PACIFIC SALMON COMMISSION
CHINOOK TECHNICAL COMMITTEE

REPORT TCCHINOOK (92)-1

REVIEW OF ALASKAN PROCEDURES TO ESTIMATE ADD-ON AND PREDICTED EFFECTS OF JUNE FISHERIES

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EXECUTIVE SUMMARY

The purpose of this report is to aid the Commission in considering a reduced risk adjustment for the 1992 Southeast Alaska (SEAK) hatchery add-on in accord with the 1991 Letter of Transmittal. Given that the magnitude of estimated SEAK hatchery contributions has increased by ten fold and the uncertainty about the estimate is greater, the adverse consequences on other stocks of over estimating SEAK hatchery contributions are greater now than when the add-on procedure was originally adopted. The CTC recommends that the Commission maintain the risk level of error at 1 in 20.

The report consists of two components: (1) a review of the methods used to estimate the variability associated with estimating the add-on in SEAK and (2) an evaluation of the impact of June fisheries targeted at SEAK hatchery stocks on several other stock groups. The review is based on a draft report prepared by the Alaska Department of Fish and Game (ADF&G) and entitled "Documentation of add-on procedures and estimated impacts of add-on fisheries on chinook salmon stocks in Southeast Alaska" (1991).

The add-on to the SEAK catch is calculated by estimating the total contribution of SEAK hatchery chinook to all fisheries, then subtracting a base-level catch and a risk adjustment. The base-level contribution of 5,000 was set to exceed the level of hatchery production that existed when the ceiling level was established. The risk adjustment, as calculated by ADF&G, is based on the variance of the hatchery contribution estimate. The variance estimate currently used accounts only for the uncertainty associated with tag sampling, the tag decoding processes, differences between tagging rates, and, for sport fisheries, estimation of sport catch.

ADF&G uses a variety of statistical procedures to estimate the contributions of SEAK hatchery fish, and the associated variances, to the various SEAK fisheries. Estimation techniques for the non-terminal commercial fisheries, terminal commercial fisheries, and sport fishery are quite different.

- The procedures employed to estimate variance for non-terminal commercial fisheries are considered satisfactory given certain assumptions. Several assumptions, e.g., "knowing the proportion of fish marked without error" need to be validated and evaluated for impacts on estimation error.

- ADF&G assumes that all fish caught in terminal commercial fisheries are of SEAK hatchery origin and, therefore, no variance is used for this portion of the SEAK hatchery contribution. The Chinook Technical Committee (CTC) recommends that this assumption be validated. If the "pure stock" assumption is verified, then catches should be treated as "terminal exclusions" and not be included in the add-on. Otherwise, the contribution and variance should be estimated as for other commercial fisheries.

- Contribution and variance estimates for the sport fishery are less rigorous than those for commercial fisheries. In the past, variances (measured as a coefficient of variation percentage) were assumed and not calculated from the sampled data. ADF&G currently is revising procedures for the sport fish sampling program to improve the contribution estimate; in addition, variances will be calculated from the sampled data. The CTC cannot comment on these new procedures until we receive more detailed operational plans.

- Unsampled fishing strata for the commercial fisheries are ignored in add-on computations (i.e., no contributions are calculated for these areas). Contribution estimates for unsampled fishing strata for the sport fishery have been calculated in the past. The CTC recommends that contribution estimates not be made for the unsampled strata. Apparently the new sport sampling procedure is expected to substantially eliminate unsampled strata in the future.

Given documented reduction in marking rates and the associated increase in uncertainty of mark rate estimates, the rapid increase in recreational catch (which has a larger variability about estimates of hatchery contributions compared to the commercial sampling program), and unaccounted for sources of potential uncertainty, the CTC concluded that the hatchery add-on is estimated with less certainty now than it was when the add-on procedure was established.

In an effort to increase the harvest of SEAK hatchery chinook, three new fisheries have been initiated during June in Alaskan inside waters: "experimental" (troll), "hatchery access" (troll), and "terminal" (troll, gillnet, seine, and sport) fisheries. The proportion of the catch comprised of SEAK hatchery chinook is much higher in the June fisheries than in the summer troll season. If the June fisheries were eliminated, there would be a resulting loss of SEAK hatchery catch by the troll fleet. However, allocation of chinook to June fisheries results in an increase in the number of chinook non-retention days in the general summer troll season. Examples of the numbers of fish involved are given in this report.

The change in fishing mortality resulting from instituting June fisheries to increase access to SEAK hatchery production differs between stocks considered. Comparing the June to general summer fisheries, the concentrations of SEAK hatchery fish, North/Central B.C., Upper and Lower Georgia Strait, and West Coast Vancouver Island stocks are higher, while concentrations of other stocks like the Harrison, Upper Fraser, Washington, and Oregon are lower.

1.0 INTRODUCTION

The purpose of this report is to aid the Commission in considering a reduced risk level for the 1992 Southeast Alaska (SEAK) hatchery add-on in accord with the 1991 Letter of Transmittal[1]. The report consists of two components: (1) a review of the methods used to estimate the variability associated with estimating the SEAK hatchery contributions to SEAK fisheries; and (2) an evaluation of the impact on SEAK hatchery stocks and several other natural stock groups of June fisheries targeted at SEAK hatchery stocks. The review is based on a draft report prepared by the Alaska Department of Fish and Game (ADF&G) and entitled "Documentation of add-on procedures and estimated impacts of add-on fisheries on chinook salmon stocks in Southeast Alaska" (1991) (referred to as the ADF&G report). The ADF&G report will be finalized after a thorough review and will contain modifications to the current methods.

Annex IV, Chapter 3, Paragraph 2 of the Pacific Salmon Treaty (PST) addresses the use of new enhancement to aid the rebuilding program and provides for additional harvest beyond ceiling levels as long as "the rebuilding schedule is not extended beyond 1998." Hence, the Treaty recognizes the merit of increasing the hatchery production to: (1) act as a buffer for the catch of natural stocks; and (2) increase the harvest of hatchery stocks so long as the rebuilding of natural stocks is not delayed beyond 1998.

Two methods have been implemented to allow the harvest of new production while maintaining the current ceilings. Add-on provides a means to harvest new production in mixed stock or terminal fisheries. Alternatively, the concept of "terminal exclusion" is applicable to the harvest of new production or production in excess of the escapement objective in terminal areas in which other stocks are not present. This report reviews the add-on procedure used in Alaska.

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[1] The 1991 Letter of Transmittal states:

> "the Commission agrees to consider a reduced risk adjustment level for 1992 based upon evaluation and review by the Chinook Technical Committee of the following information to be provided by the United States by November 1991:
>
> i) the computational procedures for estimating the coefficient of variation associated with the add-on;
>
> ii) the effects of hatchery add-on fisheries, if any, on the rebuilding of wild stocks including information on the stock composition of chinook catches in the June fisheries and on the duration of subsequent chinook non-retention periods."

2.0 BASIC CONCEPTS OF ADD-ON AND RISK ADJUSTMENT

The add-on is calculated by estimating the total contribution of SEAK hatchery chinook to all SEAK fisheries under the catch ceiling, then subtracting a base-level contribution and a risk adjustment.

Hatchery Add-on = (*Hatchery Contribution*) - (*Base Hatchery Contribution*) - (*Risk Adjustment*)

The base-level contribution of 5,000 fish was set to exceed the hatchery production that existed when the ceiling level was established. The risk adjustment, as calculated by ADF&G, is based on the variability of the hatchery contribution estimate. The risk adjustment provides a safety margin against overestimation of the SEAK hatchery contribution to protect against an increase in the harvest of natural stocks. This concept was discussed in a bilateral paper prepared in 1986, which stated that, "Procedures for estimating new enhancement add-on should take potential estimation errors into account." On the average, errors in estimation will result in underestimates of hatchery contribution as often as they result in overestimates. The risk adjustment is used to reduce the frequency of overestimation of the contribution to some pre-determined level of risk. The risk adjustment thus provides a buffer that will aid rebuilding because the base catch (total catch minus the estimated add-on) would tend to include SEAK hatchery fish (and, consequently fewer wild fish). Overestimates of SEAK hatchery contribution result in increased harvest rates on other stocks.

The risk adjustment is computed by multiplying the standard deviation (a measure of uncertainty) of the estimated hatchery contribution by a risk factor. In the years 1985 through 1991, the risk factor has been set equal to 1.645. This risk factor is equivalent to a risk level such that, within any year, the estimated contribution should not exceed the true contribution more than once in 20 estimates (assuming no bias in the estimation).

Risk Adjustment = (*Standard Deviation*) x (*Risk Factor*)

3.0 REVIEW OF CURRENT ADD-ON PROCEDURES

The Chinook Technical Committee (CTC) undertook a review of the add-on procedures documented in the ADF&G report with the objective of answering the question "Do modifications in the procedures warrant a lower risk level given that the magnitude of the add-on is increasing and the rebuilding program is now half completed?"

SEAK hatchery chinook are caught in fisheries throughout SEAK and are present in different concentrations within these fisheries (Table 1). In general, the catches in the recreational fishery and terminal commercial fisheries have been increasing. The proportion of catch comprised of SEAK hatchery chinook is also greater in these fisheries.

Table 1. Distribution of total chinook salmon catch and contribution estimates of SEAK hatchery chinook to commercial and recreational fisheries in Southeast Alaska, 1985-1990.

Catch of Chinook Salmon By S.E. Alaska Fisheries

	<---------- COMMERCIAL FISHERIES ------->					<---- RECREATIONAL FISHERIES --->			
Year	Total	Troll	Gillnet	Seine	Terminal	Total	Sampled	Unsampled	Terminal
1985	255132	218541	13471	23120	0	24474	14966	9124	384
1986	262112	239280	9132	13200	500	21793	14604	6431	758
1987	287135	268885	11603	6233	414	24324	19332	4170	822
1988	234459	210192	8762	11963	3542	23160	17418	5096	646
1989	259952	227826	11253	15745	5128	31071	19744	11027	300
1990	321585	288979	10545	12366	9695	51218	34903	11939	4376

Contributions of SEAK Hatchery Chinook Salmon To SEAK Fisheries

	<---------- COMMERCIAL FISHERIES ------->					<---- RECREATIONAL FISHERIES --->			
Year	Total	Troll	Gillnet	Seine	Terminal	Total	Sampled	Unsampled	Terminal
1985	10656	8148	1029	1479	0	3372	1874	1114	384
1986	12647	9794	1278	1075	500	4981	2977	1246	758
1987	18982	16602	1668	298	414	5277	3691	764	822
1988	24880	18974	2143	221	3542	4945	3353	946	646
1989	27540	17716	2056	2640	5128	6231	3826	2105	300
1990	43426	30024	3071	636	9695	16612	9721	2515	4376

Catch Distribution of Chinook Salmon By SEAK Fisheries

	<---------- COMMERCIAL FISHERIES ------->					<---- RECREATIONAL FISHERIES --->			
Year	Total	Troll	Gillnet	Seine	Terminal	Total	Sampled	Unsampled	Terminal
1985	91.2%	78.2%	4.8%	8.3%	0.0%	8.8%	5.4%	3.3%	0.1%
1986	92.3%	84.3%	3.2%	4.6%	0.2%	7.7%	5.1%	2.3%	0.3%
1987	92.2%	86.3%	3.7%	2.0%	0.1%	7.8%	6.2%	1.3%	0.3%
1988	91.0%	81.6%	3.4%	4.6%	1.4%	9.0%	6.8%	2.0%	0.3%
1989	89.3%	78.3%	3.9%	5.4%	1.8%	10.7%	6.8%	3.8%	0.1%
1990	86.3%	77.5%	2.8%	3.3%	2.6%	13.7%	9.4%	3.2%	1.2%

Distribution of Contributions of SEAK Hatchery Chinook Salmon To SEAK Fisheries

	<---------- COMMERCIAL FISHERIES ------->					<---- RECREATIONAL FISHERIES --->			
Year	Total	Troll	Gillnet	Seine	Terminal	Total	Sampled	Unsampled	Terminal
1985	76.0%	58.1%	7.3%	10.5%	0.0%	24.0%	13.4%	7.9%	2.7%
1986	71.7%	55.6%	7.2%	6.1%	2.8%	28.3%	16.9%	7.1%	4.3%
1987	78.2%	68.4%	6.9%	1.2%	1.7%	21.8%	15.2%	3.1%	3.4%
1988	83.4%	63.6%	7.2%	0.7%	11.9%	16.6%	11.2%	3.2%	2.2%
1989	81.5%	52.5%	6.1%	7.8%	15.2%	18.5%	11.3%	6.2%	0.9%
1990	72.3%	50.0%	5.1%	1.1%	16.1%	27.7%	16.2%	4.2%	7.3%

Percentage of SEAK Fisheries Chinook Catch Comprised of SEAK Hatchery Fish

	<---------- COMMERCIAL FISHERIES ------->					<---- RECREATIONAL FISHERIES --->			
Year	Total	Troll	Gillnet	Seine	Terminal a/	Total	Sampled	Unsampled	Terminal a/
1985	4.2%	3.7%	7.6%	6.4%	NA	13.8%	12.5%	12.2%	100.0%
1986	4.8%	4.1%	14.0%	8.1%	100.0%	22.9%	20.4%	19.4%	100.0%
1987	6.6%	6.2%	14.4%	4.8%	100.0%	21.7%	19.1%	18.3%	100.0%
1988	10.6%	9.0%	24.5%	1.8%	100.0%	21.4%	19.3%	18.6%	100.0%
1989	10.6%	7.8%	18.3%	16.8%	100.0%	20.1%	19.4%	19.1%	100.0%
1990	13.5%	10.4%	29.1%	5.1%	100.0%	32.4%	27.9%	21.1%	100.0%

a/ assumed

It is important to note that the variance estimates currently used account only for the variance introduced during the tag sampling and tag decoding processes, differences between tagging rates, and, for sport fisheries, estimation of catch. Uncertainty in reported catch or the mark rate at release are not included in the current variance computations for commercial fisheries and, if included, would increase the variance calculated. In addition, bias in the estimates (i.e., a directional error in an estimate) has not been accounted for. For example, a bias would result from differential mortality between tagged and untagged fish, not accounting for uncertainty in SEAK mark rates and numbers released, and the unsampled sport catch. Once identified and quantified, a bias may be corrected by addition or subtraction of the bias magnitude. As currently estimated, the variance of the estimated contribution is a function of the proportion of fish tagged and the recovery sampling rates. The proportion of the SEAK hatchery production which was tagged has declined since 1980 (Fig. 1). Commercial catch sampling rates have been greater than the coastwide standard (20%), fluctuating from 28% to 42% since 1985 (Fig. 2). The sport fisheries have been sampled at a rate of 8% to 17% (sampled sport catch divided by the total estimated sport catch).

The ADF&G uses a variety of statistical procedures to estimate the contributions of SEAK hatchery fish, and the associated variances, for the various SEAK fisheries. These procedures, and the data utilized, are summarized in the following sections.

3.1 Commercial Fisheries

Non-Terminal. The variance of the hatchery contribution estimates is estimated using a compound probability density function originally described in Clark and Bernard (1987). The variance estimator has been independently derived by Schnute (1992) and is believed to provide a satisfactory approximation of the true variance under specific circumstances and assumptions including:

1) Catch is known without error.

   Catch is likely a small source of error in most SEAK commercial fisheries since chinook salmon are recorded by the piece on the landing ticket.

2) Proportion marked is known without error.

   Estimates of the proportion marked are obtained directly from hatchery release data. It is assumed that there are no survival rate differences between marked and unmarked fish after release. Depending upon the accounting system used by a hatchery, the reported unmarked release may actually be an estimate with an associated degree of uncertainty.

   ADF&G has completed a hypothetical simulation of the effect of violating this assumption. The simulation indicated that uncertainty in the estimate of the proportion marked could result in a substantial increase in the co-efficient of variation (CV) of the estimated hatchery contribution, but the degree of the effect depended upon the error in commercial fishery sampling relative to the error in the estimate of the proportion marked (Fig. 3).

3) The distribution patterns of tagged and untagged fish in fisheries are identical.

Terminal Commercial Fishery. Current ADF&G procedures assume that all of the catch in designated terminal areas is of SEAK hatchery origin. These terminal areas have been selected by the ADF&G on the basis of: 1) the geographic location and timing of the fishery; 2) results from test fisheries; and/or 3) observed CWT recoveries (ADF&G, 1991). In general, the ADF&G has not presented information to substantiate this assumption. In the one data set provided (Blind Slough, Area 106-44), the proportion of the catch accounted for by expanded hatchery tag recoveries ranged on a weekly basis from 10% to 145% (pg.23, ADF&G report). Since no variance is attached to the catch in the terminal areas, the catch is, in effect, added to the ceiling and then subtracted off as add-on.

Unsampled Commercial Fishery. Commercial fisheries which are not sampled for CWT are assumed to have no contribution from SEAK hatcheries. The proportion of the commercial catch which is not sampled is quite small.

3.2 Recreational Fisheries

The procedures used by ADF&G through 1991 to estimate SEAK hatchery contributions to SEAK recreational fisheries are currently under review and are being modified. The revised procedures will use a mail survey to estimate total catch and a port sampling program to estimate the SEAK hatchery contributions. One objective of the new procedure is to obtain a direct estimate of the variance of the estimated hatchery contribution.

The current estimation procedure for variance of the SEAK hatchery contributions in sport fisheries involves the sum of two components. The first component, reflecting uncertainty in the catch estimate, is based on an assumed CV of 17% (page 30-32 in the ADF&G report) computed from a single creel survey in Juneau in 1985. The second component, reflecting sampling error for CWT's, is based on a CV computed by adjusting the average 1982-84 CV for SEAK commercial fisheries by the square root of the ratio of commercial sampling rate (1982-84 average rate 35%) to the sport sampling rate (20% sampling rate in 1985 survey). Sport catches near population centres (Juneau, Ketchikan, Petersburg, Wrangell, Haines, Sitka) have been estimated by creel surveys. Recoveries of coded-wire tags are obtained by direct sampling. Although variances for catch could be determined from the creel surveys, these estimates were not used in the add-on calculations.

The ADF&G report indicated that some uncertainty exists whether these methods were properly applied in each year. Specifically, it is unclear if: (1) the adjustment for the sampling rate was consistently applied; and (2) if the variance of the catch estimate correctly incorporated postseason revisions to preliminary estimates of catch. The ADF&G estimates these potential errors may have resulted in underestimates of the risk adjustment ranging from 100 to 1,000 fish from 1985 to 1990 (J.E. Clark, pers. comm.), and corresponding overestimates of the add-on.

Contrary to the procedures for commercial fisheries, SEAK hatchery fish in unsampled sport fisheries are assumed to contribute at the same rate as for non-terminal sampled sport fisheries. The "unsampled sport catch" is estimated as the difference between the total sport catch estimated by a mail survey of sport fishermen and the estimated catch in sampled non-terminal, derby, and terminal fisheries. In Canada and Washington, positive biases are frequently observed in mail type surveys of sport catch. However, Alaska has found no bias in its comparisons of catch estimates based on mail surveys and direct sampling.

It was proposed that the variance about the estimated hatchery contributions in these unsampled catches could be arbitrarily set at a coefficient of variation of 61%. This value is equal to setting the lower one-tail 95% confidence limit equal to 0, resulting in a 95% (i.e., 1 in 20 risk level) risk adjustment for a single value (stratum) being equal to the value (i.e., no contribution). However, including unsampled sport catches does result in an increased add-on when contributions and variances from all fisheries (sampled commercial, sampled and unsampled sport) are summed to calculate the total add-on in a year (example table page 34 of ADF&G report). A problem with this procedure is that a higher proportion of the estimated contribution to unsampled sport fisheries can be incorporated into the add-on than for estimated contributions from sampled fisheries.

3.3 Total Add-on Calculations

The annual add-on value is computed by:

1) Adding the estimated hatchery contributions of each tag code in each fishery (sampled commercial, terminal commercial, and sport) to obtain the total hatchery contribution;

2) Adding the estimated variance of the hatchery contributions of each tag code in each fishery (sampled commercial, terminal commercial, and sport) to obtain the total variance of the estimated contribution;

3) Computing the risk adjustment by multiplying the square root of the total variance by a scalar which represents the chance of over estimating the contribution in 1 year of 20 (1.645 is the appropriate scalar assuming a normal distribution of error about the estimated contribution); and then

4) Subtracting from the total hatchery contribution computed in (1) the risk adjustment computed in (3) and the base period contribution.

4.0 IMPACT OF JUNE FISHERIES

As instructed in the Letter of Transmittal, the CTC undertook a review of the effects of SEAK June fisheries on the rebuilding of wild stocks, including an assessment of stock composition in June and July fisheries and the effect of subsequent chinook non-retention periods.

In an effort to increase the harvest of SEAK hatchery chinook, three new fisheries have been initiated during June in SEAK inside waters: "experimental" (troll), "hatchery access" (troll), and "terminal" (troll, gillnet, seine, and sport) fisheries. The experimental fisheries are conducted in areas near hatcheries or migratory corridors where the contribution of SEAK hatchery chinook is expected to be high. The general objective is to select areas where the SEAK hatchery production comprises at least 33% of the catch; if the percentage drops below 20%, the experimental fishery is not conducted in that area the following year. The hatchery access fisheries are conducted in all inside waters of SEAK and are designed as two 3-day openings; although, in 1991, the second opening lasted only 1.5 days due to high catch rates. The designation of terminal fisheries was discussed in the commercial fishery section. The contribution of SEAK hatchery chinook is substantially higher in these June fisheries than in the summer troll season (July 1-Sept. 30) (Table 2).

Table 2. Total catch and percent SEAK hatchery chinook contribution (Cont.) to SEAK troll fisheries, 1985-1991. Catch data are preliminary and subject to modification (NF: no fishery).

Year	Winter Fishery		Terminal Fisheries a/		Experimental Fisheries		Hatchery Access		Summer Troll	
	Catch	Cont.	Catch	Cont.	Catch	Cont.	Catch	Cont.	Catch	Cont.
1985	22,500	5%	NF	NF	NF	NF	NF	NF	193,600	4%
1986	22,800	6%	95	100%	NF	NF	NF	NF	214,700	5%
1987	28,600	12%	6	100%	4,440	32%	NF	NF	209,000	6%
1988	60,400	13%	750	100%	8,700	33%	NF	NF	164,700	5%
1989	34,300	14%	1,008	100%	2,300	74%	30,400	19%	167,600	3%
1990	33,100	13%	16	100%	7,200	63%	34,800	19%	211,900	7%
1991	42,400	24%	6,003	100%	13,900	47%	46,400	20%	154,000	4%

a/ Contribution of SEAK hatchery chinook to the Terminal Fisheries is assumed to be 100%.

Because of the allocation and management system used in SEAK, the summer troll fishery is allowed to harvest that portion of the catch ceiling that has not been allocated to net fisheries, harvested in prior troll fisheries, or is anticipated to be taken in recreational fisheries. As such, when more chinook are taken in earlier fisheries, fewer are available for the general summer season. After the chinook ceiling is taken, chinook non-retention (CNR) is imposed and fishing continues for coho until September 30. Consequently, the allocation of chinook to June fisheries increases the number of CNR days during the summer troll season.

The following sections evaluate the most direct impacts of June fisheries on: (1) the harvest of SEAK hatchery chinook; (2) incidental mortalities; and (3) the harvest of natural stocks. The impacts are assessed by evaluating the change that would have occurred if the fish harvested in the June hatchery access and experimental fisheries had instead been allocated to the summer troll season.

4.1 Impacts on Catch of SEAK Hatchery Fish

The proportion of the catch comprised of SEAK hatchery chinook is much higher in the June fisheries than in the summer troll season. If the June fisheries were eliminated, there would be a resulting loss of SEAK hatchery catch by the troll fleet. The magnitude of this loss can be estimated for each year by:

1) Calculating the June catch of SEAK hatchery fish;

2) Calculating the June catch of the non-SEAK hatchery chinook (total catch minus (1));

3) Computing the equivalent summer catch (SEAK hatchery and other) by expanding (2) by the proportion SEAK hatchery chinook in the summer troll fishery;

4) Computing the equivalent SEAK hatchery chinook catch in the summer troll catch by multiplying the total equivalent catch in (3) by the proportion SEAK hatchery chinook in the summer troll fishery; and

5) Subtracting (4) from (1).

Because the terminal catch is assumed to be 100% SEAK hatchery origin, harvest of these fish does not reduce the number of fish that can be taken in the summer troll fishery. As such, for the purposes of this exercise, it will be assumed that these fisheries remain unchanged. The table below summarizes these calculations for 1989-1991. These estimates for the loss of catch should be considered a maximum, since some of the "lost" chinook would be harvested in terminal fisheries.

Table 3. Estimated change in troll catch of SEAK hatchery (SEAK) that would occur if SEAK June troll chinook catch had been allocated to the July general summer troll season in 1989, 1990, and 1991.

	1989			1990			1991		
	Other	SEAK	total	Other	SEAK	total	Other	SEAK	total
Total June Catch	25,142	7,504	32,646	30,742	11,262	42,004	44,644	15,689	60,333
Equivalent July Catch	25,142	820	25,962	30,742	2,228	32,970	44,644	1,947	46,591
Loss of Catch (difference)	0	6,684	6,684	0	9,034	9,034	0	13,742	13,742

a/ Does not include catches from terminal fisheries.

4.2 Impacts on Incidental Mortalities

If the fish harvested in June troll fisheries had instead been allocated to the summer troll season, a reduction in incidental mortalities during CNR periods should result. Details of the procedure used to estimate the reduction can be found in the ADF&G report. The general approach is summarized below:

1) Compute the additional summer catch that would be available without experimental or hatchery access fisheries (as in (3) in section 4.1);

2) Predict the number of boat days required to harvest the catch computed in (1);

3) Predict the number of both legal and sublegal chinook that would not have been hooked and released had the catch computed in (1) been available (this was computed by multiplying the boat days computed in (2) by the average encounter rates in the observer program from 1985-1989); and

4) Compute the number of chinook that would have been saved by multiplying the number of encounters computed in (3) by the estimated mortality rate for fish which are released.

Depending upon the mortality rate assumed, approximately 3,000-6,000 chinook per year would have been saved if catch were reallocated from the June fisheries to the summer troll season (Table 4).

Table 4. Summary of method used to estimate the magnitude of incidental mortality reduction that would occur if the fish harvested in SEAK June troll fisheries during the years 1989-1991 had instead been allocated to the summer troll season.

	1989	1990	1991
Additional summer catch	25,962	32,971	46,591
Projected additional fishing days	2.48	3.39	2.73
Number of boats	704	672	820
Projected additional effort (in boat-days)	1,746	2,279	2,235
Average encounter rates per boat-day (legal and sub-legal)	8.95	8.95	8.95
Estimated encounters (legal and sub-legal)	15,630	20,396	19,999
Estimated mortalities (legal and sub-legal) a/	3,126 - 4,689	4,079 - 6,119	4,000 - 6,000

a/ Range based on mortality rate of 20% to 30%.

4.3 Relative Impacts of June and General Summer Troll Seasons on Different Stock Groups

CWT recovery data were used to calculate contribution rates to Alaskan troll summer fisheries for selected Oregon, Washington, Alaska, and British Columbia chinook stocks. Contribution rates were calculated for: June hatchery access fisheries, June experimental fisheries, and the summer troll season. The summer troll season was further divided into inside and outside areas, and contributions were calculated for each. The "inside" SEAK summer troll fishing area corresponds closely to the area of the June hatchery access fishery.

To calculate contribution rates, recoveries for a particular fishery (expanded for sampling rates and reported marked to unmarked ratios) were divided by the total catch in that fishery and multiplied by 1,000 to get a contribution rate per 1,000 fish caught. These contribution rates were then expressed as an index by dividing each one by the contribution rate in the combined (inside and outside) summer troll season. Thus, contributions are expressed relative to the contribution in the summer troll season (i.e., indices greater than one indicate higher contribution than in the summer fishery, while indices less than one indicate lower contributions).

The contribution indices were used to estimate how landed-catch (impacts from changes in CNR fishing time were not evaluated) impacts on natural chinook stocks would have changed if the hatchery access and June experimental fisheries had not occurred. The percent change in impact without each of the June fisheries was calculated for each stock. This was done, for a given stock, by estimating the total June

and July contribution of that stock without the June fishery (or fisheries), subtracting the total June and July contribution of that stock with the June fisheries, to get a change in contribution. This was then expressed as a percentage by dividing this calculated change by the total June and July contribution with the June fisheries. The amount of summer troll catch that would have resulted from reallocating the catch from each of the June fisheries was calculated using the same methods described in Section 4.1.

Results of this assessment are summarized in Tables 5 through 7.

The areas and times of the June commercial fisheries in Alaska are selected with the objective of maximizing the harvest of SEAK hatchery fish relative to other stocks. The concentration index for the SEAK hatchery stock indicates that the experimental troll fisheries have been particularly effective in achieving this objective. Contribution indices for the years 1989 to 1991 indicate that the relative abundance of the SEAK stock is 5 to 11 times greater in the experimental troll fishery than in the summer fishery. Concentrations of the SEAK hatchery stock in the hatchery access fisheries were also 3 to 5 times greater than in the summer troll fishery. In the absence of June fisheries, it is estimated that the troll catch of SEAK hatchery fish would have been reduced by 34 to 63 percent.

The contribution indices were also used to predict the impact of each type of fishery upon natural stocks. This analysis assumes that the geographic and temporal distribution of the natural stocks is similar to the stocks which were tagged. It should be noted that the number of recoveries may be quite limited for stocks which do not contribute substantially to SEAK fisheries, or for stocks with a small number of fish tagged, e.g., Puget Sound and Snake River Fall.

In general, stock groups appear to be differentially affected by the June fisheries. Stocks that are more concentrated in the inside areas during the June time period are likely to have been negatively impacted by the June fisheries. Included in this group are stocks from North/Central B.C, Upper Strait of Georgia (UGS), Lower Strait of Georgia (LGS), and the West Coast of Vancouver Island. The predicted catch of these stocks in the absence of June fisheries in 1989 and 1990 would have been expected to decline by 4 to 18 percent. In 1991, the UGS and LGS were relatively more concentrated in the June hatchery access fisheries. In the absence of June fisheries in 1991, the impact on these stocks would have been reduced by approximately 40 percent.

Stocks from the Upper Fraser, the Harrison, Washington, and Oregon are generally more concentrated in the outside troll fishing areas. For this reason, impacts of SEAK fisheries on these stocks have been reduced from the addition of June fisheries. The greatest benefit has accrued to the Oregon Coastal stock, with an estimated reduction in the impact ranging from 8 to 25 percent.

Table 5. 1989 contribution indices for selected chinook stocks to SEAK troll fisheries, and the percent change in impacts expected without SEAK June troll fisheries.

REGION	1989 CONTRIBUTION INDEX					1989 ESTIMATED PERCENT CHANGE IN IMPACT		
	Hatch. Access	Exp. Troll	Summer Troll			W/O Hatch. Access	W/O Exp. Troll	W/O Either June Fishery
			Inside	Outside	Combined 1/			
Alaska	4.1	5.6	4.2	0.5	1.0	-38.4%	-3.7%	-42.1%
British Columbia								
N/C B.C.	2.4	0.4	2.9	0.7	1.0	-23.7%	-0.1%	-23.9%
Upper Fraser	0.6	0.0	0.2	1.1	1.0	5.3%	0.3%	5.6%
Harrison	0.0	0.0	0.0	1.2	1.0	22.4%	0.4%	22.8%
Upper St. of Geo.	1.7	0.1	2.6	0.8	1.0	-14.7%	0.2%	-14.5%
Lower St. of Geo.	1.7	0.0	5.2	0.4	1.0	-13.9%	0.3%	-13.6%
WCVI	2.0	0.2	1.2	1.0	1.0	-18.3%	0.0%	-18.3%
All B.C.	1.9	0.2	1.4	0.9	1.0	-18.1%	0.1%	-18.0%
Puget Sound	NA	NA	NA	NA	NA	NA	NA	NA
WA Coast	0.4	0.0	0.6	1.1	1.0	10.8%	0.4%	11.2%
Columbia River								
Lewis R. Wild	1.2	0.0	0.0	1.2	1.0	-6.2%	0.3%	-5.9%
Snake Fall	0.3	0.0	3.4	0.6	1.0	13.9%	0.4%	14.3%
Brights	1.1	0.0	0.4	1.1	1.0	-4.8%	0.3%	-4.5%
OR Coastal	0.2	0.0	0.6	1.1	1.0	15.3%	0.4%	15.7%

1/ Weighted average of inside and outside summer troll contributions.

Table 6. 1990 contribution indices for selected chinook stocks to SEAK troll fisheries, and the percent change in impacts expected without SEAK June troll fisheries.

REGION	1990 CONTRIBUTION INDEX					1990 ESTIMATED PERCENT CHANGE IN IMPACT		
	Hatch. Access	Exp. Troll	Summer Troll			W/O Hatch. Access	W/O Exp. Troll	W/O Either June Fishery
			Inside	Outside	Combined 1/			
Alaska	2.9	8.5	2.7	0.6	1.0	-18.7%	-15.6%	-34.4%
British Columbia								
N/C B.C.	1.7	1.1	1.7	0.8	1.0	-10.2%	-1.8%	-12.0%
Upper Fraser	0.3	0.0	0.3	1.2	1.0	8.0%	1.3%	9.2%
Harrison	0.3	0.0	1.2	1.0	1.0	9.4%	1.3%	10.7%
Upper St. of Geo.	1.9	0.6	3.6	0.4	1.0	-13.1%	-0.5%	-13.6%
Lower St. of Geo.	1.5	0.2	2.0	0.8	1.0	-8.3%	0.4%	-7.9%
WCVI	1.2	0.4	0.6	1.1	1.0	-4.3%	0.0%	-4.3%
All B.C.	1.2	0.4	0.8	1.0	1.0	-4.3%	0.0%	-4.3%
Puget Sound	0.0	8.3	5.0	0.1	1.0	11.0%	-21.0%	-10.0%
WA Coast	0.2	0.1	0.3	1.2	1.0	9.6%	0.9%	10.5%
Columbia River								
Lewis R. Wild	0.6	1.0	0.5	1.1	1.0	3.4%	-1.7%	1.7%
Snake Fall	0.5	1.4	2.7	0.6	1.0	5.6%	-3.0%	2.6%
Brights	0.4	0.0	0.8	1.0	1.0	6.5%	1.2%	7.8%
OR Coastal	0.4	0.0	0.2	1.2	1.0	7.1%	1.2%	8.3%

1/ Weighted average of inside and outside summer troll contributions.

Table 7. 1991 contribution indices for selected chinook stocks to SEAK troll fisheries, and the percent change in impacts expected without SEAK June troll fisheries.

REGION	1991 CONTRIBUTION INDEX					1991 ESTIMATED PERCENT CHANGE IN IMPACT		
	Hatch. Access	Exp. Troll	Summer Troll Inside	Summer Troll Outside	Summer Troll Combined 1/	W/O Hatch. Access	W/O Exp. Troll	W/O Either June Fishery
Alaska	4.9	11.5	4.0	0.5	1.0	-34.6%	-28.2%	-62.8%
British Columbia								
N/C B.C.	1.2	2.5	1.8	0.9	1.0	-7.1%	-11.3%	-18.4%
Upper Fraser	0.6	0.0	1.0	1.0	1.0	4.8%	4.2%	9.0%
Harrison	0.5	1.2	1.1	1.0	1.0	7.6%	-4.7%	2.9%
Upper St. of Geo.	3.6	0.6	3.4	0.6	1.0	-39.0%	-0.4%	-39.3%
Lower St. of Geo.	3.6	1.4	2.2	0.8	1.0	-38.0%	-3.5%	-41.5%
WCVI	1.1	0.4	1.0	1.0	1.0	-6.8%	1.2%	-5.5%
All B.C.	1.2	0.4	1.1	1.0	1.0	-7.3%	0.8%	-6.5%
Puget Sound	0.4	0.0	5.6	0.3	1.0	10.7%	4.4%	15.1%
WA Coast	0.2	0.1	0.5	1.1	1.0	19.3%	3.9%	23.2%
Columbia River								
Lewis R. Wild	0.5	0.0	0.3	1.1	1.0	8.0%	4.3%	12.3%
Snake Fall	0.0	0.0	0.0	1.2	1.0	25.2%	5.0%	30.2%
Brights	0.6	0.0	0.0	1.2	1.0	5.3%	4.2%	9.5%
OR Coastal	0.1	0.1	0.1	1.1	1.0	21.0%	4.1%	25.1%

1/ Weighted average of inside and outside summer troll contributions.

5.0 DISCUSSION

A reduction in the risk level from 1 in 20 would indicate that the Commission is willing to accept greater risk of an impact on the rebuilding of wild chinook stocks or that there is now less uncertainty over the contribution of SEAK hatchery stocks. This report addresses the latter possibility by reviewing the procedures used to compute the add-on in SEAK fisheries.

The hatchery add-on has increased by over a factor of 10 since 1985 when the original coefficients of variation were presented and the 1 in 20 risk level was proposed. As the estimate for the total SEAK hatchery contribution increases, the variance about the estimate will increase proportionally, assuming that tagging rates and catch/sample programs are maintained at the same intensities. To be more confident in the estimates would require increased sampling or tagging, or increased precision in the estimation of sport catch.

However, the ADF&G reports documents:

1) A reduction in marking rates at SEAK hatcheries; and

2) A rapid increase in recreational catch, which has a lower sampling rate, and a larger variability about estimates of hatchery contributions compared to the commercial sampling program.

Further, the Committee has noted several sources of uncertainty that have not been incorporated into the variance calculations.

For these reasons, **the CTC concludes that the hatchery contribution is estimated with less certainty now than it was earlier.** Further, the intention of the risk adjustment was to reduce the chance of impacting the rebuilding of wild chinook stocks. Even if the CV is not increasing, the potential impact on the rebuilding program increases as the SEAK hatchery contribution increases. Consequently, when the add-on is larger and estimated with less certainty, there is no technical basis to accept a higher risk (i.e., some value less than 1 in 20).

Given the current magnitude of the contributions, and assuming that estimates of the variance are approximately correct, modification of the risk level to 1 in 5 would change the preliminary post-season estimate (Preliminary 1991 U.S. Postseason Fishery Report) of the 1991 add-on by 7% (Table 8). However, the CTC emphasizes that the estimate of the add-on is likely to decrease if modifications to the computations to address concerns listed below are implemented.

Table 8. Example of how different risk levels would have affected the 1991 SEAK post-season add-on estimate.

Risk Level	Risk Adjustment	Change in Add-on	Total Add-on
1 in 20	9,000	0	65,550
1 in 10	7,050	1,950	67,500
1 in 5	4,650	4,350	69,900

The CTC identified several concerns about the current procedures used to compute the add-on in SEAK:

1) Uncertainty in the proportion of the production tagged (the mark rate) is not included in the estimation of hatchery contributions, thus the variance calculations presented are minimal estimates of the uncertainty in contribution.

2) The assumption of 100% SEAK hatchery composition in terminal commercial fisheries is not well documented in the ADF&G report. The CTC has requested detailed accounting of all coded-wire tags recovered in the 5 commercial terminal areas and the 3 recreational terminal areas. Contributions in these fisheries should be estimated using catch sampling and estimation procedures as applied to the other sampled fisheries.

3) The variance for the sport catch is not calculated from the data collected. Instead, assumed CV's for the catch and CWT sampling are used.

   ADF&G has informed the CTC that sampling procedures for coded-wire tags are being revised and that the variance will be calculated based on the sampling data. In addition, the variance for the catch estimate will be calculated from the sample data from the mail survey which is used to calculate the catch. The CTC can not now evaluate the effect of these new procedures, but has requested documentation of the methods and comparison of the mail survey catch estimates with creel survey estimates in order to check the accuracy of the method. The CTC notes, however, that the use of a mail survey for catch estimation will result in having final add-on values about one year after the fishery.

4) Contrary to the procedures used in the commercial fisheries, the unsampled recreational catch is included in the total contribution estimate with contribution rates assumed equal to those in sampled recreational fisheries. However, the sampled fisheries are near population centres and major hatcheries. These contribution rates may, therefore, not be appropriate for the unsampled fisheries which apparently occur in more remote areas. The CTC recommends that unsampled recreational catch strata be treated in the same manner as unsampled commercial catch strata and receive no credit for add-on.

5) Final annual add-on and risk adjustment values have not been provided to the CTC. The CTC suggests that a final accounting of the add-on be provided to the PSC on an annual basis.

Recognizing the desire to increase the harvest of SEAK hatchery chinook, and to simplify management where possible, the CTC discussed alternatives to increasing the risk level. Alternatives identified were:

1) Applying the terminal exclusion concept to terminal fisheries (following documentation of the "pure" stock) and limiting the risk adjustment to mixed-stock fisheries.

2) Applying different risk levels to different fisheries depending on the sampling intensities, etc. and the location or stock impacts of a fishery; for example, the June experimental fisheries might have a lower level of risk associated.

3) Increasing the rate of tagging of SEAK hatchery chinook and/or the sampling rate in fisheries.

6.0 REFERENCES CITED

ADF&G. 1991. Documentation of add-on procedures and estimated impacts of add-on fisheries on chinook salmon stocks in Southeast Alaska. ADF&G report prepared for the Pacific Salmon Commission.

Clark, J.E. and D.R. Bernard. 1987. A compound multivariate binomial-hypergeometric distribution describing coded microwire tag recovery from commercial salmon catches in Southeastern Alaska. Alaska Department of Fish and Game Informational Leaflet No. 261. Juneau. 113 pages.

Schnute, J. 1992. Statistical analysis of embedded replicates in mark recovery experiments. Can. J. Fish. Aquat. Sci. 49 (In press).

Figure 1. Comparison of chinook salmon hatchery coded-wire tagging rates in Southeast Alaska with British Columbia, Washington, Oregon, California, and Idaho. Tagging rates are calculated as the total number of hatchery chinook salmon tagged divided by the total number of hatchery chinook salmon released.

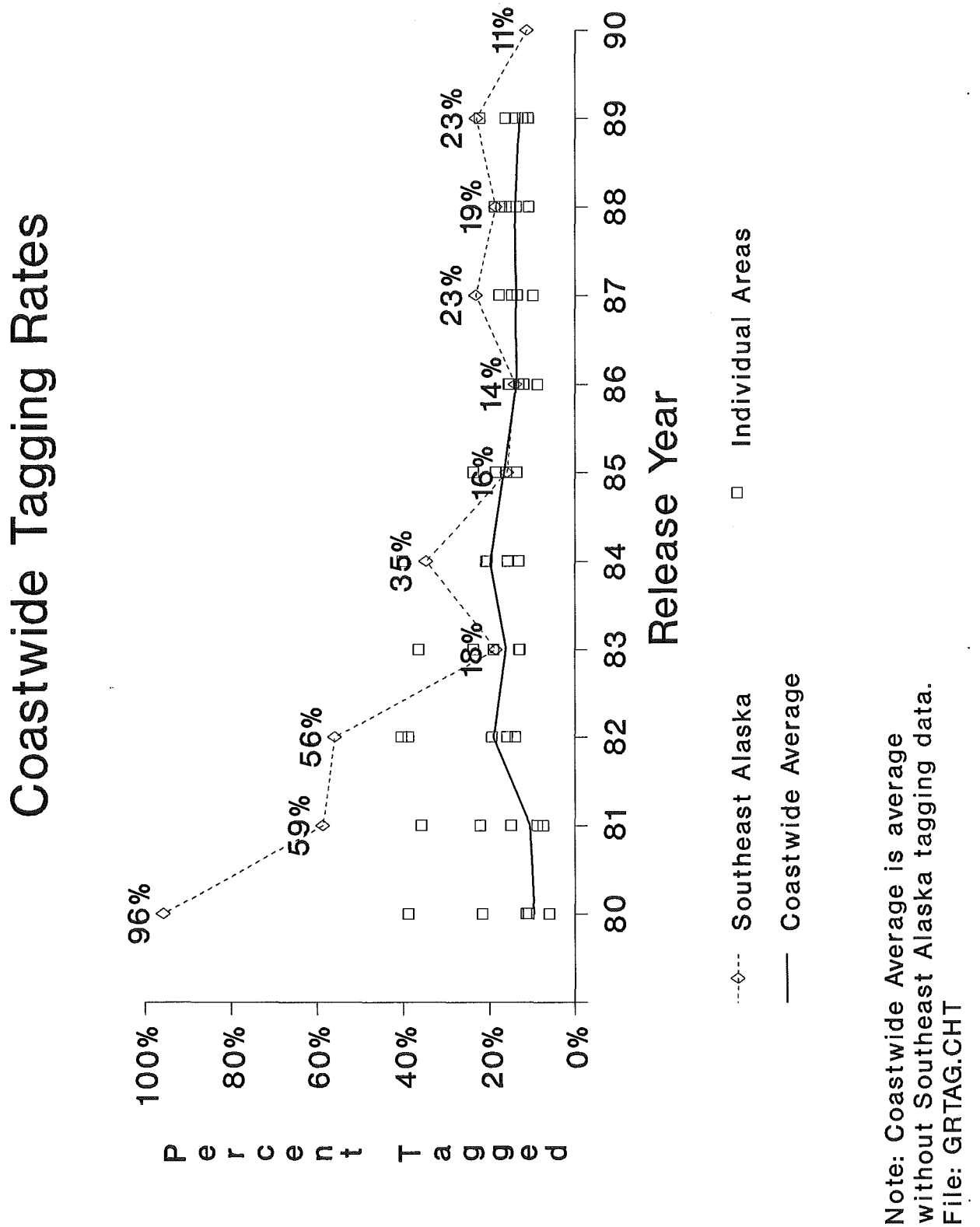
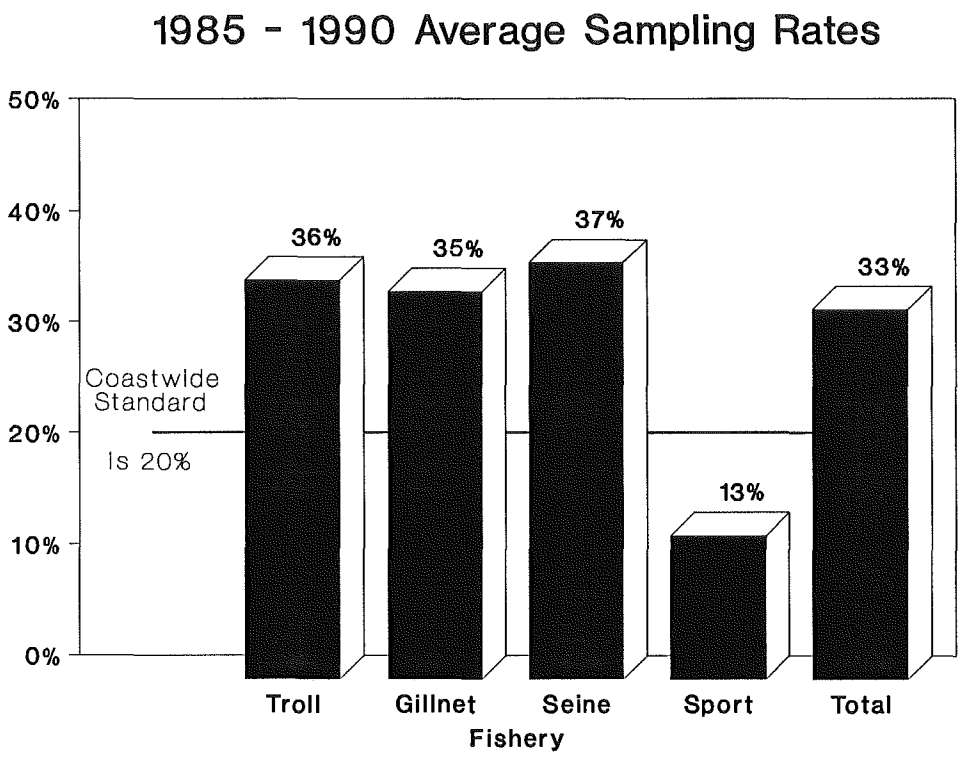


Figure 2. Comparison of 1985-1990 average CWT sampling rates and 1991 sampling rates in Southeast Alaska with the 20% coastwide standard sampling rate. Recreational fishery sampling rates are calculated by dividing the total estimated recreational harvest by the total number of chinook salmon sampled for missing adipose fins.



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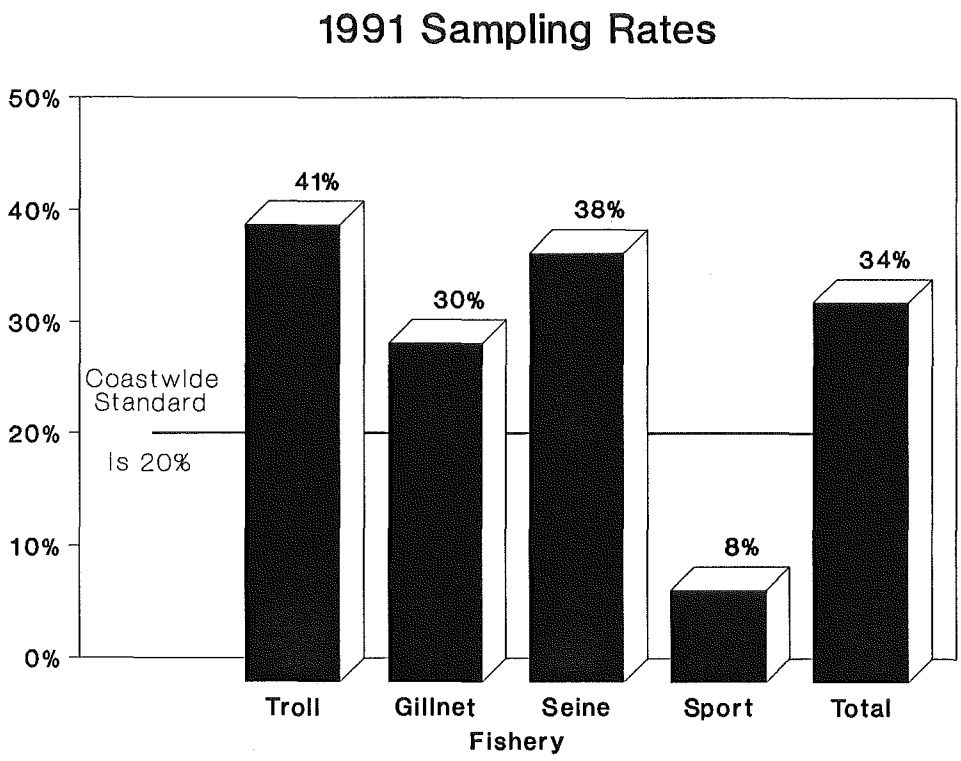

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Figure 3. True to assumed coefficient of variation related to increasing certainty in the proportion of a release tagged.