AN ECONOMIC PROFILE OF THE SOUTHEAST ALASKA SALMON FISHERY

by

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AK-SG-84-03

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Council Document #24

Final Report to the North Pacific Fishery Management Council,
in Fulfillment of Contract 82-3

February 1984

Funded by
NOAA/NMFS Cooperative Agreement

AK-SG-84-3

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ABSTRACT

Data obtained from a 1982 mail survey of fishermen who participated in the 1981 Southeast Alaska hand troll, power troll, drift gillnet, and purse seine salmon fisheries were summarized and analyzed. Profiles of "typical" vessels in each fishery were prepared, based on mean values of investment, costs, earnings, and effort. Cluster analysis was used to define major subgroups of vessels within each fishery, based on differences in their physical characteristics (length, horsepower, gross tonnage, age, and market value). Profiles of vessels in the major subfleets of each fishery were also prepared and presented.

Production and cost functions were estimated cross-sectionally for each fishery as a whole, and separately for the major subfleets, or clusters, within each fishery. These functions relate costs and earnings of vessels to fishing effort, which extends the utility of the vessel profiles for policy analysis. If the anticipated effects of a policy on fishing effort can be identified, the fishery models can be used to predict the resulting impacts on gross earnings, net cash flow of owner-operators, and crew wages. A simple example was presented to illustrate the use of these models to estimate the trade-offs in fishing income and reduced chinook salmon catch which accompany a policy to reduce fishing effort by ten percent.

KEY WORDS

Southeast Alaska, salmon fishery, economic costs and returns, cluster analysis

EXECUTIVE SUMMARY

Based on responses to a 1982 survey of fishermen, detailed profiles of costs, earnings, and investment in the 1981 Southeast Alaska salmon fishery were developed. The results indicate that gross earnings of purse seiners averaged $107,000, while power trollers grossed roughly $26,000, drift gillnetters grossed about $23,000 on average, and hand trollers reported gross earnings of roughly $4,700. Results of chi-square tests made possible by the participation of the Commercial Fisheries Entry Commission in this study indicate that the sample gross earnings distribution is representative of the population in the purse seine and drift gillnet fisheries, while in the hand and power troll fisheries there was somewhat greater representation from fishermen with higher gross earnings. No independent collection of data on fishing costs is conducted, so similar tests on representativeness of sample fishing cost data was not possible.

After subtracting all out-of-pocket fishing costs, except debt service, net cash flows were estimated to average $24,000 in the purse seine fishery, $6,700 in the power troll fishery, $5,600 in the drift gillnet fishery, and -$600 in the hand troll fishery. Net cash flow was defined in this study as what is available after fishing expenses, to pay debt service and living expenses. Including the "hidden" costs of depreciation and the opportunity cost of capital invested, the return to labor and management was found to be generally negative if a 10 percent interest rate was used to represent the opportunity cost of capital. Because it may be argued that fishing investment is illiquid and subject to considerable transactions costs, a 5 percent opportunity cost of capital was also used for comparison. Employing this rate, the return to labor and management was found to be positive for the power troll ($1,200) and purse seine ($9,800) fisheries, though it was still negative in the hand troll fishery (-$2,000) and drift gillnet (-$4,000) fisheries. The return to labor and management represents the return realized by the efforts of the owner-operator and any unpaid labor employed in fishing such as family members. The amount of unpaid labor employed varied from 0.08 persons per vessel in the purse seine fishery to 0.54 persons per vessel in the drift gillnet fishery.

Cluster analysis was employed to define subfleets in each fishery which differed in their physical characteristics. Cost, earnings, and investment profiles were prepared for these subgroups as well. Typically, one subgroup contained vessels which were bigger, newer, and more expensive, and which grossed more and had higher net cash flows. One or more other subgroups in each fishery were generally older and less expensive, and had lower gross earnings and costs of operation. When depreciation and opportunity costs of capital were included, often these "lower-tech" vessels had better economic performance reflected by higher return to labor and management, even though they may have had lower net cash flows.

To improve the usefulness of the costs and earnings data in policy analysis, functions relating fishing effort to costs and fishing effort to earnings wer estimated cross-sectionally, both for each fishery as whole and separately fo the subfleets within each fishery, and the results were compared. Because th subfleets are defined by differences in physical characteristics of vessels, they are thought to be more homogeneous with respect to fishing power, and th models for the individual subfleets, or clusters, are preferred from a conceptual standpoint. In the purse seine fishery particularly, the cluster models were better statistically than the whole fishery model.

To illustrate the use of the production and cost models, the effects on fishery-wide gross earnings, net cash flow, and crew wages of an assumed 10 percent reduction in fishing effort were estimated for each fishery. In aggregate, reductions in gross earnings in the drift gillnet fishery from a 10 percent reduction in fishing effort were estimated to be $330,000 and $350,000, by the fishery-wide and cluster models, respectively. Combined reductions in net cash flow and crew wages were estimated to range from $70,000 to $100,000. In the hand troll fleet, reductions in aggregate gross earnings were estimated at about $420,000 by both models, and combined reductions in net cash flow and crew wages were predicted to be about $190,000. Ir the power troll fishery, aggregate gross earnings would be reduced by $2.0 million to $2.2 million, based on the model predictions; combined reductions in net cash flow and crew wages would be about $1.5 million. Reductions in aggregate purse seine gross earnings would amount to roughly $1.6 million; estimates of reductions in net cash flow and crew wages were nearly as large, about $1.5 million. These estimates are in 1981 dollars, and do not include any possible supply effects on price, which if they occurred would probably be more pronounced in the troll fisheries. If price changes do result from the reduced fishing effort and catches, the estimates of reduced earnings will tend to be overestimates.

It is also possible to roughly estimate the reductions in chinook salmon catch which would accompany the reduced fishing effort. Average contribution of chinook salmon to the total value of 1981 catch was examined for each fishery, as well as higher and lower estimates of the chinook contribution, to account for the uncertainty about the actual effects of specific policies. In the drift gillnet fishery, based on the 1981 average contribution of chinook to catch value, 220 less chinook would be caught if drift gillnet fishing were curtailed by 10 percent; in the hand troll fishery this would amount to 4,700 fish; for the power troll fishery an estimated 25,000 less fish would be caught; and in the purse seine fishery an estimated 280 less chinook would be caught.

To re-emphasize, the estimates of reductions in earnings and chinook catches illustrate potential uses of empirical cost/effort and earnings/effort respons relationships. Fishery managers in charge of specific fisheries are better equipped to estimate the likely effects of specific management policies on fishing effort and chinook interception rates, and once these key parameters are specified, these models can be used to examine the trade-offs involved in those policy decisions.

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LIST OF ABBREVIATIONS AND SYMBOLS

Symbol	Meaning
AC_R	Average cost per unit gross earnings
BEP	Breakeven point
BTVAL	Value of fishing vessel, excluding the value of fishing gear and electronics equipment
CSTPUE	Total out of pocket cost per operating hour (excluding debts service)
FOIGRS	Gross earnings in the Southeast Alaska salmon fishery of interest
FSHHRS	Hours fished in the fishery of interest
GRPUE	Average gross earnings per hour fished
GRT	Gross tons
LNGTH	Keel length
MHP	Main engine horsepower
NCF	Net cash flow
OPRHRS	Total operating hours in the fishery of interest
OWNCST	Total out of pocket costs of operation (excluding debt service)
YRBLT	Year the vessel was built

ACKNOWLEDGEMENTS

The research reported here owes a debt of gratitude for assistance from several quarters. It would not have been possible without the cooperative and generous help of Southeast Alaska fishermen and their professional associations, who contributed to the success of the data collection survey. Interaction and discussion with economics staffs at the Commercial Fisheries Entry Commission, the Northwest and Alaska Fisheries Center, and the National Marine Fisheries Service-Alaska Region aided in the shaping of the final product.

This research was supported in part by the Alaska Sea Grant Program, NOAA Office of Sea Grant, Department of Commerce under grant number NA81AA-D-00009, project number M/81-01, RR/05.

INTRODUCTION

The salmon fisheries of Southeast Alaska form the backbone of the region's fishing industry, providing a major source of income for many residents of both urban and rural areas. In 1980, for instance, salmon fisheries accounted for some $56.5 million of the total exvessel value of $66.5 million for all species (except halibut) harvested in the Southeast region of Alaska (ADF&G, 1982). In addition to providing direct employment in harvesting and processing, the salmon fisheries help to provide the stimulus for other employment in many service and support industries. Salmon fishing is particularly important to the regional economy today because the region's other major employer, the forest products industry, has been hard hit by the national recession.

Despite its prominence and importance to coastal communities, not a great deal is known about the basic economic performance of the fishing industry in Alaska. While information on catches and processor production are collected and published regularly, and some aggregate information on prices paid and received at exvessel and first wholesale levels is available, little is known about costs of production and resulting cash flows and profits in either the harvesting or processing sectors. Unlike the agricultural industry, where costs of production are collected systematically, the fishing industry has not had the benefit of any regular data collection efforts to help improve the general understanding of the nature of the industry and its workings. In Alaska, salmon has been one of the more frequently studied fisheries,[1] but the regional fisheries for salmon differ so greatly in character (species available and gear used for harvest, timing and duration of run, proportion of resident vs. nonresident fishermen, etc.) and are subject to such large temporal variations that the costs and earnings picture, even for salmon, is still rather sketchy.

While the studies which have been done provide some information about costs and earnings of fishing[2] at particular points in time, their usefulness in policy analysis has been somewhat limited, for at least a couple of reasons. First, typically, profiles of costs and earnings are presented for whole

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[1]Recent costs and earnings studies include CFEC, 1983 (salmon in Prince William Sound and Cook Inlet); Larson, 1980 (salmon and herring statewide); Muse and Baker, 1978 (salmon in Prince William Sound and Cook Inlet); Queirolo et al, 1978 (shellfish statewide); Owers, 1975 (finfish and shellfish statewide).

[2]No comparable work has been done for the processing sector, although Orth et al (Vol.I--Shellfish, 1979; Vol.II--Finfish, 1981) does provide a detailed examination of market structure, market channels, and processing methods and capacity.

fleets, or for particular hull types within a fleet. This type of aggregation can mask substantial differences in fishing power, which probably influence costs and earnings to a large degree. Second, such profiles are static; that is, they don't permit any identification of how costs and earnings change in response to changes in fishery policy or regulatory regimes.

The project reported here was proposed largely in response to a need to present economic information on fishery costs and income in ways more amenable to policy analysis and identification of differentials in economic performance between segments of a fleet. It is a component of a study of the Southeast Alaska salmon fishery conducted jointly by economists at the National Marine Fisheries Service--Alaska Region, the Northwest and Alaska Fisheries Center, the Commercial Fisheries Entry Commission, and the University of Alaska Sea Grant Program. The study focused on examining the relationships between costs of production and effort expended by vessels, and between gross earnings and effort expended by vessels, for each of the four major Southeast Alaska salmon fisheries: purse seine, drift gillnet, power troll, and hand troll.

MATERIALS AND METHODS

Sampling

A mail survey was administered to samples of Southeast Alaska fishermen in the spring of 1982. Each questionnaire used, found in Appendix I, was four pages in length, and requested information on 1981 fishing activities for a specific Southeast Alaska salmon fishery: purse seine, drift gillnet, hand troll, or power troll.

Each questionnaire contained questions about the physical characteristics of the primary vessel used; costs of operation in the fishery; income from that fishery, all fishing, and other sources; and the amount of fishing effort expended during the 1981 season. The questionnaires for each fishery were essentially identical, with minor adjustments in question wording where needed to reflect differences in fishing practices.

The population from which random samples were drawn (in the cases of the drift gillnet and purse seine fisheries, censuses were taken) was limited entry permit holders for each fishery. Holders of multiple Southeast Alaska salmon permits were eligible for selection in each fishery, so some individuals may have received more than one questionnaire. Examination of multiple permit ownership patterns for these four fisheries prior to sampling indicated that this did not occur frequently.

The size of the initial mailing was 2,128, consisting of 500 power troll, 800 hand troll, 461 drift gillnet, and 367 purse seine questionnaires. The number of deliverable questionnaires (the sum of the "effective sample sizes" for each fishery in Table 1) was 2,078. Response rates (including completed surveys and other/miscellaneous responses) ranged from 30 percent for the purse seine fishery to 45 percent for the power troll fishery, with an overall average of 37 percent (769/2078). For completed surveys only, the rates

TABLE 1. Total number of responses, and response rates by mailing.

Fishery	Mailing 1	Mailing 2	Mailing 3	Total[a]
Power Troll (Population size = 825; effective sample size = 492)				
Completed surveys	151	49	8	209
Other[b]	3	4	5	12
Total Power Troll	154(0.313)	53(0.108)	13(0.026)	221(0.449)
Hand Troll (Population size = 1189; effective sample size = 780)				
Completed surveys	138	78	37	255
Other[b]	3	1	5	10
Total Hand Troll	141(0.181)	78(0.101)	42(0.004)	265(0.340)
Drift Gillnet (Population size = 461; effective sample size = 446)				
Completed surveys	114	40	13	168
Other[b]	0	2	3	7
Total Drift Gillnet	114(0.256)	42(0.094)	16(0.036)	175(0.392)
Purse Seine (Population size = 367; effective sample size = 360)				
Completed surveys	57	33	15	106
Other[b]	0	0	1	2
Total Purse Seine	57(0.158)	33(0.092)	16(0.044)	108(0.300)
Total Completed Surveys	460	200	73	738
Total Other Responses	6	7	14	31
TOTAL SURVEY RESPONSES	466(0.224)	207(0.100)	87(0.042)	769(0.370)

[a]Totals slightly exceed the sum of responses to each mailing because a few responses had mailing labels removed.

[b]Other responses: Deceased (3), Did not fish in 1981 (3), A typical season (6), Sold permit (4), No reason/fed up (13), No records (3); Total = 32

varied from 29 percent for the purse seine fishery to 42 percent for the power troll fishery, for an overall average of 36 percent (738/2078). After eliminating some unusable questionnaires, the number of surveys used for estimation in this analysis was 692, or 33 percent of the deliverable questionnaires. This was distributed as follows: 103 purse seine, 238 hand troll, 160 drift gillnet, and 191 power troll.

Cluster Analysis

Emphasis during this project was placed on determining the relationship between various measures of fishing effort and gross earnings, and between effort and costs of operation for each of the four major Southeast Alaska fisheries. One concern which arises when fishing effort is used as a variable in analyses is the differences in effective fishing effort which can be exerted by vessels of varying fishing power. Differences in fishing power are usually thought to result from differences in the physical characteristics of vessels, the amounts of gear and labor used, and the skill of the skipper.

The problem which differences in fishing power cause for the estimation of response relationships for the whole fleet participating in a fishery is essentially one of omitted variable bias. Without controlling for changes in fishing power in the fleet, biases in parameter estimates can result. For example, changes in production which occur as the result of changes in both fishing power and effort are erroneously attributed entirely to effort changes.

This difficulty can be reduced either by inclusion of additional explanatory variables in the regression equation to help explain fishing power differences, or by partitioning the sample into groups of similar fishing power and performing separate regressions on each. The former, which is more commonly done, has the advantage that it permits the estimation of the effects of incremental changes in one of the dimensions of fishing power (e.g., an increase of two feet in keel length of the vessel) on production or cost of operation, but its weakness is the assumption required for such a model that the whole fleet conforms to the same structure of operation. The effects of changes in fishing power are assumed to shift the production function or cost curve.

On the other hand, segregating the fleet into distinct subgroups based on similarities in fishing power allows for the estimation of entirely different functions for different subgroups of the fleet. It also permits easier identification of impacts on different portions of the fleet of exogenous factors which affect the level of effort expended, such as time or area closures. The latter approach was used in this study.

The amounts of gear used in the Southeast Alaska salmon fisheries are controlled fairly carefully by regulation, and differences in the skills of skippers are not generally amenable to quantification. Thus, in an effort to partition the vessels of each fishery into groups which were more homogeneous with respect to fishing power, the primary variables of interest were physical characteristics of vessels and amount of labor used.

The method of partitioning the vessels of each fishery was k-means cluster analysis (Brown, 1981). This procedure will partition a single group of cases into a specified number of clusters, based on a Euclidean distance measure computed over several variables. The variables used initially in the cluster analysis were keel length, main engine horsepower, gross tons, year built, vessel market value, and crew size. All variables were standardized to zero mean and unit variance so that differences in scale should not skew the distance computation. Crew size was later dropped as a cluster variable because it was not useful in distinguishing between vessels of any fleet, when used with the physical characteristics of vessels. This may have been due partly to the fact that crew size is very homogeneous in each fleet. For each fishery, the cluster analysis was run for 2-4 groups, and the resulting group compositions were examined. A choice of number of clusters to use was made, typically on the basis of how practical it was to do further estimation and analysis on each individual group. A representative case is the purse seine fishery, where the cluster analysis for four groups had the effect of dividing one of the groups from the 3-cluster analysis into two groups; the additional group contained only six cases, which was too small for purposes of estimating production functions and cost curves. Thus, three groups were chosen as the best partition of the purse seine fishery.

Profiles of Vessels and Fishing Operations

Statistical summaries of the whole fleet for each fishery, and for the major clusters resulting from the cluster analysis, were developed. These consisted of means for each of the variables in the survey, computed over all cases which had nonmissing values.

Vessel profiles contained means for physical characteristics, electronics configuration and investment in vessel, gear, and electronics. Fishing operation profiles consisted of: 1) itemized fixed and variable costs, with variable costs divided into two categories, effort-varying and labor costs; and 2) summaries of fishing effort, earnings from fishing and nonfishing sources, and measures of net income.

Fixed costs, depreciation, and opportunity cost of capital were prorated by the proportion of total vessel gross earnings coming from the Southeast Alaska salmon fishery of interest. Data from the survey would have permitted prorating these costs on the basis of relative effort (the ratio of vessel fishing effort in the Southeast Alaska salmon fishery of interest to total vessel fishing effort), but nonresponse was higher for the effort questions than for the gross earnings questions. Thus, gross earnings seemed a more logical choice, given that that kind of proration is somewhat arbitrary anyway. Many Southeast Alaska fishermen use their vessels for activities other than commercial fishing. This further complicates the prorating of vessel fixed costs, and means that the calculated fixed costs are probably biased upward somewhat.

The questionnaires were carefully structured to minimize problems with nonresponse, and in general, were fairly complete. Interpretation of nonresponse is always difficult, and can make a difference with variables which are the sum of several other variables. One such variable is total fixed costs, which is the sum of ten different fixed cost categories. If, for example, total fixed costs was designated missing when any single category was missing, the number of missing values for total fixed costs could be up to 10 times as high as the average number of missing values for any single cost category. On the other hand, if total fixed costs were calculated with one, two, or more of the individual costs missing, this would tend to cause a downward bias in total fixed costs, since it implicitly assumes that the missing values are zeros.

The approach chosen here was to assume that there is no systematic tendency for individual missing values to be different from nonmissing values. Thus, the mean values in each cost category are additive. This was thought to be preferable to rejecting all cases with any missing values at the one extreme, and assuming that missing values were zeros at the other extreme. Since nonresponse was not a major problem, it probably doesn't make a great difference. An informal test was made by comparing mean total fixed costs calculated with up to three missing values allowed to mean total fixed costs calculated with no missing values permitted. The difference in dollar value was uniformly a matter of a few hundred dollars, fairly small given the precision of surveys like this.

In the labor cost category, crew wages were calculated net of any costs of operation which they pay. For three of the four fisheries (hand troll, power troll, and drift gillnet), average total crew size (including skipper) was less than two, so the number of paid crew was less than one. Net crew wages, as a fleetwide average labor cost on the balance sheet, are therefore less than each paid crewman earned. The mean amount each paid crew earned can be obtained by dividing the net crew wages by the number of paid crew.

The two measures of net income which were calculated are Net Cash Flow and Return to Labor and Management. Net Cash Flow is the difference between gross earnings, or total revenues, and all out-of-pocket costs. It represents what is left over to pay debt service and living expenses, after fishing expenses have been deducted from gross earnings.

This survey did not collect information on the costs of debt service; while it is surely a cost of operation, it reflects equity stance of the vessel owner more than any business acumen. Thus, including it in measures of economic performance tends to confuse comparisons between types of vessels. Its exclusion from net cash flow must be noted when making comparisons with the results of other surveys.

Another limitation of the economic performance measures (Net Cash Flow and Return to Labor and Management) is one that seems endemic to any analysis of costs and earnings: gross earnings figures likely do not include the value of bonuses or "payments in kind" (free services) by processors. It is virtually impossible to assess the magnitude of these payments, which may range from being insignificant (in, say, the hand troll fishery) to be substantial (in the purse seine fishery).

The costs and earnings profiles are all prepared as though the vessel were owned and operated by the same individual. This is almost universally true in the troll and drift gillnet fisheries, and true for most of the purse seine fishery (about two-thirds of the vessels). Where hired skipper wages were listed, they were not subtracted as a cost, in order to maintain consistent accounting stances for the economic performance measures.

The second measure of net income is Return to Labor and Management, which takes account of other costs which are not paid directly out-of-pocket, but are nevertheless real costs of doing business. These other costs are depreciation, and the opportunity costs of investment.

The Return to Labor and Management measure differs from Net Cash Flow in two major respects:

Depreciation vs. Major Equipment Acquisition and Replacement. In the Net Cash Flow measure, actual expenditures for capital equipment purchased this year are subtracted from gross earnings for each vessel. Since capital equipment has a useful life of more than one year, it should be "costed out," or depreciated, over its useful life. A practical problem in doing this is in sorting out the useful lives and purchase costs of several capital items which may be lumped together in one estimate of major equipment expense. However, in a fleet encompassing a large number of vessels, it is reasonable to assume that the average annual capital equipment expense across vessels, which are in different phases of their equipment acquisition and replacement schedules, should approximate the fleetwide average depreciation quite well. Thus, for major equipment, fleetwide average capital equipment expense is used for depreciation.

What remains, in addition to the major equipment, is to depreciate the vessel itself. This is done by means of regressions relating the value of the vessel hull, less electronics and fishing gear, to various physical characteristics, including age of the vessel. The coefficient on vessel age provides the annual depreciaton of the hull.

Opportunity Costs of Investment vs. Debt Service, and Opportunity Costs of Labor. In attempting to judge whether a business employs its inputs (labor and capital) in a privately and socially productive manner, some measure of the alternatives available to both labor and capital should be netted out. In other words, these factors should be paid what they could earn in their next best use, in order to determine whether, once all factors of production are paid, there remain any pure economic profits, or rents.[3]

This view holds that both the capital invested in the business and the labor used to run it should be paid. Speaking first to payment of capital, debt service on outstanding loan balances represents well the opportunity cost of the borrowed capital used to finance the vessel, and what remains is to assess the opportunity cost of the owner's capital at stake.

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[3]This is of necessity a short-run concept, since in the long run firms should operate at minimum average cost, equal to price, and there will be no economic rents.

Practically speaking, it is extremely difficult to determine the equity stance of individual boat owners, so usually the opportunity costs of investment are determined as the amount the vessel's market value could earn in some alternative investement; rates of 10 to 15 percent have been used in past studies.[4]

A serious problem with simply applying the effective yield for some alternative investment to the vessel's market value is that it ignores the illiquidity of fishing investment and transactions costs associated with converting the investment. Costs and earnings studies examine profitability in the short term, so any measure of opportunity costs employed should take account of the difficulty in moving the investment to other uses. Brokers charge commissions, and often the seller must offer a discount to make a quick sale. In light of these considerations, 5 percent and 10 percent of the vessel's market value were chosen as alternatives for the opportunity cost of investment.

Paying the other major factor of production, labor, is difficult in most situations involving Alaska's fisheries. Theoretically, labor should be paid what it could earn in the next best occupation. In a less than full employment economy, which is typical of rural Alaska communities, an individual's opportunity costs associated with fishing can range from zero to more than the wages earned from fishing. This issue is complicated by the frequent presence of an unpaid crew member in addition to the owner-operator, for three of the four fisheries studied (except in the purse seine fishery). Often, but by no means always, this person will be a family member, and this person's opportunity costs must be assessed in addition to those of the operator. Also, fishing is known by many as a source of nonpecuniary benefits, which effectively lowers the opportunity costs.

Because of these difficulties in reasonably assessing the opportunity costs of unpaid labor and the owner-operator's skippering and entrepreneurial skills, all other factors of production except labor were paid. The amount which remains, the Return to Labor and Management, should be compared with returns from other possible occupations the skipper and any unpaid labor used in the vessel's operation could engage in.

Econometric Estimation

The data on costs, gross earnings and effort were used to estimate simple response relationships. Three measures of effort in the fishery of interest were obtained from the survey: days fished, hours fished, and total operation hours. The latter two were used in the estimation, since gross earnings is hypothesized to depend more on hours fished, while costs of operation are hypothesized to depend more on total operating hours.

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[4]When this is done, debt service must be added back to Net Cash Flow in order to avoid double-counting.

Total out-of-pocket costs to the owner-operator (fixed and variable) were used in formulating the dependent variable for estimating the cost response relationship; it was expressed both as total cost and as average cost per operating hour. The vessel and capital equipment owned by the business are the fixed factors, and in the short run time horizon of one season, the owner must incur both fixed costs and variable costs of operating the vessel. These are both operating costs, once the decision to operate the vessel for a year has been made. This specification performed better than attempting to estimate variable costs separately as a function of effort. The independent variable in the cost curve equations was operating hours.

The two general specifications of the cost/effort response were, then:

$$\text{OWNCST} = f\ (\text{OPRHRS}) \qquad (1)$$

$$\frac{\text{OWNCST}}{\text{OPRHRS}} = g\ (\text{OPRHRS}) \qquad (2)$$

where OWNCST is the total out-of-pocket costs of operation, and OPRHRS is the total operating hours in the fishery.

The estimation was cross-sectional, and was performed for each fishery in two ways: first, for the fleet as a whole; then for each cluster separately. Three functional forms were used: linear, exponential (dependent variable transformed to its natural logarithm), and log-linear (both variables transformed to their natural logarithms).

For gross earnings/effort response functions, gross earnings in the fishery of interest was used to formulate the dependent variable, which was expressed both as total gross earnings and as average gross earnings per hour fished. They were estimated cross-sectionally, using both operating hours and fishing hours alternately as the single independent variable. This was done because of the likelihood that there is some error associated with effort measures in general, and so that substantial errors in one measure would not preclude the development of production functions. This can also be justified in light of the fact that the two measures trend together fairly well, and if serious problems existed with hours fished as an effort measure, operating hours could be used as a suitable proxy.

The general specifications of the production function which were estimated were:

$$\text{FOIGRS} = h\ (\text{FSHHRS}), \qquad (3)$$

$$\frac{\text{FOIGRS}}{\text{FSHHRS}} = j\ (\text{FSHHRS}), \qquad (4)$$

and

$$\text{FOIGRS} = k\ (\text{OPRHRS}), \qquad (5)$$

where FOIGRS is gross earnings in the fishery of interest, FSHHRS is the hours fished in the fishery, and OPRHRS is the total operating hours in the fishery.

Finally, fishing time functions were specified to provide a transformation between gross earnings/effort response functions with hours fished independent and cost/effort response functions with operating hours independent. These were also estimated using the same three functional forms chosen for the production and cost curves.

The fishing time function was generally specified as:

$$FSHHRS = m\ (OPRHRS), \tag{6}$$

where FSHHRS and OPRHRS are as defined above.

Specifying the response functions in this fashion requires several assumptions which are not entirely realistic, but are no more gross than the usual assumptions which are employed in the generation of catch and value information. In order to estimate cross-sectionally, over vessels which fished in different areas and at different times, it is necessary to assume that price, species mix, and average weights of fish caught are constant for all vessels in the fleet or cluster. The same is true for prices of the various inputs used in production, so that differences in cost of production reflect only different amounts of the inputs used and not differences in their prices.

It must also be assumed for cross-sectional estimation that all vessels in the estimation set (either the whole fleet, or individual clusters, depending on which model is run) are homogeneous in fishing power. In the limit, this is never true, since each vessel is unique in its fishing power. This is a more tenable assumption for estimations for clusters based on differences in physical characteristics than for the fleet as a whole.

Adding explanatory variables to help account for differences in fishing power is only a partial help to alleviate this problem, since it requires the assumption that the only relevant differences in fishing power are those which are captured by the additional explanatory variables.

Simple Simulation

Once response functions are estimated, and the preferred form selected, they can be used to simulate changes in gross earnings and net cash flow which result from changes in effort induced by policy changes, regulatory changes, resource changes, etc. This is done by using the estimated functions to develop Net Cash Flow functions and Average Cost functions.

The fishing time function, with fishing hours dependent and operating hours independent, is used, where necessary, to express gross earnings as a function of operating hours. The Net Cash Flow function is simply this gross earnings-operating hours function less the cost curve, the cost-operating hours function. This Net Cash Flow function relates changes in net cash flow to changes in operating hours (effort). It could as easily be expressed as a function of fishing hours, of course, provided the fishing time function had an easily solved-for inverse.

Algebraically, from (3) and (6), we have:

$$FOIGRS = h(m(OPRHRS)) = p(OPRHRS) \qquad (7)$$

Using (1) and (7), the Net Cash Flow (NCF) function is defined as:

$$NCF = FOIGRS - OWNCST = p(OPRHRS) - f(OPRHRS).$$

The NCF function is useful, because it permits prediction of the changes in gross earnings, out-of-pocket harvesting costs, and net cash flow which accompany changes in fishing effort. Thus, if the effects of various policies on fishing effort can be established, the Net Cash Flow function allows for prediction of the possible consequences for gross income and net cash flow of fishermen, given conditions prevailing in 1981.

The Average Cost response function is defined here to be a function relating average cost per unit gross earnings to gross earnings. It is obtained by dividing the cost-operating hours function by the gross earnings-operating hours function to obtain an expression relating cost per unit gross earnings to operating hours. The gross earnings-operating hours function is inverted to obtain operating hours as a function of gross earnings. This is substituted into the average cost per unit gross earnings-operating hours function to obtain the desired relation between average cost per unit gross earnings and gross earnings. This expression easily identifies the net cash flow at various levels of gross earnings, and can be used to determine the breakeven point.

The Average Cost response (AC_R) function is derived as follows:

From (1) and (7), we can write:

$$\frac{OWNCST}{FOIGRS} = \frac{f(OPRHRS)}{p(OPRHRS)} = q(OPRHRS). \qquad (8)$$

Equation (7) can be inverted to derive the relationship between gross earnings and operating hours:

$$OPRHRS = p^{-1}(FOIGRS). \qquad (9)$$

Substituting (9) into (8), we arrive at the Average Cost response (AC_R) function:

$$AC_R = q(p^{-1}(FOIGRS)) = r(FOIGRS).$$

RESULTS AND DISCUSSION

The cluster analysis results are shown in Table 2. For each fishery, two or three groups were chosen based on the following vessel characteristics: keel length, gross tonnage, main engine horsepower, year built, and market value of the vessel, its electronics, and fishing equipment. For the drift gillnet

TABLE 2. Results of the Cluster Analysis

DRIFT GILLNET FISHERY

Cluster		Keel Length	Gross Tonnage	Main Engine Horsepower	Year Built	Vessel Market Value
1	Mean	37	17	225	1976	119,349
(50 vessels)	Std.dev.	3	5	91	5	42,007
2	Mean	32	9	176	1967	54,344
(109 vessels)	Std.dev.	3	3	79	12	21,115
Mean Squares:	Between	480	1,745	33,098	2,199	83,251
:	Within	11	19	7,170	107	1,257
F-Ratio		42.3	92.3	4.6	20.5	66.2
P-Value		0.0	0.0	0.011	0.0	0.0

HAND TROLL FISHERY

Cluster		Keel Length	Gross Tonnage	Main Engine Horsepower	Year Built	Vessel Market Value
1	Mean	31	9	128	1960	29,377
(66 vessels)	Std.dev.	7	7	102	17	23,377
2	Mean	25	4	173	1969	14,434
(80 vessels)	Std.dev.	5	4	66	11	8,024
3	Mean	22	2	85	1964	9,642
(90 vessels)	Std.dev.	6	3	62	14	11,031
Mean Squares:	Between	506	982	200,243	1,480	2,807
:	Within	46	25	5,425	190	259
F-Ratio		11.0	40.0	36.9	7.8	10.8
P-Value		0.0	0.0	0.0	0.0	0.0

(continued)

TABLE 2. Results of the Cluster Analysis (continued)

POWER TROLL FISHERY

Cluster		Keel Length	Gross Tonnage	Main Engine Horsepower	Year Built	Vessel Market Value
1 (42 vessels)	Mean	45	32	182	1971	161,786
	Std.dev.	5	10	56	18	49,269
2 (70 vessels)	Mean	36	14	136	1966	70,471
	Std.dev.	5	6	42	10	29,630
3 (79 vessels)	Mean	37	13	100	1934	47,329
	Std.dev.	5	7	29	13	19,765
Mean Squares:	Between	655	3,914	55,630	17,878	98,861
:	Within	31	76	2,077	236	1,909
F-Ratio		21.5	51.4	26.8	75.7	51.8
P-Value		0.0	0.0	0.0	0.0	0.0

PURSE SEINE FISHERY

Cluster		Keel Length	Gross Tonnage	Main Engine Horsepower	Year Built	Vessel Market Value
1 (20 vessels)	Mean	53	65	338	1977	556,300
	Std.dev.	4	13	65	3	127,354
2 (40 vessels)	Mean	52	39	294	1954	274,289
	Std.dev.	4	8	94	16	75,838
3 (42 vessels)	Mean	46	27	184	1941	155,782
	Std.dev.	4	6	48	21	52,360
Mean Squares:	Between	360	5,453	138,805	4,390	544,940
:	Within	18	156	7,802	362	17,800
F-Ratio		20.3	35.0	17.8	12.1	30.6
P-Value		0.0	0.0	0.0	0.0	0.0

fishery, two groups resulted, one composed of vessels with mean keel length 37 feet, the other containing vessels with mean keel length 32 feet, and so forth. Market value, tonnage, and age seemed to provide most of the discrimination between vessels, although engine horsepower was particularly important in the hand troll fishery, and keel length was a strong factor in the drift gillnet and purse seine fisheries. The F-statistics should not be viewed as tests of significance per se, since the groups are empirically determined, but they are good indicators of the discriminatory power of the cluster variables.

The next twelve tables present baseline data for each of the four fisheries. Tables 3 to 5 concern the drift gillnet fishery, 6 to 8 are for the hand troll fishery, 9 to 11 detail the power troll fishery, and 12 to 14 cover the purse seine fishery. For each fishery, data are provided on the characteristics of vessels, investment, costs, earnings, and effort, both for the fishery as a whole and for the groups identified in the cluster analysis.

A not-too-surprising pattern emerges: each fishery is characterized by a segment which maintain high investment in the fishery, has higher costs of doing business, and produces more, with one or more segments (usually larger) of vessels which are less competitive. These groups of vessels within the fishery may differ in their cost structure, their productivity, or both. The differences in physical characteristics of vessels, which are the basis for definition of the groups, are probably responsible in large measure for the observed differences in costs and earnings.

The drift gillnet fishery is typical. Cluster 1 consists of vessels which are larger, newer, higher-powered, and more expensive than the vessels of cluster 2. They grossed more, had higher costs of operation, and a higher net cash flow. In the short run, cluster 1 vessels were more profitable since they had higher net cash flows, based on the 1981 season's results. However, when depreciation on the hull and opportunity costs are factored in, the longer-term profitability picture changes. Both groups of vessels have a negative return to labor and management, but the return to labor and management of group 1 vessels is more negative. To further underscore the point, those returns to labor and management represent the efforts of 1.45 persons, on the average, for group 1 vessels, while only 1.24 persons worked for the returns to group 2 vessels. The greater amount of unpaid labor used in group 1 vessels probably explains the fact that labor costs for those vessels were slightly lower.

The pattern is similar for hand troll, where there are three clusters of vessels. Here, group 1 vessels earned the greatest amount, and were the only segment of the fleet to have a positive net cash flow, on average. Group 2 and Group 3 vessels earned a lower amount, but group 2 vessel operators had substantially higher out-of-pocket costs and held a larger investment in the fishery, so their economic performance was considerably poorer. In fact, the lower-producing, lower-cost group 3 vessels achieved the best return to labor and management in the fishery. It is not surprising that hand trollers reported the highest nonfishing incomes of any gear group.

The power troll fishery illustrates the concern over assessing opportunity costs. Here, with a 5 percent opportunity cost of capital, which reflects the assumption that the fishing investment is less liquid, the fishery-wide return

TABLE 3. Characteristics of Vessels, Equipment, and Investment in the 1981 Southeast Alaska Drift Gillnet Fleet

	Mean Values		
	Whole Fleet (159 vessels)	Cluster 1 (50 vessels)	Cluster 2 (109 vessels)
VESSEL CHARACTERISTICS			
Keel Length (ft.)	34	37	32
Gross Tonnage	12	17	9
Year Built	1970	1976	1967
Main Engine Horsepower (hp)	192	225	176
Type of Engine:			
Diesel (%)	66.9	58.1	71.0
Gas inboard (%)	33.1	41.9	29.0
Fuel Consumption Rates:			
While running (gal/hr)	5.69	7.00	5.07
While fishing (gal/hr)	2.31	2.85	2.03
Type of Hull:			
Wood (%)	35.6	37.5	34.7
Fiberglass (%)	59.7	60.4	59.4
Aluminum (%)	3.4	2.1	4.0
Other (%)	1.3	0.0	2.0
Hold Capacity (cubic feet)	212	317	161
Method of Holding Catch:			
Chilled seawater (slush ice)(%)	17.2	10.2	20.6
Refrigerated seawater (%)	0.7	0.0	1.0
Ice (%)	80.1	87.8	76.5
Other (%)	2.0	2.0	2.0
Usual Delivery Method:			
To a tender on the grounds (%)	72.2	68.9	73.8
To a shoreside plant (%)	27.8	31.1	26.2
ELECTRONICS CONFIGURATION			
Auto Pilot (number)	0.48	0.72	0.37
Radar (number)	0.93	0.98	0.91
Radios (number)	2.28	2.48	2.19
Loran (number)	0.13	0.28	0.06
Sidescan Sonar (number)	0.09	0.18	0.05
Fathometers:			
Paper recorder (number)	0.53	0.80	0.40
Flasher (number)	0.92	0.94	0.92
Other Electronics (number)	0.29	0.32	0.28
INVESTMENT			
Market Value of Fishing Gear ($)	15,310	19,569	13,263
Market Value of Electronics ($)	7,432	10,722	5,926
Market Value of Vessel, including Fishing Gear & Electronics ($)	75,180	119,349	54,344
Market Value of Limited Entry Permit ($)	43,000	43,000	43,000

TABLE 4. Fixed and Variable Costs of Operation in the 1981 Southeast Alaska Drift Gillnet Fishery

FIXED COSTS	Whole Fleet (159 vessels)	Cluster 1 (50 vessels)	Cluster 2 (109 vessels)
General (minor) vessel repairs and maintenance	$ 1,391	$ 1,488	$ 1,345
Major vessel repairs	1,594	1,611	1,587
Insurance	1,522	2,185	1,184
Moorage and gear storage	576	570	579
License and permit fees	296	342	274
Association dues	196	242	174
Fishing business expenses	1,697	2,169	1,468
Major equipment acquisition and replacement	2,459	2,557	2,415
Lease costs	551	102	758
Miscellaneous supplies	1,034	1,400	849
TOTAL FIXED COSTS OF VESSEL OPERATION	$11,316	$12,666	$10,633
PRORATED FIXED COSTS OF DRIFT GILLNETTING	$ 9,441	$ 9,613	$ 9,394

VARIABLE COSTS

1. Effort-Varying Costs

	Total Costs			Amount Per Man Paid by Crew		
	Whole Fleet	Cluster 1	Cluster 2	Whole Fleet	Cluster 1	Cluster 2
Food	$1,462	$1,786	$1,307	$ 78	$ 64	$ 85
Fuel	2,493	3,093	2,207	27	7	36
Ice	123	185	94	1	-0-	2
Gear repair	675	1,151	441	4	-0-	7
Aquaculture assessment	720	855	660	2	-0-	3
Other costs	459	397	489	18	-0-	26
TOTAL EFFORT-VARYING COSTS	$5,932	$7,467	$5,198	$130	$ 71	$158

2. Labor Costs	Whole Fleet	Cluster 1	Cluster 2
Total crew size (including skipper)	1.85	1.98	1.79
Number of upaid crew	0.31	0.45	0.24
Number of paid crew (excluding skipper)	0.54	0.53	0.55
Net crew wages	1,914	1,854	1,944
Net crew share (wages ÷ gross earnings)	0.156	0.131	0.169
Crew payment method:			
(Percent of gross earnings) less variable costs (%)	39.7	31.4	43.8
Percent of (gross earnings less variable costs) (%)	3.2	2.0	3.8
Other (%)	57.1	66.7	52.4

TABLE 5. Southeast Alaska Drift Gillnetters in 1981: Fishing Effort and Income from Fishing and Nonfishing Sources

THE SOUTHEAST ALASKA DRIFT GILLNET FISHERY	Whole Fleet (159 vessels)	Cluster 1 (50 vessels)	Cluster 2 (109 vessels)
Total vessel operating hours	741	759	732
Hours spent fishing	549	577	534
Days spent fishing	31	31	31
Gross Earnings	$ 22,761	$ 26,705	$ 20,975
Fixed Costs[a]	9,441	9,613	9,394
Effort Varying Costs	5,802	7,396	5,040
Labor Costs	1,914	1,854	1,944
Net Cash Flow	$ 5,604	$ 7,842	$ 4,597
Depreciation on Hull[a]	$ 765	$ 2,833	$ 435
Opportunity Cost of Capital[a]: 5%	4,930	6,161	4,300
: 10%	9,860	12,323	8,600
Return to Labor and Management:			
With 5% Opportunity Cost of Capital	-$ 91	-$ 1,152	-$ 138
With 10% Opportunity Cost of Capital	-$ 5,021	-$ 7,314	-$ 4,438
Number of Person Returns Accrue to	1.31	1.45	1.24
OTHER FISHERIES			
Vessel operating hours in other fisheries	126	149	111
Vessel gross earnings in other fisheries	$ 4,519	$ 8,481	$ 2,766
Earnings from crewing in other fisheries	$ 1,303	$ 1,439	$ 1,239
NONFISHING INCOME	$ 6,627	$ 7,326	$ 6,302

[a]Prorated based on ratio of vessel's power troll earnings to total earnings.

TABLE 6. Characteristics of Vessels, Equipment, and Investment in the Southeast Alaska Hand Troll Fleet

	Mean Values		
	Whole Fleet (236 vessels)	Cluster 1 (66 vessels)	Cluster 2 (80 vessels)
VESSEL CHARACTERISTICS			
Keel Length (ft.)	25	31	25
Gross Tonnage	5	9	4
Year Built	1965	1960	1969
Main Engine Horsepower (hp)	127	128	173
Type of Engine:			
Diesel (%)	66.0	32.3	82.8
Gas (%)	34.0	67.7	17.8
Fuel Consumption Rates:			
While running (gal/hr)	5.81	4.48	7.60
While fishing (gal/hr)	1.23	1.19	1.43
Type of Hull:			
Wood (%)	40.5	56.3	26.9
Fiberglass (%)	53.6	37.5	70.5
Aluminum (%)	4.5	4.7	1.3
Other (%)	1.4	1.6	1.3
Hold Capacity (cubic feet)	82	133	46
Method of Holding Catch:			
Chilled seawater (slush ice)(%)	15.8	7.9	13.9
Refrigerated seawater (%)	0.4	0.0	0.0
Ice (%)	82.5	92.1	84.8
Other (%)	1.3	0.0	1.3
Usual Delivery Method:			
To a tender on the grounds (%)	73.3	60.3	80.0
To a shoreside plant (%)	26.7	39.7	20.0
ELECTRONICS CONFIGURATION			
Auto Pilot (number)	0.09	0.18	0.07
Radar (number)	0.09	0.23	0.04
Radios (number)	1.48	1.74	1.65
Loran (number)	0.04	0.11	0.01
Sidescan Sonar (number)	0.01	0.03	0.
Fathometers:			
Paper recorder (number)	0.26	0.33	0.25
Flasher (number)	0.83	0.92	0.89
Other Electronics (number)	0.12	0.24	0.
INVESTMENT			
Market Value of Fishing Gear ($)	2,149	3,184	2,157
Market Value of Electronics ($)	1,401	2,236	1,297
Market Value of Vessel, including Fishing Gear & Electronics ($)	16,793	29,377	14,434
Market Value of Limited Entry Permit ($)	-0-	-0-	-0-

TABLE 7. Fixed and Variable Costs of Operation in the 1981 Southeast Alaska Hand Troll Fishery

FIXED COSTS	Whole Fleet (236 vessels)	Cluster 1 (66 vessels)	Cluster 2 (80 vessels	Cluster 3 (90 vessels
General (minor) vessel repairs and maintenance	$ 452	$ 516	$ 534	$ 341
Major vessel repairs	583	613	643	507
Insurance	327	744	233	110
Moorage and gear storage	176	228	184	130
License and permit fees	78	94	66	77
Association dues	11	8	16	9
Fishing business expenses	300	253	405	238
Major equipment acquisition and replacement	907	1,053	1,025	711
Lease costs	35	85	8	23
Miscellaneous supplies	312	396	222	332
TOTAL FIXED COSTS OF VESSEL OPERATION	$3,181	$3,990	$3,336	$2,478
PRORATED FIXED COSTS OF HAND TROLLING	$2,333	$2,559	$2,747	$1,916

VARIABLE COSTS

1. Effort-Varying Costs

	Total Cost				Amount Per Man Paid by Crew			
	Whole Fleet	Group* 1	Group 2	Group 3	Whole Fleet	Group 1	Group 2	Group 3
Food	$ 717	$1,015	$ 615	$ 592	$18	$27	-0-	$27
Fuel	986	1,067	1,185	754	18	34	-0-	22
Ice	166	213	147	148	1	3	-0-	2
Gear Repair	259	289	246	251	1	1	-0-	2
Aquaculture Assessment	147	209	109	133	1	1	-0-	3
Other costs	448	326	461	525	3	-0-	-0-	8
TOTAL EFFORT-VARYING COSTS	$2,723	$3,119	$2,763	$2,403	$42	$66	-0-	$64

2. Labor Costs

	Whole Fleet	Group* 1	Group 2	Group 3
Total crew size (including skipper)	1.56	1.72	1.61	1.40
Number of unpaid crew	0.28	0.37	0.31	0.18
Number of paid crew (excluding skipper)	0.28	0.35	0.30	0.22
Net crew wages	257	473	172	189
Net crew share (wages + gross earnings)	0.196	0.216	0.147	0.205
Crew payment method:				
(Percent of gross earnings) less variable costs	34.6	41.5	37.5	27.0
Percent of (gross earnings less variable costs)	2.6	1.5	1.3	4.5
Other	62.8	56.9	61.3	68.5

*Cluster

TABLE 8. Southeast Alaska Hand Trollers in 1981: Fishing Effort and Income from Fishing and Nonfishing Sources

THE SOUTHEAST ALASKA HAND TROLL FISHERY	Whole Fleet (236 vessels)	Cluster 1 (66 vessels)	Cluster 2 (80 vessels)	Cluster 3 (90 vessels)
Total vessel operating hours	620	574	725	557
Hours spent fishing	504	483	560	467
Days spent fishing	44	41	48	43
Gross Earnings	$ 4,682	$ 6,253	$ 3,912	$ 4,187
Fixed Costs[a]	2,333	2,559	2,747	1,916
Effort Varying Costs	2,681	3,053	2,763	2,339
Labor Costs	257	473	172	189
Net Cash Flow	-$ 589	$ 168	-$ 1,770	-$ 257
Depreciation on Hull[a]	$ 180	$ 335	$ 288	$ 129
Opportunity Cost of Capital[a]: @ 5%	616	942	594	373
: @10%	1,232	1,885	1,188	746
Return to Labor and Management:				
With 5% Opportunity Cost of Capital	-$ 1,385	-$ 1,109	-$ 2,652	-$ 759
With 10% Opportunity Cost of Capital	-$ 2,001	-$ 2,052	-$ 3,246	-$ 1,132
Number of Persons Returns Accrue to	1.28	1.37	1.31	1.18
OTHER FISHERIES				
Vessel operating hours in other fisheries	54	116	27	38
Vessel gross earnings in other fisheries	$ 1,701	$ 3,495	$ 838	$ 1,227
Earnings from crewing in other fisheries	$ 484	$ 483	$ 426	$ 538
NONFISHING INCOME	$10,859	$ 8,701	$14,410	$ 9,441

a Prorated based on ratio of vessel's hand troll earnings to total earnings.

TABLE 9. Characteristics of Vessels, Equipment, and Investment in the Southeast Alaska Power Troll Fleet

	Mean Values			
	Whole Fleet (191 vessels)	Cluster 1 (42 vessels)	Cluster 2 (70 vessels)	Cluster (79 vesse
VESSEL CHARACTERISTICS				
Keel Length (ft.)	38	45	36	37
Gross Tonnage	18	32	14	13
Year Built	1954	1971	1966	1934
Main Engine Horsepower (hp)	130	182	136	100
Type of Engine:				
Diesel (%)	95.1	100	95.5	92.1
Gas inboard (%)	4.9	-0-	4.5	7.9
Fuel Consumption Rates:				
While running (gal/hr)	3.73	4.75	3.71	3.21
While fishing (gal/hr)	1.28	1.70	1.20	1.11
Type of Hull:				
Wood (%)	67.7	17.5	61.5	100
Fiberglass (%)	28.4	67.5	36.9	-0-
Steel (%)	3.8	15.0	1.5	-0-
Hold Capacity (cubic feet)	463	796	353	364
Method of Holding Catch:				
Chilled seawater (slush ice)(%)	6.8	4.8	5.7	8.9
Ice (%)	86.4	73.8	91.4	88.6
Other (%)	6.8	21.4	2.9	2.5
Usual Delivery Method:				
To a tender on the grounds (%)	77.2	90.2	75.0	72.2
To a shoreside plant (%)	17.5	9.8	16.1	22.8
Other (%)	5.3	0.0	8.8	5.1
ELECTRONICS CONFIGURATION				
Auto Pilot (number)	0.79	0.95	0.83	0.68
Radar (number)	0.82	1.00	0.84	0.71
Radios (number)	2.74	3.07	2.80	2.52
Loran (number)	0.57	0.83	0.61	0.39
Sidescan Sonar (number)	0.06	0.07	0.09	0.03
Fathometers:				
Paper recorder (number)	0.81	0.86	0.87	0.72
Flasher (number)	0.97	0.95	0.99	0.96
Other Electronics (number)	0.59	0.67	0.57	0.56
INVESTMENT				
Market Value of Fishing Gear ($)	7,901	10,770	8,263	5,904
Market Value of Electronics ($)	7,218	11,248	7,231	4,979
Market Value of Vessel, including Fishing Gear & Electronics ($)	81,759	161,786	70,471	47,329
Market Value of Limited Entry Permit ($)	28,000	28,000	28,000	28,00

TABLE 10. Fixed and Variable Costs of Operation in the 1981 Southeast Alaska Power Troll Fishery

FIXED COSTS	Whole Fleet (191 Vessels)	Cluster 1 (42 vessels)	Cluster 2 (70 vessels)	Cluster 3 (79 vessels)
General (minor) vessel repairs and maintenance	$ 1,449	$ 1,595	$1,302	$1,496
Major vessel repairs	1,087	903	920	1,338
Insurance	1,943	3,154	1,851	1,309
Moorage and gear storage	471	587	424	450
License and permit fees	341	388	265	380
Association dues	219	267	205	206
Fishing business expenses	1,667	2,370	1,349	1,555
Major equipment acquisition and replacement	2,309	2,080	3,037	1,813
Lease costs	-0-	-0-	-0-	-0-
Miscellaneous supplies	1,153	1,082	1,040	1,279
TOTAL FIXED COSTS OF VESSEL OPERATION	$ 10,639	$12,426	$10,393	$9,826
PRORATED FIXED COSTS OF POWER TROLLING	$ 9,150	$ 9,257	$ 8,683	$9,517

VARIABLE COSTS

1. Effort-Varying Costs

	Total Cost				Amount Per Man Paid by Crew			
	Whole Fleet	Group* 1	Group 2	Group 3	Whole Fleet	Group 1	Group 2	Group 3
Food	$1,903	$2,011	$1,994	$1,768	18	$ 5	-0-	$40
Fuel	2,784	3,733	2,751	2,241	15	26	-0-	22
Ice	606	582	600	625	6	4	-0-	13
Gear Repair	767	770	833	706	1	-0-	-0-	2
Aquaculture Assessment	751	833	761	699	7	4	7	8
Other costs	917	581	713	1,271	-0-	-0-	-0-	-0-
TOTAL EFFORT-VARYING COSTS	$7,728	$8,510	$7,652	$7,310	$47	$39	$ 7	$85

2. Labor Costs	Whole Fleet	Group* 1	Group 2	Group 3
Total crew size (including skipper)	1.97	2.20	1.92	1.90
Number of unpaid crew	0.41	0.40	0.38	0.43
Number of paid crew (excl. skipper)	0.57	0.80	0.54	0.47
Net crew wages	2,240	3,469	2,067	1,708
Net crew share (wages + gross earnings)	0.150	0.145	0.151	0.151
Crew payment method:				
(Percent of gross earnings) less variable costs (%)	58.1	64.3	57.1	55.7
Percent of (gross earnings less variable costs) (%)	1.6	2.4	0.0	2.5
Other (%)	40.3	33.3	42.9	41.8

*Cluster

TABLE 11. Southeast Alaska Power Trollers in 1981: Fishing Effort and Income from Fishing and Nonfishing Sources

THE SOUTHEAST ALASKA POWER TROLL FISHERY	Whole Fleet (191 vessels)	Cluster 1 (42 vessels)	Cluster 2 (70 vessels)	Cluster 3 (79 vessels)
Total vessel operating hours	1,044	1,084	969	1,071
Hours spent fishing	812	810	800	857
Days spent fishing	68	70	64	72
Gross Earnings	$25,773	$29,789	$25,118	$23,965
Fixed Costs[a]	9,150	9,257	8,683	9,517
Effort Varying Costs	7,681	8,471	7,645	7,225
Labor Costs	2,240	3,469	2,067	1,708
Net Cash Flow	$ 6,608	$ 8,592	$ 6,723	$ 5,515
Depreciation on Hull[a]	$ 728	$ 1,625	$ 304	$ 154
Opportunity Cost of Capital[a]: @ 5%	4,720	7,070	4,114	3,648
: @10%	9,440	14,139	8,227	7,296
Return to Labor and Management:				
With 5% Opportunity Cost of Capital	$ 1,207	-$ 103	$ 2,305	$ 1,713
With 10% Opportunity Cost of Capital	-$ 3,513	-$ 7,172	-$ 1,808	-$ 1,935
Number of Persons Returns Accrue to	1.41	1.40	1.38	1.43
OTHER FISHERIES				
Vessel operating hours in other fisheries	49	143	37	9
Vessel gross earnings in other fisheries	$ 4,193	$10,196	$ 4,945	$ 777
Earnings from crewing in other fisheries	$ 295	$ 717	$ 164	$ 194
NONFISHING INCOME	$ 7,297	$ 9,164	$ 7,107	$ 6,591

a/ Prorated based on ratio of vessel's power troll earnings to total earnings.

TABLE 12. Characteristics of Vessels, Equipment, and Investment in the Southeast Alaska Purse Seine Fleet

	Mean Values			
	Whole Fleet (102 vessels)	Cluster 1 (20 vessels)	Cluster 2 (40 vessels)	Cluster 3 (42 vessels
VESSEL CHARACTERISTICS				
Keel Length (ft.)	50	53	52	46
Gross Tonnage	40	65	39	27
Year Built	1954	1977	1954	1941
Main Engine Horsepower (hp)	262	338	294	184
Type of Engine:				
Diesel (%)	100	100	100	100
Fuel Consumption Rates:				
While running (gal/hr)	9.80	13.77	10.18	7.31
While fishing (gal/hr)	5.47	8.75	5.29	3.70
Type of Hull:				
Wood (%)	65.9	5.0	73.7	87.5
Fiberglass (%)	14.1	35.0	7.9	10.0
Steel (%)	19.0	60.0	15.8	2.5
Hold Capacity (cubic feet)	1,439	1,976	1,322	999
Method of Holding Catch:				
Chilled seawater (slush ice)(%)	47.6	25.0	50.0	56.1
Refrigerated seawater (%)	17.7	60.0	12.5	2.4
Ice (%)	28.8	5.0	32.5	36.6
Other (%)	5.9	10.0	5.0	4.9
Usual Delivery Method:				
To a tender on the grounds (%)	81.3	40.0	87.5	95.1
To a shoreside plant (%)	13.7	50.0	10.0	-0-
Other (%)	5.0	10.0	2.5	4.9
ELECTRONICS CONFIGURATION				
Auto Pilot (number)	0.67	0.90	0.75	0.41
Radar (number)	0.99	1.00	1.00	0.98
Radios (number)	2.97	3.40	3.10	2.56
Loran (number)	0.34	0.80	0.28	0.15
Sidescan Sonar (number)	0.26	0.65	0.17	0.12
Fathometers:				
Paper recorder (number)	0.77	0.95	0.78	0.63
Flasher (number)	0.89	0.90	0.82	0.95
Other Electronics (number)	0.27	0.90	0.10	0.10
INVESTMENT				
Market Value of Fishing Gear ($)	66,504	76,645	80,923	48,638
Market Value of Electronics ($)	12,818	28,660	9,986	6,463
Market Value of Vessel, including Fishing Gear & Electronics ($)	290,640	556,300	274,289	155,782
Market Value of Limited Entry Permit ($)	37,000	37,000	37,000	37,000

TABLE 13. Fixed and Variable Costs of Operation in the 1981 Southeast Alaska Purse Seine Fishery

FIXED COSTS	Whole Fleet (102 vessels)	Cluster 1 (20 vessels)	Cluster 2 (40 vessels)	Cluster 3 (42 vessels)
General (minor) vessel repairs and maintenance	$ 3,809	$ 5,237	$ 3,980	$ 2,611
Major vessel repairs	4,805	6,258	5,321	3,059
Insurance	6,483	12,305	5,979	3,496
Moorage and gear storage	931	1,041	1,224	515
License and permit fees	683	705	780	556
Association dues	417	553	481	297
Fishing business expenses	2,633	2,284	3,453	1,836
Major equipment acquisition and replacement	7,803	12,128	5,806	7,053
Lease costs	6,303	4,550	6,216	7,491
Miscellaneous supplies	1,747	2,955	1,057	1,659
TOTAL FIXED COSTS OF VESSEL OPERATION	$35,614	$48,016	$34,297	$28,573
PRORATED FIXED COSTS OF PURSE SEINING	$27,002	$32,481	$25,949	$24,293

VARIABLE COSTS

1. Effort-Varying Costs

	Total Cost				Amount Per Man Paid by Crew			
	Whole Fleet	Group* 1	Group 2	Group 3	Whole Fleet	Group 1	Group 2	Group 3
Food	$ 3,407	$ 3,652	$ 3,623	$ 3,167	$ 590	$ 609	$ 710	$ 486
Fuel	6,744	9,275	7,039	5,059	772	1,248	811	509
Ice	190	104	297	125	5	5	4	6
Gear Repair	3,502	4,425	3,954	2,409	5	-0-	-0-	11
Aquaculture Assessment	3,194	4,462	3,262	2,525	353	447	438	238
Other costs	206	254	228	147	21	65	6	8
TOTAL EFFORT-VARYING COSTS	$17,243	$22,172	$18,403	$13,432	$1,746	$2,374	$1,969	$1,258

2. Labor Costs

	Whole Fleet	Group* 1	Group 2	Group 3
Total crew size (including skipper)	5.86	5.89	5.95	5.78
Number of unpaid crew	0.08	0.05	0.05	0.12
Number of paid crew (excluding skipper)	4.78	4.83	4.90	4.66
Net crew wages	9,801	12,184	9,608	8,438
Net crew share (wages ÷ gross earnings)	0.087	0.084	0.090	0.102
Crew payment method:				
(Percent of gross earnings) less variable costs (%)	42.1	55.0	45.0	33.3
Percent of (gross earnings less variable costs)(%)	45.1	35.0	42.5	52.4
Other (%)	12.8	10.0	12.5	14.3

*Cluster

TABLE 14. Southeast Alaska Purse Seiners in 1981: Fishing Effort and Income from Fishing and Nonfishing Sources

THE SOUTHEAST ALASKA PURSE SEINE FISHERY	Whole Fleet (102 vessels)	Cluster 1 (20 vessels)	Cluster 2 (40 vessels)	Cluster 3 (42 vessels)
Total vessel operating hours	862	862	950	836
Hours spent fishing	408	459	439	441
Days spent fishing	27	27	27	27
Gross Earnings	$107,114	$144,683	$106,933	$ 82,870
Fixed Costs[a]	27,002	32,481	25,949	24,293
Effort Varying Costs	8,897	10,706	8,755	7,600
Labor Costs	46,849	58,849	47,079	39,321
Net Cash Flow	$ 24,366	$ 42,647	$ 25,150	$ 11,656
Depreciation on Hull[a]	$ 2,182	$ 5,486	$ 1,199	$ 866
Opportunity Cost of Capital[a]: @ 5%	12,421	20,068	11,777	8,195
: @10%	24,841	40,135	23,553	16,390
Return to Labor and Management:				
With 5% Opportunity Cost of Capital	$ 9,763	$ 17,093	$ 12,174	$ 2,595
With 10% Opportunity Cost of Capital	-$ 2,657	-$ 2,974	$ 398	-$ 5,600
Number of Persons Returns Accrue to	1.08	1.05	1.05	1.12
OTHER FISHERIES				
Vessel operating hours in other fisheries	280	604	227	174
Vessel gross earnings in other fisheries	$ 34,162	$ 69,196	$ 34,400	$ 14,600
Earnings from crewing in other fisheries	$ 1,965	$ 1,025	$ 2,328	$ 1,934
NONFISHING INCOME	$ 4,248	$ 1,895	$ 3,305	$ 7,177

a Prorated based on ratio of vessel's purse seine earnings to total earnings.

to labor and management is positive. Assuming greater liquidity and using a 10 percent rate, the return to labor and management is negative. The calculations for the purse seine fishery reflect the same phenomenon. The purse seine fishery, incidentally, shows a far lower incidence of unpaid labor than do the troll and drift gillnet fisheries.

The hull depreciation figures used in the determination of net income are likely far lower than what would be claimed for tax purposes. They are derived from regressions explaining hull value as a function of physical characteristics, including the year built. (The depreciation modes are presented in Appendix Tables A.1, A.4, A.7, and A.10.) By controlling for other characteristics, the effect on hull market value of age can be isolated. This hull depreciation is only part of the total depreciation: the other component is the depreciation of fishing equipment and electronics, which is well represented by fishery average, or cluster average, expenditures for major equipment acquisition and replacement, as discussed earlier. A comparison of the two depreciation categories shows that the rate of depreciation for fishing equipment and electronics, as a percentage of their total value, is substantially higher than the depreciation rate for vessel hulls. This is an expected result, since useful lives of fishing equipment and electronics are shorter than those of vessels, and the replacement cost of vessels has been rising rapidly in recent years, so that depreciation of the hull through wear and tear may be somewhat offset by a general appreciation in the hull investment.

Since the depreciation figures used in the income tables are predicted from different statistical models for the whole fishery and each of the clusters separately, depreciation values for the clusters do not necessarily average out to be the same as the depreciation values for the whole fishery. In the drift gillnet fishery, this results in the fishery-wide return to labor and management (with 5 percent opportunity cost of capital) being slightly higher than, rather than between, the values for each of the two clusters.

The estimates of permit market values were provided by the Commercial Fisheries Entry Commission, based on permit transactions which took place in 1981.

The income breakdowns for other fisheries incidental to the fishery of interest must be viewed with some caution. We have no estimates of operational costs which were incurred in these other fisheries, which would offset the gross earnings. The accounting is incomplete, also, because it omits gross and net earnings an individual received while operating a different vessel. Thus, it would not be appropriate to add the incomes from other fisheries which are itemized in the income tables to the net cash flow from the fishery of interest, and conclude that a net fishing income from all fisheries would result.

Appendix Tables A.1 to A.12 present the results of the econometric estimation, for each of the four fisheries in turn. Generally, the resulting gross earnings/effort response, cost/effort response, and depreciation functions are quite good, in that they have the correct signs and are significant. Student's-t statistics are in parentheses under the regression coefficients, and p-values (probability of a type-I error) are in parentheses under the F-statistics. The depreciation functions for each fishery have the correct signs in almost all cases and the age variable is particularly significant in most cases. An exception is the purse seine fishery, where the depreciation functions for two of the three clusters were insignificant, though the depreciation function for the whole fishery was quite good.

The gross earnings/effort response functions are hypothesized to have positive signs, with a coefficient between zero and one for the power functions, first derivatives, and negative second derivatives. The average gross earnings/effort response functions (GRPUE dependent) should, therefore, have negative signs on effort. The gross earnings/effort response functions all had the correct sign, though in some cases the coefficient on power functions was greater than one; this implies increasing marginal returns, rather than decreasing marginal returns. While this is not implausible, economic theory suggests that this is not a stable relationship. If some vessel owners are achieving increasing returns in their production, we would expect them to apply more effort in the future, if it were possible given the regulatory environment, until they reach a range of decreasing marginal returns.

The estimated cost/effort response functions were all consistent with the *a priori* hypothesis, that the total cost function should have a positive first derivative. The second derivative of the total cost function is a bit more ambiguous. A negative second derivative implies a declining average cost, consistent with the achievement of economies of scale. However, unconstrained by regulation or resource constraints, vessels would not be expected to operate in that range of their cost curve over the longer term. A positive second derivative implies increasing average cost, which is more likely the range of average cost in which vessels would operate if they were unconstrained.

The estimated total cost/effort response functions all had negative second derivatives, and the average cost functions had negative first derivatives, consistent with the first case just discussed. This may not be particularly surprising, given the capacity represented by the Southeast Alaska salmon fleets and the fact that the marginal cost of additional effort is probably quite low.

These simple univariate functions explain a fairly large proportion of the variation in the dependent variables, particularly in the troll fleets. The different coefficients of the equations for different clusters suggest that, in fact, vessels within a fishery have different cost structures and productivity.

The purse seine fishery is an example of how segregating the fleet improves the estimation of the production and cost relationships. In this fishery, the whole fleet model did poorly compared with results of the separate cluster models, particularly on the production side.

The estimated relationships were used to derive Net Cash Flow and Average Cost response functions, which can be used for prediction. These are presented in Appendix Tables A.13 to A.16, and are the basis for simulation of how earnings of fishermen may change as their effort changes. The net cash flow functions are simply the gross earnings response less the cost response function, where a single effort variable (OPRHRS) is used to relate earnings and cost. The average cost response (AC_R) functions relate the cost: earnings ratio to the level of earnings.

The simple functional forms used for estimation of the earnings and cost response functions result in AC_R functions that are either increasing-cost or decreasing-cost over their range. The AC_R functions for cluster 1 of the drift gillnet fishery, and for the drift gillnet fishery as a whole, are increasing-cost, while the average cost of production functions estimated for all the other fisheries and clusters are decreasing cost.

The comments made earlier about the estimation of cost response functions apply here as well. The average cost response functions for cluster 1 of the drift gillnet fishery and the whole drift gillnet fishery are consistent with profit maximization. The average cost response functions for the other fisheries and clusters are consistent with an industry which is declining-cost over the range of observation, and which has not been able to achieve profit maximization because of resource conditions, industry conditions and regulation, or both.

The models for drift gillnet cluster 1 and the whole drift gillnet fishery indicate that these vessels are all profitable (in the sense of having positive net cash flows) over the range of observed data. Thus, no breakeven point (BEP) can be calculated because if occurs outside the range of sample data. For the other models, however, BEP occurs within the range of sample data and can be calculated. These breakeven points, where gross earnings exceeds out-of-pocket expense, are presented along with the net cash flow and average cost of production functions.

While the functional forms used in estimation have generally desirable properties for modeling economic performance, as in any model they are less reliable when extrapolations beyond the range of sample data are made. An example is the power function used to estimate a total cost curve. The power function intersects the origin, which, when used for estimation of cost functions, seems to imply that there are no fixed costs of operation. This is an extrapolation beyond the reasonable lower limit of the function, which should be one unit of effort (at effort greater than or equal to one unit, the function models fixed costs adequately). In fact, actual sample data ranges (given in Tables 15 to 18) indicate that the lowest observed effort levels were 24 operating hours in the hand troll fishery, 40 in the power troll fishery, 100 in the drift gillnet fishery, and 300 in the purse seine fishery. This comment is intended primarily as a caution when the Net Cash Flow or Average Cost response functions are used for predictive purposes.

To examine some of the implications of these functions which were just estimated and derived, the predictions of the net cash flow models at the extrema and means of sample fishing effort were examined. These are found in Tables 15 to 18. Referring to the drift gillnet fishery in Table 15, the model for the whole fishery predicts that gross earnings for drift gillnet vessels varied from $15,900 to $33,800, total out-of-pocket cost varied from $8,200 to $22,300, and net cash flow ranged from a low of $7,600 to a high of $11,500, with a mean of $10,300.

TABLE 15. Predicted Economic Performance of the Drift Gillnet Fleet at Various Levels of Effort

Effort Level	Performance Indicator	Whole Fishery Model	Cluster 1 Model	Cluster 2 Model
Lowest in Sample	Operating Hours	100	225	100
	Total Revenue	$15,973	$21,436	$ 9,325
	Total Cost	$ 8,177	$11,806	$ 7,637
	Net Cash Flow	$ 7,616	$ 9,630	$ 1,688
Mean for Sample	Operating Hours	741	759	732
	Total Revenue	$26,256	$25,316	$19,839
	Total Cost	$15,972	$18,854	$14,514
	Net Cash Flow	$10,284	$ 6,462	$ 5,325
Highest in Sample	Operating Hours	2,000	1,700	2,000
	Total Revenue	$33,782	$28,269	$29,045
	Total Cost	$22,259	$25,719	$20,073
	Net Cash Flow	$11,523	$ 2,550	$ 8,972

TABLE 16. Predicted Economic Performance of the Hand Troll Fleet at Various Levels of Effort

Effort Level	Performance Indicator	Whole Fishery Model	Cluster 1 Model	Cluster 2 Model	Cluster 3 Model
Lowest in Sample	Operating Hours	24	30	29	24
	Total Revenue	$ 135	$ 185	$ 163	$ 134
	Total Cost	$ 1,625	$ 2,097	$ 1,843	$ 1,438
	Net Cash Flow	-$ 1,490	-$ 1,912	-$ 1,680	-$ 1,304
Mean for Sample	Operating Hours	620	574	725	557
	Total Revenue	$ 3,575	$ 4,676	$ 3,292	$ 2,942
	Total Cost	$ 5,568	$ 6,466	$ 5,455	$ 5,038
	Net Cash Flow	-$ 1,993	-$ 1,790	-$ 2,163	-$ 2,096
Highest in Sample	Operating Hours	3,000	2,000	3,000	1,582
	Total Revenue	$ 17,531	$18,307	$12,400	$ 8,199
	Total Cost	$ 10,114	$10,410	$ 8,806	$ 7,639
	Net Cash Flow	$ 7,417	$ 7,897	$ 3,594	$ 560

TABLE 17. Predicted Economic Performance of the Power Troll Fleet at Various Levels of Effort

Effort Level	Performance Indicator	Whole Fishery Model	Cluster 1 Model	Cluster 2 Model	Cluster 3 Model
Lowest in Sample	Operating Hours	40	324	60	40
	Total Revenue	$ 716	$ 6,543	$ 765	$ 1,437
	Total Cost	$ 2,178	$17,568	$ 2,240	$ 6,277
	Net Cash Flow	-$ 1,462	-$11,025	-$ 1,475	-$ 4,840
Mean for Sample	Operating Hours	1,044	1,121	943	1,059
	Total Revenue	$ 23,546	$29,746	$21,519	$21,755
	Total Cost	$ 16,388	$22,534	$17,614	$16,683
	Net Cash Flow	$ 7,158	$ 7,212	$ 3,905	$ 5,072
Highest in Sample	Operating Hours	2,750	2,750	2,000	2,100
	Total Revenue	$ 66,415	$88,901	$53,505	$38,386
	Total Cost	$ 29,838	$26,978	$30,925	$20,464
	Net Cash Flow	$ 36,577	$61,923	$22,580	$17,922

TABLE 18. Predicted Economic Performance of the Purse Seine Fleet at Various Levels of Effort

Effort Level	Performance Indicator	Whole Fishery Model	Cluster 1 Model	Cluster 2 Model	Cluster 3 Model
Lowest in Sample	Operating Hours	300	400	375	300
	Total Revenue	$54,563	$127,872	$83,768	$24,942
	Total Cost	$60,655	$ 93,764	$68,895	$43,928
	Net Cash Flow	-$ 6,092	$ 34,108	$14,873	-$18,985
Mean for Sample	Operating Hours	862	871	963	774
	Total Revenue	$87,121	$143,935	$110,384	$59,454
	Total Cost	$73,835	$106,128	$ 80,265	$63,480
	Net Cash Flow	$13,286	$ 37,807	$ 30,119	-$ 4,026
Highest in Sample	Operating Hours	2,000	1,200	1,700	2,000
	Total Revenue	$126,524	$151,122	$130,351	$141,921
	Total Cost	$ 86,368	$111,682	$ 88,003	$ 91,788
	Net Cash Flow	$ 40,156	$ 39,440	$ 42,348	$ 50,133

This model does not predict mean net cash flow very well, when compared with Table 5, primarily because it overestimates gross earnings by some $3,500. The models for individual clusters are better in terms of their predictions of mean net cash flow, though the cluster 1 model is somewhat peculiar since it predicts that cash flow decreases with increasing effort (implying that variable costs are not being met). The results of the separate cluster models suggest that gross earnings in the fishery range from $9,300 to $29,000, total costs in the fishery ranged from $7,600 to $25,700, and net cash flow ranged from $1,688 to $9,630.

It should be emphasized that the predictions of economic performance at mean sample effort in Tables 15 to 18 cannot be compared directly with actual sample results in Tables 5, 8, 11, and 14. The reason is that the economic performance models are nonlinear and involve transformations of the cost, earnings, and effort variables; the means for untransformed variables do not coincide with the means of transformed variables. If the models were linear, we would expect that a perfect model would predict the same levels of costs and earnings at mean sample effort as these actually observed; this is not the case with nonlinear models. Thus, the comparisons between model predictions and actual sample results at mean effort levels are only approximate.

The whole fishery model and cluster models are similar in the hand troll fishery. The whole fishery predicts a mean net cash flow of -$2,000, while the mean net cash flows predicted for the individual clusters range from -$1,800 to -$2,200. There appears to be a slight downward bias in the production functions at the mean effort level.

In the power troll fishery, the whole fishery model predicts gross earnings ranging from $700 to $30,000, while individual cluster models predict gross earnings ranging from $800 to $89,000. Net cash flows range from -$1,500 to $37,000 in the whole fishery model, and is $7,200 at the mean effort level, while individual cluster models predict cash flows ranging from -$11,000 to $62,000, with predictions at mean effort of $3,900 to $7,200.

In the purse seine fishery, the cluster 1 and cluster 2 models predictions of net cash flow at mean effort were fairly close, though the cluster 3 model predicted a net cash flow of -$4,000, compared to a sample value of $11,000. The whole fishery model predicted cash flow at mean effort to be about $11,000 less than the sample value.

One of the important issues in salmon management in Southeast Alaska is how to achieve reductions in the catch of chinook salmon, which has been viewed as desirable in light of the threatened condition of coastwide chinook stocks and the efforts to negotiate a treaty on salmon catch with Canada. The models developed here can be used to gain insight into the reductions in gross earnings and net cash flow which could be expected to accompany the institution of policies to reduce chinook catch through curtailment of fishing effort in any or all of the Southeast Alaska salmon fisheries.

The catch of chinook varies widely from the net fisheries, where they are captured incidentally, to the troll fisheries, which target on chinook and coho salmon (Table 19). Chinook salmon constituted 15 percent of the troll

TABLE 19. Species composition of chinook in the 1981 catches of Southeast Alaska salmon fleets, by weight and by value.

Gear Group	Northern SE Alaska Catch (000 Fish)	Northern SE Alaska Value ($000)	Northern SE Alaska Value Per Fish($)	Southern SE Alaska Catch (000 Fish)	Southern SE Alaska Value ($000)	Southern SE Alaska Value Per Fish($)	SE Alaska Totals Catch (000 Fish)	SE Alaska Totals Value ($000)	SE Alaska Totals Value Per Fish($)
Gillnet:									
Chinook	4.3	71.6	16.64	3.7	56.9	15.38	8.0	128.5	16.06
All Salmon	1119.8	5312.1	4.74	1435.4	5341.7	3.72	2555.2	10,653.8	4.17
Species Composition	0.38%	1.35%	---	0.26%	1.07%	---	0.31%	1.21%	---
Purse Seine:									
Chinook	1.5	28.3	18.83	4.4	102.8	23.37	5.9	131.1	22.22
All Salmon	4799.1	9311.4	1.94	10,232.5	25,187.3	2.46	15,031.6	34,498.7	2.30
Species Composition	0.03%	0.30%	---	0.04%	0.41%	---	0.04%	0.38%	---
Troll:[a]									
Chinook							256.8	12,625.3	49.16
All Salmon							1751.8	22,414.4	12.80
Species Composition							14.66%	56.33%	---

[a]Troll figures are published only for the whole Southeast Alaska area

Source: Alaska Department of Fish and Game catch by weight and 56 percent by value in 1981, while it constituted far smaller amounts in the net fisheries. However, because chinook salmon are so large and high valued, their importance in the catch by value can be as much as an order of magnitude greater than their importance by number.

The question of distributing some of the chinook cutbacks to the net fisheries has not been extensively studied, because it seems fairly obvious that extracting significant cutbacks in chinook catch from net fisheries would impose far greater losses on net fishermen than commensurate cutbacks impose on trollers. Nevertheless, it is useful to know what kinds of impacts on incomes to fishermen would result from reductions in effort which are induced by fishery policy. Usually, gross estimates of loss have been developed by multiplying an estimated exvessel price by the expected reduction in catch, but the net cash flow models can help predict the net losses to fishermen. If effort is curtailed, gross earnings are reduced, but less inputs to production are used, so that the net loss should be smaller.

This is a complex question to which only a fairly simple treatment can be given, at present. Two important linkages are involved in the question of how fishery policy affects fishing income: (1) how does fishery policy affect effort deployment; and (2) how do effort changes affect incomes?

A satisfactory answer to the first question is beyond the scope of the present endeavor. A most difficult aspect of that question is the substitution relationships involved in effort deployment by fishermen. If a time-area closure is instituted, for example, is the historical effort in that time-area cell which is reduced by the closure a net reduction in effort, or are there increases in effort elsewhere in the fishery or in other fisheries which are offsetting?

Recognizing that the first question may never be fully answered, it is useful to examine the effects on fishing income of assumed reductions in fishing effort. If it can be determined that a particular policy or set of policies will reduce overall fishing time by 10 percent, say, in a given fishery, then the net cash flow models can provide information on the effects on income. This is still not a full accounting of the problem, unless it can be assumed that there are no substitutions of effort between fisheries. Given the time-specific and area-specific nature of many Alaska fisheries, and the logistical or financial barriers to entry which often exist, this may not be an unreasonable assumption.

With these considerations in mind, Tables 20 to 23 present, for each fishery, model predictions of the effects on fishing income of a policy which resulted in a 10 percent decrease in fishing time (hours spent fishing). The changes in total revenue, net cash flow, and net crew wages are presented, which provide an indication of how the impacts are borne by the different factors of production. Reductions in gross earnings not accounted for by the changes in net cash flow or crew wages represent reduced purchases of other inputs such as food, fuel, and gear repair.

A couple of anomalies should be noted. In the drift gillnet fleet, the cluster 1 model predicts that net cash flow will increase for this portion of the fleet if fishing time is reduced; this follows directly from the characteristics of this model, which were discussed earlier. The interpretation of this phenomenon is that savings from large reductions in other inputs (food, fuel) offsets the decline in the owner's portion of gross earnings. Thus, even though gross earnings and crew wages decline, net cash flow increases for this group.

A second anomaly is in the purse seine fleet, where the whole fishery model predicts that the sum of the reductions in net cash flow and net crew wages exceeds the loss in gross earnings. This implies that purchase of other inputs (food and fuel) increase with the decreasing effort, which is hardly sensible. The cluster 1 and cluster 2 models predict reductions in purchase of other inputs, as would be expected; the cluster 3 model, like the whole fishery model, predicts increased purchases of other inputs, though the magnitude ($55) is smaller than for the whole fishery model ($234). This tends to reinforce the conclusion that the cluster procedure improves the quality of the purse seine fishery model.

There are, of course, uncertainties about the actual effects of a policy on fishing time. To account for these uncertainties, a range of values for the reduction in fishing time should be evaluated. If the best guess was that fishing time would be reduced by 10 percent, it should be bracketed by higher and lower values (perhaps 5 percent and 15 percent) to examine the sensitivity of the model predictions to that parameter.

The aggregate impacts of each model were estimated by simple extrapolation of sample results to the population. In the cluster model, this assumed that the sample representation of each cluster was proportional to its occurrence in the population; that is, that response rates for clusters (i.e., for vessels with different physical characteristics) were equal. In both models, it assumed that the sample was representative of the population with respect to income, as well.

Some idea of the validity of these assumptions can be obtained by a comparison of the sample of vessels analyzed here with the population in certain characteristics. Because the Commercial Fisheries Entry Commission was one of the collaborating agencies in the survey, it was possible to make comparisons of the sample to the population in terms of two variables: gross earnings and keel length. These comparisons suggested that for every fishery the samples were representative of the population in terms of keel length. Chi-square tests were performed on the observed vs. expected frequency of occurrence of sample vessels in several length categories; in each instance, the null hypothesis (that sample frequencies were representative of population frequencies) could not be rejected. Similar tests were conducted on each fishery, for each of several gross earnings categories, and in two cases the null hypothesis was rejected. These were the power troll and hand troll fishery, and in each case there was slightly greater representation from higher gross earnings categories.

The species composition of 1981 catches by value presented in Table 19 can be used to provide rough estimates of the reductions in chinook salmon which would be expected to result from the reduced fishing time. For example, in

TABLE 20. Predicted Economic Effects of a 10% Reduction in Fishing Time on the Drift Gillnet Fleet[a]

	Whole Fleet Model		Cluster Models		
	Per Vessel	Aggregate	Per Vessel		Aggregate
			Cluster 1	Cluster 2	
Number of Vessels	---	461	147	314	461
ECONOMIC PERFORMANCE:					
Without Reduction					
Hours Spent Fishing	503	231,883	501	505	232,217
Operating Hours	741	341,601	759	732	341,421
Total Revenue	$26,256	$12,104,016	$25,317	$19,833	$9,949,161
Total Cost	$15,972	$ 7,363,092	$18,859	$14,515	$7,329,983
Net Cash Flow	$10,284	$ 4,740,924	$ 6,458	$ 5,318	$2,619,178
With Reduction					
Hours Spent Fishing	453	208,833	451	454	208,853
Operating Hours	659	303,799	673	651	303,345
Total Revenue	$25,486	$11,749,046	$24,903	$18,970	$9,617,321
Total Cost	$15,358	$ 7,080,038	$18,006	$13,977	$7,035,660
Net Cash Flow	$10,128	$ 4,669,008	$ 6,897	$ 4,993	$2,581,661
Effect of the Reduction:					
Change in Total Revenue	-$770	-$354,970	-$414	-$863	-$331,840
Change in Net Cash Flow	-$156	-$ 71,916	+$439	-$325	-$ 37,517
Change in Net Crew Wages	-$ 65	-$ 29,965	-$ 29	-$ 80	-$ 29,383
Possible Reductions in Chinook Harvest:					
if chinook are 0.5% by value		111 fish			103 fish
if chinook are 1.0% by value		221 fish			207 fish
if chinook are 1.5% by value		332 fish			310 fish

TABLE 21. Predicted Economic Effects of a 10% Reduction in Fishing Time on the Hand Troll Fleet[a]

	Whole Fleet Model		Cluster Models			
	Per Vessel	Aggregate	Per Vessel			Aggregate
			Cluster 1	Cluster 2	Cluster 3	
Number of Vessels	---	1,189	333	403	453	1,189
ECONOMIC PERFORMANCE:						
Without Reduction						
Hours Spent Fishing	460	546,940	428	489	447	542,082
Operating Hours	620	737,180	574	725	557	735,639
Total Revenue	$3,575	$4,250,675	$4,676	$ 3,292	$2,942	$4,216,510
Total Cost	$5,568	$6,620,352	$6,466	$ 5,455	$5,038	$6,633,757
Net Cash Flow	-$1,993	-$2,369,677	-$1,790	-$ 2,163	-$2,096	-$2,417,247
With Reduction						
Hours Spent Fishing	414	492,246	385	440	402	487,631
Operating Hours	559	664,651	519	651	503	663,039
Total Revenue	$3,220	$3,828,580	$4,188	$ 2,977	$ 2,662	$3,800,221
Total Cost	$5,354	$6,365,907	$6,222	$ 5,261	$ 4,837	$6,383,270
Net Cash Flow	-$2,134	-$2,537,326	-$2,034	-$ 2,284	-$ 2,175	-$2,583,049
Effect of the Reduction:						
Change in Total Revenue	-$ 355	-$ 422,095	-$ 488	-$ 315	-$ 280	-$ 416,289
Change in Net Cash Flow	-$ 141	-$ 167,649	-$ 244	-$ 121	-$ 79	-$ 165,802
Change in Net Crew Wages	-$ 19	-$ 22,591	-$ 37	-$ 14	-$ 13	-$ 23,852
Possible Reductions in Chinook Harvest:						
if chinook are 45% by value		3,868 fish				3,815 fish
if chinook are 55% by value		4,728 fish				4,663 fish
if chinook are 65% by value		5,588 fish				5,511 fish

[a] In 1981 dollars, and based on 1981 cost, price, regulatory, and resource conditions.

TABLE 22. Predicted Economic Effects of a 10% Reduction in Fishing Time on the Power Troll Fleet[a]

	Whole Fleet Model		Cluster Models			
	Per Vessel	Aggregate	Per Vessel			Aggregate
			Cluster 1	Cluster 2	Cluster 3	
Number of Vessels	---	825	181	302	341	825
ECONOMIC PERFORMANCE:						
Without Reduction						
Hours Spent Fishing	824	679,800	874	721	836	661,012
Operating Hours	1,044	861,300	1,121	943	1,059	848,806
Total Revenue	$ 23,546	$19,425,450	$29,746	$21,519	$21,755	$19,301,219
Total Cost	$ 16,388	$13,520,100	$22,534	$17,614	$16,683	$15,086,905
Net Cash Flow	$ 7,158	$ 5,905,350	$ 7,212	$ 3,905	$ 5,072	$ 4,214,234
With Reduction						
Hours Spent Fishing	742	612,150	787	649	752	594,877
Operating Hours	932	768,900	1,018	849	952	765,288
Total Revenue	$ 20,852	$17,202,900	$26,446	$18,948	$19,916	$17,300,378
Total Cost	$ 15,277	$12,603,525	$22,103	$16,282	$16,161	$14,428,708
Net Cash Flow	$ 5,575	$ 4,599,375	$ 4,343	$ 2,666	$ 3,755	$ 2,871,670
Effect of the Reduction:						
Change in Total Revenue	-$2,694	-$2,222,550	-$3,300	-$2,571	-$1,839	-$2,000,841
Change in Net Cash Flow	-$1,583	-$1,305,975	-$2,869	-$1,239	-$1,317	-$1,342,564
Change in Net Crew Wages	-$ 230	-$ 189,750	-$ 383	-$ 210	-$ 131	-$ 177,417
Possible Reductions in Chinook Harvest:						
if chinook are 45% by value		20,370 fish				18,338 fish
if chinook are 55% by value		24,896 fish				22,413 fish
if chinook are 65% by value		29,423 fish				26,488 fish

[a]In 1981 dollars, and based on 1981 cost, price, regulatory, and resource conditions.

TABLE 23. Predicted Economic Effects of a 10% Reduction in Fishing Time on the Purse Seine Fleet[a]

	Whole Fleet Model		Cluster Models			
	Per Vessel	Aggregate	Per Vessel Cluster 1	Per Vessel Cluster 2	Per Vessel Cluster 3	Aggregate
Number of Vessels	---	367	75	142	150	367
ECONOMIC PERFORMANCE:						
Without Reduction						
Hours Spent Fishing	401	147,167	415	421	371	146,557
Operating Hours	862	316,354	871	963	774	318,171
Total Revenue	$87,121	$31,973,407	$143,935	$110,384	$59,454	$35,387,753
Total Cost	$73,835	$27,097,445	$106,128	$ 80,265	$63,480	$28,879,230
Net Cash Flow	$13,286	$ 4,875,962	$ 37,807	$ 30,119	-$ 4,026	$ 6,508,523
With Reduction						
Hours Spent Fishing	361	132,487	374	379	334	131,968
Operating Hours	769	282,223	789	841	694	282,697
Total Revenue	$82,821	$30,395,307	$141,787	$106,095	$ 53,796	$33,768,915
Total Cost	$72,281	$26,527,127	$104,471	$ 78,523	$ 60,845	$28,112,341
Net Cash Flow	$10,540	$ 3,868,180	$ 37,316	$ 27,572	-$ 7,049	$ 5,656,574
Effect of the Reduction:						
Change in Total Revenue	-$4,300	-$1,578,100	-$2,148	-$4,289	-$5,658	-$1,618,838
Change in Net Cash Flow	-$2,746	-$1,007,782	-$ 491	-$1,742	-$3,023	-$ 737,639
Change in Net Crew Wages	-$1,788	-$ 656,196	-$ 871	-$1,891	-$2,690	-$ 737,347
Possible Reductions in Chinook Harvest:						
If chinook are 0.3% by value		213 fish				219 fish
if chinook are 0.4% by value		284 fish				291 fish
if chinook are 0.5% by value		355 fish				364 fish

[a]In 1981 dollars, and based on 1981 cost, price, regulatory, and resource conditions.

1981, chinook salmon contributed roughly 0.4 percent by value to the catches of Southeast Alaska purse seiners. Assuming the interception rate of chinook was the same during the fishing time which was reduced as during the whole season, 0.4 percent of the reduced gross earnings in the fleet would represent the value of chinook salmon not caught. Dividing this by the average value per fish from Table 19, the number of fish this represents is obtained. These numbers are also presented in Tables 20 to 23.

If managers have a good understanding of where and when chinook catches occur in a particular fishery, they may be able to achieve higher than average reductions in chinook catch by certain kinds of closures. However, the substitution of effort which a closure would probably cause should result in some offsetting increases in chinook catch. In recognition of this uncertainty, three rates of chinook interception were employed, to bracket the mean value with higher and lower estimates.

A simplification was used in the prediction of the effects of a 10 percent cut in fishing time. All vessels in a category were assumed to have identical costs and earnings equal to the mean for the category. Thus, in the whole fleet model, all vessels were assumed to have the mean value for gross earnings and total cost; all vessels in cluster 1 were assumed to have costs and earnings equal to the means for cluster 1; and so forth. When the simulation models are more fully computerized, the effects of the reductions in fishing time can be estimated for each vessel at its actual values of cost and earnings; however, it is not expected to make much difference in the results.

CONCLUSIONS

The relationships between fishing earnings, costs, and effort developed here should prove useful in the analysis of policy relating to fisheries. Previous research on the costs and earnings of Alaskan fishing vessels has typically resulted in profiles of "typical" vessels, or averages for a whole fleet or vessels of a particular hull type. While these profiles can be useful as benchmarks of average economic performance for a fishery, they are of somewhat limited utility in policy analysis. This results from the absence of any links between what happens with policy and fleet response to it.

This study develops the linkage between fleet effort and economic performance through the estimation of earnings/effort and cost/effort functions for each of the major Southeast Alaska salmon fisheries: purse seine, hand troll, power troll, and drift gillnet. These functions, estimated cross-sectionally, permit the prediction of how incomes from and costs of fishing change with fishing effort in the Southeast Alaska salmon fisheries. The way in which these relationships can be used is illustrated with an example, in which the effects of a 10 percent reduction in fishing time on fishing incomes and chinook salmon catch in each fishery are estimated.

This study's results indicate that, while vessel owner-operators were generally covering their out-of-pocket expenses in 1981 (except in the hand troll fishery), economic returns from fishing were not sufficient to attract new investment into the fishery. A particularly important element is the opportunity cost of capital, which may be less than the prevailing market rate because of the illiquidity of the fishing investment. When opportunity costs of capital were assumed to be 10 percent of the investment, which is fairly common, the returns to labor and management were negative; at a lower rate (5%) which may better reflect the illiquidity of the investment, the return to labor and management was generally positive for the power troll and purse seine fishery. However, even at the 5 percent opportunity cost rate, only the purse seine fishery yielded a return to labor and management which might equal or exceed the opportunity cost of labor and management. Needless to say, the results here, as in other studies, are sensitive to the rate of interest chosen for the opportunity cost of capital, both because of potential illiquidity of the investment and the large amounts of capital tied up in fishing, as well as the financial risk involved with fishing.

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APPENDIX I

Estimated Gross Earnings/Effort Response, Cost/Effort Response, Fishing Time, and Depreciation Functions for the 1981 Southeast Alaska Salmon Fleets.

TABLE A.1 The 1981 Southeast Alaska Drift Gillnet Fleet: Estimated Depreciation Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

$$LBTVAL = \underset{(-0.77)}{-1.22730} \underset{(5.99)}{+1.20562} LYRBLT \underset{(3.67)}{+1.45754} LLNGTH \underset{(0.95)}{+0.06786} LMHP \underset{(5.91)}{+0.60019} LGRT$$

$R'^2 = 0.615$ $F = 47.78$ (0.0000) $n = 118$

Cluster 1:

$$LBTVAL = \underset{(-3.22)}{-7.85044} \underset{(7.82)}{+3.27471} LYRBLT \underset{(2.72)}{+1.20842} LLNGTH \underset{(-1.28)}{-0.06754} LMHP \underset{(2.69)}{+0.36714} LGRT$$

$R'^2 = 0.659$ $F = 21.26$ (0.0000) $n = 43$

Cluster 2:

$$LBTVAL = \underset{(0.81)}{2.07213} \underset{(3.65)}{+0.89510} LYRBLT \underset{(1.47)}{+0.88145} LLNGTH \underset{(0.89)}{+0.10991} LMHP \underset{(3.16)}{+0.47968} LGRT$$

$R'^2 = 0.274$ $F = 7.98$ (0.0000) $n = 75$

TABLE A.2 The 1981 Southeast Alaska Drift Gillnet Fleet: Estimated Gross Earnings/Effort Response Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

LFOIGRS = 7.45512 +0.38179 LOPRHRS (16.89) (5.68)	F = 32.25 (0.0000)	$R'^2 = 0.215$ n = 115
LGRPUE = 8.22146 -0.71626 LFSHHRS (19.00) (-10.26)	F = 105.19 (0.0000)	$R'^2 = 0.500$ n = 105

Cluster 1:

LFOIGRS = 8.02337 +0.32009 LOPRHRS (5.26) (2.43)	F = 5.89 (0.0199)	$R'^2 = 0.109$ n = 41
LGRPUE = 9.16947 -0.84402 LFSHHRS (13.80) (-7.83)	F = 61.32 (0.0000)	$R'^2 = 0.613$ n = 39

Cluster 2:

LFOIGRS = 7.17382 +0.41080 LOPRHRS (15.55) (5.85)	F = 34.27 (0.0000)	$R'^2 = 0.313$ n = 74
LGRPUE = 7.28303 -0.58035 LFSHHRS (14.24) (-7.05)	F = 49.68 (0.0000)	$R'^2 = 0.428$ n = 66

TABLE A.3 The 1981 Southeast Alaska Drift Gillnet Fleet: Estimated Cost/Effort Response and Fishing Time Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

LCSTPUE = 7.46958 −0.66572 LOPRHRS	(14.79) (−8.67)	F = 75.20 (0.0000)	R'^2 = 0.444, n = 94
LFSHHRS = 0.30956 +0.89456 LOPRHRS	(0.69) (13.10)	F = 171.62 (0.0000)	R'^2 = 0.617, n = 107

Cluster 1:

LCSTPUE = 7.29122 −0.61497 LOPRHRS	(9.18) (−5.08)	F = 25.79 (0.0000)	R'^2 = 0.422, n = 35
LFSHHRS = 0.39975 +0.87716 LOPRHRS	(0.37) (5.40)	F = 29.14 (0.0000)	R'^2 = 0.419, n = 40

Cluster 2:

LCSTPUE = 7.45536 −0.67743 LOPRHRS	(12.20) (−7.31)	F = 53.38 (0.0000)	R'^2 = 0.475, n = 59
LFSHHRS = 0.26344 +0.90376 LOPRHRS	(0.70) (15.70)	F = 246.43 (0.0000)	R'^2 = 0.788, n = 67

TABLE A.4 The 1981 Southeast Alaska Hand Troll Fleet: Estimated Depreciation Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

LBTVAL =	−6.04907	+1.34265 LYRBLT	+0.244333 LGRT	+0.15211 LMHP	+2.70177 LLNGTH
	(−2.93)	(5.47)	(1.63)	(1.77)	(5.05)

$R'^2 = 0.591$ F = 41.07 (0.0000) n = 112

Cluster 1:

BTVAL =	−38681.58722	+521.87974 YRBLT	+13912.90606 GRT	+39.75019 MHP	+494.93121 L…
	(−1.86)	(3.26)	(3.51)	(1.58)	(0.77)

$R'^2 = 0.659$ F = 19.35 (0.0000) n = 39

Cluster 2:

LBTVAL =	−7.83047	+1.85188 LYRBLT	+0.063333 LGRT	+0.34853 LMHP	+2.35541 LLNGTH
	(−2.43)	(3.59)	(0.330)	(2.00)	(3.07)

$R'^2 = 0.581$ F = 12.45 (0.0000) n = 34

Cluster 3:

LBTVAL =	2.92210	+0.03344 YRBLT	+0.01274 GRT	−0.84976E−3 MHP	+0.15894 LNGTH
	(2.73)	(3.36)	(0.32)	(−0.37)	(5.55)

$R'^2 = 0.532$ F = 14.07 (0.0000) n = 47

TABLE A.5 The 1981 Southeast Alaska Hand Troll Fleet: Estimated Gross Earnings/Effort Response Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

LFOIGRS = 1.69803 +1.00848 LOPRHRS (4.05) (14.61)	F = 213.44 (0.0000)	R'^2 = 0.551 n = 174
LFOIGRS = 2.44670 +0.92816 LFSHHRS (6.33) (13.92)	F = 193.70 (0.0000)	R'^2 = 0.528 n = 173

Cluster 1:

LFOIGRS = 1.38453 +1.11881 LOPRHRS (1.93) (9.55)	F = 91.10 (0.0000)	R'^2 = 0.662 n = 47
LFOIGRS = 2.11315 +1.04589 LFSHHRS (3.43) (9.95)	F = 99.02 (0.0000)	R'^2 = 0.685 n = 46

Cluster 2:

LFOIGRS = 1.94830 +0.93385 LOPRHRS (2.72) (7.99)	F = 63.86 (0.0000)	R'^2 = 0.520 n = 59
LFOIGRS = 3.18320 +0.77874 LFSHHRS (4.70) (6.65)	F = 44.26 (0.0000)	R'^2 = 0.427 n = 59

Cluster 3:

LFOIGRS = 1.74009 +0.98954 LOPRHRS (2.53) (8.62)	F = 74.30 (0.0000)	R'^2 = 0.522 n = 68
LFOIGRS = 2.15416 +0.95597 LFSHHRS (3.36) (8.59)	F = 73.83 (0.0000)	R'^2 = 0.521 n = 68

TABLE A.6 The 1981 Southeast Alaska Hand Troll Fleet: Estimated Cost Effort/Response and Fishing Time Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

LCSTPUE = 6.19025 -0.62137 LOPRHRS (21.50) (-13.32)	F = 177.48 (0.0000)	R'2 = 0.568 n = 135
LFSHHRS = -0.36588 +1.01040 LOPRHRS (-2.51) (41.78)	F = 1745.49 (0.0000)	R'2 = 0.906 n = 181

Cluster 1:

LCSTPUE = 6.35080 -0.61850 LOPRHRS (10.20) (-6.19)	F = 38.28 (0.0000)	R'2 = 0.523 n = 35
LFSHHRS = -0.58302 +1.04544 LOPRHRS (-2.46) (26.85)	F = (720.64) (0.0000)	R'2 = 0.939 n = 48

Cluster 2:

LCSTPUE = 6.38346 -0.66280 LOPRHRS (-7.91) (12.34)	F = 62.51 (0.0000)	R'2 = 0.589 n = 44
LFSHHRS = -0.20980 +0.97201 LOPRHRS (-0.56) (15.82)	F = 250.26 (0.0000)	R'2 = 0.801 n = 63

Cluster 3:

LCSTPUE = 6.00337 -0.60122 LOPRHRS (14.90) (-9.16)	F = 83.94 (0.0000)	R'2 = 0.601 n = 56
LFSHHRS = -0.39132 +1.92694 LOPRHRS (-3.99) (62.17)	F = 4451.37 (0.0000)	R'2 = 0.985 n = 70

TABLE A.7. The 1981 Southeast Alaska Power Troll Fleet: Estimated Depreciation Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

BTVAL = -101,340 +847.1028 YRBLT +68.81457 MHP +1375.89255 GRT +2293.48023 LNGTH
(-5.01) (6.95) (1.29) (4.46) (3.79)

R'^2 = 0.654 F = 69.41 (0.0000) n = 146

Cluster 1:

BTVAL = -192,550 +2181.01525 YRBLT +6.18057 MHP +835.42164 GRT +3268.47117 LNGTH
(-2.39) (5.10) (0.06) (1.20) (1.92)

R'^2 = 0.472 F = 7.71 (0.003) n = 31

Cluster 2:

LBTVAL = 4.72204 +0.42169 LYRBLT +0.03067 LMHP +0.46775 LGRT +0.85840 LLNGTH
(2.50) (2.75) (0.15) (3.70) (1.69)

R'^2 = 0.465 F = 11.65 (0.0000) n = 50

Cluster 3:

BTVAL = -54440.74605 +159.36634 YRBLT +1856.65392 LNGTH +734.23361 GRT +80.74605 MHP
(-2.65) (0.85) (3.09) (1.90) (0.97)

R'^2 = 0.280 F = 7.21 (0.0001) n = 65

TABLE A.8 The 1981 Southeast Alaska Power Troll Fleet: Estimated Gross Earnings/Effort Response Functions for the Fleet as a Whole, and for Major Subfleets

<u>Whole Fleet</u>:

LFOIGRS = 2.62465 +1.07067 LOPRHRS	F = 408.70	R'^2 = 0.740
(7.84) (19.08)	(0.0000)	n = 144
LFOIGRS = 3.42682 +0.99124 LFSHHRS	F = 324.22	R'^2 = 0.701
(9.48) (18.01)	(0.0000)	n = 139

<u>Cluster 1</u>:

LFOIGRS = 1.73396 +1.22003 LOPRHRS	F = 139.28	R'^2 = 0.807
(2.44) (11.80)	(0.0000)	n = 34
LFOIGRS = 4.98957 +0.78504 LFSHHRS	F = 36.87	R'^2 = 0.536
(5.78) (6.07)	(0.0000)	n = 32

<u>Cluster 2</u>:

LFOIGRS = 1.67969 +1.21151 LOPRHRS	F = 302.86	R'^2 = 0.846
(3.61) (17.40)	(0.0000)	n = 56
LFOIGRS = 2.22238 +1.18075 LFSHHRS	F = 279.98	R'^2 = 0.843
(4.93) (16.73)	(0.0000)	n = 53

<u>Cluster 3</u>:

LFOIGRS = 4.21052 +0.82944 LOPRHRS	F = 73.97	R'^2 = 0.584
(6.37) (8.60)	(0.0000)	n = 53
LFOIGRS = 4.44688 +0.82196 LFSHHRS	F = 71.96	R'^2 = 0.577
(6.92) (8.48)	(0.0000)	n = 53

TABLE A.9 The 1981 Southeast Alaska Power Troll Fleet: Estimated Cost/Effort Response and Fishing Time Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

LOWNCST = 5.95798 +0.55553 LOPRHRS	F = 71.40	R'^2 = 0.395
(13.16) (8.45)	(0.0000)	n = 109
LFSHHRS = -0.30057 +1.00717 LOPRHRS	F = 2914.18	R'^2 = 0.954
(-2.37) (53.98)	(0.0000)	n = 143

Cluster 1:

LCSTPUE = 8.61438 -0.79943 LOPRHRS	F = 23.56	R'^2 = 0.495
(7.41) (-4.85)	(0.0001)	n = 24
LFSHHRS = -0.83004 +1.08268 LOPRHRS	F = 218.92	R'^2 = 0.875
(-1.64) (14.80)	(0.0000)	n = 32

Cluster 2:

LOWNCST = 4.64889 +0.74865 LOPRHRS	F = 117.38	R'^2 = 0.726
(10.03) (10.83)	(0.0000)	n = 45
LFSHHRS = -0.32989 +1.00904 LOPRHRS	F = 1051.66	R'^2 = 0.953
(-1.59) (32.43)	(0.0000)	n = 53

Cluster 3:

LCSTPUE = 7.64405 -0.70164 LOPRHRS	F = 32.93	R'^2 = 0.477
(8.98) (-5.74)	(0.0000)	n = 36
LFSHHRS = -0.15370 +0.98808 LOPRHRS	F = 1769.54	R'^2 = 0.969
(-0.96) (42.07)	(0.0000)	n = 57

TABLE A.10 The 1981 Southeast Alaska Purse Seine Fishery: Estimated Depreciation Functions for the Fleet as a Whole, and for Major Subfleets

<u>Whole Fleet</u>:

LBTVAL = 8.90813 +0.01702 YRBLT +0.01666 GRT +0.35570E-3 MHP +0.02903 LNGTH
(14.38) (5.14) (3.34) (0.55) (2.15)

$F = 30.09$ $R'^2 = 0.618$ $n = 73$

<u>Cluster 1</u>:

LBTVAL = 8.65294 +1.37035 LYRBLT -0.09992 LGRT +0.21602 LMHP -0.60887 LLNGTH
(0.96) (0.61) (-0.31) (0.59) (-0.62)

$F = 0.21$ (0.9275) $R^2 = 0.07$ $R'^2 = -0.25$ $n = 16$

<u>Cluster 2</u>:

LBTVAL = 15.46613 +0.47009 LYRBLT -0.05864 LGRT -0.31381 LMHP -0.81771 LLNGTH
(1.98) (1.90) (-1.17) (-0.12) (-0.51)

$F = 1.84$ (0.1565) $R'^2 = 0.115$ $n = 27$

<u>Cluster 3</u>:

LBTVAL = 1.05182 +0.42187 LYRBLT +0.79515 LGRT +0.60566 LMHP +0.81096 LLNGTH
(0.16) (2.10) (1.54) (1.15) (0.53)

$F = 3.52$ (0.0207) $R'^2 = 0.258$ $n = 30$

TABLE A.11 The 1981 Southeast Alaska Purse Seine Fishery: Estimated Gross Earnings/Effort Response Functions for the Fleet as a Whole, and for Major Subfleets

<u>Whole Fleet:</u>		
LFOIGRS = 7.74184 +0.53198 LOPRHRS (5.92) (2.73)	F = 7.47 (0.0079)	R'^2 = 0.084 n = 72
LFOIGRS = 8.45284 +0.48759 LFSHHRS (9.10) (3.12)	F = 9.76 (0.0027)	R'^2 = 0.124 n = 63
<u>Cluster 1:</u>		
LGRPUE = 10.99612 -0.85384 LFSHHRS (7.39) (-3.43)	F = 11.77 (0.0089)	R'^2 = 0.545 n = 10
<u>Cluster 2:</u>		
LGRPUE = 9.33407 -0.62305 LFSHHRS (7.64) (-3.04)	F = 9.24 (0.0067)	R'^2 = 0.292 n = 21
<u>Cluster 3:</u>		
LFOIGRS = 5.37573 +0.94934 LFSHHRS (4.16) (4.38)	F = 19.16 (0.0002)	R'^2 = 0.393 n = 29

TABLE A.12 The 1981 Southeast Alaska Purse Seine Fishery: Estimated Cost/Effort Response and Fishing Time Functions for the Fleet as a Whole, and for Major Subfleets

Whole Fleet:

LCSTPUE = 9.95040 -0.81371 LOPRHRS	F = 26.95	$R'^2 = 0.298$
(9.410) (-5.191)	(0.0000)	n = 62
LFSHHRS = -0.15267 +0.90924 LOPRHRS	F = 57.36	$R'^2 = 0.468$
(-0.19) (7.57)	(0.0000)	n = 65

Cluster 1:

LCSTPUE = 10.49488 -0.84083 LOPRHRS	F = 13.23	$R'^2 = 0.550$
(6.68) (-3.64)	(0.0054)	n = 11
LFSHHRS = -1.01527 +1.04034 LOPRHRS	F = 4.39	$R'^2 = 0.220$
(-0.309) (2.10)	(0.0601)	n = 13

Cluster 2:

LCSTPUE = 10.18048 -0.83805 LOPRHRS	F = 20.12	$R'^2 = 0.502$
(8.10) (-4.49)	(0.0003)	n = 20
LFSHHRS = 0.71049 +0.77610 LOPRHRS	F = 21.20	$R'^2 = 0.479$
(0.63) (4.60)	(0.0002)	n = 23

Cluster 3:

LCSTPUE = 8.47467 -0.61155 LOPRHRS	F = 10.81	$R'^2 = 0.260$
(6.83) (-3.29)	(0.0028)	n = 29
LFSHHRS = -0.50460 +0.96542 LOPRHRS	F = 38.13	$R'^2 = 0.570$
(-0.48) (6.18)	(0.0000)	n = 29

TABLE A.13 The 1981 Southeast Alaska Drift Gillnet Fishery: Net Cash Flow and Average Cost Response Functions

Whole Fleet:

$NCF = 4906.81\ OPRHRS^{0.25382} - 1753.87\ OPRHRS^{0.33428}$

$AC_R = 0.024\ FOIGRS^{0.31700}$

Breakeven Point (BEP) = Indeterminate[a]

Cluster 1:

$NCF = 10217.15\ OPRHRS^{0.13682} - 1467.36\ OPRHRS^{0.38503}$

$AC_R = 7.65\ E\text{-}09\ FOIGRS^{1.81414}$

BEP = Indeterminate[a]

Cluster 2:

$NCF = 1625.52\ OPRHRS^{0.37926} - 1729.11\ OPRHRS^{0.32257}$

$AC_R = 3.21\ FOIGRS^{-0.14948}$

BEP = $2,458

[a]The models for Cluster 1 and the whole fleet predict increasing average cost over the range of sample data; it is not possible to extrapolate for low values of effect to determine the breakeven point.

TABLE A.14 The 1981 Southeast Alaska Hand Troll Fishery: Net Cash Flow and Average Cost Response Functions

Whole Fleet:

$NCF = 5.46\ OPRHRS^{1.00848} - 487.97\ OPRHRS^{0.37863}$

$AC_R = 257.94\ FOIGRS^{-0.62455}$

Breakeven Point (BEP) = $7,264

Cluster 1:

$NCF = 4.50\ OPRHRS^{1.09342} - 572.95\ OPRHRS^{0.38150}$

$AC_R = 339.09\ FOIGRS^{-0.65109}$

BEP = $7,696

Cluster 2:

$NCF = 7.02\ OPRHRS^{0.93385} - 591.97\ OPRHRS^{0.33720}$

$AC_R = 292.94\ FOIGRS^{-0.63892}$

BEP = $7,259

Cluster 3:

$NCF = 5.93\ OPRHRS^{0.98172} - 404.79\ OPRHRS^{0.39878}$

$AC_R = 196.43\ FOIGRS^{-0.59379}$

BEP = $7,257

TABLE A.15 The 1981 Southeast Alaska Power Troll Fishery: Net Cash Flow and Average Cost Response Functions

Whole Fleet:

$NCF = 13.80\ OPRHRS^{1.07067} - 222.26\ OPRHRS^{0.61870}$

$AC_R = 48.77\ FOIGRS^{-0.42214}$

Breakeven Point (BEP) = $9,980

Cluster 1:

$NCF = 5.66\ OPRHRS^{1.22003} - 5510.33\ OPRHRS^{0.20057}$

$AC_R = 4140.95\ FOIGRS^{-0.83560}$

BEP = $21,318

Cluster 2:

$NCF = 5.36\ OPRHRS^{1.21151} - 104.47\ OPRHRS^{0.74865}$

$AC_R = 37.00\ FOIGRS^{-0.38205}$

BEP = $12,727

Cluster 3:

$NCF = 67.39\ OPRHRS^{0.82944} - 2088.18\ OPRHRS^{0.29836}$

$AC_R = 459.19\ FOIGRS^{-0.64029}$

BEP = $14,371

TABLE A.16 The 1981 Southeast Alaska Purse Seine Fishery: Net Cash Flow and Average Cost Response Functions

Whole Fleet:

$NCF = 4352.04\ OPRHRS^{0.44334} - 20{,}960.61\ OPRHRS^{0.18629}$

$AC_R = 128.74\ FOIGRS^{-0.57980}$

Breakeven Point (BEP) = $4,352

Cluster 1:

$NCF = 51{,}417.11\ OPRHRS^{0.15206} - 36{,}130.04\ OPRHRS^{0.15917}$

$AC_R = 0.42314\ FOIGRS^{0.04676}$

BEP = Indeterminate[a]

Cluster 2:

$NCF = 14{,}792.70\ OPRHRS^{0.29255} - 26{,}383.13\ OPRHRS^{0.16195}$

$AC_R = 129.68\ FOIGRS^{-0.44642}$

BEP = $54,066

Cluster 3:

$NCF = 133.85\ OPRHRS^{0.91651} - 4791.84\ OPRHRS^{0.38845}$

$AC_R = 601.57\ FOIGRS^{-0.57617}$

BEP = $66,638

[a]The model for Cluster 1 predicts increasing average cost over the range of sample data; it is not possible to extrapolate for low values of effort to determine the breakeven point.

APPENDIX II

Questionnaires used in the study

SOUTHEASTERN ALASKA
SEINE BOAT OWNERS & OPERATORS

Alaska Sea Grant Program

The United Fishermen of Alaska and Southeast Alaska Seine Boat Owners and Operators Association, assisted by the Alaska Sea Grant Program, are conducting a survey of fishermen who participated in the Southeast Alaska purse seine fishery in 1981. Information from this survey will be provided for public release in summary form only. Be assured all information you provide will be held in strictest confidence. Respondents need not include their name, vessel name, or ADF&G number.

INSTRUCTIONS: Please try to answer every question as completely as possible. Except where noted, all questions refer to your Southeast Alaska salmon purse seine activities only.

I. VESSEL AND GEAR INFORMATION. (If you purse seined for salmon in Southeast Alaska with more than one vessel in 1981, just fill out information for your PRINCIPAL vessel-the one you used the most).

1. Register length ________ ft

2. Gross tons ________ tons

3. Main engine: horsepower ________ hp
(circle one) a. gas b. diesel
(circle one) c. inboard d. outboard

4. Hull Construction: (circle one)
a. wood b. aluminum c. steel
d. ferro-cement e. Fiberglas

5. Year Built 19________

6. Hold capacity in cubic feet: ________ cu.ft.

7. Did you usually deliver: (circle one)
a. shore-side b. to a tender on the grounds

8. Method of holding product: (circle one)
a. chilled seawater (slush ice) b. refrigerated seawater
c. ice d. other (please list) ________

9. Vessel Electronics: (circle the items your vessel has, and list the number of radios)
a. Auto pilot b. Radar c. Radios (number ________)
d. Loran (A or C) e. Sidescan Sonar f. Other (please list)
g. Fathometer: paper recorder h. Fathometer: flasher ________

10. What is the approximate TOTAL VALUE of your vessel's electronic equipment? (That is, what could you sell the equipment for today?) $________

11. What is the approximate TOTAL VALUE of your vessel's fishing equipment (including nets and lines, power blocks, skiffs, etc.)? $________

12. What is the approximate TOTAL VALUE of your vessel, including its electronics and fishing gear? (Again, what could you sell your vessel for today?) $________

13. Do you own the vessel you fished with? (circle one) a. yes b. no

PLEASE TURN THE PAGE AND CONTINUE

a. If yes, what percent do you own? ________

b. If you don't own the vessel you fished with, did you lease it? (circle one) a. yes b.

c. What were your lease costs (if any) for Southeast purse seining in 1981? (put zero if you had no lease costs) $________

14. Were you SKIPPER of the vessel? (circle one) a. yes b.

15. What is the vessel's approximate FUEL CONSUMPTION RATE: while running? ________ gal./

while fishing? ________ gal./

16. What is the city or town of your permanent residence? ________

17. What were your TOTAL 1981 gross earnings with your PRINCIPAL vessel in all fisheries? $________

a. About how much of this was earned in the Southeast Alaska purse seine fishery? $________

18. Did you participate in OTHER fisheries as a crewman? (circle one) a. yes b. r

a. If yes, please list the fisheries ________

b. What was your TOTAL CREWSHARE from these fisheries (net of deductions)? $________

9. Do you currently work in a nonfishing occupation during the off-season from fishing? (circle one) a. yes b.

a. If yes, how many months per year? ________ mos./

b. What was the approximate gross pay per month for your non-fishing occupation (before taxes)? $________ /r

II. COSTS. All of the questions below refer to your 1981 purse seine activities and the PRINCIPAL vessel you used for purse seining.

20. Variable Costs. Sometimes these costs are shared by skipper and crew. For each iter would you indicate both the TOTAL SEASON COST for purse seining in 1981 and the total amount PER MAN paid by each of the crew and the skipper? (Be sure to include amounts withheld by processors, and please put zeros in where costs were zero.)

	TOTAL SEASON COST	AMOUNT PER MAN PAID BY CREW	AMOUNT PAID BY SKIPPER
a. food and galley costs	$________	$________	$________
b. fuel, oil, filters	$________	$________	$________
c. ice costs	$________	$________	$________
d. gear repair (just put costs for repair of existing gear here - purchase of NEW gear goes under question 22(h))	$________	$________	$________

	TOTAL SEASON COST	AMOUNT PER MAN PAID BY CREW	AMOUNT PAID BY SKIPPER
e. Aquaculture Association assessment	$ ______	$ ______	$ ______
f. Other (please list ______)	$ ______	$ ______	$ ______

21. Labor Costs.

a. What was your typical crew size, INCLUDING skipper, for purse seining in 1981? (Also include family members and unpaid crew.) ______ persons

b. How many were unpaid crew members? (If none, please put zero.) ______ persons

c. What was the average percentage CREW share per man for paid crew? ______ %

d. How was it calculated? (circle one)

(1) percentage of gross ex-vessel value of the catch

(2) deductions from question 20 subtracted first, then a percent share

(3) other (please list ______)

e. What was the SKIPPER share? ______ %

f. What was the BOAT share? ______ %

g. What was the GEAR share? ______ %

22. Fixed costs for your PRINCIPAL purse seining vessel in 1981. Please include just your out-of-pocket costs for these items. (If you performed the work yourself, don't include the value of your labor). Be sure to put zeros where costs were zero.

a. General (minor) vessel repairs and maintenance $ ______

b. Major vessel repairs (to the engine, shaft, keel, etc.) $ ______

c. Insurance (for hull, P&I, etc.) $ ______

d. Vessel moorage and gear storage $ ______

e. Fishing licenses (permit renewal fees, vessel licenses, etc.) $ ______

f. Fishermen's association dues $ ______

g. Fishing business expenses (may include office-related, legal, accounting, travel, freight, vehicle expenses, etc.) $ ______

h. Your costs of acquiring or replacing major items of equipment and electronics for your business in 1981 (such as power block, new engine, office equipment, etc.) $ ______

i. Miscellaneous supplies (clothing, cables, knives, rope, etc.) and other costs not covered above $ ______

PLEASE CONTINUE ON REVERSE SIDE

III. FISHERY PARTICIPATION. Except as noted, these questions refer to your fishing acti[v] with your principal purse seining vessel. If you used more than one vessel for Sout[h] salmon purse seining in 1981, please respond only for fishing activities with your PRINCIPAL vessel (the one you used the most).

23. What was your TOTAL number of VESSEL OPERATING HOURS logged with your principal vessel in the 1981 Southeast Alaska salmon purse seine fishery? (This should INCLUDE transit to and from fishing areas as well as actual fishing time.) ________ h[rs]

a. What was the total number of vessel operating hours you actually fished your gear in the 1981 Southeast purse seine fishery? ________ ho[urs]

24. How many TOTAL VESSEL OPERATING HOURS did you log IN ALL FISHERIES with your PRINCIPAL purse seining vessel? ________ ho[urs]

25. How many DIFFERENT DAYS did you actually have your gear in the water purse seining? ________ d[ays]

26. Did you run outside Southeast Alaska with your principal purse seining vessel in 1981? (To bring your vessel in from another area; for repairs and maintenance, etc.) (circle one)

a. yes b. [no]

a. If yes, about how many TOTAL running hours did this take? ________ ho[urs]

27. Did you use a second vessel for salmon purse seining in Southeast in 1981? (circle one)

a. yes b. [no]

a. If yes, about what percentage of your TOTAL time spent purse seining did you use the second vessel? ________

PLEASE USE THIS SPACE FOR YOUR COMMENTS

Please return the survey in the enclosed envelope to:

ALASKA SEAGRANT PROGRAM 2010323
UNIVERSITY OF ALASKA
303 TANANA DRIVE
FAIRBANKS, AK 99701

Alaska Sea Grant Program

The United Fishermen of Alaska and United Southeast Alaska Gillnetters, assisted by the Alaska Sea Grant Program, are conducting a survey of fishermen who participated in the Southeast Alaska drift gillnet fishery in 1981. Information from this survey will be provided for public release <u>in summary form only</u>. Be assured <u>all</u> information you provide will be held in strictest confidence. Respondents need not include their name, vessel name, or ADF&G number.

INSTRUCTIONS: Please try to answer every question as completely as possible. Except where noted, all questions refer to your Southeast Alaska salmon drift gillnet activities only.

I. VESSEL AND GEAR INFORMATION. (If you drift gillnetted for salmon in Southeast Alaska with more than one vessel in 1981, just fill out information for your PRINCIPAL vessel-the one you used the most).

1. Register length ________ ft

2. Gross tons ________ tons

3. Main engine: horsepower ________ hp
   (circle one) a. gas b. diesel
   (circle one) c. inboard d. outboard

4. Hull Construction: (circle one)
   a. wood b. aluminum c. steel
   d. ferro-cement e. Fiberglas

5. Year Built 19________

6. Hold capacity in cubic feet: ________ cu.ft.

7. Did you usually deliver: (circle one)
   a. shore-side b. to a tender on the grounds

8. Method of holding product: (circle one)
   a. chilled seawater (slush ice) b. refrigerated seawater
   c. ice d. other (please list) ________

9. <u>Vessel Electronics</u>: (circle the items your vessel has, and list the <u>number</u> of radios)
   a. Auto pilot b. Radar c. Radios (number ________)
   d. Loran (A or C) e. Sidescan Sonar f. Other (please list)
   g. Fathometer: paper recorder h. Fathometer: flasher ________

10. What is the approximate TOTAL VALUE of your vessel's <u>electronic equipment</u>? (That is, what could you <u>sell</u> the equipment for today?) $________

11. What is the approximate TOTAL VALUE of your vessel's <u>fishing equipment</u> (including nets and lines, net drum, etc.)? $________

12. What is the approximate TOTAL VALUE of your <u>vessel</u>, <u>including</u> its electronics and fishing gear? (Again, what could you <u>sell</u> your vessel for today?) $________

13. you <u>own</u> the vessel you fished with? (circle one) a. yes b. no

PLEASE TURN THE PAGE AND CONTINUE

a. If you don't own the vessel you fished with, did you lease it? (circle one) a. yes b. r

b. What were your lease costs (if any) for Southeast drift gillnetting in 1981? (put zero if you had no lease costs) $ ______

14. Were you SKIPPER of the vessel? (circle one) a. yes b. r

15. What is the vessel's approximate FUEL CONSUMPTION RATE: while running? ______ gal./hr

while fishing? ______ gal./hr

16. What is the city or town of your permanent residence? ______

17. What were your TOTAL 1981 gross earnings with your PRINCIPAL vessel in all fisheries? $ ______

a. About how much of this was earned in the Southeast Alaska drift gillnet fishery? $ ______

18. Did you participate in OTHER fisheries as a crewman? (circle one) a. yes b. nc

a. If yes, please list the fisheries ______

b. What was your TOTAL CREWSHARE from these fisheries (net of deductions)? $ ______

9. Do you currently work in a nonfishing occupation during the off-season from fishing? (circle one) a. yes b.

a. If yes, how many months per year? ______ mos./y

b. What was the approximate gross pay per month for your non-fishing occupation (before taxes)? $ ______ /m

II. COSTS. All of the questions below refer to your 1981 drift gillnet activities and th PRINCIPAL vessel you used for drift gillnetting.

20. Variable Costs. Sometimes these costs are shared by skipper and crew. For each item would you indicate both the TOTAL SEASON COST for drift gillnetting in 1981 and the t amount PER MAN paid by each of the crew? (Don't include skipper's portion.) Be sure include amounts withheld by processors, and please put zeros in where costs were zero

	TOTAL SEASON COST	AMOUNT PER MAN PAID CREW, EXCLUDING SKIP
a. food and galley costs	$ ______	$ ______
b. fuel, oil, filters	$ ______	$ ______
c. ice costs	$ ______	$ ______
d. gear repair (just put costs for repair of existing gear here - purchase of NEW gear goes under question 22(h))	$ ______	$ ______
e. Aquaculture Association assessment	$ ______	$ ______

	TOTAL SEASON COST	AMOUNT PER MAN PAID BY CREW, EXCLUDING SKIPPER
f. Other (please list ________________)	$ ________	$ ________

21. Labor Costs.

a. What was your typical crew size, INCLUDING skipper, for drift gill-netting in 1981? (Also include family members and unpaid crew.) ________ persons

b. How many were unpaid crew members? (If none, please put zero.) ________ persons

c. What was the average percentage CREW share per man for paid crew? ________ %

d. How was it calculated? (circle one)

(1) percentage of gross ex-vessel value of the catch

(2) deductions from question 20 subtracted first, then a percent share

(3) other (please list ________________________________)

e. What was the SKIPPER share? ________ %

22. Fixed costs for your PRINCIPAL drift gillnetting vessel in 1981. Please include just your out-of-pocket costs for these items. (If you performed the work yourself, don't include the value of your labor). Be sure to put zeros where costs were zero.

a. General (minor) vessel repairs and maintenance $ ________

b. Major vessel repairs (to the engine, shaft, keel, etc.) $ ________

c. Insurance (for hull, P&I, etc.) $ ________

d. Vessel moorage and gear storage $ ________

e. Fishing licenses (permit renewal fees, vessel licenses, etc.) $ ________

f. Fishermen's association dues $ ________

g. Fishing business expenses (may include office-related, legal, accounting, travel, freight, vehicle expenses, etc.) $ ________

h. Your costs of acquiring or replacing major items of equipment and electronics for your business in 1981 (such as net drum, new engine, office equipment, etc.) $ ________

i. Miscellaneous supplies (clothing, cables, knives, rope, etc.) and other costs not covered above $ ________

PLEASE CONTINUE ON REVERSE SIDE

III. FISHERY PARTICIPATION. Except as noted, these questions refer to your fishing activities with your principal drift gillnetting vessel. If you used more than one vessel for Southeast salmon drift gillnetting in 1981, please respond only for fishing activities with your PRINCIPAL vessel (the one you used the most).

23. What was your TOTAL number of VESSEL OPERATING HOURS logged with your principal vessel in the 1981 Southeast Alaska salmon drift gillnet fishery? (This should INCLUDE transit to and from fishing areas as well as actual fishing time.) ________ hc

a. What was the total number of vessel operating hours you actually fished your gear in the 1981 Southeast drift gillnet fishery? ________ hc

24. How many TOTAL VESSEL OPERATING HOURS did you log IN ALL FISHERIES with your PRINCIPAL drift gillnetting vessel? ________ hc

25. How many DIFFERENT DAYS did you actually have your gear in the water drift gillnetting? ________ d

26. Did you run outside Southeast Alaska with your principal drift gillnetting vessel in 1981? (To bring your vessel in from another area; for repairs and maintenance, etc.) (circle one) a. yes b.

a. If yes, about how many TOTAL running hours did this take? ________ hc

27. Did you use a second vessel for salmon drift gillnetting in Southeast in 1981? (circle one) a. yes b.

a. If yes, about what percentage of your TOTAL time spent drift gillnetting did you use the second vessel? ________

PLEASE USE THIS SPACE FOR YOUR COMMENTS

Please return the survey in the enclosed envelope to:

ALASKA SEAGRANT PROGRAM 303.205
UNIVERSITY OF ALASKA
303 TANANA DRIVE
FAIRBANKS, AK 99701

United Fishermen of Alaska — I Vote Fish

Alaska Sea Grant Program

The United Fishermen of Alaska, assisted by the Alaska Sea Grant Program, is conducting a survey of fishermen who participated in the Alaska hand troll fishery in 1981. Information from this survey will be provided for public release in summary form only. Be assured all information you provide will be held in strictest confidence. Respondents need not include their name, vessel name, or ADF&G number.

INSTRUCTIONS: Please try to answer every question as completely as possible. Except where noted, all questions refer to your Alaska salmon hand troll activities only.

I. VESSEL AND GEAR INFORMATION. (If you hand trolled for salmon in Alaska with more than one vessel in 1981, just fill out information for your PRINCIPAL vessel-the one you used the most).

1. Register length ________ ft

2. Gross tons ________ tons

3. Main engine: horsepower ________ hp
   (circle one) a. gas b. diesel
   (circle one) c. inboard d. outboard

4. Hull Construction: (circle one)
   a. wood b. aluminum c. steel
   d. ferro-cement e. Fiberglas

5. Year Built 19________

6. Hold capacity in cubic feet: ________ cu.ft.

7. Did you usually deliver: (circle one)
   a. shore-side b. to a tender on the grounds

8. Method of holding product: (circle one)
   a. chilled seawater (slush ice) b. refrigerated seawater
   c. ice d. other (please list) ________________

9. Vessel Electronics: (circle the items your vessel has, and list the number of radios)
   a. Auto pilot b. Radar c. Radios (number ________)
   d. Loran (A or C) e. Sidescan Sonar f. Other (please list)
   g. Fathometer: paper recorder h. Fathometer: flasher ________________

10. What is the approximate TOTAL VALUE of your vessel's electronic equipment? (That is, what could you sell the equipment for today?) $________

11. What is the approximate TOTAL VALUE of your vessel's fishing equipment (including outriggers, gurdies, lines and weights, tackle, etc.)? $________

12. What is the approximate TOTAL VALUE of your vessel, including its electronics and fishing gear? (Again, what could you sell your vessel for today?) $________

13. ' you own the vessel you fished with? (circle one) a. yes b. no

PLEASE TURN THE PAGE AND CONTINUE

a. If you don't own the vessel you fished with, did you lease it? (circle one)

a. yes b.

b. What were your lease costs (if any) for Alaska hand trolling in 1981? (put zero if you had no lease costs)

$ ____

14. Were you SKIPPER of the vessel? (circle one)

a. yes b.

15. What is the vessel's approximate FUEL CONSUMPTION RATE: while running? ____ gal./

while trolling? ____ gal./

16. What is the city or town of your permanent residence? ____

17. What were your TOTAL 1981 gross earnings with your PRINCIPAL vessel in all fisheries?

$ ____

a. About how much of this was earned in the Alaska hand troll fishery?

$ ____

18. Did you participate in OTHER fisheries as a crewman? (circle one) a. yes b.

a. If yes, please list the fisheries ____

b. What was your TOTAL CREWSHARE from these fisheries (net of deductions)?

$ ____

19. Do you currently work in a nonfishing occupation during the off-season from fishing? (circle one)

a. yes b.

a. If yes, how many months per year? ____ mos./y

b. What was the approximate gross pay per month for your non-fishing occupation (before taxes)?

$ ____ m

II. COSTS. All of the questions below refer to your 1981 hand troll activities in Alaska the PRINCIPAL vessel you used for hand trolling.

20. Variable Costs. Sometimes these costs are shared by skipper and crew. For each item would you indicate both the TOTAL SEASON COST for hand trolling in 1981 and the total amount PER MAN paid by each of the crew? (Don't include skipper's portion.) Be sure include amounts withheld by processors, and please put zeros in where costs were zero

	TOTAL SEASON COST	AMOUNT PER MAN PAID CREW, EXCLUDING SKIP
a. food and galley costs	$ ____	$ ____
b. fuel, oil, filters	$ ____	$ ____
c. ice and bait costs	$ ____	$ ____
d. gear repair (just put costs for repair of existing gear here - purchase of NEW gear goes under question 22(h))	$ ____	$ ____
e. Aquaculture Association assessment	$ ____	$ ____

	TOTAL SEASON COST	AMOUNT PER MAN PAID BY CREW, EXCLUDING SKIPPE
f. Other (please list ________________)	$ ________	$ ________

. Labor Costs.

a. What was your typical crew size, INCLUDING skipper, for hand trolling in 1981? (Also include family members and unpaid crew.) ________ person

b. How many were unpaid crew members? (If none, please put zero.) ________ person

c. What was the average percentage CREW share per man for paid crew? ________

d. How was it calculated? (circle one)

(1) percentage of gross ex-vessel value of the catch

(2) deductions from question 20 subtracted first, then a percent share

(3) other (please list ________________________________

e. What was the SKIPPER share? ________

22. Fixed costs for your PRINCIPAL hand trolling vessel in 1981. Please include just your out-of-pocket costs for these items. (If you performed the work yourself, don't includ the value of your labor). Be sure to put zeros where costs were zero.

a. General (minor) vessel repairs and maintenance $ ________

b. Major vessel repairs (to the engine, shaft, keel, etc.) $ ________

c. Insurance (for hull, P&I, etc.) $ ________

d. Vessel moorage and gear storage $ ________

e. Fishing licenses (permit renewal fees, vessel licenses, etc.) $ ________

f. Fishermen's association dues $ ________

g. Fishing business expenses (may include office-related, legal, accounting, travel, freight, vehicle expenses, etc.) $ ________

h. Your costs of acquiring or replacing major items of equipment and electronics for your business in 1981 (such as gurdies, new engine, office equipment, etc.) $ ________

i. Miscellaneous supplies (clothing, cables, knives, rope, etc.) and other costs not covered above $ ________

PLEASE CONTINUE ON REVERSE SIDE

III. FISHERY PARTICIPATION. Except as noted, these questions refer to your fishing activities <u>with your principal hand trolling vessel</u>. If you used more than one vessel for salmon hand trolling in Alaska in 1981, please respond <u>only</u> for fishing activities with your PRINCIPAL vessel (the one you used the most).

What was your TOTAL number of VESSEL OPERATING HOURS logged with your principal vessel in the 1981 Alaska salmon hand troll fishery? (This should INCLUDE <u>transit to and from fishing areas</u> as well as actual trolling time.) ________ hours

a. What was the total number of vessel operating hours you actually <u>fished your gear</u> in the 1981 hand troll fishery? ________ hours

24. How many <u>TOTAL</u> VESSEL OPERATING HOURS did you log <u>IN ALL FISHERIES</u> with your PRINCIPAL hand trolling vessel? ________ hours

25. How many DIFFERENT DAYS did you actually <u>have your gear in the water</u> hand trolling? ________ days

26. Did you run outside Southeast Alaska with your principal hand trolling vessel in 1981? (To bring your vessel in from another area; for repairs and maintenance, etc.) (circle one) a. yes b. no

a. If yes, about how many TOTAL running hours did this take? ________ hours

27. Did you use a <u>second</u> vessel for salmon hand trolling in Alaska in 1981? (circle one) a. yes b. no

a. If yes, about what percentage of your TOTAL time spent hand trolling did you use the second vessel? ________ %

PLEASE USE THIS SPACE FOR YOUR COMMENTS

Please return the survey in the enclosed envelope to:

ALASKA SEAGRANT PROGRAM [illegible]
UNIVERSITY OF ALASKA
[illegible] TANANA DRIVE
FAIRBANKS, AK 99701

Alaska Trollers Association

The United Fishermen of Alaska and Alaska Trollers Association, assisted by the Alaska Sea Grant Program, are conducting a survey of fishermen who participated in the Alaska power troll fishery in 1981. Information from this survey will be provided for public release in summary form only. Be assured all information you provide will be held in strictest confidence. Respondents need not include their name, vessel name, or ADF&G number.

INSTRUCTIONS: Please try to answer every question as completely as possible. Except where noted, all questions refer to your Alaska salmon power troll activities only.

I. VESSEL AND GEAR INFORMATION. (If you power trolled for salmon in Alaska with more than one vessel in 1981, just fill out information for your PRINCIPAL vessel-the one you used the most).

1. Register length ________ ft

2. Gross tons ________ tons

3. Main engine: horsepower ________ hp
   (circle one) a. gas b. diesel
   (circle one) c. inboard d. outboard

4. Hull Construction: (circle one)
   a. wood b. aluminum c. steel
   d. ferro-cement e. Fiberglas

5. Year Built 19________

6. Hold capacity in cubic feet: ________ cu.ft.

7. Did you usually deliver: (circle one)
   a. shore-side b. to a tender on the grounds

8. Method of holding product: (circle one)
   a. chilled seawater (slush ice) b. refrigerated seawater
   c. ice d. other (please list) ________________

9. Vessel Electronics: (circle the items your vessel has, and list the number of radios)
   a. Auto pilot b. Radar c. Radios (number ________)
   d. Loran (A or C) e. Sidescan Sonar f. Other (please list)
   g. Fathometer: paper recorder h. Fathometer: flasher ________________

10. What is the approximate TOTAL VALUE of your vessel's electronic equipment? (That is, what could you sell the equipment for today?) $________

11. What is the approximate TOTAL VALUE of your vessel's fishing equipment (including outriggers, gurdies, lines and weights, tackle, etc.)? $________

12. What is the approximate TOTAL VALUE of your vessel, including its electronics and fishing gear? (Again, what could you sell your vessel for today?) $________

Do you own the vessel you fished with? (circle one) a. yes b. no

PLEASE TURN THE PAGE AND CONTINUE

a. If you don't own the vessel you fished with, did you lease it? (circle one) a. yes b. no

b. What were your lease costs (if any) for power trolling in 1981? (put zero if you had no lease costs) $ ________

14. Were you SKIPPER of the vessel? (circle one) a. yes b. no

15. What is the vessel's approximate FUEL CONSUMPTION RATE:
while running? (at about 8 knots) ________ gal./hr.

while trolling? (at about 2 knots) ________ gal./hr.

16. What is the city or town of your permanent residence? ________

17. What were your TOTAL 1981 gross earnings with your PRINCIPAL vessel in all fisheries? $ ________

a. About how much of this was earned in the Alaska power troll fishery? $ ________

18. Did you participate in OTHER fisheries as a crewman? (circle one) a. yes b. no

a. If yes, please list the fisheries ________________________

b. What was your TOTAL CREWSHARE from these fisheries (net of deductions)? $ ________

Do you currently work in a nonfishing occupation during the off-season from fishing? (circle one) a. yes b. no

a. If yes, how many months per year? ________ mos./yr.

b. What was the approximate gross pay per month for your non-fishing occupation (before taxes)? $ ________ mo.

II. COSTS. All of the questions below refer to your 1981 power troll activities in Alaska and the PRINCIPAL vessel you used for power trolling.

20. Variable Costs. Sometimes these costs are shared by skipper and crew. For each item, would you indicate both the TOTAL SEASON COST for power trolling in 1981 and the total amount PER MAN paid by each of the crew? (Don't include skipper's portion.) Be sure t include amounts withheld by processors, and please put zeros in where costs were zero.

	TOTAL SEASON COST	AMOUNT PER MAN PAID BY CREW, EXCLUDING SKIPPE
a. food and galley costs	$ ________	$ ________
b. fuel, oil, filters	$ ________	$ ________
c. ice and bait costs	$ ________	________
d. gear repair (just put costs for repair of existing gear here - purchase of NEW gear goes under question 22(h))	$ ________	$ ________
e. Aquaculture Association assessment	$ ________	$ ________

	TOTAL SEASON COST	AMOUNT PER MAN PAID BY CREW, EXCLUDING SKIPPER
f. Other (please list ____________)	$ ________	$ ________

Labor Costs.

a. What was your typical crew size, INCLUDING skipper, for power trolling in 1981? (Also include family members and unpaid crew.) ________ persons

b. How many were unpaid crew members? (If none, please put zero.) ________ persons

c. What was the average percentage CREW share per man for paid crew? ________

d. How was it calculated? (circle one)

(1) percentage of gross ex-vessel value of the catch

(2) deductions from question 20 subtracted first, then a percent share

(3) other (please list ____________________

e. What was the SKIPPER share? ________

22. Fixed costs for your PRINCIPAL power trolling vessel in 1981. Please include just your out-of-pocket costs for these items. (If you performed the work yourself, don't include the value of your labor). Be sure to put zeros where costs were zero.

a. General (minor) vessel repairs and maintenance $ ________

b. Major vessel repairs (to the engine, shaft, keel, etc.) $ ________

c. Insurance (for hull, P&I, etc.) $ ________

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f. Fishermen's association dues $ ________

g. Fishing business expenses (may include office-related, legal, accounting, travel, freight, vehicle expenses, etc.) $ ________

h. Your costs of acquiring or replacing major items of equipment and electronics for your business in 1981 (such as gurdies, new engine, office equipment, etc.) $ ________

i. Miscellaneous supplies (clothing, cables, knives, rope, etc.) and other costs not covered above $ ________

PLEASE CONTINUE ON REVERSE SIDE

III. FISHERY PARTICIPATION. Except as noted, these questions refer to your fishing activiti with your principal power trolling vessel. If you used more than one vessel for salmon power trolling in Alaska in 1981, please respond only for fishing activities with your PRINCIPAL vessel (the one you used the most).

23. What was your TOTAL number of VESSEL OPERATING HOURS logged with your principal vessel in the 1981 Alaska salmon power troll fishery? (This should INCLUDE transit to and from fishing areas as well as actual trolling time.) ________ hour

   a. What was the total number of vessel operating hours you actually fished your gear in the 1981 power troll fishery? ________ hour

24. How many TOTAL VESSEL OPERATING HOURS did you log IN ALL FISHERIES with your PRINCIPAL power trolling vessel? ________ hour

25. How many DIFFERENT DAYS did you actually have your gear in the water power trolling? ________ day

26. Did you run outside Southeast Alaska with your principal power trolling vessel in 1981? (To bring your vessel in from another area; for repairs and maintenance, etc.) (circle one) a. yes b. n

   a. If yes, about how many TOTAL running hours did this take? ________ hour

27. Did you use a second vessel for salmon power trolling in Alaska in 1981? (circle one) a. yes b. n

   a. If yes, about what percentage of your TOTAL time spent power trolling did you use the second vessel? ________

PLEASE USE THIS SPACE FOR YOUR COMMENTS

Please return the survey in the enclosed envelope to:

ALASKA SEAGRANT PROGRAM 21 ...
UNIVERSITY OF ALASKA
... TANANA DRIVE
FAIRBANKS, AK 99701

NORTH PACIFIC FISHERY MANAGEMENT COUNCIL

Other Council Documents Available

1 REPORT OF THE HALIBUT WORKING GROUP 8/16/77

2 PROCEDURES FOR SOCIOECONOMIC DATA NEEDS AND DETERMINATION OF OPTIMUM YIELDS IN FISHERY MANAGEMENT PLANS 3/8/78

3 THE SOCIAL AND ECONOMIC IMPACTS OF A COMMERCIAL HERRING FISHERY ON THE VILLAGES OF THE ARCTIC/YUKON/KUSKOKWIM AREA 9/15/78

4 INVESTIGATIONS ON THE CONTINENTAL ORIGIN OF SOCKEYE AND COHO SALMON IN THE AREA OF THE JAPANESE LAND-BASED FISHERY 10/1/78

5 EFFECTS OF HYDRAULIC CLAM HARVESTING IN THE BERING SEA 5/79

6 SOCIOECONOMIC DATA: COLLECTION AND ANALYSIS FOR USE IN FISHERY MANAGEMENT PLANS 8/23/79

7 PRIORITIES FOR SOCIOECONOMIC DATA COLLECTION AND ANALYSIS FOR USE IN FISHERY MANAGEMENT PLANS 1/80

8 ASSESSMENT OF SPAWNING HERRING AND CAPELIN STOCKS AT SELECTED COASTAL AREAS IN THE EASTERN BERING SEA 4/80

9 KEYPUNCHING AND ANALYSIS OF HALIBUT FISH TICKETS 7/80

#10 MARKET ASPECTS OF THE FOREIGN ALLOCATION OF C. OPILIO TANNER CRAB IN THE BERING SEA UNDER THE FRAMEWORK OF THE FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976 10/16/80

#11 OCEAN SALMON MICRO-WIRE TAG RECOVERY PROGRAM 11/80

#12 HALIBUT/CRAB POT STUDY 1/81

#13 REDUCING THE INCIDENTAL CATCH OF PROHIBITED SPECIES BY FOREIGN GROUNDFISH FISHERIES IN THE BERING SEA 4/81

#14 THE APPLICABILITY OF LIMITED ENTRY TO THE ALASKA HALIBUT FISHERY 4/81

#15 A STUDY OF THE OFFSHORE CHINOOK AND COHO SALMON FISHERY OFF ALASKA 4/81

#16 AN OBSERVER PROGRAM FOR THE DOMESTIC GROUNDFISH FISHERY IN THE GULF OF ALASKA AND BERING SEA/ALEUTIAN ISLANDS 12/80

#17 ANALYSIS OF SOUTHEASTERN ALASKA TROLL FISHERIES DATA 5/81

#18 SEASONAL USE AND FEEDING HABITS OF WALRUSES IN THE PROPOSED BRISTOL BAY CLAM FISHERY AREA 11/81

#19 FEEDING HABITS, FOOD REQUIREMENTS, AND STATUS OF BERING SEA MARINE MAMMALS 11/1/82

#19a ANNOTATED BIBLIOGRAPHY OF FEEDING HABITS, FOOD REQUIREMENTS, AND STATUS OF BERING SEA MARINE MAMMALS 11/1/82

#20 LIMITED ENTRY IN THE PACIFIC HALIBUT FISHERY: THE INDIVIDUAL QUOTA OPTION 12/83

#20a NPFMC STAFF SYNOPSIS OF DOCUMENT #20 6/20/83

#21 GULF OF ALASKA PROHIBITED SPECIES WORKING GROUP PHASE I REPORT 9/23/83

#22 FINAL REPORT, CRAB OBSERVER PROGRAM IN THE SOUTHEASTERN BERING SEA (DEC. 1983)

#23 PROJECTIONS OF DOMESTIC FLEET AND EFFORT REQUIRED TO HARVEST THE ALASKA GROUNDFISH OPTIMUM YIELD MARCH 1984

#24 AN ECONOMIC PROFILE OF THE SOUTHEAST ALASKA SALMON FISHERY 2/84