aquaculture notes

THE ALASKA SALMON ENHANCEMENT PROGRAM: IMPERATIVES FOR ECONOMIC SUCCESS

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INTRODUCTION

It is becoming increasingly accepted that salmon enhancement facilities for Alaska are sound investments. This acceptance is the result of some apparent early successes by private and public facilities, the success of the Japanese enhancement program, and a generally favorable disposition on the part of the Alaska citizenry toward renewable resource investments. The present popularity is manifested by public bond issues for state hatcheries, and by the grant, loan, and technical assistance programs for private nonprofit hatcheries.

There are pockets of opposition, however. There are those who emphasize the biological risks, mostly genetic, of a rapidly developed enhancement program. There are those who, citing the "free ride" provided by nature through a natural stock rebuilding program, do not wish to incur the present or potential future costs of enhancement programs. The first group is a decided minority at present because of the natural and rational human tendency to discount future (relative to present) benefits and costs, and because, by the very nature of the biological issues involved, it is more difficult for those in opposition to generate convincing empirical evidence in the short-run. The ranks of the second group can be expected to expand and recede in direct proportion to the size of present natural runs of salmon. Thus, this group of doubters is enjoying a strong year due to the strength of the 1977 runs.

It is not the purpose of the present article to evaluate the positions of proponents and opponents of a rapid aquaculture development policy. It is presumed that the proponents are in the majority and that the political process has, therefore, responded appropriately with supportive policies. Further, it is recognized that the conclusions of economic evaluations, based on assumptions that appear to be reasonable in light of experience in Alaska and elsewhere, are consistent with the belief that salmon enhancement projects are sound investments.

Economic studies do not, however, project such a large margin of net benefits (benefits less costs) that decision makers can, in their position of public trust, afford to be unconcerned with the level of costs of producing more salmon through enhancement investments and with the distribution of these costs among beneficiary and nonbeneficiary groups. *Cost efficiency and cost distribution will be the primary determinants of the amount and distribution of the net benefits (benefits less costs) to be derived from enhancement investments.*

They are the economic imperatives which will determine the degree of success of Alaska's salmon enhancement program. Due to the relative obscurity of these determinants of success, however, they are being overlooked in favor of concerns of much lesser long-run significance (e.g., how to maximize federal subsidies). In the process, policymakers are risking the eventual economic failure of Alaska's salmon enhancement program independent of whatever biological successes are eventually realized.

It is the purpose of this article to focus attention on the economic imperatives, cost efficiency, and cost distribution a concern for which must be reflected in Alaska's policy towards salmon enhancement investments if the potential maximum *net benefits* are to be realized. Given the magnitude of the direct and indirect commitment of public funds under consideration, the present apparent apathy toward cost efficiency and cost distribution considerations is indeed disheartening. The author's thoughts on the subject are offered with the belief that a broader awareness about these relevant economic considerations might cause present decision options to be more widely recognized and more thoroughly evaluated.

Time for evaluation is short however. Decisions made today without proper consideration of relevant economic factors may lock out future decision-making flexibility for two reasons: 1) present-period decisions create long-term financial commitments in the form of annual investment amortization and annual operating costs, and 2) they generate institutional responses which may be politically irreversible over very long periods of time, i.e., several decades or longer.

The next section will introduce the criteria that are appropriate for judging the degree of economic success (or failure) of salmon enhancement investments. The following section will evaluate the present Alaska salmon enhancement program in terms of these success criteria and discuss probable long-run results. Finally, an alternative enhancement program structure will be suggested and its probable long-run results discussed. The article will conclude with a summary of its contents.

GUIDELINES FOR EVALUATING ECONOMIC SUCCESS

The market criterion of relative profitability -- relative to other potential uses of resources -- can and should be applied to both private and public salmon enhancement investments. Thus it would appear that judging economic success is a straightforward matter of identifying instances

where benefits exceed costs. As a first approximation this is correct, but the reasoning must be carried a step further to avoid a decision error. The example shown in Table 1 for Hatchery Site A is used to make this point. Owner #1 has an unprofitable investment in that after allowing for the rate of return that invested funds could earn in alternative investments of comparable risks (assumed in this example to be ten percent) the hatchery has a negative present value; that is, its revenues (measured in present value) over its useful life are less than the costs which must be incurred (also measured in present value) over the same period.[1] Owner #1 has an investment which is an economic failure, both absolutely in that net present value is negative, and relative to owners #2 and #3.

Owner #2 clearly has a profitable investment in that after allowing for the rate of return on funds in other potential investments of comparable risks, the hatchery project has a positive net present value. That is, its return is greater than the ten percent return that could have been earned had the funds been invested elsewhere. If hatchery investments are more likely to be typified by Owner #2 than Owner #1 as economic evaluations suggest, a policy of public support (in some form) for salmon enhancement is rational on economic grounds.[2]

While a supportive public policy is rational under these conditions, decisions made are unlikely to be optimal unless a further decision refinement is introduced. The asterisks appear in the example for Hatchery A to mark additional (in addition to net present value) variables which policymakers must consider if the salmon enhancement program is to be successful. These are hatchery productivity and hatchery cost efficiency.[3]

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[1]Revenues are those which result from the returning adult fish, whether captured and sold by fishermen or by the hatchery, after deducting brood-stock requirements. "Present value" is explained in footnote #2 in Table 1.

[2]This statement assumes that the private sector cannot or will not invest (without some form of public encouragement) due to the existance of some market imperfections. Examples of market imperfections relevant to salmon enhancement are: 1) vaguely defined property rights, 2) extreme uncertainty, and 3) significant economic externalities, i.e., significant benefits received by noninvestors. These factors, in addition to the legal barrier to the entry of private, profit-seeking investors, constitute significant impediments to private investment activity. See Orth, F.L., 1977, pp. 6-11.

[3]"Returning fish per year" constitutes the productivity of a hatchery. "Investment costs" and "Operating and maintenance costs" constitute the cost efficiency of a hatchery operation.

TABLE 1

HATCHERY SITE A (Pink Salmon, Twenty Million Egg Capacity)

	OWNER #1	OWNER #2	OWNER #3
*Returning surplus fish/year[1]	283,400	383,400	493,400
Total revenue/year @ value/fish = $1.60 ($)	453,440	613,440	789,440
Useful life of hatchery (years)	20	20	20
Present value of revenue[2] over hatchery life @ 10% ($)	3,860,390	5,222,561	6,720,948
*Investment costs ($)	2,500,000	2,250,000	2,000,000
*O & M costs/year ($)	340,000	320,000	300,000
Present value of O & M over hatchery life @ 10% ($)	2,894,612	2,724,340	2,554,069
Present value of total costs ($)	5,394,612	4,974,340	4,554,069
Net present value ($)	-1,534,222	248,221	2,166,879
Absolute economic success	no	yes	yes
Relative economic success	no	no	yes

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[1]The following schedule of survival rates are used for calculating this entry, along with an assumed brood-stock requirement of 16,600 fish:

SURVIVAL RATE	OWNER #1	OWNER #2	OWNER #3
Egg-to-fry	.750	.800	.850
Fry-to-adult	.020	.025	.030

[2]Discounting to present value is necessary whenever a comparison is made between revenue flows and cost flows which are incurred at different rates through time. Conceptually, discounting to present value is the opposite of compounding to future value. For a thorough discussion of the discounting concept see Edward Shapiro, *Macroeconomic Analysis*, Third Edition, 1974, pp. 158 - 163.

The third column of the example for Hatchery A (see Table 1) modifies the example to represent the same site but with a third owner. The higher productivity and cost efficiency, resulting, it is assumed, from the superior business management policies of the third owner, have made Hatchery A an even more attractive investment than it was under the management policies of Owner #2. The return on investment for Owner #2 is sufficiently high to justify having made the investment, yet even this investment cannot be judged an economic success if returns are significantly lower than those which are readily obtainable under an alternative set of business management decisions.

The implications of greater productivity and cost efficiency for the net benefits available to user groups (and society in general) from the utilization of a hatchery site will be immediately recognized by the reader. However, the relevance of these economic imperatives for public policy may be less obvious. After all, how can policymakers structure the Alaska salmon enhancement program to influence individual hatchery productivity and efficiency? The answer, which will be addressed in practical terms in the following section, is deceptively straightforward: *Avoid placing production-hatchery units in institutions which are isolated from the discipline imposed by normal market forces.* It is predictable with a high degree of probability that the failure to adhere to this simple rule will produce relatively poor results (like Owner #2 rather than Owner #3). That is, it will produce a lower degree of economic success. Even worse, results like those shown for Owner #1 are not unlikely in the long-run if production hatchery units are insulated from market forces.

The market forces which are relevant in this context are of three sorts. *The first is the characteristic of control over hatchery management being in the hands of owners or user groups.* When a production entity is structured so that management employees serve at the pleasure of, and whose level of compensation is determined by, those who benefit or suffer from management's performance there is a built-in bias towards productive and cost-efficient hatcheries. Obversely, if the tenure and compensation of management employees is unrelated to performance (except where performance is extremely good or bad), there is a built-in bias away from productive and cost-efficient hatcheries.

Second, if the user groups are also investors (or contributors in the nonprofit context) the attention paid to management's performance by these groups will be significantly enhanced. That is, user groups will be much more attentive

to performance if their own funds are invested in the hatchery than if hatcheries are somehow funded externally. A related benefit of investor commitment is that the beneficiaries of hatcheries are paying the costs of enhancement facilities; economic equity is thereby achieved directly and voluntarily, and the cost-distribution imperative is satisfied. This point will be discussed further below.

The third relevant market force is that of competition. Competition among hatchery units, if it exists, can be a constructive force toward maximizing net benefits from enhancement investments. The reasons are: 1) that the existance of competitive units provides a basis for judging relative performance, and 2) in the struggle to surpass the performance of rivals, competition encourages management to search out cost-saving and productivity-increasing innovations.

THE PRESENT ALASKA SALMON ENHANCEMENT PROGRAM: PROSPECTS FOR ECONOMIC SUCCESS

From an economic perspective, the present Alaska Salmon Enhancement Program has four dominant characteristics: 1) it is a "dual" program in that it allows for (and subsidizes) both public and private-nonprofit *production* hatcheries, 2) private profit-seeking hatchery entities are not allowed, 3) the state's public hatchery unit enjoys organizational, financial, and regulatory advantages that are not available. to the private-nonprofit firms, and 4) no formal mechanism has been established for ensuring that public dollars spent on the program will be repaid by those benefiting from the expenditures. These characteristics suggest that the economic imperatives of cost efficiency and cost distribution have been given little weight in structuring the program. As a result, as suggested by the preceding section, the program may eventually fail to even approximate maximum net benefits. The remainder of this section is devoted to an evaluation of the characteristics of the present program in terms of their probable long-run economic impacts.

Cost Efficiency

The best way to create a pattern of economic incentives which will make production hatchery units cost efficient is to allow for the creation of private profit-seeking hatchery firms. The second-best way is to allow for private-nonprofit hatchery firms whose funds come primarily from 1) assessments of beneficiaries, and 2) the direct or indirect debt obligation of beneficiaries. Due to the political opposition of fishermen, the for-profit alternative is legally barred. Whether this opposition reflects enlightened self interest is debatable,

but this will not be debated here. Time and the Oregon experiment with private profit-seeking ocean ranching will establish the efficacy of that institutional approach. In the remainder of this article, the legal-political barrier to the for-profit alternative is assumed to be insurmountable in Alaska at the present time; therefore, this alternative will not be considered further.

Private Nonprofit Hatcheries. Private nonprofit hatcheries are potentially a strong second best means to cost efficiency. The regional nonprofit association is required by law to represent user groups, the most important of which become investors (contributors) with the authority to exercise control over management and with a strong self-interest in monitoring management performance. Thus two of the three market forces conducive to cost efficiency and productivity are present. To the extent that there are several regional associations and several independent nonprofit hatchery firms the market force of competition should be present as well, at least in sufficient strength to provide a basis for comparison of performance and for exerting some pressure on management for efficiency and innovation. *The central point is that the incentive structure of private-nonprofit hatchery firms, and of the salmon enhancement "market" which they together constitute, is conducive to cost efficiency and productivity.*

State Hatcheries. The state hatchery system, the FRED Division of Alaska Department of Fish and Game, is financed by bond issues and by general fund appropriations. Its employees are public employees. While there is certainly no reason to doubt the dedication of individual FRED Division employees to the task of enhancing the productivity of salmon stocks, it is important to recognize that the incentive structure within which these employees operate is fundamentally different than that which is found in the private sector. The first two desireable market forces, contributor or user group control over management and the incentive to exercise control derived from financial commitment, are completely absent, and the force of competition within the system is weak, at best. *The absence of a conducive incentive system makes it highly probable that the long-run performance of a public production-hatchery system with respect to cost efficiency and productivity will be significantly inferior to that which would be obtained from a production-hatchery system within the private sector.*

Cost Distribution

The cost distribution imperative concerns the distribution of the financial burden of an enhancement program among the

tax-paying citizens of the state. Economic equity is achieved when costs are distributed in proportion to the benefits received. A distribution system which fails to exploit the fact that nearly all of the benefits accrue to a relatively small, clearly-identifiable group is deficient on economic-equity grounds. It is instructive to examine private and public aquaculture in terms of the degree to which each satisfies the criterion of equitable cost distribution.

Private-Nonprofit Hatcheries. Private-nonprofit hatchery firms are financed primarily by contributions (voluntary self-assessments), by the sale of surplus fish, and by long-term debt secured by assessments. This financial commitment is desireable not only because it creates an incentive to monitor management's performance but also because it means that economic equity is achieved automatically. Fishermen, the primary beneficiary group, are paying the bulk of the costs either directly through long-run assessments or indirectly by allowing, through their representation on the Regional Planning Team, a level of escapements to hatcheries which will generate sufficient revenues to cover costs. Another important benefit of the private-sector hatchery approach is that at least part of the cost of enhancement will enter the price of salmon products and be borne ultimately by consumers.

State Hatcheries. As mentioned, the state hatchery system is financed by bond issues (future general-fund expenditures) and current general-fund expenditures. At present there are no specific taxing mechanisms designed to recapture revenue from beneficiaries to cover these costs. Thus, public funds allocated to the state hatchery system violate the equity criterion; that is, the general taxpayer bears the costs with little or no direct benefit, while an identifiable beneficiary group makes no special tax payments.[4]

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[4]A contrary view is that state hatcheries will be surplus, rather that deficit, economic units owing to the sale of surplus fish by these hatcheries. In this view, special taxation would not be needed. Assuming comparable cost efficiency, productivity and long-run technological progressiveness in state hatcheries, and assuming away potential marketing conflicts between the state hatcheries and common-property fishermen, this method of financing (in lieu of specific taxes) would make state production hatcheries an equitable alternative to private-nonprofit production hatcheries. The caveat in this view, in the author's opinion, is that the underlying assumptions concerning comparable long-run economic performance of state and private-nonprofit hatcheries are unrealistic, for the reasons thoroughly discussed in this paper. Since escapements to a hatchery are an implicit form of tax on fishermen, cost control remains a primary concern in order to minimize the escapements required to produce a "surplus" hatchery.

The injustice of such a cost-distribution system is not likely to remain unnoticed by the political process. In fact, there are already signs of an awareness, even among legislators from coastal areas, that the costs of a public hatchery system must be borne by beneficiaries. *Therefore, the view that a state hatchery system is a way for fishermen to obtain the benefits of a hatchery program without having to bear the costs is likely to be quite inaccurate as a long-run political judgement. It is for this reason that the relative cost efficiency and productivity of a state hatchery system as compared to a private hatchery system is of paramount importance to fishermen and other user groups.*

In the absence of a mechanism for taxing beneficiaries, a public hatchery system creates an additional but less obvious injustice -- the Alaska taxpayer is required to subsidize consumers of salmon products. This occurs because general taxes will not enter the prices of these products. Only specific taxes or assessments become direct costs to producers and enter the prices of salmon products. It is in this way that the market ensures that the other major group benefiting from enhancement, consumers of salmon products, pay a portion of the costs. An enhancement program financed by general taxes bypasses this mechanism for ensuring an equitable distribution of costs and leaves the entire financing burden on the general taxpayer. Almost everyone, probably including most Alaska fishermen, would object to the illogic of requiring Alaska residents to subsidize consumers of salmon products, virtually all of whom are nonresidents.

AN ALTERNATIVE STRUCTURE FOR THE ALASKA SALMON ENHANCEMENT PROGRAM

The preceding arguments suggest that there are significant long-run benefits to be derived by a restructuring of the Alaska salmon enhancement program in a manner which would assign nearly exclusive responsibility for *production* hatcheries to private-nonprofit regional associations and the independent nonprofit hatchery firms approved by the associations. This section develops the lines along which such restructuring might proceed.

There are several problems one encounters in attempting to allocate enhancement-program responsibilities to regional nonprofit hatchery firms and state hatcheries. One is the need to distinguish between hatcheries intended primarily for production purposes and those which can be classified as primarily research hatcheries. And for production hatcheries it is necessary to distinguish between exempt and nonexempt

species-area combinations. Exempt combinations are those for which development of production hatcheries must be delayed until certain bio-technical problems are overcome; nonexempt combinations are those for which no such problems exist.[5] There is also the question of whether hatcheries on the rivers of interior Alaska are economically feasible and whether special institutional and equity considerations apply to these situations. This would appear to be the case given that there is a domination of subsistence uses along the lengths of the major rivers, although commercial fisheries do exist.

The preceding suggests that it might be appropriate for the state to divide enhancement efforts between state hatcheries and private-nonprofit hatcheries according to function and specific circumstances. Under those circumstances where it would appear improbable that private-sector investment would be forthcoming (purely research hatcheries, species-area combinations for which enhancement may be accompanied by serious bio-technical problems, and interior hatcheries) a public-sector investment should be considered assuming that the biological and economic feasibility of the specific site have been established. *For all other circumstances, production hatcheries should be built and operated by private nonprofit firms.*

The approach suggested for selecting between the public-sector and private-sector options is that of giving preference to private-sector hatchery investments unless there are compelling reasons to have a public hatchery. This approach would allocate to the public and private sectors the roles shown in Table 2. The justifications for this division of responsibility are three: 1) that cost control resulting in higher net benefits to fishermen, processors, and other beneficiaries is more likely to be achieved by private nonprofit hatcheries structured around the economic incentive of self-interest, 2) that achieving equitable cost distribution is accomplished in nonprofit firms without compulsory taxation because beneficiaries accept financial responsibility for hatchery investment and operating costs, and 3) that for state owned and operated hatcheries there is the potential for serious marketing conflicts with the common-property fishery as fish in excess of brood stock needs return to state hatcheries.

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[5]An example of an exempt species-area combination might be sockeye salmon in a lake-river system experiencing serious disease problems. The Board of Fisheries could be assigned the responsibility of reviewing and determining species-area combinations proposed for the exempt classification by the Department of Fish and Game. This would provide the regional associations an opportunity to provide input to the Board on each proposal.

Table 2

Alaska Salmon Enhancement Program:
Suggested Institutional Distribution of Functions

Public-Sector Enhancement Functions	Private-Sector Enhancement Functions
Issue hatchery permits to nonprofit corporations	Organize regional nonprofit firms
Monitor hatchery operations	Arrange self-assessment and loan financing
Management of natural and hatchery stocks	Construct and operate production hatcheries for non-exempt species-area combinations
Construct and operate research hatcheries	Make recommendations on management of hatchery stocks
Disseminate research results	Make policy recommendations on state enhancement programs
Construct and operate production hatcheries for exempt species-area combinations	
Make policy recommendations on state enhancement programs	

While some may argue with the specific division of responsibilities suggested here, there are no economic bases for questioning a dominant role for the private sector for production hatcheries. The reader will recognize that what is involved here are these basic and by now familiar questions. If fish-tax laws are changed to cover the full cost of state enhancement projects, will not fishermen and fishing communities be better served by enhancement projects which they finance and control themselves? Will not other citizens of Alaska be better served by entrusting state subsidy investments[6] in salmon enhancement production units to private-sector institutions that operate under economic incentives that are conducive to cost efficiency and technological progressiveness? These are questions on which every serious observer should reflect as requests are made for additional public bond and general fund expenditures for state owned and operated salmon enhancement production units.

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[6]The Alaska Statutes provide for grant and loan subsidies to regional private nonprofit associations. In addition, these associations are eligible for various federal grants. The economic justification for subsidy exists up to a point (see Orth, 1977, pp. 65-69) and does not contradict the incentive and equity arguments in favor of private nonprofit hatcheries; the latter must still accept the primary financial responsibility for the construction and operating costs of their hatcheries.

SUMMARY

The two economic imperatives which will determine the long-run economic success of the Alaska salmon enhancement program are cost efficiency and equitable cost distribution. The failure to account for these economic considerations early in the development stage of the program may irreversibly condemn the program to economic failure. A concern for these considerations can be built into the structure of the enhancement program by requiring that production hatchery units be exposed to the market forces of user and contributor control over management, incentive to exercise control, and competition. Such exposure is accomplished automatically for production-hatchery units constructed and operated by private nonprofit hatchery firms. In comparison, state production-hatchery units operate within an inferior incentive system that is not conductive to cost efficiency and which may require special taxation to insure equitable cost distribution.

Policymakers should consider a restructuring of the Alaska salmon enhancement program which would strongly favor private nonprofit hatchery firms for production-hatchery units. Such a restructuring would promote cost efficiency and progressiveness, user-group participation and control, and an equitable distribution of costs to fishermen and consumers. These benefits, along with the favorable induced economic impacts on employment -- income and state-local tax revenues, should obviate the need for specific salmon-enhancement taxation.

LIST OF REFERENCES

Alaska Statutes §§16.10.375 through §§16.10.620.

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