model assumes. This complexity could include more sales between seafood industry establishments and more value added by these establishments. To the extent that the model's assumptions underestimate value added, the economic impacts of this value added are also underestimated.

Management of memory and computing demands

The model is relatively large, approximately 19 megabytes. To manage the computing and memory demands of the model, several steps have been taken.

Based on the methodology used in a similar model created for the New England region, the allocation of impacts to the 12 subregions is based on the ratio of each subregion's employment, income, or output to the Mid-Atlantic region's employment, income, or output. These ratios were created for each IMPLAN economic sector used in the model. They were then used to allocate the Mid-Atlantic regional impact for landings at the subregional level to each of the 12 subregions. Specifically, the model takes subregional landings by gear type and estimates the Mid-Atlantic regional impacts of the expenditures and profits associated with these landings. Each of the regional impacts associated with a specific expenditure is then allocated to the 12 subregions based on the ratio of the subregional/regional employment, income, or output. These expenditure level impacts are then aggregated to create estimates of impacts of subregional landings by gear type at the regional and subregional level. The same method is used to allocate impacts of the activities of dealers/processors, wholesalers/distributors, and Fulton Market from the Mid-Atlantic region to the 12 subregions.

This allocation scheme creates a fixed ratio of impacts among the subregions regardless of the location of those subregional landings. Thus, the New York subregion accounts for approximately one-third of the employment in the Mid-Atlantic region in the economic sectors affected by commercial fishing and seafood industry activities. As a result, the model allocates about one-third of employment impacts of each subregional landing, regardless of its location, to the New York subregion.

A second procedure used to reduce computing and memory demands of the model is the assumption that the ratios between landings and regional and subregional impacts are fixed for all subregions outside of the New York subregion. This in turn assumes that the expenditure patterns of harvesters and the seafood industry used by the model represent Mid-Atlantic regional averages.

The reason for treating the New York subregion as an exception is Fulton Market which in 1999 purchased an estimated $400 million of fish and seafood products and had sales of over $650 million. Estimates are available for the product flow to and from Fulton Market for the New York subregion, but not for other subregions although it is known that Fulton Market purchases substantial quantities of fish and seafood from other East Coast states. As a result of this, the model underestimates the volume of fish and seafood that flows through Fulton Market. Instead this volume is assumed to flow through wholesalers/distributors, which create similar impacts.

The New Jersey north subregion is used as a model for the relationship between landings and economic impacts for harvesters and the seafood industry. The model uses the ratios of New Jersey north landings to New Jersey north impacts to estimate impacts for all other non-New York subregions. Because the model distributes landings among 14 gear types, there must be positive New Jersey north landings values for each of these gear types in order for the model to estimate impacts by all gear types for the other subregions.

Modifying the Model

The default configuration of the model supports estimating the impacts of Mid-Atlantic commercial landings in their totality. With little additional effort by the user, the model can estimate the impacts of any particular component or components of those landings, hypothetical values of landings, or of landings from other years.

Basic inputs

The user must provide two types of data in order for the model to operate. All of these data are entered in the first worksheet, User Inputs-Landings, Dates.

First, the year of landings' value is entered in cell C3. By entering the relevant year for the landings data, the proper adjustments are made to convert these dollars into the 1998 dollars used by the estimating algorithms of the model. At present, the model can make these adjustments for landings during the period 1998 through 2002. Similarly, the year for output values is entered in cell C4. This allows the model to convert dollar estimates made by the model to current year dollars. At present, the model can convert estimates to dollars for any year in the period 1999 through 2003.

The model can be modified to accept input data for years outside the period 1998 through 2002 and to present output values in dollars for years other than those in the period 1999 through 2003. The mechanism for accepting data for other years is to expand the periods for adjusting input and output data. In the worksheet, Print Tables and Macros, the cells D19…I33 contain annual and quarterly GDP deflator values. By adding annual values for the years 2003 through 2005 when available, the model will automatically update its capacity to adjust input and output values.

Expanding the adjustment periods beyond those stated above will require more effort by the user. Quarterly or annual GDP deflator values must be added to the model. The specific adjustment values shown in cells A10…C31 will then need to be expanded. The named ranges "InputDeflationAdjustment" and "OutputDeflationAdjustment" must then be modified to capture the cells with new data. When making these adjustments, the user needs to take care not to change the location of the impact tables. For example, the user should not expand the area of the named ranges (i.e., InputDeflationAdjustment and OutputDeflationAdjustment) by inserting rows or columns in this worksheet.[5]

Second, values for landings are entered in cells D12 through O23 of the worksheet, User Inputs-Landings, Dates. This range of cells includes all 12 subregions and 14 gear types. The model computes estimates for whichever cells are filled. Thus, the user can enter values in one category, several categories, or all categories. These values can be real or hypothetical. As noted earlier, because the model uses the New Jersey north subregion to

[5] Adding rows or columns in this worksheet will change the location of the impact tables. Because the print macros do not automatically adjust to reflect the insertion or deletion of rows or columns, they will no longer work properly. Moving the location of the impact tables would necessitate the editing of 26 print macros to redefine the print ranges for each macro.

calculate impact estimates for all other non-New York subregions, there must be positive values for landings for all gear types in the New Jersey north subregion. Consequently, if there is no value for landings for a given gear type in this subregion, the model is programmed to set a minimum value of $1 for each gear type in New Jersey north landings.[6]

As a guide to the user, all data input cells are highlighted in red. The user should avoid entering data in other cells. For example, directly below the area for manually inputting landings data is a similar array of landings data (in cells D31..O42). This second array is used to adjust the data entered by the user to 1998 dollars. Thus, overriding these adjustments by directly entering data in these cells distorts the estimating process.

Variations on basic inputs

One straightforward variation of the inputs is to consider the impacts associated with a single gear type and/or a single subregion. Once the value of landings data is entered for any given gear type and/or single subregion, the model will estimate the full set of impacts related to those landings.

Similarly, the impacts associated with a given species or group of species can be assessed by the model. In this case, the user must link that species or group of species to one or more gear types. For example, the impacts of swordfish landings can be evaluated by entering the value of swordfish landings in the cell for the longline gear type.

Modifying gear-type, other cost-earnings, or product flow data

Proxy data is used for some of the gear types addressed by the model. Should better data on these gear types become available, the model can be updated by revising the calculations in the two worksheets used to estimate impacts. These worksheets convert landings values into expenditures made by harvesters or seafood businesses.

In updating the expenditure data, care must be taken to coordinate expenditures with the I/O data that is used to generate estimated impacts. These include RPCs (regional purchase coefficients), margins, adjusted margins, and the sets of multipliers. These data are available within the current version of the model for many expenditures, but other types of spending may occur. In the latter case, this spending must be matched to an appropriate sector in the IMPLAN data set. In turn this may require the regeneration of IMPLAN models that are the source of these I/O data.

Better data on product flow can be entered in the spreadsheet dedicated to product flow. The range A33:I50 in the Product Flow spreadsheet holds the data used by the model to allocate sales among harvesters and seafood industry segments. Currently, the data

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[6] If a value of $1 is entered for any New Jersey north landings by gear type, the appropriate ratios between landings and impacts will be available to generate estimates of impacts for all other non-New York subregions. At this minimal level of value for landings, however, impacts for that gear type for the New Jersey north subregion will be expressed as zeros.

differentiate between New York and other states in the Mid-Atlantic region because of the availability of New York data on Fulton Market. Any modifications need to preserve this distinction. Care must also be taken to account for all sales from harvesters and each seafood industry segment including those to export markets and final consumers. Finally, because of the potential for creating circular logic in the model's calculation of impacts, any modifications to product flow must avoid allocating sales from downstream segments to upstream segments in the value-added chain. (See discussion of product flow in the next section on background data.)

Background Data

Additional detail on the Mid-Atlantic model is presented here. This section also includes a discussion of IMPLAN and its use in the methodology employed by the model.

The Mid-Atlantic region and defined subregions

The model addresses commercial fishing and the non-retail seafood industry in the Mid-Atlantic region. That region includes six states—New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina.

Within the Mid-Atlantic region, the model addresses 12 distinct subregions. Each subregion is located within one of the six states; no subregion crosses state boundaries. They are defined by the counties shown in Table 3.

Table 3: Definitions of Mid-Atlantic subregions

Subregion	***Counties and independent cities within subregion (1)***
New York	Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester
New Jersey north	Bergen, Essex, Hudson, Morris, Passaic, Sussex, Union, Warren
New Jersey south	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Ocean, Salem, Somerset
Delaware	Kent, New Castle, Sussex
Maryland west	Anne Arundel, Baltimore, Baltimore City, Carroll, Cecil, Harford, Howard, Montgomery, Prince Georges
Maryland east	Calvert, Caroline, Charles, Dorchester, Kent, Queen Anne’s, St. Mary’s, Somerset, Talbot, Wicomico, Worcester
Virginia east	Accomack, Northampton
Virginia south	Charles City, Chesapeake, Chesterfield, Gloucester, Hampton, Henrico, Isle of Wight, James City, Mathews, Newport News, Norfolk, Poquoson, Portsmouth, Prince Georges, Suffolk, Surry, Virginia Beach, York
Virginia north	Essex, Fairfax, King and Queen, King George, King Williams, Lancaster, Middlesex, New Kent, Northumberland, Richmond, Stafford, Westmoreland
North Carolina north	Bertie, Camden, Chowan, Currituck, Pasquotank, Perquimans, Tyrell, Washington
North Carolina central	Beaufort, Carteret, Craven, Dare, Hyde, Pamlico, Pitt
North Carolina south	Brunswick, New Hanover, Onslow, Pender

Note.
(1) Maryland and Virginia have independent cities that are geographically and politically separate from counties in those states.

Product flow

Seafood industry economic impacts are determined in large part by estimating where commercial harvesters and segments of the seafood industry sell their products. So long as these products remain in the chain of value-added activity, they continue to create economic impacts. Whenever they are purchased by final consumers or are exported outside the region being analyzed, new economic impacts are no longer generated. This movement of fish and seafood products from harvesters through intermediary establishments to final consumers or export markets is termed product flow.

Three sources of data on product flow were reviewed. Two studies looked at a broad range of fish and seafood products from the perspective of individual states, specifically Virginia and New York. (A.T. Kearney 1997, TechLaw 2001) These state-level studies present their own idiosyncrasies. In Virginia, a substantial share of harvested, processed, and distributed fish and seafood products is exported outside of the state. Most of these exports from Virginia, however, are sold within the Mid-Atlantic region**.** New York's fish and seafood product flow is substantially influenced by Fulton Market, a mecca for fish and seafood products from many locations (including most or all states in the Mid-Atlantic region) that occupies a unique place in the Mid-Atlantic (and national) seafood industry structure. Finally, a study of the shrimp industry in the Southeastern U.S. addressed product flow of shrimp from harvesters to dealers to processors to final markets. (Keithly 1994) While this was a narrowly focused study and Mid-Atlantic shrimp landings are a small fraction of Mid-Atlantic regional landings, shrimp are the single most valuable species harvested commercially in the U.S.

Landings from New York and Virginia have accounted for over 40 percent of Mid-Atlantic landings in recent years and shrimp from North Carolina are a small but significant fishery there.[7] While other states are not included in these product flow data, in the absence of other data, they represent the best picture of product flow currently available. Table 4 presents product flow statistics from these three sources.

The TechLaw study of product flow in New York (2001) found that product flow was complex with harvesters and seafood establishments selling some portion of their output to virtually all seafood industry segments as well as exporters and final consumers. Such patterns of sales present challenges to modeling which are met by simplifying assumptions. The model assumes a linear flow of product sales from upstream to downstream segments of the value-added chain. At any given point, a business establishment is assumed to sell its output to any downstream establishment. Segments of the value-added chain are arrayed from upstream to downstream as follows.

Harvesters ⇨ Dealers/Processors ⇨ Fulton Market ⇨ Wholesalers/Distributors ⇨ Exporters/Final Consumers

[7] In 1997 and 1998, New York and Virginia accounted for 43 percent and 42 percent of Mid-Atlantic regional landings. See U.S. Department of Commerce, National Marine Fisheries Service, *Fisheries of the United States, 1998*, July 1999, pp. 6. Shrimp landings in the Mid-Atlantic region are almost exclusively from North Carolina and account for a few percent of the total value of regional landings.

Table 4: Product flow for fishing and seafood industries

Source of fish, seafood products/Source of data		Destination of fish, fish products (percentage distribution)					
		Dealers/ processors	Whole-salers/ distributors	Food-service/ restaurants	Groceries/ Retail markets	Exports	Final Consumers
Landings/ harvesters	NY	15.0%	63.0%	4.0%	10.0%	6.0%	2.0%
Landings/ harvesters	VA (2)	83.4%	0.0%	0.8%	4.0%	12.0%	0.0%
Landings/ harvesters	Keithly	87.5%	12.5%	0.0%	0.0%	0.0%	0.0%
Net imports	NY	10.1%	42.2%	2.6%	13.5%	31.6%	0.0%
Primary wholesalers/ processors	NY		40.0%	15.0%	20.0%	23.0%	2.0%
Primary wholesalers/ processors (1)	Keithly		10.0%	72.0%	17.8%	0.3%	0.0%
Primary wholesalers/ processors	VA		18.8%	5.1%	6.2%	69.8%	0.0%
Secondary wholesalers/ distributors	NY			60.0%	30.0%	8.0%	2.0%
Secondary wholesalers/ distributors	VA	25.0%		8.8%	8.4%	57.8%	
Notes.							
(1) Assumes Keithly's institutional markets equal foodservice/restaurants.							
(2) VA model categories equal VA restaurants, VA retail, other VA distributors, and out of VA							

Cost-earnings data for gear types

In the course of this project, a significant effort was made to identify and collect available cost-earnings data for commercial harvesters. These data were found in a variety of reports as well as databases. Formal sources are listed in the bibliography.

These data were collected and standardized in a separate Excel spreadsheet. The method of standardization was to match the types of expenditures reported in these sources with the categories of expenditures that can be assessed by IMPLAN. These expenditures included profit, not strictly speaking an expenditure. Nevertheless, they are included to reflect the total distribution of revenues.

By accounting for all revenues associated with costs and earnings for harvesters using the 14 specific gear types addressed by the model, it was possible to relate the value of landings (i.e., revenues for harvesters) to a set of expenditures. These expenditures in turn are used to generate estimated economic impacts.

Typical expenditures for harvesters are presented in Table 5. Not every gear type addressed by the model generates expenditures in these categories. For example, dredges and trawlers require no spending on bait. Many commercial fishing operations are relatively small scale and do not necessitate the maintenance of an office with its attendant general and administrative expenses. The listed expenditures account for the substantial majority of expenditures of commercial fishing operations.

Table 5: Typical categories of harvester expenditures

- Purchases of goods
    - Fishing gear
    - Miscellaneous hardware & supplies
    - Electronics
- Repair & maintenance
    - Fishing gear, nets
    - Vessel & engine
    - Electronics
- Trip expenses
    - Groceries, food, & supplies
    - Fuel & lubricants
    - Ice
    - Bait
- Fixed and general expenses
    - Moorage
    - Dues, fees
    - Licenses, permits
    - Accounting
    - Insurance
    - Bank fees, services expenses
    - General and administrative (rent, utilities, supplies)
    - Vehicle costs
    - Capital costs, boats
    - Legal/miscellaneous services
    - Taxes
- Income and profit
    - Crew & captain shares, other income
    - Profit

The review of cost earnings data and its conversion to a standardized format involved a series of judgements on particular data issues. The following notes address those judgements.

1. Cost-earnings data from all sources have been converted to a percentage distribution of costs and income, including profit. Even in the few cases where data from published sources provided just this type of information, certain assumptions have been made in order to use the data in the Mid-Atlantic model. The authors of this Mid-Atlantic model take responsibility for these judgements.

2. Unless explicit information to the contrary is available in data sources, all capital costs are assigned to boats, rather than motor vehicles. This may overestimate the expenditures of commercial fishing monies on vessels and underestimate the expenditures for trucks and other motor vehicles.

3. Loan expenses are assumed to be split evenly between interest and capital costs unless data are available to estimate a more precise estimate. Interest costs are excluded from the model. Bank fees and services related to loans are assumed to equal 2 percent of the amount financed and are annualized over the life of the loan.

4. When ice and bait costs are aggregated, they are split evenly between these two categories.

5. For the East Coast small trawler study by Lallemand et al, mean values have been multiplied by number of respondents to create aggregate values for the surveys. This process tended to narrow the differences between the reported totals for broad categories of costs (e.g., trip costs, repair and maintenance costs) and the total computed from the components of those categories. These aggregated values were then used to create percentage distributions of costs relative to revenues. This technique was not used on the survey data for East Coast large trawler because of the wide disparity between the number of responses for revenue (24) and those for costs (maximum of 13).

6. Cost-earnings data for medium trawlers are an average of large and small trawlers. This weighted average of trawlers' cost and earnings distribution is based on revenues for 1997 through 1999 landings. In that period 85.8% of revenues were landed by trawlers of more than 50 gross registered tons (GRT), according to "Status of Fishery Resources off the Northeastern United States," Rountree et al. Large trawlers surveyed by Lallemand et al were a minimum size of 65 GRT while small trawlers ranged in size from 5 GRT to 78 GRT. The mode, median, and mean sizes of small trawlers were 16 GRT, 26 GRT, and 31 GRT with a standard deviation of 18 GRT. The weighted average underestimates or underrepresents the costs and earnings for smaller trawlers to an unknown, but likely small extent.

7. Fishing gear repair is assumed to be the repair of electronic equipment (rather than the repair of trawls, nets, dredges, and other similar gear) unless more specific information on the repair of equipment is available.

8. The values assigned by IMPLAN to RPCs for certain sectors have been adjusted to reflect conditions for the commercial fishing and seafood sectors. RPCs estimate the percentage of demand for a good or service that can be met by business establishments in the economic region being analyzed. For example, the IMPLAN model assumes that about 60 percent of the demand for manufactured ice in the Mid-Atlantic region is met by the region's ice plants. For the Mid-Atlantic regional model, it is assumed that all demand for ice by the region's fishing operations or seafood businesses is met by regional ice plants. The particular sectors for which RPCs have been adjusted are shown in Table 6.

Table 6: Adjusted RPCs

IMPLAN sector	Sector description	Expenditure category	IMPLAN RPC	Adjusted RPC
25	Commercial fishing	Bait	0.15	1.00
101	Manufactured ice	Ice	0.60	1.00
393	Boat building & repair	Vessel maintenance & repair	0.03	1.00
393	Boat building & repair	Moorage	0.03	1.00
421	Sports goods	Fishing gear—trawlers, longline	0.02	0.10
421	Sports goods	Fishing gear—dredges	0.02	0.90
421	Sports goods	Fishing gear—lobster boats	0.02	1.00
462	Real estate	Rent	0.70	1.00

Cost-earnings data for seafood industry

The same sources that were used to develop product flow also included information on cost and earnings for seafood industry establishments. These sources of data were standardized using IMPLAN expenditure categories. Typical expenditure categories for seafood dealers/processors, seafood wholesalers/distributors, and Fulton Market are shown in Table 7.

It is important to emphasize that these expenditures do not include the cost for fish or seafood products purchased by the seafood industry as inputs into their value-added activities. The economic impacts of these inputs have been estimated as a part of the activities of harvesters or dealers/processors that are providing these inputs. By focusing the estimation of economic impacts on the value added by the seafood industry, the analysis avoids double counting of impacts.

Table 7: Typical categories of seafood industry expenditures

- Supplies/packaging
- Other supplies
- Breading
- Ingredients
- Transportation
- Real estate
- Utilities, telephone
- Administration
- Overhead, miscellaneous
- Insurance
- Accounting
- Maintenance and repairs
- Bank fees, services expenses
- Capital costs
- Ads, promotion
- Taxes/employment taxes
- Wages & profits

The estimation of value added to the fish or seafood products purchased by seafood industry establishments is based on data from value-added statistics published in *Fisheries of the United States* (2002). For dealers/processors this figure is 100 percent; for wholesalers/distributors, the figure is 63 percent.

IMPLAN and general methodology for estimating impacts

IMPLAN (IMpact analysis for PLANning) is a system for conducting economic analyses based on Mid-Atlantic input-output (I/O) structural matrices. IMPLAN was originally developed by the U.S. Forest Service and has gained wide acceptance in a variety of impact assessment applications. In addition to the Forest Service, users of IMPLAN have included the U.S. Army Corps of Engineers, the National Park Service, the Soil Conservation Service, the Federal Emergency Management Agency, the Bureau of Land Management, universities, and numerous state and regional planning agencies.

The basic IMPLAN model performs an I/O analysis for a given region in terms of as many as 528 economic sectors, roughly corresponding to 3-digit and 4-digit SIC codes. In addition, IMPLAN allows the analyst to add custom sectors (e.g., groceries) for a particular application. Impacts are specified in terms of output, income, and employment (both full and part-time jobs).

Multipliers and other variables used in the analysis are generated using IMPLAN's software and a separate IMPLAN data file for each study area. In this case the IMPLAN data files for the six states in the Mid-Atlantic region were used to create regional level variables, corresponding to the Mid-Atlantic study area. This study area does not include all the territory of those six states. Rather the region comprises those counties and independent cities listed in Table 3.

The I/O methodology employed here measures economic impacts in terms of business sales (referred to as "output" in I/O terminology), labor income, and employment. These impact measures are defined as follows:

- Output is the gross sales by businesses within the economic region affected by an activity.

- Labor income includes personal income (wages and salaries) and proprietors' income (income from self-employment).

- Employment is specified on the basis of total full and part-time jobs and is measured in terms of annual average jobs.

Multipliers are presented for direct, indirect, induced and total impacts. Multipliers express the respective impacts resulting from demands for goods or services associated with a particular activity such as commercial fishing. Types of impacts are defined as follows:

- Direct effects express the economic impacts (for output, income or employment) in the sector in which the expenditure was initially made. For example, the direct income multiplier for the wholesale trade sector would show the total income generated among wholesale employees and proprietors per unit of sales by the wholesale trade sector. This direct impact would result, for example, from expenditures made by commercial fishermen in wholesale establishments.

- Indirect effects measure the economic impacts in the specific sectors providing goods and services to the directly affected sector. For directly affected wholesalers, indirect effects would include the purchases of products from manufacturers and purchases of accounting services. These indirect impacts extend throughout the economy as each supplier purchases from other suppliers in turn. For example, the accounting firms would need to purchase office supplies and business equipment. Thus, the indirect output multiplier would represent the total output generated in the various supplier sectors per unit of sales by the direct sector.

- Induced effects are the economic activity generated by personal consumption expenditures by employees in the directly and indirectly affected sectors, as wholesalers, accountants, and other directly and indirectly affected employees spend their paychecks. These household purchases have additional "indirect" and "induced" effects as well, all of which are defined as induced effects.

- Total effects are the sum of the direct, indirect and induced economic impacts. Total effects quantify the total impact (i.e., for output, income or employment) throughout the economy per unit of sales by the direct sector.

The multipliers express the economic impacts, which occur within a defined study area, in this case, the Mid-Atlantic region. The multipliers do not account for economic impacts taking place outside of the study area (i.e., outside the region).

As noted above, a combination of sources has been used to estimate budgets and expenditures for commercial fishers and the seafood industry. These estimates of expenditures serve as the base for estimating economic impacts of the industries' activities.

Given these estimated expenditure patterns, I/O multipliers were developed by business sector for the U.S. These multipliers express the economic impacts generated as a function of the amount of these expenditures. For output (sales), income, and employment, impact ratios were developed for direct, indirect, induced and total multipliers.

In estimating the economic impacts of specific expenditures, the first step is to determine whether the expenditures occurred in the study area. For the Mid-Atlantic model, a simplifying assumption is made that all expenditures occur in the region. Certain of these expenditures almost certainly occurred outside the region. To the extent that purchases of goods or services actually are directly made outside the region, the model will also overestimate economic impacts.

For expenditures on goods, IMPLAN requires the disaggregation of spending into value-added shares attributed to manufacturing, transportation, wholesale, and retail activities, using allocations (termed margins) generated by IMPLAN. The model assumes that all purchases are made from wholesalers. Consequently, the model uses IMPLAN's information on margins to distribute the value of purchased goods among manufacturing, transportation, and wholesale sectors, thereby creating adjusted margins.

A substantial portion (usually a majority) of the value of any good is created by the manufacturing of the item. The economic impacts associated with expenditures on goods will then largely occur where those items are manufactured, often different than the location of the purchase. Given the increasingly global nature of manufacturing, this is true even when the scope of the impact analysis is the U.S. Thus, for the purchase of motor vehicles, the model assumes that Mid-Atlantic manufacturers will meet only 15 percent of the demand. An even more extreme case is boat manufacturing. The model assumes that regional manufacturers are only able to meet 3 percent of the demand for boats. Thus, a purchase of trucks or boats will create only modest manufacturing-related economic impacts in the region. Most will occur elsewhere in the U.S. or in the world (e.g., Japan for trucks).

The provision of services tends to be much more local. For many services, it is assumed that establishments located within the region being analyzed can meet the great majority of demand for the service. Thus, the model assumes that 92 percent of motor freight services and 99 percent of wholesale services are met by regional businesses.

The estimation of the ability of the region being analyzed to meet regional demands for goods and services is measured by regional purchase coefficients (RPC). RPCs are generated by IMPLAN and are specific to economic regions. Generally, regions with larger and more comprehensive economies are more able to meet demand for goods and services and have higher values for their RPCs.

The I/O methodology converts expenditures to economic impacts with multipliers. These multipliers were developed using the IMPLAN software and the Mid-Atlantic data set. The multipliers for business sectors corresponding to particular types of expenditures made by commercial fishing and seafood industry establishments were used to estimate economic impacts. For example, impacts of purchases of diesel, gasoline and other fuels and lubricants were estimated using the IMPLAN multipliers for several sectors: petroleum refining, transportation services, and wholesale businesses. Purchases of repair and maintenance services for the harvester sector were estimated using the boat repair sector. These multipliers address output, income, and employment impacts.

Custom multipliers were developed for three types of expenditures that do not directly correspond to a specific sector in the IMPLAN multiplier system. This resulted in custom multipliers, analogous to the standard IMPLAN industry sector multipliers. These consisted of expenditures for grocery or food expenditures, for vehicle ownership costs, and for wages.

Grocery expenditures are developed using a standard “basket” of foodstuffs and other grocery goods purchased by consumers. Like all other goods, part of the value of grocery purchases is assigned to the transportation and wholesale sectors.

Wages are similar to groceries in that they represent a mix of purchases made by typical households. These include food, shelter, transportation, and other goods and services consumed by households. For goods, part of the value is assigned to transportation, wholesale, and (because these are purchases made by consumers) retail activities. Unlike all other expenditures addressed by the model, a percentage of wages is assumed to be saved, devoted to taxes, or otherwise not spent in the economy. For the Mid-Atlantic model, 73 percent of wages is assumed to be personal consumption spending.

Vehicle ownership costs are based on American Automobile Association data on operating and fixed costs. The specific costs for this custom sector were based on the ownership costs of an SUV driven 15,000 miles annually with a useful life of 8 years. Costs include gas and oil, maintenance, tires, insurance, fees and taxes, capital costs, and bank loan fees.

Finally, an overall model was developed which integrates the above data in an EXCEL spreadsheet. This model allows the user to input the value of landings data to produce the impact estimates. The model also allows for modifications to structural parameters such as the RPCs, distribution of expenditures and other economic variables.

The following summarizes the key aspects of the I/O analysis:

- The IMPLAN economic analysis system served as the starting point for the I/O analysis and directly generated most of the variables used in the analysis.

- Sets of multipliers were developed for the Mid-Atlantic region.

- Custom multipliers were developed for critical sectors not effectively represented by the IMPLAN model

- For each expenditure, a Regional Purchase Coefficient (RPC) was applied to estimate the portion of demand that could be fulfilled by Mid-Atlantic businesses.

- Appropriate margins were applied to the purchase of goods where there is activity in the transportation, wholesale, or retail sectors as well as the manufacturing sector.

- These variables were used to evaluate representative expenditures for commercial fishing and seafood industry activities resulting from the harvesting of fish in the Mid-Atlantic region and subsequent processing and distribution of fish and seafood products.

Allocation of impacts to subregions

The Mid-Atlantic model addresses impacts at the regional and subregional levels. The subregional impacts are the disaggregated regional impact. Conversely, the sum of all subregional impacts equals the regional impact.

Different methods can be employed to estimate subregional impacts. For example, IMPLAN can be used to create an I/O model of any county-level economy. Thus, one option for understanding subregional impacts would be to create separate I/O models for each of the 12 subregions. Each of these subregional models could estimate impacts for landings for that specific subregion. These impacts would be smaller than the regional-level impacts for the same landings. The difference between the subregional and regional impacts would then be assigned to the other 11 subregions. Such a procedure would require a substantially larger model than the current model and would place much larger demands on computing and memory resources.

The current model adopts a method used by Steinback and Thunberg (2000) in a similar model that estimates regional and subregional impacts of the commercial fishing and seafood industries in New England. This allocation method is based on the relative importance of each subregion's economy to the total regional economy. IMPLAN provides an estimate of the employment, labor income, and output for each individual economic sector of each subregion. Thus, for example, total output (i.e., sales) of wholesalers in the Mid-Atlantic region is $125 billion. Because wholesale output in the New York subregion is $51 billion or 41 percent of the regional total, 41 percent of the regional wholesale output is allocated to the New York subregion. Conversely, wholesale output in the North Carolina south subregion is $0.5 billion or 0.4 percent of the region's wholesale output. The model then allocates 0.4 percent of the region's wholesale output to the North Carolina south subregion. This allocation methodology is extended to employment and income impacts and to all other economic sectors.

Such a methodology has strengths and weaknesses. Significant advantages include simplicity and concision. This methodology also does not add substantially to the computing or memory demands of the model. On the other hand, the allocation process is insensitive to the location of landings. For example, the New York subregion is allocated 41 percent of the regional wholesale output impacts whether landings occur in New York or in North Carolina.

Opportunities to improve the Mid-Atlantic model

Any model is a tool for creating estimates. Necessarily, elements of uncertainty are introduced into models. There are, however, opportunities to improve the current model that could reduce the uncertainties built into the current version of the Mid-Atlantic model.

Better cost-earnings data on harvesters may be the best opportunity for improvement. For example, no data are available for midwater trawls or for other mobile gear. In both cases, cost-earnings data for medium bottom trawls are used as a proxy. While there are data for scallop dredges, these data have been averaged for all sizes of vessels. The model differentiates between small, medium, and large vessels. A richer understanding of the differences between the costs and earnings of small, medium, and large scallop dredges would allow the model to make distinctions among the landings made by different size vessels. Similarly, the costs and earnings for medium bottom trawls is a weighted average of small and large bottom trawls, not a distinct set of data generated by the experience of medium bottom trawl vessels. The estimated costs and earnings for onshore and offshore lobster vessels are the same and do not recognize any cost and earnings distinctions between these two types of lobster harvesting.

Cost-earnings data for the seafood industry are available for dealers/processors, wholesalers/distributors, and Fulton Market. The Fulton Market data are relatively recent from a study published in 2001 (TechLaw). Data for the other segments are older and could be improved with more recent data.

More importantly for the seafood industry, the model does not capture the impacts of retail level activities at markets and restaurants. Each segment makes a significant contribution, particularly restaurants, which add substantial value to the fish and seafood products they purchase, thereby creating substantial economic impacts. For example, in a study of New York's commercial fishing and seafood industries, restaurants and food service establishments accounted for 62 percent of the total economic contribution (TechLaw 2001).

Finally, better information on the flow of fish and seafood products in the Mid-Atlantic region would help understand the economic impacts of the commercial fishing and seafood industries. Current flow data is based principally on data for New York and

Virginia. While these states contribute about 40 percent of the region's total landings, the flow data for the remaining landings are unknown. Furthermore, the existing flow data address flow within state, not regional, boundaries.

A particular gap in these data is the regional flow to and from Fulton Market, which almost certainly receives substantial inputs from Mid-Atlantic sources outside of New York. The specific Mid-Atlantic sources are, however, unknown. Because Fulton Market sells its products to processors and wholesalers in New York, it almost certainly sells to other similar customers in other Mid-Atlantic states. Again the flow to these customers is unknown.

The absence of better data has led to some simplifying assumptions about product flow. For example, the model assumes that dealers/processors receive inputs only from harvesters and that wholesalers/distributors only sell their products to retail level businesses or final consumers. As noted, the product flow characteristics of Fulton Market sales to non-New York customers other than retail, export, or final customers are not known.

The absence of better product flow data almost certainly results in an underestimation of the economic impacts of fish and seafood products on the Mid-Atlantic region. Estimates of product flow in New York state (TechLaw 2001) indicate that product flow is quite complicated with seafood products often moving among several processing or wholesale level seafood industry establishments before moving to the retail level, to exporters, or to final consumers. This model of the Mid-Atlantic region makes a number of simplifying assumptions that may well underestimate the number of processing or distribution establishments that handle these products. Consequently, to the extent that the model underestimates the number of processing or distribution steps taken, it also underestimates the value added by these establishments and the overall economic impact of the seafood industry.

Impact Estimates by the Mid-Atlantic I/O Model

The Mid-Atlantic input/output (I/O) model has been used to estimate economic impacts related to Mid-Atlantic regional landings in 1998 and 2002. In these years, landings of commercial harvesters totaled $382 million for 1998 and $364 million for 2002. Both figures are expressed in current dollars for those years. Table 8 presents these landings by the types of gear used by the Mid-Atlantic model.

Table 8: Landings for the Mid-Atlantic Region by Gear Type

Fishery	Landings for 1998 (1998 $)	Landings for 2002 (2002 $)
Inshore lobster	62,320,520	46,932,271
Offshore lobster	4,225,055	1,300,553
Large bottom trawl	46,230,285	29,342,727
Medium bottom trawl	16,460,890	17,541,381
Small bottom trawl	2,780,392	3,049,604
Large scallop dredge	26,845,745	74,858,612
Medium scallop dredge	2,022,748	10,658,445
Small scallop dredge	3,982,474	5,300,364
Surf clam/ocean quahog	35,803,704	52,300,516
Midwater trawl	41,223,512	22,626,761
Bottom longline	4,480,749	12,107,315
Other gear	65,246,477	57,027,695
Pots & traps	47,201,825	9,368,695
Gill nets	23,076,255	21,584,345
Total value of landings	381,900,631	363,999,284

These same landings are presented in Table 9 by the 12 subregions defined by the model. As shown, certain subregions had either no landings or relatively small landings.

Table 9: Landings for Mid-Atlantic Region by Subregion

Region	Landings for 1998 (1998 $)	Landings for 2002 (2002 $)
New York	81,827,989	51,350,527
New Jersey north	2,035	1,088,470
New Jersey south	97,110,488	111,464,440
Delaware	5,837,411	6,066,848
Maryland west	384	-
Maryland east	57,933,869	49,013,039
Virginia east	13,461,405	11,994,931
Virginia south	49,062,787	80,338,371
Virginia north	50,517,148	30,971,113
North Carolina north	-	-
North Carolina central	25,937,228	21,150,439
North Carolina south	209,887	561,106
Total value of landings	381,900,631	363,999,284

For the Mid-Atlantic region, the economic impact of these landings, as estimated by the model, are expressed in terms of employment, income and output. Employment is expressed in terms of average annual jobs (both full and part-time). Income as used by the model is labor income and includes all employee compensation and proprietors' income. Output is defined as the sales of goods and services by businesses.

These impacts are defined for the commercial fishing operations (i.e., harvesters) and the seafood industry. The model defines the seafood industry as three segments—dealers/processors, wholesalers/distributors, and Fulton Market. Excluded from consideration is the retail level seafood industry.

For 1998, the Mid-Atlantic total regional impacts of commercial landings for the commercial fishing and seafood industries include 10,392 total jobs, $484 million in labor income, and $1.3 billion in output by regional businesses. These impacts occurred throughout the six-state region. Dollar values are expressed in 2003 dollars. Table 10 presents these impacts of 1998 landings for each gear type and as a total for the region.

Table 10: Economic Impacts of 1998 Landings in the Mid-Atlantic Region by Gear

Fishery	Employment Impacts (Total Jobs)	Labor Income Impacts (000 2003$)	Output Impacts (000 2003$)
Inshore lobster	2,128	100,000	265,015
Offshore lobster	111	5,213	13,870
Large bottom trawl	1,208	56,628	149,262
Medium bottom trawl	416	19,518	51,538
Small bottom trawl	68	3,216	8,529
Large scallop dredge	746	34,591	92,629
Medium scallop dredge	55	2,548	6,824
Small scallop dredge	111	5,131	13,741
Surf clam/ocean quahog	1,018	47,906	125,417
Midwater trawl	1,133	53,238	140,126
Bottom longline	116	5,258	14,030
Other gear	1,529	71,896	189,726
Pots & traps	1,177	51,988	137,602
Gill nets	578	26,618	70,516
All gear types	10,392	483,750	1,278,824

Table 11 presents economic impacts of 1998 commercial landings by subregion within the Mid-Atlantic region. Again the monetary impacts are presented in thousands of 2003 dollars. These data reflect the fact that the landings in several subregions (New Jersey north, Maryland west, North Carolina north, and North Carolina south) were very small or nonexistent.

Table 11: Economic Impacts of 1998 Landings in the Mid-Atlantic Region

Region	Employment Impacts (Total Jobs)	Labor Income Impacts (000 2003$)	Output Impacts (000 2003$)
New York	2,005	93,850	249,743
New Jersey north	0	4	10
New Jersey south	2,701	126,541	333,406
Delaware	196	9,139	24,140
Maryland west	0	1	1
Maryland east	1,483	66,818	176,502
Virginia east	422	19,729	52,151
Virginia south	1,455	67,913	180,040
Virginia north	1,428	67,081	176,656
North Carolina north	-	-	-
North Carolina central	696	32,404	85,462
North Carolina south	6	271	713
Mid-Atlantic region	10,392	483,750	1,278,824

The economic impacts of the 2002 landings by gear type are shown in Table 12. Dollar values for income and output are presented in thousands of 2003 dollars and can be directly compared to the values shown in Table 10.

Table 12: Economic Impacts of 2002 Landings in the Mid-Atlantic Region by Gear

Fishery	Employment Impacts (Total Jobs)	Labor Income Impacts (000 2003$)	Output Impacts (000 2003$)
Inshore lobster	1,495	70,258	185,443
Offshore lobster	31	1,440	3,819
Large bottom trawl	654	30,644	80,732
Medium bottom trawl	378	17,747	46,835
Small bottom trawl	63	2,979	7,898
Large scallop dredge	1,748	81,086	217,132
Medium scallop dredge	243	11,287	30,226
Small scallop dredge	124	5,733	15,354
Surf clam/ocean quahog	1,243	58,456	153,066
Midwater trawl	523	24,565	64,656
Bottom longline	287	13,116	34,846
Other gear	1,120	52,616	138,915
Pots & traps	196	8,664	22,937
Gill nets	903	41,742	110,507
All gear types	9,005	420,331	1,112,365

The economic impacts of 2002 commercial landings by subregion within the Mid-Atlantic region are presented in Table 13. Again the monetary impacts are presented in thousands of 2003 dollars. These data reflect the fact that the landings in several subregions (New Jersey north, Maryland west, North Carolina north, and North Carolina south) were very small or nonexistent.

Table 13: Economic Impacts of 2002 Landings in the Mid-Atlantic Region

Region	Employment Impacts (Total Jobs)	Labor Income Impacts (000 2003$)	Output Impacts (000 2003$)
New York	988	46,156	122,488
New Jersey north	25	1,176	3,095
New Jersey south	2,801	130,956	345,921
Delaware	178	8,298	21,957
Maryland west	-	-	-
Maryland east	1,359	63,488	167,585
Virginia east	340	15,755	41,664
Virginia south	1,988	92,412	245,963
Virginia north	756	35,420	93,320
North Carolina north	-	-	-
North Carolina central	558	26,061	68,764
North Carolina south	13	610	1,607
Mid-Atlantic region	9,005	420,331	1,112,365

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