INCOME ESTIMATES AND REASONABLE RETURNS IN ALASKA'S SALMON FISHERIES[1]

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ABSTRACT

Earnings in some fisheries may fall to a level that is unacceptable from the viewpoint of public policy. Using the Alaska salmon fisheries as an example, this paper examines a method for establishing the number of operating units that will provide a reasonable economic return in a fishery. Estimates are provided of the rates of return that can be expected with various numbers of operating units. Three criteria are then developed to determine a reasonable rate of return. These criteria include: 1) a comparison with wages in a similar industry in an equal time period, 2) a comparison with total annual incomes from all sources with total incomes of workers in other occupations, and 3) an estimate provided by fishermen themselves. These three different measures indicate an optimum number of operating units within a fairly narrow range. In some fisheries it appears that substantial reductions in the number of fishing units will not be sufficient to raise incomes to an "acceptable" level. This raises questions about the allocation of valuable fishery resources among various user groups.

During the last two decades economists have developed a general theory of a common property fishery under conditions of open access. The salient implications of that theory are that: 1) there is a danger that the resource will be fished beyond maximum sustained yield, 2) the resource will not be harvested with maximum economic efficiency, and 3) there will be a misallocation of productive factors between the fishing sector and other sectors of the economy (Crutchfield and Pontecorvo 1969). Empirical research has shown that there may be a fourth consequence of open access that is not adequately dealt with in the theoretical literature. This is the fact that earnings of fishermen under conditions of open access may fall below a level that is acceptable from the viewpoint of public policy (Sinclair 1960; Owers 1974; Huq[3]; Smith[4]). The public interest arises from the fact that poor earnings have been responsible for creating sanitation, health, safety, and other hazards; that programs providing government assistance for fishermen are becoming increasingly expensive; and that in many cases commercial users can no longer afford to pay their share of management costs. The cause of the problem appears to be the very low opportunity costs of fishermen who have only an avocational interest in fishing or else have little mobility and limited access to alternative employment.

Data collected by interview and from landing records indicate that 44% of the purse seiners, 15% of the drift gill netters, and 60% of the set gill netters in Alaska showed a net loss in 1973 (Smith et al.[5]). In the same year, the average net return to the more than 6,400 gear operators who participated in those salmon fisheries which now have limited entry was about $1,600 per gear operator.

Recognition of the recurring problems created by low earnings in many of the state's fisheries led Alaska to pass the first comprehensive limited entry law in the United States in 1973. The law directs an independent commission to stabilize or reduce the number of legal units of gear that can be fished in those fisheries where economic or biological conditions require it. Specifically the law states the following must be considered in establishing an economically sound number of entry permits: "The number of entry permits sufficient to maintain an economically healthy fishery that will result in a reasonable average

[1]The opinions and conclusions set forth in this paper are not those of the Commercial Fisheries Entry Commission nor the State of Alaska.

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[3]Huq, A. M. 1971. A study of the economic impact of changes in the harvesting labor force in the Maine lobster fishery. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., contract 14-17-007-1121, Wash., D.C., 34 p.

[4]Smith, F. S. 1974. 1972 commercial fishermen survey. Dep. Agric. Econ., Oreg. State Univ., Corvallis, 7 p.

[5]Smith, F. S., D. Liao, J. Martin, and P. Adelman. 1975. Profitability analysis for Alaska fishing businesses. Dep. Agric. Econ. Oreg. State Univ., Corvallis, 13 p.

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rate of economic return to the fisherman participating in that fishery considering time fished and necessary investments in vessels and gear . . . (Anonymous 1973a)." As used in the law and this discussion, a "fishery" refers to a specific combination of species, gear type, and management district. Figure 1 shows the salmon management districts in the state. An entry permit entitles the holder to operate a legal unit of gear in a fishery.

In 1974 entry was limited in the power troll fishery and all salmon net fisheries, with the exception of those in the Arctic, Yukon, and Kuskokwim management districts. This paper examines a procedure that can be used to evaluate the gear cutbacks that may be required to achieve "reasonable" earnings in these fisheries. Because the limited entry law seeks to achieve a balance among social objectives, biological management, and economics, the reductions suggested here, which consider only possible economic objectives, are not necessarily those which the law would require.

A detailed discussion of sample size, methodology, and other factors affecting the validity of data used can be obtained from several of the references cited at the end of the article. Further elaboration is not provided in the text, other than to briefly describe the data used and its source. It should be further recognized that it is not the purpose of this paper to present a rigorous mathematical definition of a problem, but rather to point out its general magnitude and direction.

ESTIMATING EXPECTED RETURNS IN THE SALMON FISHERIES

Several equations were used to estimate returns salmon fishermen might receive with various numbers of operating units in the fisheries. All the equations are presented below, followed by a more detailed description of the variables. Table 1 summarizes the input data used in the equations. To estimate gross returns per operating unit in each fishery, the following equation was used:

$$G = \frac{T \cdot (1 + S)}{P \cdot E} \quad (1)$$

where G is the gross return per fishing unit in the particular fishery; T is the total exvessel revenue paid to all fishermen in that particular fishery; S is the percent of revenue paid as bonus payments to fishermen; P is the percent of entry permits actually used in a particular fishery; and E is the total number of entry permits outstanding.

To estimate net returns per entry permit holder, exclusive of opportunity costs of capital, the following equation was used:

$$N_1 = G - \frac{T \cdot L}{P \cdot E} - C \quad (2)$$

where N_1 is net return not including the opportunity cost of capital; L is the percent of total

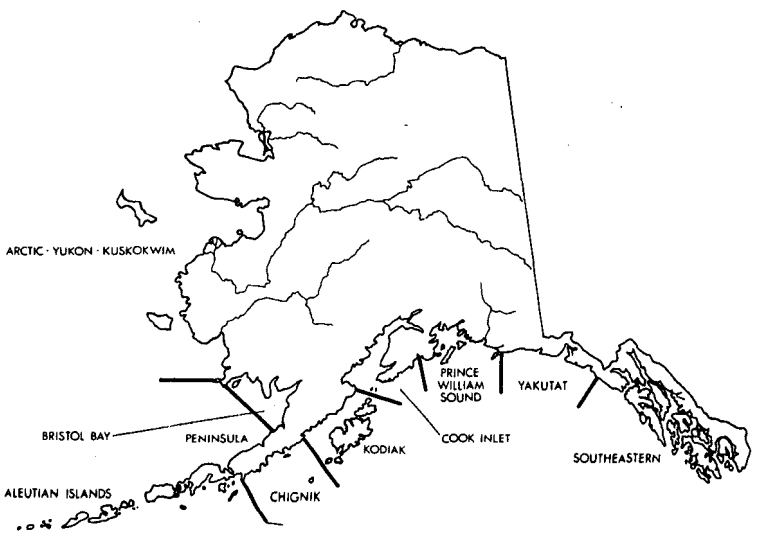

FIGURE 1.—Alaska salmon management areas.

TABLE 1.—Input data used to generate estimates of fishermen's incomes by fishery.

Fishery	Total exvessel revenue (T) in thousands[1]	Costs (C) per operating unit[2]	Crew share (L) [fraction of T paid][2]	Net earnings from other fisheries (X)[2]	Market value of investment (I)[2]	Fraction of gross return earned in other fisheries (F)[2]	Estimated fraction of permits actually (P) fished[3]	Earnings from nonfishing sources (O)[4]	Bonus payments (S) [fraction of T][2]	No. of entry permits issued (E)
Purse seine:										
Southeast	$9,750	$10,279	0.500	$7,390	$91,212	0.46	0.87	$4,155	0.196	395
Prince Wm Sound	4,385	5,804	.450	2,128	39,592	.31	.89	3,016	—	238
Cook Inlet	467	4,506	.510	2,607	33,657	.37	.61	4,343	.004	68
Kodiak	5,947	4,805	.430	—	37,902	.33	.91	4,685	.019	368
Chignik	2,541	10,213	.420	—	66,307	.18	.95	2,007	.045	80
Peninsula-Aleutians	1,603	1,627	.340	8,703	51,473	.74	.78	4,061	—	111
Drift gill net:										
Southeast	4,404	4,381	.072	2,583	27,254	.12	.74	4,012	.092	453
Prince Wm Sound	3,063	4,436	.058	879	15,642	.23	.79	1,906	.024	511
Cook Inlet	2,235	2,744	.176	589	15,254	.17	.67	2,501	.029	545
Peninsula-Aleutians	1,526	3,780	.092	1,171	23,428	.22	.83	1,925	—	155
Bristol Bay	13,933	1,879	.380	—	11,548	.12	.85	3,378	—	1,669
Set gill net:										
Yakutat	476	[5]2,930	—	—	[5]8,223	—	.82	1,632	—	150
Prince Wm Sound	119	[5]2,930	—	—	[5]8,223	—	.68	3,540	—	32
Cook Inlet	1,508	2,930	—	—	8,223	—	.71	3,874	.002	686
Kodiak	459	2,590	—	—	8,139	—	.83	1,511	.050	183
Peninsula-Aleutians	226	1,485	—	—	4,317	—	.48	318	—	77
Bristol Bay	1,248	1,021	—	—	1,758	—	.78	473	—	803
Power troll:										
Statewide	5,290	3,580	.272	2	33,002	.36	.88	3,439	.026	895

[1]Computed from landing records of the Alaska Department of Fish and Game for the years 1969–73. Adjusted by Wholesale Price Index using 1973 as a base year.
[2]Information gathered from a cost survey of Alaskan fishermen (Source: Owers 1974).
[3]Computed from landing records and license files of the Alaska Department of Fish and Game for the years 1969–72.
[4]Information gathered from a random sample of gear license holders. Reported from Internal Revenue Service in confidential format that did not reveal individual identities.
[5]No reliable data. Data from Cook Inlet used as an approximation.

exvessel revenue paid to crewmembers, exclusive of the entry permit holder; and C is expenses per vessel.

To estimate net returns to the entry permit holder, including the opportunity cost of capital, the following equation was used:

$$N_2 = N_1 - A \cdot B \cdot I \cdot (1 - F) - 2 \cdot N_1 \cdot B \quad (3)$$

where N_2 is the net return less opportunity capital costs; A is a constant term used to deflate the average value of investment; B is a constant used for the opportunity cost of capital; I is the average total value of investment per operating unit in the fishery as estimated by fishermen; and F is the percent of income received in other fisheries.

Finally, to estimate the entry permit holder's total annual income from all sources, the following equation was used:

$$Y = N_1 + X + O \quad (4)$$

where Y is total annual income; X is net earnings from other fisheries; and O is income earned from employment other than commercial fishing.

All these equations provide an estimate of the average rate of return per entry permit holder or operating unit in a particular fishery. Analysis of fish landings indicates that a large number of fishermen participate only a short period out of the total fishing time available. A study of returns in Alaska's fisheries shows there is evidence that the time an operator spends fishing is correlated with profit (Smith et al. see footnote 5). Therefore, the average rate of return discussed here is assumed to be the potential earnings of a fisherman who participates during the entire season in that particular fishery but, it is still likely that there will be some concentration of landings by top producers.

A further simplifying assumption in these equations is that the resource will be harvested at the same level of output with all the various numbers of operating units considered. Preliminary estimates provided by management biologists of the Alaska Department of Fish and Game indicate that the magnitude of cutbacks described in this paper would not affect the ability of the salmon fishing fleet to harvest at the maximum sustainable yield level (Jackman et al. 1973).

Base Period for Determining Total Exvessel Revenue

In the salmon fisheries total revenue fluctuates widely from year to year depending upon the size of the salmon runs and the price paid fishermen. In the analysis, the 5-yr period from 1969 to 1973 was used as the base period for determining the total revenue produced by the state's salmon fisheries. This period was used because it appears to be the most recent, reasonably representative period for which good data exist. The total catch value was adjusted for each year by the wholesale price index using 1973 as a base year.

It was assumed in estimating the total revenue produced by each fishery that regulatory decisions would seek to maintain an historical allocation among gear types. If a reduction in the size of the southeast drift gill net fleet were to occur, for example, it is assumed that no attempt would be made to reduce the percentage of the total catch available to this fishery. It was also assumed that gear reductions in one fishery would not be made without considering the effect on catches by other fisheries utilizing the same stock. For example, a large reduction in the Cook Inlet drift gill net fishery could lead to increased catches in the set gill net fishery if it is not reduced in some reasonable proportion.

Fixed and Variable Costs

Fishing costs include such standard items as fuel, food, repairs, moorage, administrative costs, and so forth. Average costs in each fishery were collected by means of a survey in spring 1974 (Owers 1974). For vessels fishing in several fisheries, costs were prorated among each fishery based upon the length of time fished and percent of total earnings received. Other items were specifically allocated, such as gear repairs.

Because there is presently so much excess capacity in the harvesting segment of the Alaska salmon fishery, it was assumed that the total cost of harvesting the resource was a linear function of the number of boats in the fishery. This logic is used in Equations (2), (3), and (4). While this might appear to be inconsistent with economic theory because fish production would be increased for each operating unit without increasing any factor of production, in reality it is likely that costs would decrease even faster than the number of operating units leaving the fishery. This is because overcrowding in the salmon fisheries involves frequent delays in setting nets and tangled gear, and forces operators to travel long distances to make all openings. Should substantial reductions take place in a fishery, consideration of increasing costs per boat would be necessary.

Depreciation has been standardized for all vessels to a 30-yr straight line writeoff with no salvage value. Depreciation for set net sites is standardized with a 10-yr writeoff since most equipment includes small skiffs and outboard motors with a shorter useful life span.

Labor Costs

Labor costs in the fisheries are determined by a share system and fluctuate directly in proportion to gross earnings. Crew shares are ordinarily computed before bonus payments are made to the boat operator. In the analysis, it was assumed that the entire bonus was kept by the entry permit holder, which is the logic used in Equation (2). Labor costs, as used here, do not include a return to the entry permit holder's own labor.

Capital Costs

The opportunity cost of capital is assumed to be 10% and is the constant value used in Equation (3). The estimated market value of each operating unit was used in determining capital investment in the fishing business. Average market values of vessels, equipment, and fishing gear were derived for each fishery by survey. It was found in surveys conducted by the British Columbia License Control Program that the true market value of vessels averaged about 84% of the estimated value supplied by fishermen (Campbell[6]). In this analysis it was assumed that the market value of investment was 85% of the value estimated by fishermen in the survey. This is the constant value used in Equation (3) to deflate the estimated value of investment.

In addition to vessels and gear, the capital investment in the freely transferable entry permit was included in estimating total capital costs. Theoretically the permit value might be calculated by discounting future cash flows or some

[6]Campbell, B. A. 1973. A review of the development of the buy-back program and its impact on the salmon fishery. Fish. Serv., Vancouver, B.C., 54 p.

other method of determining future benefits. The problem with this approach is that it involves making implicit assumptions about the worth of the operator's own contribution of labor and management and deducting this as an expense. As an approximation of permit value, it was assumed that the permit value would equal 2 years' net earnings for those remaining in the fishery, but further research is needed to determine actual values and the relationship between price and productivity. A preliminary survey of permit values after 6 mo of limited entry indicates permits may not be worth as much as the values used here (Anonymous 1975). Using the above relationship in Equation (3), however, the permit value will increase as the number of permits is reduced and capital costs per boat will rise.

Outside Earnings

Outside earnings come principally from two sources: earnings in other fisheries and earnings from nonfishing employment. Information on average earnings from outside employment for a randomly selected sample of gear operators who fished in 1971 and 1972 was provided by the Internal Revenue Service in a format which did not disclose individual identities (Anonymous[7]).

Data on earnings from other fisheries were extrapolated from fish price data, landing statistics, and by survey. It was assumed in the analysis that outside earnings in other fisheries would not be affected by limited entry and would remain constant, except in those instances where other fisheries produced a net loss. In those cases it was assumed that a fisherman would break even in other fisheries and the value of net earnings from other fisheries would be zero.

No data have been collected to determine how much gear operators may have earned as crewmembers in other fisheries, but it is not likely that this is a substantial amount since a fisherman responsible for a vessel in one fishery is most likely the operator in other fisheries as well. No reliable data has been collected on incomes of spouses, investment earnings, transfer payments, and pensions, so no estimates were included.

[7]Anonymous. 1975. Data collection and analysis necessary to limit entry in Alaska's salmon fisheries. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., contract 03-4-208-262, Juneau, 75 p.

Fraction of Permits Issued That Are Used

Because there is no requirement that a fisherman use his entry permit every fishing season, it can be expected that not all outstanding permits will be fished.

In the analysis, the fraction of gear licenses sold to gear licenses fished during the period from 1969 to 1972 was taken as the fraction of entry permits that would be used. It will be important to monitor actual rates of participation from year to year to establish more meaningful figures.

Examples of Estimates

Using the equations and input data discussed above, tables similar to that shown in Table 2 for the southeast Alaska purse seine fishery were prepared for all those salmon fisheries which had entry limited in 1974. In each fishery, returns were first calculated using the present number of entry permits issued in that fishery. Returns were then calculated for a hypothetical reduction in the number of outstanding permits by 5% increments of the total number issued. No calculations were prepared for greater than a 45% reduction in permits because many of the assumptions discussed above would probably no longer prove correct. Table 3 shows the four estimates of returns with the present number of entry permits in each of the fisheries considered.

OPERATING UNITS NECESSARY TO ACHIEVE REASONABLE RETURNS

Once expected returns with various numbers of

TABLE 2.—Expected returns in the southeast purse seine fishery with the present number of entry permits and reductions in the number by 5% increments. No estimates have been made for greater than a 45% reduction in the number of entry permits. Similar data was prepared for all those fisheries which had entry limited in 1974.

Number of permits	Expected gross earnings	Net earnings	Net earnings less interest at 10%	Total annual income from all sources
395	$33,933	$ 9,468	$ 3,388	$21,013
375	35,719	10,507	4,219	22,052
356	37,703	11,662	5,143	23,207
336	39,921	12,953	6,175	24,498
316	42,416	14,405	7,337	25,950
296	45,244	16,050	8,653	27,595
277	48,475	17,931	10,158	29,476
257	52,204	20,101	11,894	31,646
237	56,555	22,632	13,919	34,177
217	61,696	25,624	16,313	37,169

TABLE 3.—Estimated earnings per operating unit by fishery with the present number of entry permits.

Fishery	Gross return	Net return per entry permit holder with no allowance for capital costs	Net return per entry permit holder with opportunity capital cost of 10%	Total annual income from all sources per entry permit holder
Purse seine:				
Southeastern	$33,933	$9,468	$3,388	$21,013
Prince Wm Sound	20,702	5,582	2,143	10,726
Cook Inlet	11,303	1,056	−958	8,006
Kodiak	18,096	5,655	2,365	10,340
Chignik	34,939	10,683	3,925	12,690
Peninsula-Aleutians	18,515	10,593	7,337	23,357
Drift gill net:				
Southeastern	14,346	9,019	5,177	15,614
Prince Wm Sound	7,770	2,894	1,291	5,679
Cook Inlet	6,298	2,477	905	5,567
Peninsula-Aleutians	11,862	6,990	4,039	10,086
Bristol Bay	9,821	4,210	2,504	7,588
Set gill net:				
Yakutat	3,870	940	53	2,572
Prince Wm Sound	5,469	2,539	1,332	6,079
Cook Inlet	3,102	172	−561	4,046
Kodiak	3,173	583	−225	2,094
Peninsula-Aleutians	6,115	4,630	3,337	4,948
Bristol Bay	1,993	972	628	1,445
Power troll:				
Statewide	6,820	1,432	−650	4,873

operating units have been estimated, it is possible to compare these figures with similar data from other sectors of the economy. This provides some indication of the magnitude of cutbacks in fleet size that may be necessary to achieve similar earnings in the fisheries.

Comparison With Wages Earned in a Similar Industry

As a minimum, the average rate of return should be sufficient to cover all normal operating expenses, labor costs besides those of the operator, depreciation, and a minimum return on investment of about 10%. An amount less than this indicates that the average return to the operator's labor is actually zero or less than zero. As Table 3 shows, with the present number of operating units, returns in the Cook Inlet and Kodiak set net fisheries, the Cook Inlet purse seine fishery, and the power troll fishery are not adequate. In these four fisheries, returns under this assumption were negative.

It is reasonable to expect, however, that the fisheries should provide some wage for the operator's physical labor and ability to work with mechanical equipment under hazardous working conditions. The contract construction industry is similar to the fisheries in this respect, as well as the fact that work is highly seasonal and characterized by long periods of unemployment. The comparison used here assumes that a fisherman should earn a wage equal to that of a worker in the contract construction industry during the time he is actually fishing.

The time spent in each fishery was derived by an examination of the dates of fish landings. The number of weeks shown in Table 3 represents the typical maximum length of the season between 1969 and 1972. It is recognized that not all boats fish every opening in a season, but these figures also make no allowance for the time spent preparing vessels and gear, travelling to the fishing grounds prior to the season, or time spent storing and repairing gear at the close of the season. For this reason the figures are probably somewhat conservative. Prior to the construction boom created by the Alaska pipeline, the 1973 average weekly earnings of workers in the contract construction industry in Alaska was $378 per week (Anonymous 1973b). Table 4 shows the average wage earned in the construction industry in a period of time equal to the length of the fishing season. This is compared with the number of operating units that would provide an equal rate of return to the fisherman; which can then be compared to the number of operating units now licensed.

None of the large set net fisheries or the power troll fishery are capable of earning a comparable rate of return with even a 45% reduction of entry permits. The southeast and peninsula drift gill net fisheries would require some reduction and the other drift gill net fisheries including Bristol Bay, Cook Inlet, and Prince William Sound would require substantial reductions. The purse seine

TABLE 4.—Number of permits required to produce reasonable returns assuming earnings from fishery considered are equal to wages paid in an equal time period in contract construction. The average wage in contract construction in 1973 was $378 per week.

Fishery	Length of fishing season (weeks)	Average wage paid in equal time period in contract construction	No. of permits that would provide an equal return	Present no. of permits
Purse seine:				
Southeastern	14	$5,292	356	395
Prince Wm Sound	10	3,780	202	238
Cook Inlet	10	3,780	[1]37	68
Kodiak	12	4,536	258	368
Chignik	12	4,536	76	80
Peninsula-Aleutians	12	4,536	[2]111	111
Drift gill net:				
Southeastern	22	8,316	362	453
Prince Wm Sound	19	7,182	[1]281	511
Cook Inlet	9	3,402	327	545
Peninsula-Aleutians	13	4,914	147	155
Bristol Bay	11	4,158	1,252	1,669
Set gill net:				
Yakutat	17	6,426	[1]83	150
Prince Wm Sound	9	3,402	21	32
Cook Inlet	15	5,670	[1]377	686
Kodiak	12	4,536	[1]101	183
Peninsula-Aleutians	14	5,292	54	77
Bristol Bay	9	3,402	[1]442	803
Power troll:				
Statewide	23	8,692	[1]492	895

[1]Reasonable returns cannot be achieved with a 45% reduction in entry permits.
[2]Reasonable returns can be achieved with the present number of entry permits.

fisheries, with the exception of Cook Inlet, are capable of providing a comparable rate of return with either the present maximum number or a modest reduction.

Comparison With Total Annual Earnings of Nonfarm Workers

An equally important objective of limited entry may be to bring the total income of fishermen up to levels comparable to the average earned by all workers in Alaska. It has been tacitly accepted that earnings in the fisheries, particularly in areas where few other employment opportunities exist, can be lower than in other segments of the State's economy. The continuation of this policy in the future probably makes little sense. As Alaska's economy develops, a more reasonable approach is to provide vocational training to residents of the State in areas of traditionally high unemployment so they can find employment in other sectors of the economy. If this approach is not adopted, it can be expected that job openings in the future will continue to be filled by trained persons from outside the State. In achieving increased incomes from the fisheries it should also be pointed out that a reduction in entry permits under the Alaska law will be achieved through a voluntary buy back of permits and vessels spread over as many as 10 yr. Thus, older persons in the fisheries that would have trouble finding other employment need not be displaced. Furthermore, a person who voluntarily sells to a buy-back program will receive a cash settlement that will ease the transition period.

A comparison can be made with the average incomes earned in other employment in Alaska. Estimates of total income include income from other fisheries and nonfishing employment. Because of the seasonal nature of salmon fishing, it is anticipated that many permit holders will continue to seek other employment when it is available.

Statistics collected by the Alaska Department of Labor show that average nonagricultural wage and salary earnings in 1973 were $1,006/mo, or $12,072/yr (Anonymous 1973b). Table 5 compares the number of operating units in each fishery that would be required to provide fishermen with a level of earnings equal to the state average. It is assumed that any increase in earnings will come from the particular fishery being examined.

With the exception of the small Prince William Sound set net fishery, none of the set net fisheries, the Cook Inlet and Prince William Sound drift gill net fisheries, or the power troll fishery could provide this level of income with even a 45% reduction of entry permits. The purse seine fisheries, with the exception of Cook Inlet, and the southeastern and peninsula drift gill net fisheries would provide a reasonable income with either the present number of operating units or a modest reduction.

TABLE 5.—Number of permits required to produce reasonable returns assuming the total annual income from all sources of fishermen is equal to the average earnings of nonfarm wage and salaried workers in Alaska in 1973. Nonfarm wage and salaried workers earned $12,072 in 1973.

Fishery	No. of permits required to provide total annual income of $12,072	Present no. of permits
Purse seine:		
Southeastern	[1]395	395
Prince Wm Sound	[1]214	238
Cook Inlet	41	68
Kodiak	313	368
Chignik	[1]80	80
Peninsula-Aleutians	[1]111	111
Drift gill net:		
Southeastern	[1]453	453
Prince Wm Sound	[2]281	511
Cook Inlet	[2]300	545
Peninsula-Aleutians	132	155
Bristol Bay	918	1,669
Set gill net:		
Yakutat	[2]83	150
Prince Wm Sound	19	32
Cook Inlet	[2]377	686
Kodiak	[2]101	183
Peninsula-Aleutians	[2]42	77
Bristol Bay	[2]442	803
Power troll:		
Statewide	[2]492	895

[1]Reasonable returns can be achieved with the present number of entry permits.
[2]Reasonable returns cannot be achieved with a 45% reduction in entry permits.

TABLE 6.—Number of permits required to produce reasonable returns assuming expected gross earnings equal necessary gross earnings as estimated by fishermen.

Fishery	Reasonable gross return estimated by fishermen (thousands)	No. of permits required to provide equal level of earnings	Present no. of permits
Purse seine:			
Southeastern	$31.9	[1]395	395
Prince Wm Sound	26.9	178	238
Cook Inlet	24.2	[2]37	68
Kodiak	32.8	202	368
Chignik	39.5	72	80
Peninsula-Aleutians	12.2	[1]111	111
Drift gill net:			
Southeastern	22.6	294	453
Prince Wm Sound	19.6	[2]281	511
Cook Inlet	14.5	[2]300	545
Peninsula-Aleutians	17.9	101	155
Bristol Bay	16.4	1,001	1,669
Set gill net:			
Yakutat	14.9	[2]83	150
Prince Wm Sound	14.9	[2]18	32
Cook Inlet	14.9	[2]377	686
Kodiak	11.1	[2]101	183
Peninsula-Aleutians	7.8	62	77
Bristol Bay	12.4	[2]442	803
Power troll:			
Statewide	15.3	[2]492	895

[1]Reasonable returns can be achieved with the present number of entry permits.
[2]Reasonable returns cannot be achieved with a 45% reduction in entry permits.

Comparison With Estimates Provided by Fishermen

In addition to the two measures discussed so far, as part of a survey fishermen were asked to estimate what they needed to gross from fishing in a particular year in order to earn a reasonable return (Owers 1974). In Table 6 the mean value of responses for each fishery is shown with the corresponding number of entry permits that would yield an equal level of gross earnings.

In the power troll fishery, all the set gill net fisheries with the exception of the Alaska Peninsula, the drift gill net fisheries in Prince William Sound and Cook Inlet, and the Cook Inlet purse seine fishery, it would not be possible to earn a level of earnings considered reasonable by fishermen with even a 45% reduction in entry permits.

Several other fisheries would need some reduction in the amount of gear. The purse seine fisheries in southeastern, Chignik, and the Alaska Peninsula appear capable of earning a reasonable return with either the present number of entry permits or a slight reduction.

SUMMARY BY FISHERY OF THE COMPARISONS USED

It will be noticed in Table 7 that the three comparisons used provide an estimate of the optimum number of entry permits that falls within a fairly narrow range. The following summarizes the economic performance by type of fishery.

Purse Seine

Purse seining in general appears to be the most economically viable of the four types of salmon gear fished. This is due in part to the fact that purse seiners are used in a variety of fisheries, which allows overhead expenses to be spread, and minimizes risks in any one fishery. As can be seen in Table 1, this is particularly true of the purse seine fisheries in the Alaska Peninsula and southeastern Alaska where a substantial percentage of gross earnings comes from other fisheries. The Prince William Sound and Kodiak purse seine fisheries could justify a modest reduction, although income levels would be only slightly reduced with the present maximum number. The Cook Inlet purse seine fishery, which is restricted to a hand purse seine fishery, does not appear able to provide a reasonable return with the present number of entry permits under any of the criteria.

Drift Gill Net

Unlike the purse seine fishery, the typical vessel

TABLE 7.—Number of entry permits required to produce reasonable earnings—summary of three measures.

Fishery	Return to gear operator equal to average wage in contract construction	Total annual income of gear operator equal to annual income of nonfarm wage and salaried workers	Reasonable earnings estimated by fishermen	Present no. of permits
Purse seine:				
Southeastern	356	[1]395	[1]395	395
Prince Wm Sound	202	214	178	238
Cook Inlet	[2]37	41	[2]37	68
Kodiak	258	313	202	368
Chignik	76	[1]80	72	80
Peninsula-Aleutians	[1]111	[1]111	[1]111	111
Drift gill net:				
Southeastern	362	[1]453	294	453
Prince Wm Sound	[2]281	[2]281	[2]281	511
Cook Inlet	327	[2]300	[2]300	545
Peninsula-Aleutians	147	132	101	155
Bristol Bay	1,252	918	1,001	1,669
Set gill net:				
Yakutat	[2]83	[2]83	[2]83	150
Prince Wm Sound	21	19	[2]18	32
Cook Inlet	[2]377	[2]377	[2]377	686
Kodiak	[2]101	[2]101	[2]101	183
Peninsula-Aleutians	54	[2]42	62	77
Bristol Bay	[2]442	[2]442	[2]442	803
Power troll:				
Statewide	[1]492	[2]492	[2]492	895

[1]Reasonable returns can be achieved with the present number of entry permits.
[2]Reasonable returns cannot be achieved with a 45% reduction in entry permits.

used in the drift gill net fisheries is not generally used in other fisheries besides salmon. In the southeast drift gill net fishery the present level of income appears adequate. All measures indicate that the Prince William Sound and the Cook Inlet drift gill net fisheries require a reduction in the number of entry permits. With a 45% reduction, total income and a reasonable gross income as estimated by fishermen cannot be achieved.

The Alaska Peninsula drift gill net fishery would require a reduction under all three measures examined, although substantial reductions are not required.

The Bristol Bay drift net fishery would also require a gear reduction under all of the criteria examined.

Set Gill Net

Returns in all of the set net fisheries are extremely low. The Kodiak and Cook Inlet set net fisheries cannot provide a rate of return sufficient to cover operating and capital costs. All the measures discussed indicate a 45% reduction or more. The other set net fisheries in the State would require substantial reductions in the number of entry permits.

Other data collected indicate that the set net fisheries have a rapid rate of license turnover from year to year, a high percentage of casual fishermen who participate only a few weeks out of the season, and many fishermen with low income dependence on commercial fishing (Owers 1975).

Power Troll

Returns in the power troll fishery appear inadequate to cover any of the measures discussed with a 45% reduction in permits. The fishery again cannot provide a rate of return sufficient to cover all expenses.

The power troll fishery is similar to the set net fisheries in that there is a large license turnover from year to year, and fishermen show relatively little dependence on commercial fishing for a source of income.

CONCLUSION

In many salmon fisheries it appears that restricting or reducing the number of operating units will enable earnings to rise to levels comparable to that earned in other sectors of Alaska's economy. This is probably not a practical objective in other fisheries, however, particularly the set net fisheries and the power troll fishery. This does not imply that limited entry is not necessary in these fisheries. Limited entry is still a desirable policy for management reasons and the fact that reducing or stabilizing the number of operating units in other fisheries in the same area could

result in increased catches by these fisheries if they are not limited.

Rather, the problem that must be faced is one of resource allocation. If a commercial fishery cannot be made a viable economic enterprise, the public interest to be served by allowing it to exist at all must be carefully examined. This is particularly relevant in such areas as Cook Inlet and southeastern Alaska where sport fishing is in many cases in direct competition with the commercial fisheries for a share of the resource. The fisheries are a valuable asset that belong to all the people of a state and allocation decisions must be made with this in mind.

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