Exhibit C.6.a
Attachment 5
June 2004

APPENDIX D:
COUNCIL FISHERIES INCOME IMPACT MODELING

(Excerpted and adapted from: the Final Report of West Coast Groundfish Fishery Economic Assessment Model Update Project, Cooperative Agreement No. NEPA-0402, The Research Group, September 28, 2003).

Introduction

The Pacific Fishery Management Council (Council) uses economic impact models to assess the income impacts resulting from West Coast commercial and recreational fisheries. Data on reported landings taken from a recent PacFIN vessel summary or estimates of recreational angler trips are combined with regional economic response coefficients generated by the Fishery Economic Assessment Model (FEAM) to estimate local income impacts resulting from observed historical fishing activity and/or activity levels expected under alternative fisheries management scenarios (Jensen 1996).

Regional economic response coefficients are taken from input-output models. These models were constructed using the IMPLAN economic modeling software originally developed by the U.S. Forest Service (MIG 2000). IMPLAN can be used to construct county or multi-county models for any region in the United States. The regional models are based on technical coefficients from a national input-output model, local employment and payroll data and estimated regional trade propensities. IMPLAN adjusts the national level data to fit the economic composition and estimated trade balance of a chosen region. Some valid criticisms have been directed at synthesized input-output as opposed to survey based input-output. First, the synthesized industry spending coefficients are based on average relationships between industries aggregated at a national scale. These generalized relationships may not apply to the specific region under study. However, an input-output model, unlike many other economic models, is constrained and consistent. The model is a double entry book keeping system of accounts. Total sales must equal total purchases in each sector and for the economy as whole, including imports and exports from the study region.

One limitation of this type of regional impact analysis is that it presents a picture of the economy at a single point in time. This picture is based on historical ratios between different sectors of the economy rather than a dynamic structure of changing relationships. When prices or costs change, consumers and producers respond by substituting among final goods, substituting among inputs to production, migrating between regions, and shutting down businesses that are no longer profitable. To evaluate these sorts of changes, economists must first estimate the direct effects and translate these into equivalent changes in final demand that are then used to drive the input-output model. Accurate estimates of regional impact are dependent upon the projections of direct effects on the sectors that drive the input-output model. It has also been suggested that this type of regional analysis tends to overstate actual impacts because it assumes that all possible adjustments to disturbance are instantaneous and permanent, and that behavioral responses to disturbances are limited. For example, people who lose a job are assumed to stay unemployed. In reality people and businesses adjust over time as they try alternative occupations, technologies and locations.

Economic changes triggered by disturbances can be short-run or long-run. Short-run impacts include the initial construction or other temporary changes in spending that typically last for less than a few years. Long-run effects, on the other hand, include the more permanent aspects of economic adjustment as industries, workers and consumers react to emerging economic realities. Examples of long-run adjustments include construction of new facilities, adoption of labor-saving technology and outsourcing of intermediate production steps. Results generated by input-output models are generally considered to be better indicators of impacts in the short-run than over the long-run.

IMPLAN itself includes only a single aggregated commercial fisheries sector and two seafood processing sectors. Data for these sectors is notoriously sparse since much of the employment is informal or part time and so is not covered by state unemployment insurance programs or recorded in county employment data. Consequently it is necessary to construct "custom" expenditure coefficients for commercial fishing and processing industry spending categories. To do this FEAM combines elements of IMPLAN sectoral expenditure functions to better fit the observed spending patterns of vessels and processors for labor, provisioning, repairs and other costs. The custom category coefficients are then entered into a computer program that handles the accounting of vessel harvests and vessel and processor expenditures, and multiplies these by IMPLAN total income coefficients to calculate the income multiplier effects.

Limitations

The regional economic impacts calculated using economic impact models are indicators of the dislocation costs that may occur in the event of reductions in ocean fisheries, but are not indicators of the net loss to the nation from such reductions. If sufficient quantitative information and defensible analytical models are available, net gain or loss to the nation determined through a benefit-cost analysis is the value suggested by Executive Order 12866 and the Regulatory Flexibility Act (5 U.S. C. 601 *et seq.*) for analyzing actions of federally managed fisheries (NMFS 2000).[1/, 2/]

In general, there is no particular relationship between regional economic impacts and changes in NEV derived from a benefit-cost analysis, and regional economic impacts are certainly not additive with NEV. However, both measures are useful for showing the consequences of management actions. Regional income impact estimates provide a measure that is comparable to values often used to describe activities in nonfishing sectors of the economy. If the fishing activity is reduced, personal income would not necessarily be reduced by a proportional amount. The effect on personal income in the local and national economies will depend on alternative activities available and the location of those activities. If there were a reduction in the ocean fisheries, over the long run workers in the commercial and recreational fisheries, vessel and processing plant owners, and food fish consumers would adjust by changing their behavior in observable ways. The types of the alternative activity adopted compared with the fishing activity foregone determines the net effect of the change in ocean fisheries on total income.

For example, if as a result of reduced fishing opportunity a worker on a vessel loses her job and receives government assistance. If no new job or income is created elsewhere in the economy, then the net loss to the nation and local economy with respect to the worker's job is measured by the entire prior wages of that worker. However, if additional income is generated elsewhere in the

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1/ Other laws, such as the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, and the Endangered Species Act also have economic analysis requirements.

2/ The benefit-cost analysis from management actions includes the sum of changes in: consumer surplus derived from recreational fishing, consumer surplus derived from non-consumptive use, existence value, and consumer and producer surplus from commercial fishing landings, less management costs (administration, monitoring, and enforcement).

economy either through increased harvest in other fisheries or through consumers' redirection of their food expenditures, with the consequent generation of additional income and jobs in another fishery or food producing industry, then the magnitude of the net loss in income should be reduced by some portion of the value of the increased economic activity elsewhere in the economy. The effect on the local economy may differ from the effect on the national economy to the degree the alternative activities occur outside the local community.

FEAM personal income estimates provide an indicator of the magnitude of the possible redirection of money between fishing-dependent and nonfishing-dependent sectors that may result from changes in the fishery. The amount of redirection represents a dislocation that may have economic and social costs that would not be reflected in a typical NEV analysis. However, income impacts should not be used as a substitute for a proper assessment using benefit-cost framework.

Commercial Fishing Economic Impact Model

Landings data and industry (vessels and processors) economic factors are used to develop the commercial fishing economic impact model. FEAM was developed by Hans Radtke and William Jensen for the West Coast Fisheries Development Foundation in 1984, resulting from a need to utilize existing data on fisheries to estimate the economic contribution of the fishing industry to regional economies. The Council first utilized this model in response to a threatened lawsuit by the Small Business Administration that contended the Council had not considered the economic and social impact of their salmon management decisions on small businesses. FEAM combines an IMPLAN input/output model with landings and other local industry information to generate economic analysis relating to fishery resource use. IMPLAN-generated response coefficients are applied to specific business expenditures to calculate the personal income contributions of these expenditures. FEAM results have been useful because much of the commercial fishing industry information is not described in published employment data.

Commercial fishing landings data is a model input and is received from the Pacific Coast Fisheries Information Network (PacFIN) data system. PacFIN contains a standardized compilation of selected information from state fish ticket databases maintained by West Coast states. Landing volume and ex-vessel value data flows through the model from the harvesting sectors (boat and gear type) through the intermediate use (buyers and processors) to final demand (consumers). The contribution of the resulting economic activity to the local economy is measured by the amount of personal income generated. IMPLAN derived response coefficients translate direct business spending into the household personal income.

The FEAM model is a menu driven computer program that allows the analyst to change data and key assumptions about harvesting and processing activities. When subtracted from baseline conditions, the model results show the economic impacts of fishery and fishing industry changes. The personal income estimates can be made for any single or multiple of counties. It is assumed that county boundaries surrounding a port-of-landing define economic regions. To the degree that processing activities, the vessel home port, and the homes of workers and owners in the industry are located in the port of landing, the personal income generated is more likely to occur in the community associated with the port of landing than in other areas of the county. To the degree processing activities, the vessel home port, and the homes of workers and owners in the industry are located outside of the county, the person income estimates likely overestimate income generated in the county. Where landings are made in one port and a vessel is home located in another port or the workers live in another port, or where processors transfer product from one port to another, there are likely some cross-impacts between ports that are not measured or are attributed to the wrong geographic area. Some of the cross impacts may cancel each other out.

For each defined area, the key elements of the commercial FEAM model are:

- Response coefficients (Generated by IMPLAN and applied to expenditures of the firms and income earned by those employed and owning fishing enterprises).
- Inventories of vessels (number of fishing vessels of different types by port).
- Harvester fixed costs.
- Harvester variable costs (expenditures per pound landed).
- Inventories of processors and buyers (number of processors/buyers of different types by port).
- Processor/buyer fixed costs.
- Processor/buyer variable costs, processor margins and recovery rates by product form and species.
- Inventories of the species, weights and value of fish landed.
- Distribution of species among harvesters.
- Distribution of species among processors.

With the exception of the response coefficients, each of these segments requires input by the model user. Inventories and distribution information was derived largely from PacFIN data. Information on processor and buyer inventories (counts of firms by type and community) was augmented by prior knowledge of the industry. The processor margins and harvester and processor budgets were based on interviews and numerous studies.

Three types of income are included in the income impact estimates:

- Direct (earnings of labor and owners in the harvesting and processing sectors).
- Indirect (earnings of labor and owners in firms supplying harvesters and processors, e.g. wages paid by a gear manufacturer).
- Induced (earnings of labor and owners that occur when those earning direct and indirect income spend their income, e.g. income earned by the owner of a grocery store).

IMPLAN response coefficients were based on the 1998 economy and landings data is for year 2000. Modeling results can be extended to other years based on processor and harvester marginal impacts per pound. Per pound processor margins and expenditures are assumed to be constant and harvester impacts are adjusted based on changes in ex-vessel price. Species and port specific ratios per pound are multiplied by the price for a particular year to get an income impact estimate for that year.

The following figure illustrates how a difference in ex-vessel price for troll chinook affects marginal impacts per pound. A concern in using this approach is that the more the ex-vessel price deviates from the range of prices used to develop the estimate in the base year, the more the estimate of harvester related income impacts is likely to be inaccurate and the more likely that processor margins will change.

The FEAM results for average economic impact factors by species/gear categories are then transported to a spreadsheet for convenience in analyzing management alternatives. There is a great level of detail to the spreadsheet model, however there are several major simplifying assumptions:

1. The model relies on response coefficients generalized from IMPLAN. Several studies have evaluated the overall performance of IMPLAN, and although results are inconclusive, IMPLAN's outcomes have been shown to be plausible (Crihfield and Campbell 1991); (Rickman and Schwer 1995). Nevertheless, it is prudent to be aware of several simplifying assumptions concerning the structure and data contained in the model. In addition to the problems generally associated with input-output modeling, IMPLAN implicitly assumes national average production coefficients and margins, and uses a set of econometric equations to predict interregional trade flows at the regional level. Users of IMPLAN must be willing to accept these assumptions and estimation methods or else have the ability to incorporate user-supplied data to improve the accuracy of their impact estimates.

2. The inter-industry dollar flows from 1998 IMPLAN coefficients apply to the analysis year.

3. The marginal economic impacts from harvesters and processors per landed pound at the state level also apply to port areas. This implies that the type of processing and fleet mix is uniform for each port group. However there is some fleet variability captured in the analysis due to species and gear combinations, and the marginal economic impacts are adjusted by port area prices.

4. The amount of processing done within each state and port area equals the amount landed. That is, there is no cross hauling of raw product.

5. The sum of port areas within each state will not equal the state total. This is because a) not all landings reported by PacFIN are associated with a port, and b) the port area price is used to calculate local harvester economic impacts rather than the statewide average price.

6. The three-state economic impacts are a sum of individual state economic impacts, rather than completing a region-wide analysis. This is because many species management regimes that affect landing locations, ex-vessel price, processing product forms, etc. are associated with state boundaries.

7. With three exceptions, there is only one finished product form per species category. The exceptions are Dungeness crab, albacore tuna, and Pacific whiting.

8. Ex-processor sales price is estimated using cost calculation from the FEAM model or using published sales price information for the product form sold in an area.

9. Fish license fees and product taxes/surcharges are constantly changing. The current model was specified to use year 2000 fees.

10. Marginal impacts are a constant percentage of average impacts. To estimate marginal impacts per pound, divide average impacts by 89%.

Recreational Fishing Economic Impact Model

Recreational fishing economic impacts measure the economic activity (business sales, jobs or personal income) generated by the spending of recreational fishing participants. Calculating these impacts is simple when angler effort, expenditures, and economic response coefficients are all known. Trip and equipment related impacts are determined by the following formulas:

1. Total trip-related economic impacts = total trips x spending per trip x economic response coefficients.

2. Total annual angler expenditure economic impacts = total anglers x annual equipment costs x economic response coefficients.

Total trip-related impacts are disaggregated by mode (boat, shore, charter, etc.), residency of the fisher (resident or non-resident), location of the trip, and type of expenditures (bait, lodging, license fees, etc.).

Total annual angler expenditure impacts are disaggregated by type of equipment purchased, and adjusted to reflect effective counts of representative spenders.[3/]

Decision makers need to be aware of the assumptions used to estimate each of the terms in these formulas to correctly reveal how changes in recreational fisheries management may affect the economy.

For each defined area, the key elements of the recreational FEAM model are:

- Response coefficients (Generated by IMPLAN and applied to estimated expenditures by recreational angling businesses and independent recreational anglers).
- Estimated number of angler trips by type of trip (guided, charter, private).
- Businesses fixed and variable costs (guides and charters).
- Independent angler per trip expenditures and annual equipment expenditures.

The outputs of the model are personal income and number of jobs. Jobs are calculated by dividing the personal income estimate by BEA earnings per job.

3/ Survey results usually show "typical" and "representative" spending by anglers. Typical spending occurs when purchases are made for an item. In this case zeros are not included when tabulating average spending per angler). Representative spending occurs when purchases are made for some items but not others. In this case zeros are included when tabulating average spending per angler.

Two alternative information sources were used to calibrate the recreational model. The first alternative used (Gentner 2001) for trips, participants, and annual and per trip spending. The second alternative used (PFMC 2003) for trip estimates, (USFWS 2003) participation estimates, and (Gentner 2001) for spending per trip.

Gentner's publication describes the results of a MRFSS economic add-on survey that was administered on the West Coast in 2000. Gentner’s trips are for saltwater fisheries at the state level for Oregon and Washington and for two regions (northern and southern) in California. Application to smaller sub-state regions thus assumes that local trip expenditures are the same as the state average. However local IMPLAN economic response coefficients that are specific to the sub-state region an be applied.

Gentner divides fishing trips by whether the angler’s residence is located within or outside of the region. However the trips are not categorized by target species. So even though the declared target species for recreational trips is available through RecFIN, the current recreational FEAM model assumes the same average spending patterns no matter what the declared target species.[4/]

Obtaining angler counts and their place of residence is also problematic because available sources of information, such as RecFIN, usually do not provide these tallies directly. Methods for estimating angler counts, such as using a factor based on annual average effort per angler, need to be devised.

Spending per trip is highly dependent on fishing mode, trip duration, and location. Anglers fishing from boats, hiring guides or charters, or staying overnight will obviously spend more money than those who do not. Sometimes the trip occurs in remote locations where there are no businesses. Trip spending may occur elsewhere (resident home or somewhere along the way) than in the destination economy being analyzed. Annual equipment costs are also highly variable, depending on anglers' fishing interest, avidity and ability to afford amenities in fishing pursuits. All of these factors need to be considered to make economic impact analyses sensitive to management alternatives.

Recreational fishing is usually considered a household decision for using discretionary income. If not spent for fishing, other forms of household leisure would likely be substituted. Household income spent for local recreational fishing is derived from jobs in other industries, so fishing by residents is not considered to be bringing new money into the economy. However non-residents traveling to an area are bringing new money into an economy. Regional economic impact analysis typically only considers non-resident angler expenditures made at the destination as contributing to the local economy. Clearly, though, resident spending does support recreational activity. Anglers may choose to travel to other regions to fish. Therefore their expenditures near home represent a type of "import substitution” to a regional economy.

4/ The Recreational Fisheries Information Network (RecFIN) is an online retrieval database sponsored by the Pacific States Marine Fisheries Commission. The database contains results from the Marine Recreational Fisheries Statistics Survey (MRFSS) Program and cooperative angler surveys administered by states.

Economic Valuation

Economic valuation assessments measure the economic welfare that users derive from fish resources. Anglers obtain benefits above and beyond their expenditures, however these benefits are not shown through spending in the market place. Non-market valuation methods must be used, such as the hedonic price approach (Mendelsohn *et al.* 1992); the travel cost method (Smith 1989); and the contingent valuation method (Hoehn 1987).

The hedonic model is limited in its scope of application (Getz and Huang 1978), so the travel cost and contingent valuation methods are more commonly employed. The comparative measurement using any of these methods is to subtract the fishing costs from the assessed benefit for the derivation of net economic value (NEV). This differs from measuring the gross economic value where the assessed benefit is added to the actual expenditures to fish. Calculating the per trip NEV is controversial because, theoretically, a fisheries total prosecution effort, benefits, and costs would have to first be known.

Moreover, this would calculate average value when marginal value should be used for determining incremental changes in fisheries. (Marginal net economic value is what an angler is willing to pay to catch an additional fish less costs for pursuing that fish.)

The project did not have the budget resources to determine original per trip NEV through special surveys. Furthermore, NOAA Fisheries, Southwest Fisheries Science Center is using the MRFSS economic add-on survey to develop an NEV model. Therefore, per trip NEV estimates were borrowed from other studies as placeholders until more recent information from other studies is available. The borrowing of trip related NEV is called the benefit transfer approach. A major problem with this approach is the violation of the assumption that individuals share a common representative utility function. Practically speaking, one individual will place a value on a fishing experience based on a number of variables, including catch rates, size of fish, site characteristics, and their own personal avidity and motives to fish. Intuitively, transferring values from one group fishing in one location to another group at a different location at a different time may introduce large errors in the estimate. Minimizing differences in site and species conditions and angler demographics and motivations when selecting studies to borrow per trip values will help in alleviating the errors. Decision makers should recognize the inherent problems in determining net economic value through the benefit transfer approach when reviewing management alternatives.

There are other use values that data sources for trip and angler counts may omit. Data sources generally only tabulate consumptive trip purposes, but trips can be made for nonconsumptive use of fish resources. Diving to observe fish would be an example. Other examples of non-consumptive use values come from scientific research, indirect benefits from preserving ecological functions, etc. (Bishop 1987).

Non-Use Values

There are other valuations that can be given to fish resources. There are some people who are willing to pay for a resource, even though they never use it. This type of non-use value is called existence value, because people are willing to pay to insure that the resource exists, in case they want to use it in the future or to insure the resource exists for future generations to enjoy. There are extensions of existence value that economists like to discuss, such as option value, amenity value, bequest value, and others. All of these values are useful concepts for trying to understand what it means for measuring the worth of the resources. While the modeling for this project did not calculate non-use values, all types of values to society may be important to decision makers. For example, if a particular fish resource is not threatened with extinction, then the existence value is probably not relevant. If there are vary large changes to fish resources through management actions, then the average use values are important. If there are only incremental changes, then the marginal use value would be a more applicable comparison.

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