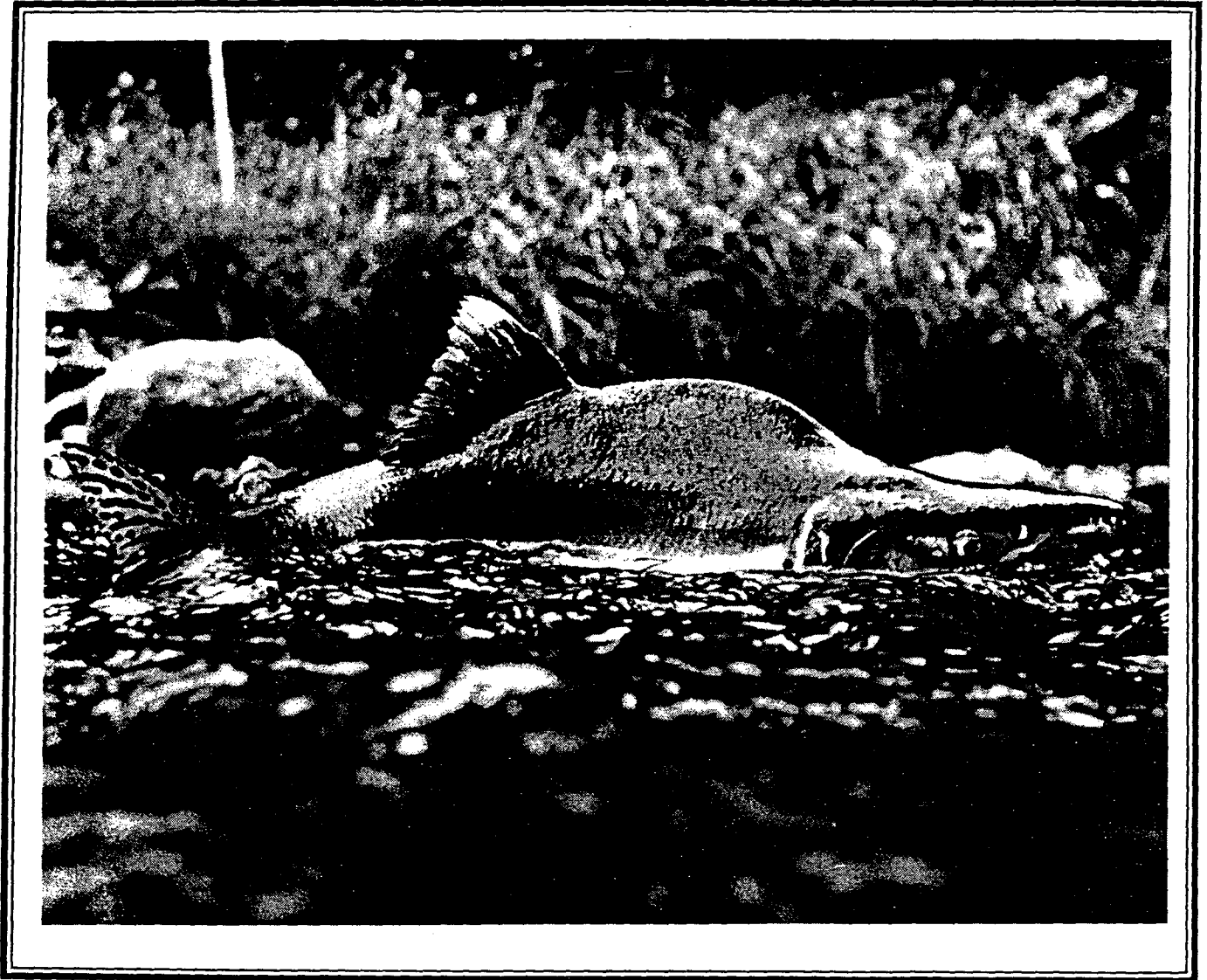


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BENEFIT-COST DIFFERENCES CAUSED BY THE EFFECTS
OF REARING AND TIME OF RELEASE OF HATCHERY-PRODUCED
PINK AND CHUM SALMON

by

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ABSTRACT

Pink or chum salmon were released either as emergent (unfed) or reared (fed in net pens) fry at three Alaska hatcheries. Since time of release was not a variable in the case of pink salmon, marine survival comparisons were made only for fed and unfed groups. Hatchery-reared pink salmon survived to adult at about 2.6 and 1.9 times the rate of fry released unfed from Kitoi and Tutka Hatcheries, respectively. Reared chum salmon released from Hidden Falls Hatchery survived to adult at about 6.0 times the rate of fry released unfed; however, the unfed fish were released about 3 weeks earlier. The value of additional adult fish produced by releasing fed juveniles exceeded the cost of feeding by factors ranging from 4.4 to 12.8. Under the existing experimental designs, size at release did not appear correlated to survival to adult for either species. Large yearly variation in survival may have caused this lack of correlation when all years are looked at as a whole.

INTRODUCTION

With the knowledge that releasing fed juvenile pink and chum salmon almost always results in significantly better survivals to adult, the Fisheries Rehabilitation, Enhancement and Development (FRED) Division of the Alaska Department of Fish and Game feeds every fry that budget constraints allow. Using the results from as many as 10 years of releases, this paper examines the effects of hatchery rearing, time of release, and size at release on the marine survival of pink and chum salmon; additionally, it compares the cost of rearing to the monetary benefits accrued.

METHODS

At the Kitoi and Tutka Hatcheries, managers load their rearing pens with the earliest emergent pink salmon fry, except that the first 10% of the emergents are often released unfed. After the pens are filled, the remaining fry are released into marine waters as they emerge from the incubators. Fry in the pens are reared for about 6 weeks or until natural plankton levels appear sufficient to supply their needs. This regime results in some overlapping in the release timing of fed and unfed fry. A representative group of fish from each group are marked by fin excision and/or insertion of coded-wire tags for future evaluation.

At Hidden Falls Hatchery, water temperature regimes cause the earliest chum salmon fry to emerge in February. Net pens are loaded with fry as they emerge until all pens are filled. Because of the limited pen capacity, many

fry emerging in early April are released unfed. Those in the pens are released as early as 15 April and as late as 21 May. Representative numbers of juveniles are tagged with coded-wires to allow comparison of survivals of fish released either fed or unfed.

RESULTS AND DISCUSSION

Figures 1 and 2 illustrate that release weight of fed pink salmon fry is apparently not correlated to survival when data are examined as a whole; however, the obvious differences in survivals among years (Figure 3) probably masked any effect of size at release. Similarly, Figure 4 indicates that the release weight of fed chum salmon fry did not appear to affect marine survival. To examine the effect of release weight on survival, groups of fry having different mean weights would have had to have been released at the same size and during the same year.

Figure 3 illustrates the strong odd-year and weak even-year cycles for pink salmon returning to Tutka Hatchery. This trend is not apparent for Kitcoi Hatchery.

Figure 4 shows that time of release of chum salmon fry from Hidden Falls strongly affects survival to adult. For the one brood year in which all age classes have returned, fry released at a mean weight of 1.2g on 21 May survived at almost three times the rate of those released at 1.1g on 21 April. For these two lots, it appears that time of release had a greater effect than size at release. Presumably, marine conditions are better suited for chum salmon fry survival in May than in April.

Table 1 illustrates the numbers of fish reared in a single year at each hatchery, feeding costs, survivals, the ex-vessel value of the additional fish produced by using a rearing strategy, and benefits in dollars gained divided by the cost of feeding. Figure 5 shows that there is no question that the feeding program was cost effective. Tutka Hatchery production showed a better benefit-cost ratio partly because of the lower feeding cost per fish and partly because of higher survival. The apparent lower feeding cost per fish is either a result of economy of scale, a less complete accounting of costs involved, or a combination of both. The much higher cost per fish at Hidden Falls is partly due to a much longer rearing period for the chum salmon and also a more comprehensive review of all costs associated with feeding.

Finally, these three facilities are not meant to be prioritized according to the benefit-cost values of the feeding programs. Each should be examined on its own merits and/or undergo more stringent benefit-cost analysis based upon net present value.

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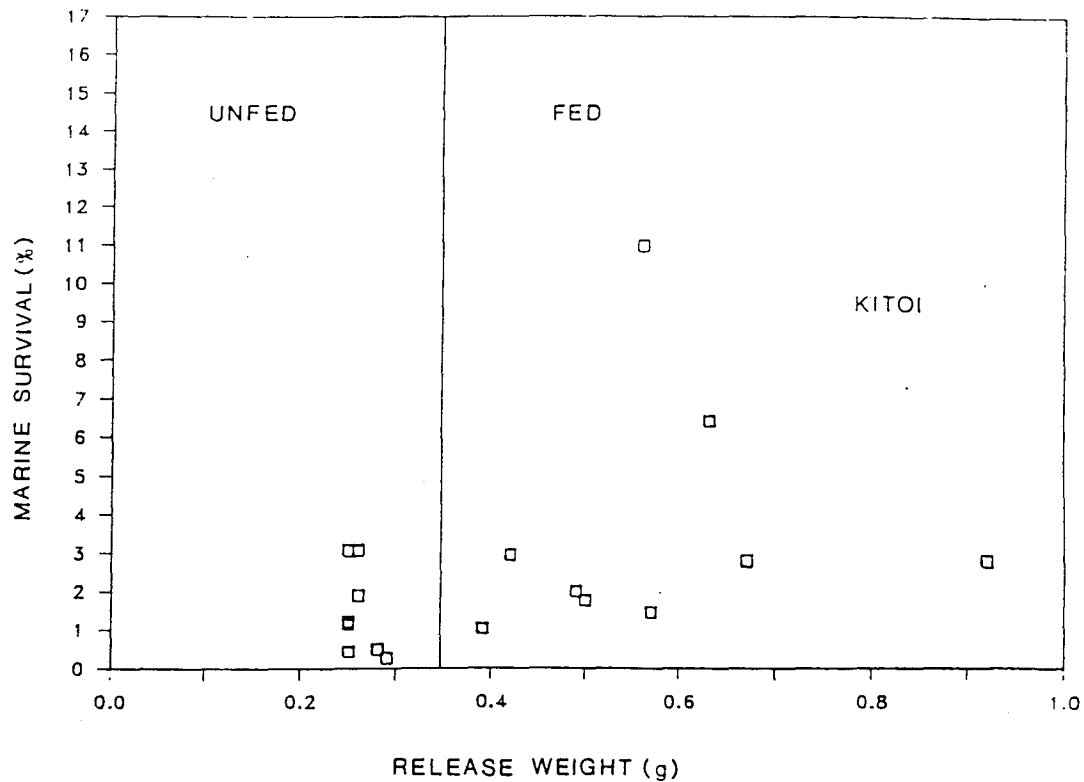


Figure 1. Effect of weight at release on the survival of pink salmon from the Kitoi Hatchery.

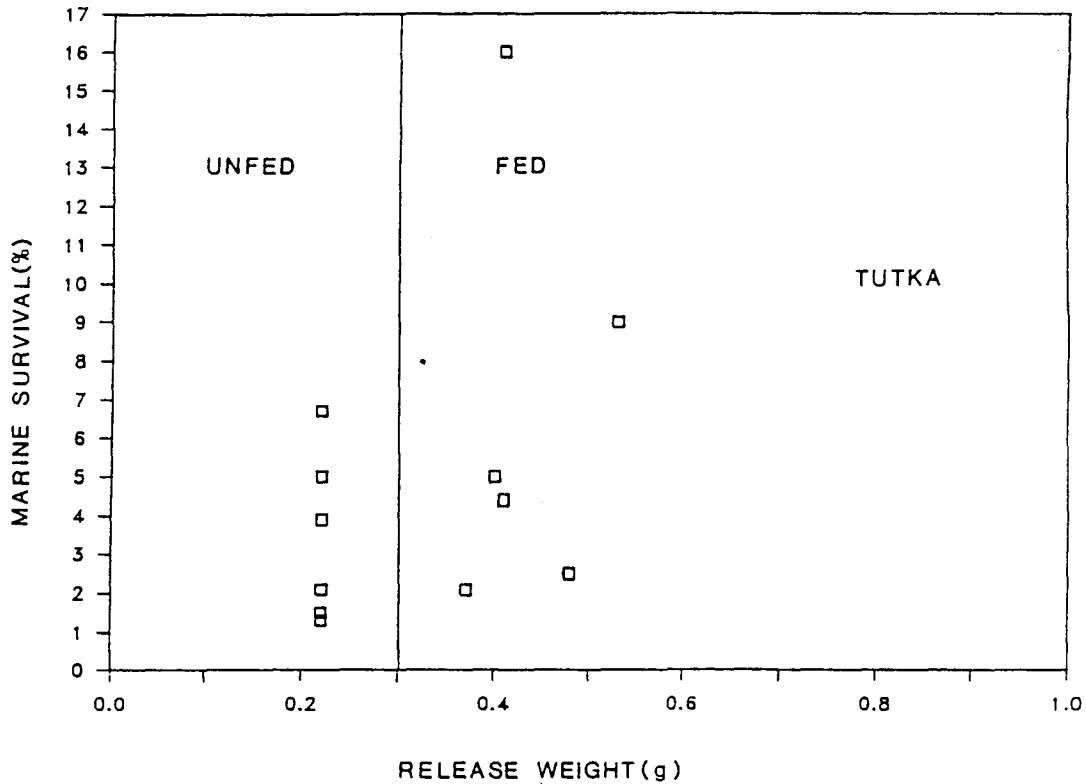


Figure 2. Effect of weight at release on the survival of pink salmon from the Tutka Hatchery.

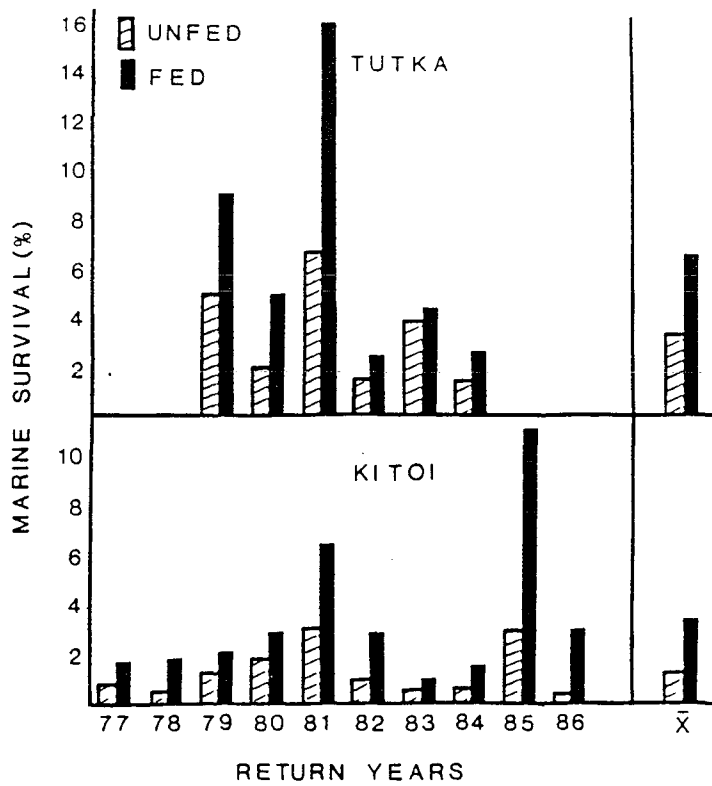


Figure 3. Comparative survivals of fed and unfed pink salmon released from the Tutka and Kitoi Hatcheries.

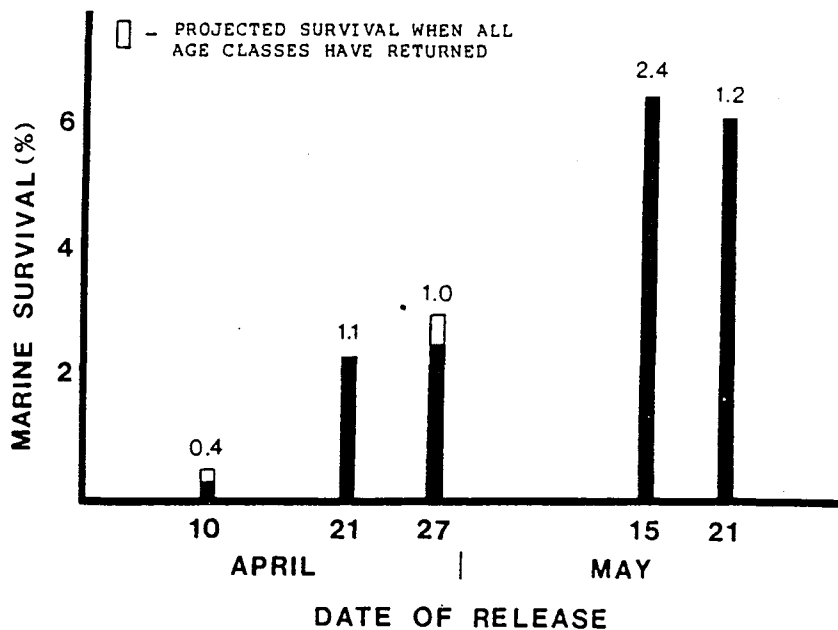


Figure 4. Effect of time and size at release on the survival of Hidden Falls chum salmon. Values above each bar are mean release weights in grams.

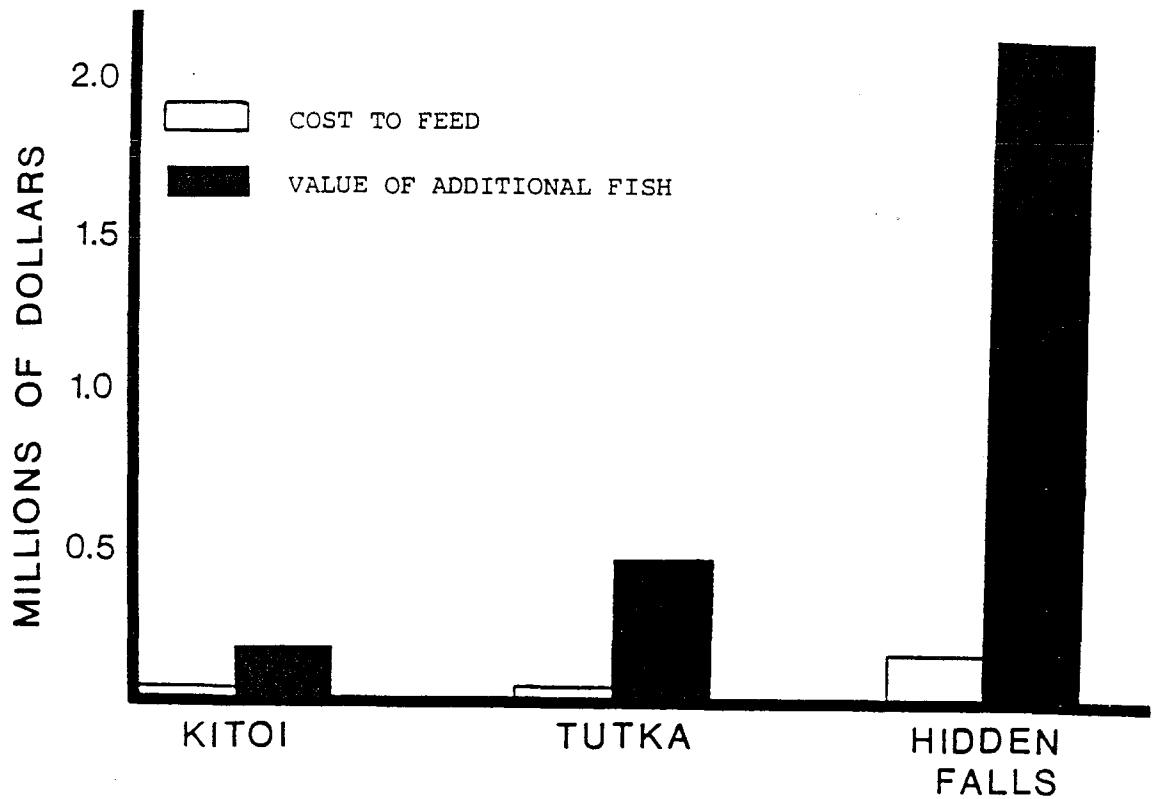


Figure 5. Benefit/cost relationships of the pen-rearing programs for salmon at three Alaska hatcheries.

Table 1. Additional dollar value of adult fish resulting from pen-reared fry compared to unfed fry.

Hatchery	Millions of fish fed	Feeding cost (thousands)	Estimated survival (%)		Added value (millions)	B/C
			Unfed	Fed		
Kitoi	12.2 pink	41	1.3	3.4	0.179	4.4
Tutka	21.5 pink	44	3.4	6.5	0.467	10.6
Hidden Falls	21.0 chum	164	0.5	3.0	2.100	12.8