Chapter 1
Optimum Numbers Under Alaska's Limited Entry Law

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CHAPTER 1
Optimum Numbers Under Alaska's Limited Entry Law

Optimum numbers under Alaska's limited entry law are not a directive to choose the number of units of gear that will maximize the net economic benefits derived from the fishery. Instead, the law requires the commission to establish optimum numbers based upon a reasonable balance of three general standards which contain conservation, management, efficiency and distributional objectives.

This chapter examines the optimum number standards in AS 16.43.290. The chapter includes a brief review of understandings of the standards used in previous optimum number studies. The rationale behind the concepts used in this report is also included.

1.0 Optimum Numbers Under AS 16.43.290

AS 16.43.290 reads as follows:

> ***Optimum number of entry permits***. *Following the issuance of entry permits under AS 16.43.270, the commission shall establish the optimum number of entry permits based upon a reasonable balance of the following general standards:*
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> > *(1) the number of entry permits sufficient to maintain an economically healthy fishery that will result in a reasonable average rate of economic return to the fishermen participating in that fishery, considering time fished and necessary investments in vessels and gear;*
> >
> > *(2) the number of entry permits necessary to harvest the allowable commercial take of the fishery resource during all years in an orderly, efficient manner, and consistent with sound fishery management techniques;*
> >
> > *(3) the number of entry permits sufficient to avoid serious economic hardship to those currently engaged in the fishery, considering other economic opportunities reasonably available to them.*

Under the original law, it was not clear if the commission could establish a range of numbers as the optimum number. Because of this, the only optimum number regulations adopted by the commission, to date, have been for a specific number of permits. Since conditions in a fishery can change annually, commission staff has believed that a range of numbers would be a more appropriate and defendable approach to defining an "optimum." The design of fleet reduction programs would also have greater flexibility if the optimum number was defined as a range of numbers with a minimum and a maximum. This might increase the chances that a feasible fleet reduction program could be implemented, by providing a range of numbers that would be acceptable targets.

In 2000, Alaska's legislature revised the limited entry law and made several revisions to the optimum number and buyback portions of the law.[1] Among the changes, the legislature made it clear that the optimum number could be established as a range of numbers.[2]

1.1 Previous Understandings of AS 16.43.290

The commission's staff did considerable work on optimum numbers in the early years of the limited entry program. These efforts were summarized by Martin, in a contract report to CFEC.[3] Martin said the commission understood the three standards in AS 16.43.290 to require the following:

> *The commission interpreted these standards as requiring independent determination of: (1) the economic optimum number of entry permits; and (2) the management optimum number of entry permits. The third criteria was to be utilized to adjust the economic and management optimum numbers as required by local employment conditions.*

In 1994, the commission used similar reasoning and rationale to establish an optimum number for the Southeastern Alaska Roe Herring Purse Seine Fishery.[4]

1.2 The Economic Optimum Number of Permits: Previous Work

Martin indicates that optimum number Standard One is considered to be the "economic optimum number of entry permits."[5] Of course, the standard does not reflect an economic optimum number in the sense of maximizing net economic benefits from the fishery. Rather, the standard represents an economic optimum as defined by the law and as clarified by the Alaska Supreme Court in *Johns.* From the beginning of limited entry, the commission understood this standard to mean the number of permits which will, on average, produce a reasonable average economic return for permit holders in the fishery, where reasonable means sufficient earnings to cover all costs including the opportunity cost of the investment in vessel, gear, and equipment and the opportunity cost of the permit holder's time.

To review, optimum number Standard One (AS 16.43.290(1)) reads as follows:

> *(1) the number of entry permits sufficient to maintain an economically healthy fishery that will result in a reasonable average rate of economic*

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[1] See Chapter 135 SLA 2002 (CSHB288 (FIN) am).
[2] See AS 16.43.990 (6).
[3] See Martin: *Optimum Numbers*.
[4] See *Southeastern Alaska Roe Herring Purse Seine Fishery: Optimum Number Report*. CFEC Report 92-2. Juneau: Alaska Commercial Fisheries Entry Commission. (1992).
[5] See Martin: *Optimum Numbers.*

return to the fishermen participating in that fishery, considering time fished and necessary investments in vessels and gear.

The definitions section of the limited entry law provides further clarification of Standard One above by defining "economically healthy fishery" as follows:[6]

(2) "economically healthy fishery" means a fishery that yields a sufficient economic return to the fishermen participating in it to provide for, among other things, the following:

(A) maintenance of vessels and gear in satisfactory and safe operating condition; and

(B) ability and opportunity to improve vessels, gear, and fishing techniques, including, when permissible, experimentation with new vessels, new gear, and new techniques;

From the early days of the limited entry commission, CFEC researchers understood a "reasonable average rate of economic return" to mean earnings which, at minimum, would cover all of the different costs of a fishing operation including the opportunity cost of the investment in vessel and gear and the opportunity cost of the skipper's time.[7] The earliest survey work related to economic optimum numbers under Standard One (AS 16.43.290(1)) was done by James E. Owers.[8]

For each fishery surveyed, Owers calculated average total gross revenue over the 1969-1973 time period in 1973 dollars. He used that average as his forecast of average expected total gross earnings for the fishery in the future. He then coupled his total gross earnings estimate with his survey data on average costs to forecast how future average gross revenue per permit holder and future average net returns per permit holder would change as the number of permits was changed.

Owers "costs" included operating expenses, labor costs (excluding the skipper), depreciation, and a minimum return on investment of about 10% (vessel, gear, and equipment used in multiple fisheries were prorated). Owers also included in his measure of net returns an estimate of the opportunity cost of the investment in an entry permit.[9]

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[6] See AS 16.43.990 (2).

[7] This is sometimes called a "normal profit" in the economics literature. The opportunity cost of a skipper's time refers to the alternative earnings the skipper forgoes in order to participate in the fishery.

[8] Owers was a CFEC economist who produced three papers. The first, *Cost and Earnings of Alaskan Fishing Vessels – An Economic Survey* (CFEC 1974) reported the results of a CFEC baseline survey on operating costs and net returns by salmon fishery. The second paper was: *An Empirical Study of Limited Entry in Alaska Salmon Fisheries.* Marine Fisheries Review 37(7) (1975): p22-25. The third paper, *Income Estimates and Reasonable Returns in Alaska's Salmon Fisheries,* Fishery Bulletin 75(3) (1977): p 35-42, addressed the optimum number issue.

[9] Owers' net return measure included the opportunity cost of the entry permit. He erred in assuming that a net return measure that subtracts off the opportunity cost of the permit would increase substantially as he reduced the number of permits. In theory, the permit's value reflects the present value of the future expected economic profit stream from the fishery, where profits are calculated excluding the opportunity cost of the permit. As the number of permits decline, *ceteris paribus,* average economic profits per permit would increase and the market value of the permit would rise commensurately. A net earnings measure that tries to subtract off the opportunity cost of the permit should not change substantially as the fleet size is reduced because the permit's market value and the permit's concomitant opportunity cost would simply adjust by rising to reflect the increase in economic profits. Nevertheless, Owers forecasted a substantial increase in his average net earnings measure as he reduced the size of the fleet despite the fact that he was subtracting off an estimate for the

Owers used his methodology to estimate the economic optimum number of permits for 18 of the 19 salmon fisheries placed under limitation in 1974. Owers argued that the number of permits required to produce reasonable earnings under the first optimum number standard in the law should, on average, cover all costs including the opportunity cost of the skipper's time.

Owers actually used three methods to estimate the number of permits that would produce a reasonable net economic return. In his first method, Owers estimated the time a skipper spent in each fishery and then applied an estimate of the opportunity cost of a skipper's time to the time spent in the fishery. He used the 1973 average weekly earnings of workers in contract construction in Alaska as his estimate of the skipper's weekly opportunity costs. The number of permits that would make the skipper's total opportunity cost for time spent in the fishery equal to his "Returns to Labor and Management" was his first estimate of the economic optimum number of permits.

In his second method, he used the level of earnings that (coupled with other earnings) would bring a skipper up to the average nonagricultural wage and salary earnings in Alaska in 1973. Again, these amounts were calculated based upon his survey results in each fishery.

Owers used a third method of the economic optimum number of permits based upon what his survey respondents in each fishery said they needed to gross to earn a reasonable return. This amount would presumably include all costs, including their opportunity costs.

These three methods gave rise to three different estimates of the number of entry permits required under the first optimum number standard. For the Bristol Bay salmon drift gillnet fishery these estimates were 1,252 permits, 918 permits, and 1,001 permits respectively.

Following Owers, the commission conducted additional surveys and worked on developing baseline data for determining economic optimum numbers. The commission also worked to develop a systematic optimum number methodology. In 1979, Martin summarized a suggested methodology for developing forecasts of future rates of economic return and for determining the number of permits that would result in a "reasonable" average rate of economic return for the fishermen in a fishery.[10] In his report, Martin used the Bristol Bay salmon drift gillnet fishery as an example for estimating management and economic optimum numbers.[11]

To estimate economic optimum numbers, Martin took the average total costs, excluding the opportunity cost of the skipper's time, from a CFEC survey of the fishery which covered the

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opportunity cost of the permit. This was likely due to his method of forecasting the permit's market value and the opportunity cost of the permit as the number of permits varied. For forecasting purposes he assumed that the market value for the permit would be two times an average net earnings measure that excluded the opportunity cost of capital.

[10] See Martin: *Optimum Numbers.*

[11] For forecasting purposes, Martin held future ex-vessel prices constant at 1976 levels. He thought his main forecasting problem would be to forecast the distribution of salmon returns in the future. He was concerned that hatcheries would have a large but unknown impact. One reason he picked Bristol Bay for his example of the optimum number methodology was that he didn't think Bristol Bay harvests would be impacted by hatchery production. His forecast did, however, factor in the effects of the Fisheries Management and Conservation Act and its reduction of Japanese interceptions of Bristol Bay salmon.

1976 season.[12] To make forecasts of future net earnings, Martin made the simplifying assumption that his estimate of average total costs per operation would remain constant in real terms over all years, even as the size of the harvest, gross earnings, and the number of fishing operations changed. He also assumed that ex-vessel prices in future years would remain the same as they were in 1976, irrespective of factors that might influence real prices.[13]

The main variable component of his forecast was future harvests. Martin assumed that future harvests would vary in the same fashion as harvests had varied over the 25-year period from 1952 through 1976. He calculated domestic harvests over this period and added estimates of the Japanese catches of Bristol Bay sockeye salmon over the same period to obtain a time series of what domestic harvests would have been in the absence of the Japanese interceptions.[14] This became his estimate of the distribution of future harvests in the fishery and, after applying 1976 ex-vessel prices, he derived his estimate of the distribution of future total gross earnings in the fishery, measured in 1976 dollars.

This time series of future gross earnings were then used to make forecasts of the distribution of average gross earnings per permit under different assumptions about the number of permits in the fishery. These projections, coupled with the assumption about the average cost per unit of gear, were then used to generate similar estimates of the distribution of average net returns per permit using different assumptions about the number of permits.

Like Owers, Martin concluded that the economic optimum number should be a number that allowed the permit holder to at least "break even" for an acceptable percentage of the time. To "break-even" Martin reasoned that his measure of average net returns (returns to labor and management) should be sufficient to cover the opportunity cost of the skipper's time for an acceptable percentage of the time. His estimate of the opportunity cost of a skipper's time was one-third of the average gross earnings per permit in 1976, which was $5,150 (in 1976 dollars). He suggested that the commission could decide that a reasonable average net return per permit (returns to labor and management) might exceed the opportunity cost of the skipper's time for some acceptable percentage of the time. For example, average net returns per permit might exceed an average skipper's opportunity cost 50% of the time and be less than or equal to that opportunity cost 50% of the time.

[12] The CFEC report *Summary of Cost and Net Return Information for the Bristol Bay Drift Gillnet Fishery* by June Baker and Ben Muse, was released in February, 1979. It contains different average costs figures (higher) than those used by Martin. Thus, if this was the source of Martin's data, he may have modified the estimates. Martin does not indicate what costs he included in his "Average Total Costs" measure other than to note that it does not include the opportunity cost of the permit holder (skipper's time). In a later part of the report he titles some tables: "Average Returns to Labor and Management Ability," which is a net return measure similar to that used by James Owers: it subtracts from gross earnings all normal costs, plus an estimate of the opportunity cost of the investment in fishing capital, but it does not subtract an estimate of the opportunity cost of the skipper's time. Thus, "Returns to Labor and Management" is likely the net return measure that Martin was using, since he compared that amount with his estimate of "the opportunity cost of the skipper's time" to solve for an economic optimum number of permits that would allow the permit holder to just break even an acceptable percentage of the time.

[13] Martin wanted to make comparisons across all years using the same "dollar units." However, his methodology went even further and held ex-vessel prices and average total costs per permit constant in all years. He argued this more accurately reflected the current earnings picture than allowing real prices to vary as they had historically. The variables that did change in his model were the total pounds harvested, the total estimated gross earnings (harvest pounds multiplied by the 1976 ex-vessel prices), and the number of permits.

[14] Following the passage of the Fisheries Conservation and Management Act in 1976 (currently known as the Magnuson-Stevens Fishery Conservation and Management Act).

From his forecasts of average net earnings, he generated a subjective cumulative probability distribution of achieving different levels of average net earnings (returns to labor and management) given different permit levels in the Bristol Bay salmon drift gillnet fishery. His permit levels ranged from 1,200 permits to 1,750 permits in increments of 50 permits. Given his forecasts based on 1952-1976 harvests, 1976 prices, and a constant average cost per operation, he concluded that 1,450 permits would be appropriate for the economic optimum number for the Bristol Bay salmon drift gillnet fishery. Again, his report was intended to be an example of the methodology used for optimum number studies in Alaska fisheries.

John Martin's 1979 report came at a time when conditions were dramatically improving in Alaska's salmon fisheries. Rising permit prices had given rise to concerns that permits were leaving the state and that young Alaskans would not be able to get into the fishery. The legislature was ready to undertake a comprehensive review of the limited entry program. Moreover, the commission was facing a number of legal challenges in the courts. For all of these reasons, Martin stated in his report: *"At this point in the Commission's history, it appears that vigorously pursuing optimum numbers is inappropriate."*

During the 1980's, the commission conducted more surveys on operating costs and net returns in several salmon fisheries, but made no optimum number determinations. In 1988, the Alaska Supreme Court's decision in *Johns* led to an optimum number study for the Southeast Alaska roe herring purse seine fishery. The Court indicated that the commission needed to do optimum number studies even if the initial permit allocation process had not been completed. The Court's concern was for fisheries that might be "too exclusive" under Alaska's constitution.

In 1992, the commission research staff completed an optimum number study for the Southeastern Alaska roe herring purse seine fishery.[15] The staff surveyed participants in the fishery to obtain data on their operating costs and net returns over time. The survey data, coupled with ancillary data on the vessel attributes and fishing effort of each operation, were used to model different costs. With these models, the report was able to provide time-series estimates of historic average costs and net economic returns in the fishery over the 1975 through 1992 time period.

The main measure of net economic returns used in the 1992 report was economic profits. This measure calculated gross earnings per permit, then subtracted off estimates of fixed and variable operating costs, depreciation, an estimate of the opportunity cost of the investment in vessel, gear, and equipment, and an estimate of the opportunity cost of the skipper's time.[16] Using this measure of net returns, achieving a positive average economic profit would be consistent with the reasonable rate of return measures and criteria used by Owers and Martin in the earlier studies. In the 1992 report, the estimates of historic average economic profits varied by year and were positive in some years and negative in others.[17]

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[15] See CFEC: *Southeastern Alaska Roe Herring Purse Seine Fishery: Optimum Number Report*.
[16] The investment in vessel, gear, and equipment was prorated to the fishery based upon gross earnings in the year.
[17] A July 31, 1995 Attorney General's Opinion, written by Assistant Attorney General Steven A. Daugherty for Attorney General Bruce M. Botelho, responded to questions raised by Representative Alan Austerman of the Alaska House of Representatives. The memorandum indicated that that the legislative history of the final language of the constitutional amendment allowing for limited entry in Alaska Fisheries was intended to broaden the grounds for restricting entry "to include not only conservation of the fisheries themselves but of the capital and

A bio-economic simulation model for the Southeast Alaska purse seine roe herring fishery was then used to forecast future average net economic returns and to make corresponding estimates of the present value of average net economic returns under different scenarios. Again, the measure of net economic returns used was economic profits. The main policy variable was the number of permits, and permit levels of 25, 50, 75, and 100 were examined.

Costs of a fishing operation were modeled as a simple function of gross earnings based on estimates from survey and ancillary data. This forecasting cost function for a fishing operation had a fixed and variable component. The ex-vessel price was modeled as a function of average percent roe content of the harvest, the yen/dollar exchange rate, and roe product inventories. Gross earnings forecasts were generated by multiplying the forecasted ex-vessel price by the forecasted harvest in the year.

The key portion of the model generated estimates of the biomass and the harvest in each year. To do this, the model follows each cohort of herring through its life cycle using assumptions about the percent of each age group entering the spawning population, growth rates, natural mortality rates, and random deviations from harvest targets. Fish were assumed to recruit at age three and random recruitment levels (drawn from historic distributions) coupled with other assumptions, were the key determinants of biomass and harvests in subsequent years.

Simulations over a 30-year period were run using low revenue, baseline revenue, and high revenue assumptions. The low revenue scenarios assumed that recruitment would reflect the distribution of the relatively lower recruitment levels that occurred over the 1971 through 1977 time period and a weak yen (strong dollar) assumption for the exchange rate. The high revenue scenarios assumed that recruitment would reflect the distribution of relatively higher recruitment levels that occurred from 1978 through 1992 (when the report was written) and a strong yen (weak dollar) assumption for the exchange rate. The baseline scenarios assumed that recruitment would reflect the distribution of recruitment levels over the entire time period of the fishery and exchange rates would also take on an intermediate value.

Under simulations using low revenue assumptions, the forecasted average present value of economic profits per permit were negative at all four permit levels (25, 50, 75, and 100). Under simulations using high revenue assumptions, the forecasted average present value of economic profits per permit were positive at all four permit levels. Under simulations using the baseline assumptions, the forecasted average present value of economic profits per permit were usually negative at permit levels of 75 and 100, but positive at permit levels of 25 and 50.[18]

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labor resources which are expended in harvesting them." This suggests that the constitutional amendment allowing for limited entry for resource conservation purposes may help justify higher rates of economic return that are the result of reducing the waste of capital and labor resources in Alaska's fisheries. See: *Legality and Constitutionality of IFQ Programs*, A.G. file 223-95-0472, Alaska Department of Law, Attorney General's Office.

[18] One set of simulations which made some *ad hoc* assumptions about adjustments that fishermen might make annually in response to profits and losses, resulted, on average, in a slightly positive present value of net economic returns under baseline revenue assumptions even at 75 permits.

The report showed that economic returns in the fishery could be highly variable, both in the short term and the long term. A few critical factors could have a dramatic impact on results. While the authors never selected an economic optimum number under Standard One, they considered the results of the historic economic profit estimates and the simulated forecasts of future economic returns to help determine a “reasonable balance” of the three optimum number criteria for the fishery. The authors recommended the optimum number should be between 44 to 50 permits, based upon a reasonable balance of all three optimum number criteria. The commission subsequently adopted an optimum number of 46 for the Southeast Alaska roe herring purse seine fishery. The regulation became effective in January, 1994.

In summary, from the earliest days of limited entry, the commission has understood that a reasonable rate of economic return under optimum number Standard One (AS 16.43.290(1)) is a rate of economic return that will, on average, at least cover all costs of the fishing operation, including the opportunity cost of the investment in vessel, gear, and equipment and the opportunity cost of the skippers’ time. Prior efforts to estimate the optimum number of entry permits have varied somewhat in methodology but have all used this general understanding of optimum number Standard One.

1.3 The Management Optimum Number of Entry Permits: Previous Work

AS 16.43.290(2) contains the second optimum number standard under Alaska’s limited entry law. It reads as follows:

> *(2) the number of entry permits necessary to harvest the allowable commercial take of the fishery resource during all years in an orderly, efficient manner, and consistent with sound fishery management techniques;*

Martin described the commission’s understanding of this standard in 1979.[19] Martin referred to optimum number Standard Two as the “management optimum number of permits.” He indicated that the management optimum number of permits was determined to be “a range bounded by: (1) the minimum number of units of gear adequate to harvest the highest runs anticipated in the next ten years; and, (2) the maximum number of units of gear that can be effectively managed during low run years.

Martin indicated that CFEC had been working with ADFG since 1974 to try to refine the criteria with certain assumptions and determine management optimum numbers for the salmon fisheries. However, it proved difficult to standardize the approaches and formats across all fisheries, and the estimates were not a priority for ADFG area staff, who had other pressing responsibilities and demands on their time. As a result, Martin indicated that management optimum number reports had not been received from all areas.

In his report, Martin presented the results that had been obtained from ADFG for the Bristol Bay salmon drift gillnet and set gillnet fisheries. To calculate management optimum numbers, CFEC and ADFG assumed that the Board of Fisheries regulations would remain

[19] See Martin: *Optimum Numbers*.

unchanged; that the allocation between gear types would be the average over the years since statehood; and that processing capacity would remain constant. To make the management optimum number estimates, ADFG biologists made some further assumptions about the length and frequency of openings in an orderly fishery and catch rates under different assumptions. For the Bristol Bay salmon drift gillnet fishery, ADFG biologists calculated the lower and upper bounds of the management optimum number range as 840 (low average harvest years) and 1,338 (high average harvest years) units of gear.

In CFEC's 1992 optimum number study for the Southeast Alaska roe herring purse seine fishery, two concepts were used to help evaluate the management optimum number of permits.[20] These concepts were close to those suggested by Martin but were refined somewhat because of the short, intense nature of the roe herring fishery and the wide variation in the harvestable surplus from year-to-year.

The first concept for management optimum numbers used in the Southeast roe herring report was concerned with how many fishing operations were actually needed (the minimum required) to harvest the available resource in all years in an orderly, efficient manner and consistent with sound fishery management techniques. The question was asked for a range of quota sizes and for both the lower Lynn Canal and Sitka sub-fisheries. This concept is close to an economically efficient number of permits for the fishery and the quota size. It also is similar to Martin's concept of the "minimum number of units of gear" adequate to harvest the highest anticipated runs.

The second concept for management optimum numbers was concerned with how many fishing operations could be reasonably managed and controlled (the maximum that could be handled) given available resources and existing regulatory authority, without creating a serious risk of a substantial over-harvest or a substantial under-harvest. Again, the questions were asked for a range of quotas and for both the lower Lynn Canal and Sitka sub-fisheries.

The answers to both of these questions varied by the size of the harvest quota and the sub-fishery and hence created a wide range of management optimum numbers to consider. The results under Standard Two were all considered in determining a reasonable balance of the three optimum number criteria.

1.4 The Third Optimum Number Criterion: Previous Work

AS 16.43.290(3) contains the third optimum number standard under Alaska's limited entry law. The standard reads as follows:

> *(3) the number of entry permits sufficient to avoid serious economic hardship to those currently engaged in the fishery, considering other economic opportunities reasonably available to them.*

[20] See CFEC: *Southeastern Alaska Roe Herring Purse Seine Fishery: Optimum Number Report.*

This standard is the most nebulous of the three optimum number standards. As noted above, Martin indicated that the commission believed that: "The third criteria outlined in the statute was to be utilized to adjust the economic and management optimum numbers as required by local employment conditions."[21]

In CFEC's 1992 optimum number report on the Southeast Alaska roe herring purse seine fishery, the authors concluded that the third criterion would mainly come into play when the optimum number was less than the number of permits outstanding in the fishery.

Under Alaska's limited entry law, if the optimum number is greater than the number of permits outstanding, then the commission is required to put additional permits into the fishery.[22] Any optimum number must be consistent with *Johns v. State*,[23] in which the Alaska Supreme Court declared:

> *[T]here is a tension between the limited entry clause of the state constitution and the clauses of the constitution which guarantee open fisheries. We suggested that to be constitutional, a limited entry system should impinge as little as possible on the open fishery clauses consistent with the constitutional purposes of limited entry, namely, prevention of economic distress to fishermen and resource conservation . . . . The optimum number provision of the Limited Entry Act is the mechanism by which limited entry is meant to be restricted to its constitutional purposes. Without this mechanism, limited entry has the potential to be a system which has the effect of creating an exclusive fishery to ensure the wealth of permit holders and permit values, while exceeding the constitutional purposes of limited entry.*

In contrast, when the optimum number is less than the maximum, the commission may establish a fisherman-funded buyback program. Imposition of a buyback assessment might force some fishermen out of the fishery if they cannot profitably continue in the fishery and pay the tax. Some of those fishermen may have few other occupational alternatives. Such individuals would arguably have lower opportunity costs and it might be in the best interest of the State to allow some of them to stay in the fishery. Using Standard Three to achieve a reasonable balance might lead to a higher optimum number under such circumstances, to avoid disenfranchising persons with few other alternatives. This might help more persons stay in the fishery since fishermen would be taxed less and fewer permits would be removed from the fishery.

1.5 Summary

This chapter has reviewed the commission's previous efforts at determining optimum numbers. It also summarizes the commission's understandings of the optimum number criteria under the Alaska's limited entry law. These same understandings will be used in this report to evaluate optimum numbers for the Bristol Bay salmon drift gillnet fishery.

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[21] See Martin: *Optimum Numbers.*
[22] See AS 16.43.330.
[23] See *Johns*, p. 1266 [citation and footnote omitted].